Volume 2

BROWNS FERRY NUCLEAR PLANT UNIT 2 PROBABILISTIC RISK ASSESSMENT INDIVIDUAL PLANT EXAMINATION

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PLG

3.3 SEQUENCE QUANTIFICATION

3.3.1 LIST OF GENERIC DATA

3.3.1.1 Introduction

This section presents the database developed for the Browns Ferry Nuclear Plant Probabilistic Risk Assessment (PRA) and provides a discussion of the techniques used and steps taken in developing the database.

The following three general areas define the scope of the data analysis presented in this section:

- Component Failure Rates
- Component Maintenance Frequency and Duration
- Internally Caused Initiating Event Frequencies

Human error rate distributions are developed in Appendix B and presented in Section 3.3.3. Common cause failure parameters are presented in Section 3.3.4. Flood initiating event and selected split fraction frequencies used in the flood analysis are presented in Section 3.3.8 and initially developed in Appendix E, Section E.1. Initiating event and selected split fraction frequencies used in the interfacing systems LOCA analysis are presented in Section 3.3.9 and initially developed in Appendix E, Section E.2.

The PRA database is primarily based on generic data developed from the cumulative experience of a large population of nuclear power plants documented in the PLG proprietary database. Nevertheless, many plant-specific features were considered in selecting the appropriate generic distributions. For example, some common cause failure parameters were developed based on detailed screening and reclassification of data to ensure applicability of the generic information used for the Browns Ferry PRA.

The proprietary PLG generic database has evolved from the PRAs that PLG has performed to date. It is based on data collected from U.S. reliability data sources and from operating data of U.S. light water reactors evaluated in past PLG PRAs. The current database can be updated using the plant-specific data. Such updating can be achieved by means of Bayes' theorem as described later in this section. The following subsections discuss the methods used in developing the data for each of the three general areas; common cause failure parameters are discussed in Section 3.3.4.

3.3.1.2 Basic Concepts

The methodology used to develop the database for this study is based on the Bayesian interpretation of probability and the concept of "probability of frequency." In this context, component failure rates are treated as measurable quantities whose uncertainty is dependent on the state of knowledge of the investigation. The "state of knowledge" is presented in the form of a probability distribution over the range of possible values of that quantity. The probability associated with a particular numerical value of an uncertain but measurable quantity indicates the likelihood that the numerical value is the correct one.

A key issue in developing state of knowledge for the parameters of the PRA models is to ensure that the information regarding each parameter, its relevance, and its value as viewed by the analyst are presented correctly, and that various pieces of information are integrated coherently. "Coherence" is preserved if the final outcome of the process is consistent with every piece of information used and all assumptions made. This is done by using the fundamental tool of probabilistic inference; i.e., Bayes' theorem. Mathematically, Bayes' theorem is written as

$$P(x|E, E_0) = F^{-1}\, L(E|x, E_0)P(x|E_0) \qquad (3.3.1.1)$$

where

$P(x|E, E_0)$ ≡ probability of x being the true value of an unknown quantity in light of new evidence, E, and prior body of knowledge, E_0.

$L(E|x, E_0)$ ≡ likelihood of the new evidence, E, given that the true value is x.

$P(x|E_0)$ ≡ probability of x being the true value of the unknown quantity based on the state of knowledge, E_0, prior to receiving E.

Finally, F is a normalizing factor defined as

$$F \equiv \int_{\text{all } x} L(E|x, E_0)P(x|E_0)\, dx \qquad (3.3.1.2)$$

In the context of a plant-specific PRA, three types of information are available for the frequency of elemental events:

Type 1 = the historical information from other similar plants.

Type 2 = general engineering knowledge such as that of the design and manufacture of equipment, sometimes expressed in terms of expert estimate of parameter values or their uncertainty distributions.

Type 3 = the past experience in the specific plant being studied.

The information of types 1 and 2 together constitute the "generic" information, and type 3 is the "plant-specific" or "item-specific" information. The synthesis of information types 1 and 2 to develop generic distributions is explained in Section 3.3.1.3.

The 3 units at the Browns Ferry site have had collectively about 22 years of operating experience. However, between late 1984 and middle 1985, all 3 units were shut down and have undergone substantial changes in equipment, procedures, and operating and maintenance policies. It was judged that the old data are not applicable anymore. Therefore, generic data are used for the Browns Ferry PRA. Some of the generic data being used, however, contain the past Browns Ferry experience. Therefore, these data are not completely discarded but are treated as data from a plant other than Browns Ferry. Any additional plant-specific information collected in the course of operating the Browns

Ferry units in the future can be incorporated into the existing data by applying Bayes' theorem. This process is explained in more detail in Section 3.3.2.

It is very important to note that the information type 1 brings an element of plant specificity into the generic data developed for a plant-specific PRA. In general, decisions regarding the relevance and applicability of different pieces of information in developing each generic distribution are made based on type 1 information. Therefore, a piece of information may be judged as being relevant in developing the generic data in one PRA and not relevant in another. As a result, generic distributions for different plant-specific studies could be significantly different. The following sections describe how the general framework described above can be applied for different types of data.

3.3.1.3 Synthesis of Generic Distributions

To discuss the way in which the failure rate distributions were developed based on different types of information, we consider the following information types:

- Type 1. Failure data from operating experience at various nuclear power plants.
- Type 2. Failure rate estimates or distributions contained in various industry compendia, such as WASH-1400 (Reference 3.3.1-1) and IEEE-500 (Reference 3.3.1-2).

By type 1 information, we mean failure and success data collected from the performance of similar equipment in various power plants. Type 2 information, which could be called processed data, is estimates ranging from the opinion of experts with engineering knowledge about the design and manufacturing of the equipment to estimates based on observed performance of the same class of equipment in various applications.

Normally, type 2 data are either a point estimate, usually referred to as the "best estimate," or a range of values centered about a "best estimate." In some cases, a distribution is provided covering a range of values for the failure rate with the mean or median representing the "best estimate" of the source. For instance, IEEE-500 provides a "low," "high," or "recommended" value for the failure rates under normal conditions and a "maximum" value under extreme environments. WASH-1400, on the other hand, assesses a probability distribution for each failure rate to represent the variability of the available data from source to source. Such distributions are normally centered around a median value judged to be most representative of the equipment in question for nuclear applications.

The methodology used to develop Browns Ferry failure rate data uses both types of information to generate generic probability distribution for the failure rates. Such distributions represent variability of the failure rates, from source to source (for type 2 information) and/or from plant to plant (for type 1 information). Obviously, these distributions are, in fact, our state of knowledge curves for the failure rate of components. The following discussion helps to clarify the distinction and serves as a prelude to the discussion of the methodology.

Suppose that we have 100 plants and that for each plant the exact value of the failure rate of a particular type of pump is known. Let λ_i be the failure rate of the pump at the ith plant. Suppose further that the λ_i's can be grouped into a limited number of discrete values, say λ_1^*, through λ_5^*, with 20 of the λ_i's being equal to λ^* , 35 equal to λ_2^*, 25 equal to λ_3^*, 15 equal to λ_4^*, and finally, 5 equal to λ_5^*. The frequency distribution of the λ_i's is then given by the histogram shown in Figure 3.3.1-1.

This histogram represents the "population variability" of the λ_i's because it shows how the failure rate of the particular type of pumps under consideration varies from plant to plant. It is an exact and true representation of the variability of the failure rate at the 100 plants in the population without any uncertainty or ambiguity because the distribution is based on presumed perfectly known failure rates at each and every plant.

Consider now, the case where only estimates, and not the exact values of the failure rates, are available for some, but not all, of the 100 plants in the population. With this state of knowledge, obviously we are not able to know the exact population variability distribution. The question is how one can use this more limited information to estimate the population variability curve and how close the estimate will be to the true distribution, as given in Figure 3.3.1-1.

To answer this question, first note that the desired distribution is a member of the set of all histograms. Because of our limited information, we are uncertain as to which member of that set is, in fact, the true distribution. This situation can be represented by a probability distribution over the set of all possible histograms expressing our state of knowledge about the nature of the true histogram.

For instance, if the entire space, H, of all possible histograms is composed of only n histograms; i.e., if

$$H \equiv \{h_1, h_2, \ldots, h_n\}$$

where h_i represents the ith histogram, the evidence regarding the pump failure rates at different power plants can be used to assess a probability distribution over H as follows:

$$P(H) = \{p_1, p_2, \ldots, p_n\} \quad \text{with} \sum_{i=1}^{n} p_i = 1 \qquad (3.3.1.3)$$

where p_i is the chance that h_i is the true histogram.

Figure 3.3.1-2 depicts the situation in which the variable λ is considered to be continuous, and the desired distribution is a density function.

For a perfect state of knowledge, we would be able to say which h_i is the true distribution; consequently, the corresponding p_i would be equal to 1, and all others equal to 0. However, based on the state of knowledge expressed by Equation (3.3.1.3), our estimate of the true histogram is

$$\bar{h} = \sum_{i=1}^{n} p_i\, h_i \qquad (3.3.1.4)$$

which is called the "expected distribution." Another histogram of interest is one which is assigned the highest chance of being the true histogram. We call it the "most likely distribution," h_m, and we have

$$p_m = \max\{p_i\ i = 1, \ldots, n\} \qquad (3.3.1.5)$$

The problem of obtaining P, as defined by Equation (3.3.1.1), is formulated in the Bayesian context as follows:

$$P(h_i|E) = F^{-1}\, L(E|h_i)P_0(h_i) \qquad (3.3.1.6)$$

where $P_0(h)$ is the prior state of knowledge regarding the set H as defined by Equation (3.3.1.3), and $P(h_i|E)$ is the posterior state of knowledge in light of the evidence E. The evidence is incorporated via the likelihood term $L(E|h_i)$, which is the probability of observing the evidence, given that the true histogram is h. Finally, F is a normalizing factor defined as [see Equation (3.3.1.2)]:

$$F = \sum_{i=1}^{n} L(E|h_i)\, P_0(h_i) \qquad (3.3.1.7)$$

The expected distribution, Equation (3.3.1.4), is our estimate of the true population variability of the failure rate. It shows how the failure rates of similar pumps are distributed among plants in the population. Now, if all we know about a specific pump before we have any experience with it is that it is one member of the population, the population variability curve also becomes our state of knowledge distribution for the failure rate of that specific pump. In other words, generic distributions representing the population variability can also be used to predict the expected behavior of any member of the population, if no other information is available.

For this reason, the generic frequency distributions developed based on type 1 and type 2 information are used as the state of knowledge distributions for the components at Browns Ferry prior to collecting and incorporating the site-specific information.

The following sections describe how types 1 and 2 information can be used to develop generic distribution.

3.3.1.3.1 Generic Distributions Based on Actual Performance Records (Type 1)

The following discussion is based on the method presented in Reference 3.3.1-3. Consider the case where the following set of information is available about the performance of a generic component in N plants:

$$I_1 = \{< k_i, T_i >; i = 1, \ldots, N\} \qquad (3.3.1.8)$$

where k_i is the number of failures of the component in the ith plant during a specific period of time, T_i.

The desired information is $\phi(\lambda)$, the distribution of the failure rate of the component, λ, in light of evidence I_1. This distribution represents the variation of λ from one plant to another, and is analogous to Figure 3.3.1-1.

Following our discussion at the beginning of Section 3.3.1.3, we would like to express a posterior state of knowledge about the true nature of the function $\phi(\lambda)$. To make matters practical, it is assumed that $\phi(\lambda)$ belongs to a particular parametric family of distributions. Let θ be the set of m parameters of $\phi(\lambda)$:

$$\theta = \{\theta_1, \ldots, \theta_m\} \qquad (3.3.1.9)$$

For each value of θ, there exists a distribution $\phi(\lambda|\theta)$ and vice versa. Therefore, the state of knowledge distribution over the space of all possible $\phi(\lambda|\theta)$s is the state of knowledge over all possible values of θ and vice versa.

Bayes' theorem, in this case, is written as [see Equation (3.3.1.6)]

$$P(\theta|I_0 I_1) = F^{-1} L(I_1|\theta, I_0)\, P_0(\theta|I_0) \qquad (3.3.1.10)$$

where

$P(\theta|I_0 I_1)$ = posterior state of knowledge about θ in light of evidence I_1 and prior information I_0.

$L(I_1|\theta, I_0)$ = the likelihood of evidence I_1 given that the actual set of parameters of $\phi(\lambda)$ is θ.

$P_0(\theta|I_0)$ = prior state of knowledge about θ based on general engineering knowledge I_0.

and F is a normalizing factor

$$F = \int_\theta (I_0|\theta, I_0) P_0(\theta|I_0)\, d\theta$$

The likelihood term is the (conditional) probability of observing the evidence, I_1, given that the data are based on an underlying population variability curve $\phi(\lambda|\theta)$ with θ as the value of its parameters

$$L = P(<k_i, T_i>; i = 1, \ldots, N|\theta, I_0) \tag{3.3.1.11}$$

Note that L is also conditional on the prior state of knowledge I_0.

If we assume that the length of operating hours, T_i's, at different plants is independent of one another and that the observed failures, k_i's, also have no dependence (according to our model, each k_i is based on a different underlying failure rate), the joint probability distribution given by Equation (3.3.1.11) can be reduced to the product of the marginal distributions as follows:

$$L(I_1|\theta, I_0) = \prod_{i=1}^{N} P_i(k_i, T_i|\theta, I_0) \tag{3.3.1.12}$$

where $P_i(k_i, T_i|\theta, I_0)$ is the probability of observing k_i failures of the equipment in question during the period T_i in the ith plant assuming that the set of parameters of the underlying population variability curve is θ.

If the failure rate, λ_i, at the ith plant is known exactly, using a Poisson model, the likelihood of observing k_i in T_i can be calculated from

$$P_i(k_i, T_i|\lambda_i) = \frac{(\lambda_i T_i)^{k_i}}{k_i!} \exp(-\lambda_i T_i) \tag{3.3.1.13}$$

However, λ_i is not known. All we know is that λ_i is one of possibly many values of variable λ that represents the variation of the failure rate from plant to plant. In addition, according to our model, λ is distributed according to $\phi(\lambda|\theta)$, with θ being unknown. For this reason, we calculate the probability of observing the evidence, $<k_i, T_i>$, by allowing the failure rate to assume all possible values. This is achieved through averaging Equation (3.3.1.13) over the distribution of λ

$$\begin{aligned} P_i(k_i, T_i|\theta, I_0) &= \int_0^\infty P_i(k_i, T_i|\lambda)\, \phi(\lambda|\theta) d\lambda \\ &= \int_0^\infty \frac{(\lambda T_i)^{k_i} e^{-\lambda T_i}}{k_i!}\, \phi(\lambda|\theta) d\lambda \end{aligned} \tag{3.3.1.14}$$

Depending on the parametric family chosen to represent $\phi(\lambda|\theta)$, the integration in Equation (3.3.1.14) can be carried out analytically or by numerical techniques. For example, if $\phi(\lambda_i|\theta)$ is assumed to be a gamma distribution that has the following form:

$$\phi(\lambda|\alpha, \beta) = \frac{\beta^\alpha}{\Gamma(\alpha)} \lambda^{\alpha-1} e^{-\beta\lambda} \tag{3.3.1.15}$$

with α and β, both nonnegative, as its parameters, the integral can be done analytically resulting in (Reference 3.3.1-4)

$$P_i(k_i, T_i|\alpha,\beta) = \frac{T_i^{k_i}}{k_i!}\frac{\beta^\alpha}{\Gamma(\alpha)}\frac{\Gamma(\alpha+k_i)}{(\beta+T_i)^{\alpha+k_i}} \qquad (3.3.1.16)$$

In developing failure rate distributions, $\phi(\lambda|\theta)$ is assumed to be lognormally distributed with μ as the median and σ as the standard deviation of the underlying normal. Then,

$$\phi(\lambda|\mu,\sigma) = \frac{1}{\sqrt{2\pi}\,\sigma\lambda}\exp\left\{-\frac{1}{2}\left(\frac{\ell n\,\lambda-\mu}{\sigma}\right)^2\right\} \qquad (3.3.1.17)$$

In this case, Equation (3.3.1.14) is calculated numerically.

The total likelihood for all N plants can now be found by using Equation (3.3.1.14) in Equation (3.3.1.12):

$$L(I_1|\theta, I_0) = \prod_{i=1}^{N}\left\{\int_0^\infty \phi(\lambda|\theta)\frac{(\lambda T_i)^{k_i}}{k_i!}\exp(-\lambda T_i)d\lambda\right\} \qquad (3.3.1.18)$$

The posterior distribution resulting from using the likelihood of Equation (3.3.1.18) in Bayes' theorem, Equation (3.3.1.10), is a probability distribution over the m-dimensional space of θ. Any point, θ, in this space has a one-to-one correspondence with a distribution, $\phi(\lambda_i|\theta)$, in the space of $\phi(\lambda|\theta)$. Figure 3.3.1-3 is an example of $P(\theta|I_0, I_1)$ constructed for $\theta = \{\alpha,\beta\}$, the two parameters of gamma distribution based on the pump data from all U.S. nuclear power plants (Reference 3.3.1-4).

The "expected distribution" is obtained from [see Equation (3.3.1.4)]

$$\overline{\phi}(\lambda) = \int_\theta \theta(\lambda|\theta)P(\theta|I_0, I_1)d\theta \qquad (3.3.1.19)$$

The quantity $\overline{\phi}(\lambda)$ "summarizes" the information about λ and is used in this study as the model for generic failure distributions.

Sometimes it is also useful to obtain the "most likely distribution" [see Equation (3.3.1.4)]. According to the definition, the most probable distribution of λ is the one whose parameters maximize $P(\theta|I_0I_1)$. These parameters are therefore the solution of the following system of m equations:

$$\frac{\partial P(\theta|I_0I_1)}{\partial\theta_i}\Big|\,\theta_{i,\max} = 0; \qquad i = 1, \ldots, m \qquad (3.3.1.20)$$

The methodology discussed above also applies to failure on demand-type data where the evidence is of the form

$$I_1 = \{< k_i, D_i >, i = 1, \ldots, N\} \tag{3.3.1.21}$$

where k_i and D_i are the number of failures and demands in the ith plant, respectively. This can be done if the Poisson distribution used in Equation (3.3.1.14) is replaced by the binomial distribution

$$P(k_i, D_i | \lambda) = \frac{D_i!}{k_i!(D_i - k_i)!} \lambda^{k_i} (1 - \lambda)^{D_i - k_i} \tag{3.3.1.22}$$

Example

For motor-operated valve failure to start on demand, the following data from six plants were available:

Plant	Number of Failures (k)	Number of Demands (D)
1	10	$1.65 \times 10^{+3}$
2	14	$1.13 \times 10^{+4}$
3	7	$1.73 \times 10^{+3}$
4	42	$6.72 \times 10^{+3}$
5	3	$1.26 \times 10^{+3}$
6	31	$9.72 \times 10^{+3}$

These data, which form a set of type 1 information, I_1, were used in mode 1 of the Data Analysis module of RISKMAN (Reference 3.3.1-5), which calculates Equations (3.3.1.14) and (3.3.1.18) and generates $\phi(\lambda)$ based on Equation (3.3.1.19). The result was a 20-bin discrete probability distribution with the following characteristics:

Parameter	Value
5th Percentile	6.82×10^{-4}
50th Percentile	3.06×10^{-3}
95th Percentile	1.42×10^{-2}
Mean	5.09×10^{-3}

3.3.1.3.2 Generic Distributions Using Estimates of Available Sources of Generic Data (Type 2)

As mentioned earlier, generic data frequently are not in the fundamental form given by Equations (3.3.1.8) and (3.3.1.21). Rather, most sources report point or interval estimates, or even distributions for failure rates (type 2 information). These estimates are either judgmental (expert opinion), or based on standard estimation techniques used by the analysts to translate raw data into point or interval estimates, and sometimes into a full distribution.

An example of such estimation techniques is the well-known maximum likelihood estimator given by

$$\lambda_M = \frac{k}{T} \qquad (3.3.1.23)$$

where k is the total number of failures in T units of operating time. Most data sources report λ_M, and not k and T.

To develop a model for constructing generic distributions using this type of data, the following cases are considered.

3.3.1.3.2.1 Estimating an Unknown Quantity Having a Single True Value. The following method is adopted from Reference 3.3.1-6. Suppose that there are M sources, each providing its own estimate of λ; which has a single true, but unknown, value, λ_t. An example is the failure rate of a particular component at a given plant. The true value of that failure rate, λ_t, will be known at the end of the life of the component. Before then, however, the failure rate may be estimated by one or more experts who are familiar with the performance of the component. Let

$$I_2^* = \{\lambda_i^*; i = 1, \ldots, M\} \qquad (3.3.1.24)$$

be the set of such estimates where λ_i^* is the estimate of the ith expert for λ_t.

The objectives are to use information I_2^* and to obtain a state of knowledge distribution for λ_t. Obviously, when everything is known about λ_t, such a state of knowledge distribution is a delta function centered at λ_t.

$$P(\lambda|\text{Perfect Knowledge}) = \delta(\lambda - \lambda_t) \qquad (3.3.1.25)$$

Note that, in Equation (3.3.1.25), λ is used as a variable representing the unknown failure rate.

Assuming a prior state of knowledge, $P_0(\lambda)$, about the quantity λ, Bayes' theorem can be used to incorporate information I_2^* into the prior and to obtain an "updated" state of knowledge about λ.

$$P(\lambda|\lambda_1^*, \ldots, \lambda_N^*) = k^{-1} L(\lambda_1^*, \ldots, \lambda_N^*|\lambda)P_0(\lambda) \qquad (3.3.1.26)$$

For N independent sources of information, the likelihood term, $L(\lambda_1^*, \ldots, \lambda_N^*|\lambda)$ can be written as

$$L(\lambda_1^*, \ldots, \lambda_N^*|\lambda) = \prod_{i=1}^{N} P_i(\lambda_i^*|\lambda) \qquad (3.3.1.27)$$

where $P_i(\lambda_i^* | \lambda)$ is the probability that the estimate of the ith source is λ_i^*, when the true value of the unknown quantity is λ.

The case of dependent sources of information is discussed in Reference 3.3.1-6. Obviously, if the ith source is a perfect one,

$$P_i(\lambda_i^* | \lambda) = \delta(\lambda_i^* - \lambda) \tag{3.3.1.28}$$

which means that the estimate, λ_i^* , is the true value. The posterior, $P(\lambda | \lambda_1^*, \ldots, \lambda_N^*)$, in this case, will be entirely determined by the estimate of this source

$$P(\lambda | \lambda_1^*, \ldots, \lambda_N^*) = \delta(\lambda - \lambda_i^*) \tag{3.3.1.29}$$

In another extreme, when it is believed that the source is totally unreliable,

$$P_i(\lambda_i^* | \lambda) = C \tag{3.3.1.30}$$

where C is a constant. This means that if the true value is λ, the estimate of the ith source can be anything. Using a likelihood of this form in Equation (3.3.1.27) will show that the estimate of this source, as expected, has no effect on shaping the posterior state of knowledge.

The likelihood term in this approach is the most crucial element. It reflects the analyst's degree of confidence in the sources of information, their accuracy, and the degree of applicability of their estimates to the particular case of interest.

As can be seen, the subjective nature of evaluating and "weighting" of the evidence from different sources fits very well in the above formulation. This becomes clearer in discussing the following models for the likelihood functions in Equation (3.3.1.27).

Suppose that in estimating the true value of λ_t, the ith source makes an error of magnitude E. Two simple models relating λ_t, E, and λ_i^* are

$$\lambda_i^* = \lambda_t + E \tag{3.3.1.31}$$

$$\lambda_i^* = \lambda_t \times E \tag{3.3.1.32}$$

In the model of Equation (3.3.1.31), if a normal distribution is assumed for the error term of the estimate of each source, the likelihood function will be a normal distribution with mean equal to $\lambda_t + b_i$, where b_i is the expected error, or, in other words, a "bias" term about which the error of the ith source is propagated.

Formally, we have

$$P\left(\lambda_i^* | \lambda_t\right) = \frac{1}{\sqrt{2\pi}\,\sigma_i} \exp\left\{-\frac{1}{2}\left(\frac{\lambda_i^* - (\lambda_t + b_i)}{\sigma_i}\right)^2\right\} \quad (3.3.1.33)$$

The variance of the likelihood, σ_i^2, is the variance of the error distribution. Values of b_i and σ_i are subjectively assessed by the data analyst, and reflect the credibility and accuracy of the source as viewed by the data analyst. Sometimes, certain information provided by the source, such as the uncertainty bound for the estimate, can be used to assess σ_i.

If, in addition to a normal likelihood function, a normal prior distribution representing the state of knowledge of the data analyst is assumed for λ_t with mean λ_0 and variance σ_0^2, the posterior distribution in Equation (3.3.1.26) will also be normal with mean, λ_p, given by

$$\lambda_p = \sum_{i=0}^{N} w_i\left(\lambda_i^* - b_i\right) \quad (3.3.1.34)$$

and variance

$$\sigma_p^2 = \left(\sum_{i=0}^{N} \frac{1}{\sigma_i^2}\right)^{-1} \quad (3.3.1.35)$$

where w_i, defined as

$$w_i = \left(\frac{\sigma_p}{\sigma_i}\right)^2 \quad (3.3.1.36)$$

is the weight given to the ith source.

Note that

$$\sum_{i=0}^{N} w_i = 1 \quad (3.3.1.37)$$

The mean therefore is a weighted average of the individual estimates after correcting for their expected biases. Also, as can be seen from Equation (3.3.1.36), smaller values of σ_i result in higher weights, implying that the source that is believed to make errors of smaller magnitudes (σ_i is the variance of E) is assigned a higher weight, which is intuitively expected. Extreme cases are when $\sigma_i = 0$ (highest degree of confidence in the ith estimate), for which $w_i = 1$, and when $\sigma_i = \infty$ (no confidence at all) for which $w_i = 0$.

If, instead of the model of Equation (3.3.1.31), the model of Equation (3.3.1.32) is applied and the logarithm of the error is assumed to be normally distributed, the likelihood function for the ith source becomes a lognormal distribution

$$P_i\left(\lambda_i^*|\lambda_t\right) = \frac{1}{\sqrt{2\pi}\ \sigma_i\lambda_i^*} \exp\left\{-\frac{1}{2}\left(\frac{\ell n\lambda_i^* - (\ell n\lambda_t + \ell nb_i)}{\sigma_i}\right)^2\right\} \tag{3.3.1.38}$$

where ℓnb_i is the logarithmic mean error about the logarithm of the true value, $\ell n\lambda_t$, and σ_i is the multiplicative standard deviation. Again, $P_i(\lambda_i^* | \lambda_t)$ is the probability that the estimate of the ith source is λ_i^* when the true value of the failure rate is λ_t. Some evidence in support of the lognormality of $P_i(\lambda_i^* | \lambda_t)$ is provided in References 3.3.1-6 and 3.3.1-7.

By using the model of Equation (3.3.1.38) for individual likelihoods in Bayes' theorem, Equation (3.3.1.26), and assuming a lognormal prior distribution for λ_t, the posterior state of knowledge will also be a lognormal with the following median value:

$$\lambda_{50,p} = \prod_{i=0}^{N}\left(\frac{\lambda_i^*}{b_i}\right)^{w_i} \tag{3.3.1.39}$$

where w_i is defined, as in Equation (3.3.1.36).

The median, then, is a weighted geometric average of the individual estimates after correcting for the multiplicative biases. Note that the usual arithmetic and geometric average methods frequently used in the literature are special cases of these Bayesian normal and lognormal models. For instance, Reference 3.3.1-2 uses the following geometric average of the estimates provided by several experts:

$$\bar{\lambda} = \left(\prod_{i=1}^{N}\lambda_i\right)^{1/N} \tag{3.3.1.40}$$

which assumes equal weights ($w_i = 1/N$), no bias ($b_i = 1$), no prior information, and does not show any uncertainty about the resulting value.

Example

Reference 3.3.1-8 provides a point estimate of 5.60×10^{-3} for the demand failure rate of motor-operated valves. We would like to use this estimate and to obtain a state of knowledge distribution for the MOV failure rates. We use the lognormal model of Equation (3.3.1.38) to express our confidence in the estimated value

$$P\left(\lambda_1^*|\lambda_t\right) = \frac{1}{\sqrt{2\pi}\ \sigma_1\lambda_1^*} \exp\left\{-\frac{1}{2}\left(\frac{\ell n\lambda_1^* - \left(\ell n\lambda_t + \ell nb_1\right)}{\sigma_1}\right)^2\right\} \tag{3.3.1.41}$$

where λ_i^* is the estimate (5.60×10^{-3}), and λ_t is the assumed true value of the failure rate that remains an unknown variable at this point. Our subjective judgment about the magnitude of error of the data source is expressed by assigning numerical values to the "bias" term b_1 and the logarithmic standard deviation σ_1.

We assume that there is no systematic bias ($b_1 = 1$). We estimate σ_1 with the aid of range factor, which is a more understandable quantity. Unless otherwise indicated, the range factor here is defined as the ratio of the 95th to the 50th percentiles of the lognormal distribution. Therefore, given the range factor, the value of σ_1 is obtained from the following equation:

$$\sigma_1 = \frac{\ell n\, RF}{1.645} \quad (3.3.1.42)$$

For our example, we assume a range factor of 3. Normally, such a range factor represents a relatively high degree of confidence and means that the source's estimate could be a factor of 3 higher or lower than the true failure rate and that such a statement is made with 90% confidence. Using this range factor in Equation (3.3.1.42) results in a value of 0.67 for σ_1.

If we now use the likelihood of Equation (3.3.1.41) in Bayes' theorem, Equation (3.3.1.26), and assume a flat prior distribution, $P_0(\lambda_t)$, the posterior distribution will be

$$P(\lambda | \lambda_1^* = 5.6 \times 10^{-3}) = 106.65 \exp\left\{-\frac{1}{2}\left(\frac{\ell n\, \lambda - \ell n\, 5.6 \times 10^{-3}}{0.67}\right)^2\right\} \quad (3.3.1.43)$$

which has the following characteristics:

Parameter	Value
5th Percentile	1.87×10^{-3}
50th Percentile	5.60×10^{-3}
95th Percentile	1.68×10^{-2}
Mean	7.01×10^{-3}

3.3.1.3.2.2 Estimating Distributions Using Point Estimates of Various Sources. We now go back to our original problem, which was estimating the generic failure rate distribution $\phi(\lambda | \theta)$. This time, however, we assume that instead of having the set of $<k_i, T_i>$ defined in Equation (3.3.1.8) from various plants, we are given one estimate, λ_i^*, for each plant. That is, the evidence is of the form

$$I_2 = \{\lambda_i^*\ i = 1, \ldots, N\} \quad (3.3.1.44)$$

The model to be used is a combination of the methods presented previously and is fully discussed in References 3.3.1-4 and 3.3.1-9. A particular family of parametric distributions, $\phi(\lambda | \theta)$, is assumed for λ, and the information I_2 is used in Bayes' theorem to obtain a posterior distribution over the entire set of possible values of θ and consequently over all possible distributions $\phi(\lambda|\theta)$. Formally,

$$P(\theta|I_2, I_0) = F^{-1} L(I_2|\theta, I_0) P_0(\theta|I_0) \quad (3.3.1.45)$$

See the set of definitions immediately following Equation (3.3.1.10) for interpretation of the terms in Equation (3.3.1.45).

The total likelihood function in the present case when λ_i's are independently estimated can be written as [see Equation (3.3.1.12)]

$$L(I_2|\theta, I_0) = \prod_{i=1}^{N} P_i\left(\lambda_i^*|\theta, I_0\right) \quad (3.3.1.46)$$

where

$P_i(\lambda_i^* |\theta, I_0)$ ≡ probability that the estimate provided for the ith plant is λ_i^* if the parameter of the population variability distribution of the failure rates is θ. (3.3.1.47)

To make matters clearer, note that we are assuming that the ith source of data is providing an estimate for the failure rate at a particular plant, and all we know is that failure rates vary from plant to plant according to the variability curve $\phi(\lambda|\theta)$. Each λ_i therefore is an estimate of one point in that distribution. As a result, there are two sources of variability in the estimates. First, estimates of individual sources are not necessarily perfect; i.e., they could involve errors and biases, as discussed in the previous section. Second, even if all the sources were perfect, the estimates would still be different due to the actual variation of the failure rate from plant to plant.

Based on our discussion in the previous section, the confidence that we have in the accuracy of the estimate λ_i^* for the failure rate at the ith plant can be modeled by a lognormal distribution [see Equation (3.3.1.38)]. Assuming no bias, we have

$$P_i\left(\lambda_i^*|\lambda_i\right) = \frac{1}{\sqrt{2\pi}\,\sigma_i\lambda_i^*} \exp\left\{-\frac{1}{2}\left(\frac{\ell n\lambda_i^* - \ell n\lambda_i}{\sigma_i}\right)^2\right\} \quad (3.3.1.48)$$

where λ_i is the true value of the failure rate at the ith plant. Again, we really do not know λ_i, but we assume that it belongs to $\phi(\lambda|\theta)$, the distribution representing the variability of λ_i's from plant to plant. The relationship between $P_i(\lambda_i^* |\theta, I_0)$ and $\phi(\lambda|\theta)$ is shown in Figure 3.3.1-4.

Therefore, as we did in the case of Equation (3.3.1.14), we can write

$$P_i\left(\lambda_i^*|\theta, I_0\right) = \int_0^{\infty} P_i\left(\lambda_i^*|\lambda\right) \phi(\lambda|\theta) d\lambda \quad (3.3.1.49)$$

As mentioned earlier, in developing the failure rate distributions, $\phi(\lambda|\theta)$ is assumed to be lognormally defined by Equation (3.3.1.17). With this assumption, the integration in Equation (3.3.1.49) can be done analytically, and the result is

$$P_i\left(\lambda_i^*|\theta, I_0\right) = \frac{1}{2\pi\sqrt{\sigma_i^2+\sigma^2}\ \lambda_i^*} \exp\left\{-\frac{1}{2}\frac{\left(\ell n\lambda_i^* - \mu\right)^2}{\sigma_i^2+\sigma^2}\right\} \qquad (3.3.1.50)$$

Equation (3.3.1.45), Bayes' theorem, is now written as:

$$P\left(\theta|\lambda_1^*, \ldots, \lambda_N^*\right) = F^{-1}\prod_{i=1}^{N} P_i\left(\lambda_i^*|\theta, I_0\right) P_0\left(\theta|I_0\right) \qquad (3.3.1.51)$$

The most probable and expected distributions of λ can be found in the same way as discussed in Section 3.3.1.3.2. The expected distribution is calculated by using the result of Equation (3.3.1.48) in Equation (3.3.1.19). The parameters of the most likely distribution are shown to be solutions of the following system of equations:

$$\mu = \sum_{i=0}^{N} \frac{\left(\sigma_i^2+\sigma^2\right)^{-1}}{\sum_{i=0}^{N}\left(\sigma_i^2+\sigma^2\right)^{-1}} \ell n\lambda_i^* \qquad (3.3.1.52)$$

$$\sum_{i=1}^{N}\left[\frac{1}{\sigma_i^2+\sigma^2} - \left(\frac{\left(\ell n\lambda_i^* - \mu\right)^2}{\sigma_i^2+\sigma^2}\right)\right] = 0 \qquad (3.3.1.53)$$

For perfect sources of information (i.e., $\sigma_i = 0$), the above equations simplify and result in the following solution:

$$\mu = \ell n\left(\prod_{i=1}^{N} \lambda_i^*\right)^{1/N} \qquad (3.3.1.54)$$

$$\sigma^2 = \frac{1}{N}\sum_{i=0}^{N}\left(\ell n\ \lambda_i^* - \mu\right)^2 \qquad (3.3.1.55)$$

Note that Equations (3.3.1.54) and (3.3.1.55) are similar to the conventional results for fitting a lognormal distribution to a set of estimates. It should also be mentioned that the results of this section apply to any set of failure rate estimates from various sources where a true variability is suspected to exist among the actual values being estimated by each source. For instance, if several generic sources of data provide estimates for a particular type of equipment and it is known or suspected that each source's estimate is based on a different subset of the population, the methods of this section can be applied to obtain a generic distribution representing the "source-to-source" variability of the failure rate.

Example

The following set of estimates is available for the demand failure rate of MOVs:

Source	Estimate
WASH-1400 (Reference 3.3.1-1)	1.00×10^{-3}
NUREG/CR-1363 (Reference 3.3.1-8)	5.60×10^{-3}
GCR (Reference 3.3.1-10)	1.00×10^{-3}

To use the model of this section, we need to assign range factors to each source as a measure of our confidence in the estimate provided by that source. In this way, we will be able to determine $P_i(\lambda_i^* | \lambda_i)$, Equation (3.3.1.48), for each source.

Following our discussion in the previous example, we assign a range factor of 3 to the estimate of NUREG/CR-1363. For the estimate of WASH-1400, we assign a range factor of 5, which results in a broader likelihood, $P_i(\lambda_i^* | \lambda_i)$, for that source and represents a lesser degree of confidence as compared to NUREG/CR-1363. This is due to the fact that the estimate of NUREG/CR-1363 appears to be based on a larger sample of MOV failures in nuclear applications than does the estimate of WASH-1400. The latter provides a range factor of 3 for the lognormal distribution whose median (1.00×10^{-3}) we have taken as the estimate. Assigning a larger range factor of 5 also means that we believe that WASH-1400 has overstated its confidence in the estimated median value.

The idea of broadening some WASH-1400 distributions when used as generic curves was introduced in an early site-specific PRA study (References 3.3.1-11 and 3.3.1-12) where the WASH-1400 curves (as given) were used as generic prior distributions. It was then found that several posterior distributions, reflecting the evidence of the specific plant, lay in the tail region of the prior distributions on the high side. These results led us to the conclusion that the generic curves had to be broadened to reflect greater uncertainty.

References 3.3.1-13 and 3.3.1-14 provide further support to our decision. In Reference 3.3.1-13, the authors reviewed experimental results that test the adequacy of probability assessments, and they concluded that "the overwhelming evidence from research on uncertain quantities is that people's probability distributions tend to be too tight. The assessment of extreme fractiles is particularly prone to bias." Referring to the Reactor Safety Study, they state, "The research reviewed here suggests that distributions built from assessments of the 0.05 and 0.95 fractiles may be grossly biased."

Commenting on judgmental biases in risk perception, Reference 3.3.1-14 states:

> *A typical task in estimating uncertain quantities like failure rates is to set upper and lower bounds such that there is a 98% chance that the true value lies between them. Experiments with diverse groups of people making many different kinds of judgments have shown that, rather than 2% of true values falling outside the 98% confidence bounds, 20 to 50% do so* [Reference 3.3.1-13]. *Thus, people think that they can estimate such values with much greater precision than is actually the case.*

The numerical effect of using a larger range factor is illustrated in the following table:

Distribution	5th Percentile	Median	Mean	95th Percentile	Range Factor
WASH-1400	3.3×10^{-4}	1.0×10^{-3}	1.2×10^{-3}	3.0×10^{-3}	3
Broadened Distribution	2.0×10^{-4}	1.0×10^{-3}	1.6×10^{-3}	5.0×10^{-3}	5

We see here that the medians are the same and that the mean value increases slightly reflecting the extension of the high side tail of the curve.

For the cases where WASH-1400 was the only source used for a failure rate, the above methodology was used to generate a broader generic curve from the distribution of WASH-1400. The applied range factor, however, was not necessarily the same for each case. For the estimates from the three sources listed previously, the range factors are assigned as follows:

Source	Range Factor
WASH-1400	5
NUREG/CR-1363	3
GCR	10

The above values and the estimates from the three sources were used as input to mode 2 of the Data Analysis module of RISKMAN, which evaluates Equations (3.3.1.48) through (3.3.1.51) and obtains an expected distribution based on an integration similar to Equation (3.3.1.19).

The resulting histogram has the following characteristics:

Parameter	Value
5th Percentile	1.72×10^{-4}
50th Percentile	2.15×10^{-3}
95th Percentile	1.22×10^{-2}
Mean	4.55×10^{-3}

3.3.1.3.3 Generic Distributions Based on a Mixture of Type 1 and Type 2 Data

An obvious extension of the situations discussed in the previous sections is the case where a mixture of types 1 and 2 information is available. In this case, the equivalent of Equations (3.3.1.10) and (3.3.1.45) is

$$P(\theta|I_2, I_1, I_0) = F^{-1} L(I_2, I_1|\theta, I_0) P_0(\theta|I_0) \qquad (3.3.1.56)$$

If I_1 and I_2 are independent pieces of information,

$$L(I_2, I_1|\theta, I_0) = L(I_2|\theta, I_0) L(I_1|\theta, I_0) \qquad (3.3.1.57)$$

where the terms in the right side of the equation are defined by Equations (3.3.1.10) and (3.3.1.46).

The expected distribution of λ can now be found from

$$\bar{\phi}(\lambda) = \int_0^\infty \phi(\lambda|\theta) P(\theta|I_2 I_1, I_0) d\theta \qquad (3.3.1.58)$$

Example

As an example, we use the combination of the data given in the examples in the previous sections. This information was used as the main input to the Data Analysis module of RISKMAN, which calculates Equations (3.3.1.56) through (3.3.1.58). The resulting discretized distribution has the following characteristics:

Parameter	Value
5th Percentile	7.28×10^{-4}
50th Percentile	2.96×10^{-3}
95th Percentile	1.01×10^{-2}
Mean	4.27×10^{-3}

A summary of the types 1 and 2 evidence and the results of this example are presented in Figure 3.3.1-5.

3.3.1.3.4 Failure Rate Distributions

Developing a generic database requires a thorough review, analysis, and tabulation of the available generic data for each identified component failure mode. The PLG generic database is proprietary, and is documented in Reference 3.3.1-15. This generic database was used as the generic data basis for Browns Ferry. In addition to generic data sources such as WASH-1400 (Reference 3.3.1-1) and IEEE-500 (Reference 3.3.1-2), several well-documented site-specific failure rate data from power plants examined in previous or ongoing risk studies were used in the development of the generic database. This ensures that the final failure rate distributions accurately reflect all of the information that is currently available.

A practical difficulty in using the available generic estimates in the process of developing generic distributions is the lack of standardization in the generic literature. This dictates that using generic sources involves much more than a simple catalog of published failure rate estimates. Each source presents its own unique set of advantages and drawbacks, and these factors must be carefully evaluated before a meaningful comparative analysis may be performed. Typical problems that are encountered include incompatibility between failure and test data, inclusion of failures due to other than hardware-related causes, exclusion of failures due to licensing-based reporting criteria, and a general lack of specific documentation of assumptions, boundary conditions, and methodologies. Often, it is simply not possible to discern the reasons for significant differences among several sources publishing data for the same component failure mode.

Because of the inherent difficulty in ascertaining the direct comparability among these various estimates, the only practical approach to the problem is the assignment of subjective "weighting factors" to each piece of data, based on the perceived compatibility of the source with the desired failure rate information. These weights are assigned by assessing either a range factor or σ parameter for the likelihood functions for each source according to the models discussed in Section 3.3.1.3.2. This process is computerized in RISKMAN, which takes as input various point estimates and corresponding subjective range factors as well as actual plant operating experience of the component in question at various plants. The code then performs Bayesian calculations based on the models and generates an average distribution for the failure rate representing source-to-source and/or plant-to-plant variability of the data. This process involves several iterations in running the code and reviewing the results to ensure that the range of discrete probability distribution is a reasonable representation of the input information and that the binning of the distribution (20 bins or less) was done properly.

In other cases, where only one source of data is available for the component, failure rate distributions are represented as lognormal. In general, these failure rate distributions are derived by defining the median value and range factor as the two most physically meaningful parameters of the lognormal distribution. (The range factor is defined here as the ratio of the 95th percentile to the median, or the square root of the ratio of the 95th and 5th percentiles.) To provide traceable documentation of the data sources used in this analysis, the median value of such distributions is based on published data. The range factor is subjectively assigned so that the resulting 5th and 95th percentiles of the distribution represent realistic bounds for expected or observed component failure rates.

The relative magnitudes of the range factors developed for the various distributions are influenced by a set of consistent evaluation criteria. In general, range factors significantly greater than 10 (i.e., a span of more than 100 in failure frequency between the 5th and 95th percentiles) are considered to produce distributions so broad as to convey a nearly uninformed state of knowledge and therefore would be of marginal utility in any quantification process. The mean value of such a broad distribution, while defined mathematically, is virtually meaningless as a representation of expected component performance because, in truth, very little is known about how the entire population behaves. Some distributions are assigned range factors on the order of 10. Typically, these distributions are characterized by sparse generic data not closely correlated to the desired component failure mode and a relatively low degree of confidence in the available source. It is felt that a distribution this broad conveys only marginal knowledge as to the behavior of a population and is generally indicative of the application of good engineering judgment to minimal prior information. Some distributions are assigned range factors on the order of 3 to 5; i.e., spans of approximately 10 to 25 between the 5th and 95th probability percentiles. While these distributions are still relatively broad, they represent a higher degree of confidence in the failure rate estimate used as the median value.

Treatment of the generic distributions from IEEE-500 (Reference 3.3.1-2) is discussed. This reference contains data for electronic, electrical, and sensing components. The reported values are mainly synthesized from the opinions of some 200 experts (a form of the Delphi procedure is used). Each expert reports a "low," "recommended," and "high" value of the failure rate under normal conditions and a "maximum" value that would be applicable under all conditions (including abnormal ones). The pooling of the estimates is done using a geometric averaging technique; e.g.,

$$\lambda_{max} = \left(\prod_{i=1}^{N} \lambda_{max,\, i} \right)^{1/N} \qquad (3.3.1.59)$$

This method of averaging is considered a better representation of the expert estimates, which are often given in terms of negative powers of 10. In effect, the usual arithmetic averages of the exponents are used, which, as discussed in Section 3.3.1.3.2, is a special case of the Bayesian model presented in this report.

Reference 3.3.1-2 does not recommend a distribution. The method of averaging, however, suggests that the authors have in mind a lognormal distribution. Our task now is to determine this distribution from the given information.

The recommended value is suggested to be used as a "best" estimate. The word "best" is, of course, subject to different interpretations. We have decided to use it as the median value mainly for two reasons. First, for skewed, lognormal type distributions, the median is a more representative measure of central tendency than the mean, which is very sensitive to the tails of the distribution. Thus, we suspect that the experts who submitted their "recommended" estimates actually had median values in mind. Experimental evidence (Reference 3.3.1-16) also indicates that assessors tend to bias their estimates of mean values toward the medians. The second reason is that this choice is conservative since the mean value of our resulting distribution is then larger than the "recommended" value. The "maximum" value is taken to be the 95th percentile of the lognormal distribution.

For the majority of the components for Browns Ferry, generic component failure rates were taken from PLG Generic Database (Reference 3.3.1-15). In a few cases, additional generic distributions had to be developed for some specific types of equipment.
Reference 3.3.1-15 provides a detailed documentation of the generic distributions used in this study. The main characteristic values of the generic failure distributions used for the Browns Ferry PRA are presented in Table 3.3.1-1.

3.3.1.4 Component Maintenance Data

3.3.1.4.1 Introduction

Maintenance activities that remove components from service and alter the normal configurations of mechanical or electrical systems can provide a significant contribution to the overall unavailability of those systems. This section describes how generic maintenance data were used to develop distributions for generic component maintenance unavailability.

These distributions apply to maintenance performed during normal operation or, in some cases, at hot shutdown (but not during cold shutdown). These include both regularly scheduled preventive maintenance activities and unplanned maintenance events. The specific causes leading to these maintenance activities can include repairs of component failures experienced during operation, repairs of failures discovered during periodic testing, removal of components from service for unplanned testing or inspection, minor adjustments, and hardware modifications.

To quantify maintenance unavailabilities, both the frequency and the mean duration of maintenance are necessary. The frequency defines the rate at which components are removed from service, while the mean duration is the average amount of time that the component will be out of service. The unavailability due to maintenance is calculated according to

$$Q_M \cong f \bullet \tau \qquad (3.3.1.60)$$

where f is the maintenance frequency and τ is the mean maintenance duration or, equivalently, the mean time to repair.

To obtain a state of knowledge distribution for the maintenance-related unavailability Q_M, state of knowledge distributions for both f and τ are needed. Such distributions are developed as described in the following section.

3.3.1.4.2 Frequency of Maintenance

The generic maintenance frequency distributions used for the Browns Ferry PRA were selected from generic maintenance frequency distributions developed for 17 different categories of component types and normal service duty; i.e., operating or standby. The basis for these distributions is described in the PLG Generic Database (Reference 3.3.1-15), and the component categories are presented in Figure 3.3.1-6. The corresponding distributions were developed based on observed maintenance data from 14 light water reactor (LWR) operating units covering approximately 150 reactor-years of experience. The statistical method used to develop these distributions was the same as the two-stage method applied in the case of component failure rates. The distributions, consequently, represent the probable range of variation of component maintenance data within the generic population. In the absence of plant-specific data, such population variability distributions are the best estimate of the maintenance frequency of various components. The main characteristics of these distributions are presented in Table 3.3.1-2.

3.3.1.4.3 Duration of Maintenance

As defined in this database, the duration of a maintenance event includes the entire time period during which the affected component is unavailable for operation. This is defined to be the period starting when the component is originally isolated or otherwise removed from service, and ending when the component is returned to service in an operable state. In many cases, this duration may be only weakly dependent on the actual time required for maintenance personnel to effect the needed repairs.

Generic distributions for mean maintenance durations were developed for 12 categories of components based on the component type and the inoperability limitations imposed by plant technical specifications. The basis for these distributions is described in the PLG proprietary database (Reference 3.3.1-15), and the component categories are presented in Figure 3.3.1-7. These distributions were developed based on over 150 reactor-years of experience with 14 LWR units, as collected and analyzed in various PRAs performed by PLG on those reactors. The two-stage methodology described in Section 3.3.1.2 was used to develop the maintenance duration uncertainty distributions. These distributions represent the plant-to-plant variability of mean maintenance duration among the plants in the generic population. The main characteristics of these distributions are presented in Table 3.3.1-3.

3.3.1.5 Internally Caused Initiating Events Frequencies

3.3.1.5.1 Introduction

The initiating events considered for this PRA are divided into two groups according to the method used for quantifying their frequencies. The first group is those events for which data available from other nuclear plants are judged to be relevant. Data from other plants are then used, as described in Section 3.3.1.3.2 to create generic distributions for the event frequencies.

The second group consists of events that are caused by loss of support systems. These systems have designs that are unique to plants and data for similar events from other plants are not relevant to Browns Ferry. The frequencies of these events are evaluated using system-specific analysis.

3.3.1.5.2 Group 1 Initiating Events

The methodology used to develop the distributions for the frequencies of these initiating events is similar to the two-stage approach used for component failure rates. The details of the development of the generic frequencies and the compiled raw data are described in Reference 3.3.1-15. All of the initiating events defined for a generic BWR in Reference 3.3.1-15 are directly relevant to Browns Ferry, except the initiator "One or Two SRVs Inadvertently Open." This initiator has been split into two for the Browns Ferry PRA: "One SRV Inadvertently Opens" and "Two SRVs Inadvertently Open." Table 3.3.1-4 provides the main characteristics of the initiating events frequency distributions.

In addition to the initiating events developed in Reference 3.3.1-15, two more initiators were defined for Browns Ferry. These are ZIEIAU [Instrument Tap Analmolies (upper reference leg)] and ZIEIAL [Instrument Tap Analmolies (lower reference leg)]. The detailed information for these is presented in Tables 3.3.1-5 and 3.3.1-6.

3.3.1.5.3 Group 2 Initiating Events

The initiating events analysis of Section 3.1.1 identifies support systems that will cause a plant trip when the system fails. Failure of these systems will also impact other support and frontline systems. These are as follows:

- LICA Loss of Instrument and Control Board 2A
- LICB Loss of Instrument and Control Board 2B
- LUPS Loss of Unit 2 120V Preferred Power
- LRCW Loss of Raw Cooling Water

The frequencies of each of these events are estimated through system analysis and are presented in the appendices of their respective system notebooks. Table 3.3.1-4 provides the main characteristics of these distributions.

3.3.1.6 References

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Table 3.3.1-1 (Page 1 of 6). Component Failure Data for Browns Ferry Components

Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZESCIL	Secondary Containment Leakage - Events per Year	1.32-01	3.87-02	1.08-01	2.94-01
ZCNTPT	Containment Pressure Tap Fails during Operation	1.69-07	3.98-08	1.27-07	3.07-07
ZESWYD	Loss of a Switchyard - Events per Year (BFN)	9.56-02	2.42-02	7.61-02	1.97-01
ZLCOND	Unavailability of Condenser after Initiating Event	3.15-02	5.42-03	2.13-02	7.02-02
ZLDMIN	Loss of Five or More Demineralizer Strings after Initiating Event	2.57-05	4.10-07	6.42-06	9.63-05
ZLFWP	Loss of the Running MFW Pump in 24 Hours/Initiating Event	4.97-02	3.33-03	2.41-02	1.68-01
ZLFWT	Loss of the Running MFW Pump in 24 Hours/Initiating Event	4.97-02	3.33-03	2.41-02	1.68-01
ZTBATD	Batteries Fail To Operate on Demand	5.19-04	6.26-05	3.46-04	1.16-03
ZTBATR	Batteries, 125V DC - Fail during Operation	7.53-07	6.36-08	3.79-07	1.64-06
ZTBCHR	Battery Chargers - Fail during Operation	1.86-05	9.80-07	8.25-06	5.38-05
ZTBS1R	Buses - Fail during Operation	4.98-07	8.74-08	3.40-07	1.13-06
ZTCB1C	Circuit Breaker (480V AC and Above) - Fail To Close on Demand	1.61-03	2.68-04	1.07-03	3.40-03
ZTCB1O	Circuit Breaker (480V AC and Above) - Fail To Open on Demand	6.49-04	6.48-05	3.65-04	1.40-03
ZTCB1T	Circuit Breakers (480V AC and Above) - Transfer Open	8.28-07	5.48-08	3.79-07	2.28-06
ZTCB2C	Circuit Breakers (Less Than 480V) - Fail To Close on Demand	2.27-04	8.54-06	8.54-05	8.54-04
ZTCB2O	Circuit Breakers (Less Than 480V) - Fail To Open on Demand	8.39-04	3.15-05	3.15-04	3.15-03
ZTCB2T	Circuit Breakers (Less Than 480V) - Transfer Open	2.68-07	2.99-08	1.28-07	8.69-07
ZTCCOS	Cables, Control - Fail Open or Short	4.64-06	9.77-07	3.46-06	1.22-05
ZTCMPR	Compressors Air - Fail during Operation	9.81-05	9.84-06	4.98-05	2.40-04
ZTCMPS	Compressors, Air - Fail To Start on Demand	3.29-03	2.01-04	1.63-03	1.12-02
ZTCRSD	Single Scram Rod (BWR) - Fail on Demand	2.42-04	9.35-06	9.21-05	8.72-04

Note: Exponential notation is indicated in abbreviated form; e.g., 1.32-01 = 1.32×10^{-01}.

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Table 3.3.1-1 (Page 2 of 6). Component Failure Data for Browns Ferry Components

Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZTDAOD	Dampers, Pneumatic - Fail on Demand	1.52-03	2.37-04	1.08-03	3.32-03
ZTDAOT	Dampers, Pneumatic - Transfer Open or Closed	2.67-07	1.50-08	1.10-07	8.06-07
ZTDBDD	Backdraft Damper - Fails on Demand	2.69-04	5.33-05	1.44-04	6.27-04
ZTDBDP	Backdraft Dampers - Transfer Closed or Plugged	1.04-08	2.78-09	8.33-09	2.50-08
ZTDGS1	Diesel Generators - Fail during First Hour	1.70-02	1.07-03	8.24-03	5.36-02
ZTDGS2	Diesel Generators - Fail after First Hour	2.51-03	2.97-04	1.49-03	7.44-03
ZTDGSS	Diesel Generators - Failure To Start on Demand	2.14-02	2.50-02	1.35-02	6.44-02
ZTDHOT	Dampers, Manual - Transfer Open or Closed	4.20-08	1.57-09	1.30-08	1.19-07
ZTDMOD	Dampers, Motor-Operated - Fail on Demand	4.30-03	7.49-04	2.84-03	1.05-02
ZTDMOT	Dampers, Motor-Operated - Transfer Open or Closed	9.27-08	9.65-09	5.05-08	2.33-07
ZTDRYP	Air Dryer Fails during Operation	9.11-05	1.41-06	2.19-05	2.76-04
ZTEXJL	Expansion Joint Leaks/Ruptures during Operation	2.66-06	9.33-08	9.70-07	9.68-06
ZTFA1P	Filters, Air - Plug during Operation	5.83-06	2.04-07	2.12-06	2.12-05
ZTFA2P	Filters, Oil Removal - Plug during Operation	1.76-05	6.16-07	6.40-06	6.39-05
ZTFA3P	Filters, Compressed Air - Plug during Operation	3.54-05	1.15-06	1.13-05	1.08-04
ZTFL1P	Filters, Ventilation - Plug during Operation	1.07-06	4.00-08	4.00-07	4.00-06
ZTFN1R	Fans, Large (Cooling Tower, Containment) - Fail during Operation	7.88-06	1.55-06	6.23-06	1.58-05
ZTFN1S	Fans, Large (Cooling Tower, Containment) - Fail To Start	2.93-03	3.27-04	1.66-03	8.35-03
ZTFN2R	Fans, Small (Ventilation) - Fail during Operation	7.89-06	1.55-06	6.23-06	1.58-05
ZTFN2S	Fans, Small (Ventilation) - Failure To Start on Demand	4.84-04	6.00-05	3.00-04	1.50-03
ZTFU1R	Fuses - Fail Open	9.20-07	2.67-08	2.91-07	2.56-06

Note: Exponential notation is indicated in abbreviated form; e.g., 1.32-01 = 1.32×10^{-01}.

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Table 3.3.1-1 (Page 3 of 6). Component Failure Data for Browns Ferry Components

Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZTHTRR	Heaters/Heat Tracing Lines - Fail during Operation	8.80-06	2.24-07	2.76-06	3.26-05
ZTHXRB	Heat Exchangers - Rupture/Leak	1.95-06	2.21-07	1.32-06	5.18-06
ZTINVR	Inverters - Fail during Operation	1.83-05	1.60-06	1.13-05	4.37-05
ZTLC1D	Trip Logic Modules - Fail on Demand	8.52-05	3.20-06	3.20-05	3.20-04
ZTLC1R	Trip Logic Modules - Fail during Operation	2.70-06	1.10-07	1.10-06	1.10-05
ZTMGSR	Motor-Generators - Fail during Operation	3.59-05	9.60-07	1.10-05	1.20-04
ZTPBSD	Switches, Pushbutton - Fail on Demand	2.40-05	8.92-07	8.98-06	8.68-05
ZTPMOR	Pumps, Normally Operating Motor-Driven - Fail during Operation	3.36-05	2.03-06	1.59-05	9.83-05
ZTPMOS	Pumps, Normally Operating Motor-Driven - Fail To Start	2.35-03	2.47-04	1.45-03	7.38-03
ZTPMSR	Pumps, Standby Motor-Driven - Fail during Operation	3.42-05	2.68-06	1.77-05	9.32-05
ZTPMSS	Pumps, Standby Motor-Driven - Fail To Start on Demand	3.29-03	2.01-04	1.63-03	1.12-02
ZTPP1B	Pipes (Greater Than 3-Inch Diameter) Rupture/Plug	8.60-10	3.00-12	9.49-11	3.00-09
ZTPP2B	Pipes (Less Than 3-Inch Diameter) Rupture/Plug	8.60-09	3.00-11	9.49-10	3.00-08
ZTPS1R	Power Supplies - Fail during Operation	1.71-05	1.03-06	7.60-06	4.90-05
ZTPSHR	Power Supplies (+120V DC ESFAS) - Fail during Operation	1.33-04	5.00-06	5.00-05	5.00-04
ZTPSLR	Power Supplies (+5V or +25V DC ESFAS) - Fail during Operation	5.33-05	2.00-06	2.00-05	2.00-04
ZTPTSR	Pumps, Turbine-Driven - Fail during Operation	1.03-03	6.53-05	4.21-04	3.01-03
ZTPTSS	Pumps, Turbine-Driven - Fail To Start on Demand	3.31-02	6.05-03	2.45-02	8.25-02
ZTRL1D	Relays - Fail on Demand	2.41-04	1.39-05	1.10-04	7.47-04
ZTRL1R	Relays - Fail during Operation	4.20-07	2.39-08	1.98-07	1.31-06
ZTSC1P	Strainers, Service Water - Plug during Operation	6.22-06	8.08-07	3.90-06	1.58-05

Note: Exponential notation is indicated in abbreviated form; e.g., 1.32-01 = 1.32×10^{-01}.

Table 3.3.1-1 (Page 4 of 6). Component Failure Data for Browns Ferry Components

Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZTSCAB	Accumulators, Scram - Rupture/Leak	2.46-06	8.61-08	8.94-07	8.93-06
ZTSEQD	ECCAS/LOP Sequencer - Fail on Demand	2.94-06	4.74-07	1.90-06	6.76-06
ZTSMDR	Signal Modifiers - Fail during Operation	2.94-06	4.74-07	1.90-06	6.76-06
ZTSPNP	Nozzles, Containment Building Spray (One Train) - Plug during Operation	7.06-08	3.49-09	3.00-08	2.58-07
ZTSWBD	Bistables - Fail on Demand	3.89-07	7.08-08	2.76-07	1.08-06
ZTSWBI	Bistables - Spurious Operation	2.21-06	4.00-09	1.68-07	7.00-06
ZTSWPD	Switches, Pressure - Fail on Demand	2.69-04	1.15-05	1.09-04	9.37-04
ZTTK1B	Tanks, Storage - Rupture/Leak	2.66-08	1.00-09	1.00-08	1.00-07
ZTTM1X	Temperature Monitor Loops - No Output	3.41-06	3.39-08	6.68-07	1.26-05
ZTTORP	All Strainers To Ring Header Plugged	1.30-06	2.78-08	3.74-07	4.84-06
ZTTRFR	Transmitters, Flow - Fail during Operation	6.25-06	6.04-07	4.39-06	1.40-05
ZTTRLR	Transmitters, Level - Fail during Operation	1.57-05	3.96-06	1.26-05	3.34-05
ZTTRPR	Transmitters, Pressure - Fail during Operation	7.60-06	8.90-07	4.70-06	1.96-05
ZTV3WD	Valves, Pressure Control (Three-Way) - Fail on Demand	1.52-03	2.37-04	1.08-03	3.32-03
ZTVAOD	Valves, Air-Operated - Fail on Demand	1.52-03	2.37-04	1.08-03	3.32-03
ZTVAOF	Valves, Air-Operated - Fail To Transfer To Failed Position	2.66-04	1.00-05	1.00-04	1.00-03
ZTVAOT	Valves, Air-Operated - Transfer Open or Closed	2.67-07	1.50-08	1.10-07	8.06-07
ZTVCOD	Valves, Check (Other Than Stop Valves) - Fail on Demand	2.69-04	5.33-05	1.44-04	6.27-04
ZTVCOL	Valves, Check (Other Than Stop) - Gross Reverse Leakage	5.36-07	9.23-08	3.17-07	1.26-06
ZTVCOP	Valves, Check (Other Than Stop) - Transfer Closed or Plugged	1.04-08	2.78-09	8.33-09	2.50-08
ZTVCSD	Valves, Checkstop Valves - Fail on Demand	9.13-04	7.07-05	4.14-04	2.61-03

Note: Exponential notation is indicated in abbreviated form; e.g., 1.32-01 = 1.32×10^{-01}.

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Table 3.3.1-1 (Page 5 of 6). Component Failure Data for Browns Ferry Components					
Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZTVCSL	Valves, Checkstop Valves - Gross Reverse Leakage	5.36-07	9.23-08	3.17-07	1.26-06
ZTVCSP	Valves, Checkstop Valves - Transfer Closed or Plugged	1.04-08	2.78-09	8.33-09	2.50-08
ZTVE1D	Valves, Electrohydraulic (Except TSV,TCV) - Fail on Demand	1.52-03	2.37-04	1.08-03	3.32-03
ZTVE1T	Valves, Electrohydraulic (Except TSV,TCV) - Transfer Open/Closed	2.67-07	1.50-08	1.10-07	8.06-07
ZTVE21	Valves, Turbine Stop/Control - Transfer Closed	2.88-05	1.08-06	1.08-05	1.08-04
ZTVE2D	Valves, Turbine Stop/Control - Fail on Demand	1.25-04	3.33-05	1.00-04	3.00-04
ZTVHOT	Valves, Manual - Transfer Open or Closed	4.20-08	1.57-09	1.30-08	1.19-07
ZTVMCX	Disc Check Valve or Motor-Operated Valve - Rupture	1.55-08	1.40-10	2.87-09	5.87-08
ZTVMOD	Valves, Motor-Operated - Fail on Demand	4.30-03	7.49-04	2.84-03	1.05-02
ZTVMOE	Valves, Motor-Operated - Fail To Close While Showing Closed	1.07-04	2.10-05	7.47-05	3.07-04
ZTVMOT	Valves, Motor-Operated - Transfer Open or Closed	9.27-08	9.65-09	5.05-08	2.33-07
ZTVMSD	MSIV - Fails To Close on Demand (BWR)	1.80-04	7.07-06	6.34-05	4.92-04
ZTVR1O	Valves, Safety - Fail To Open on Demand	3.28-04	1.21-05	1.19-04	1.06-03
ZTVR1S	Valves, Safety - Fail To Reseat after Steam Relief	2.87-03	7.66-04	2.30-03	6.90-03
ZTVR1W	Valves, Safety - Fail To Reseat after Water Relief	1.00-01	3.45-03	8.37-02	3.33-01
ZTVR2O	Valves, Relief (Except PORVs or Safetys) - Fail To Open on Demand	2.42-05	9.95-07	9.49-06	9.04-05
ZTVR2T	Valves, Relief (Other Than PORVs or Safetys) - Transfer Open	6.06-06	9.76-07	4.01-06	1.44-05
ZTVR3C	Valves, Relief (Power-Operated) - Fail To Close on Demand	2.50-02	6.66-03	2.00-02	6.00-02
ZTVR3O	Valves, Relief (Power-Operated) - Fail To Open on Demand	4.27-03	1.14-03	3.42-03	1.03-02
ZTVR4C	Valves, Relief (Two-Stage Target Rock) - Fail To Close on Demand	8.88-03	8.93-04	5.85-03	1.99-02
ZTVR4O	Valves, Relief (Two-Stage Target Rock) - Fail To Open on Demand	9.07-03	1.03-03	5.50-03	1.68-02

Note: Exponential notation is indicated in abbreviated form; e.g., 1.32-01 = 1.32×10^{-01}.

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Table 3.3.1-1 (Page 6 of 6). Component Failure Data for Browns Ferry Components					
Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZTVSOD	Valves, Solenoid - Fail on Demand	2.43-03	9.95-05	9.49-04	9.04-03
ZTVSOT	Valves, Solenoid - Transfer Open or Closed	1.27-06	5.19-08	4.91-07	4.07-06
ZTVSQD	Squibb Valve Fails To Operate on Demand	2.66-03	9.33-05	9.70-04	9.68-03
ZTVTCD	Valves, Temperature Control (Butterfly) - Fail on Demand	1.52-03	2.37-04	1.08-03	3.32-03
ZTVTCF	Valves, Temperature Control (Butterfly) Fail To Transfer To Failed Position	2.66-04	1.00-05	1.00-04	1.00-03
ZTVTCT	Valves, Temperature Control (Butterfly) - Transfer Open or Closed	4.20-08	1.57-09	1.30-08	1.19-07
ZTXR1R	Transformers (4.16-kV and Above) - Fail during Operation	1.56-06	2.66-07	1.05-06	3.57-06
ZTXR2R	Transformers (4.16-kV to 480V) - Fail during Operation	6.87-07	1.05-07	4.47-07	1.37-06
ZTXR3R	Transformers, Instrument (480V to 120V) - Fail during Operation	1.55-06	7.94-08	7.00-07	4.87-06
Note: Exponential notation is indicated in abbreviated form; e.g., 1.32-01 = 1.32×10^{-01}.					

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Table 3.3.1-2. Component Maintenance Frequency Data for Browns Ferry Components					
Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZMBUSF	Buses	2.66-06	1.29-07	9.86-07	7.04-06
ZMCMPF	Compressors	2.93-04	1.22-05	1.06-04	7.85-04
ZMDGSF	Diesel Generators	1.03-03	1.65-04	5.99-04	2.13-03
ZMELEF	Batteries, Battery Chargers and Inverters	2.49-05	3.87-06	1.41-05	4.14-05
ZMFN1F	Large Fans	1.47-04	3.85-06	4.03-05	4.05-04
ZMFN2F	Small Fans	2.09-04	8.85-06	7.13-05	5.74-04
ZMHXRF	Heat Exchangers	4.15-05	2.38-06	1.62-05	1.12-04
ZMPMSF	Other Standby Motor- and Diesel-Driven Pumps	1.17-04	7.96-06	4.52-05	3.27-04
ZMPOPF	Other Operating Pumps	1.58-04	1.29-05	7.35-05	3.87-04
ZMPPDF	Positive Displacement Pumps	6.37-04	5.73-05	3.41-04	1.35-03
ZMPSWF	Operating Service Water Pumps	3.35-04	2.64-05	1.39-04	8.46-04
ZMPTSF	Other Standby Turbine-Driven Pumps	4.19-04	5.99-05	2.41-04	8.89-04
ZMSC1F	Strainers	9.27-05	5.33-06	3.69-05	2.27-04
ZMVLVF	Valves	2.74-05	3.94-06	1.41-05	5.72-05
ZMXFRF	Transformers	4.40-06	1.21-07	1.26-06	1.25-05

Note: Exponential notation is indicated in abbreviated form; e.g., 2.66-06 = 2.66×10^{-06}.

Table 3.3.1-3. Component Maintenance Duration Data for Browns Ferry Components					
Designator	Description	Median	5th Percentile	Median	95th Percentile
ZMGNAD	Type A (Nonroutine Maintenance)	1.08+01	6.97+00	9.91+00	1.60+01
ZMGNBD	Type B (Nonroutine Maintenance)	2.09+01	1.31+01	2.02+01	2.88+01
ZMGNCD	Type C (Nonroutine Maintenance)	4.04+01	2.12+01	3.71+01	6.47+01
ZMGNDD	Type D (Nonroutine Maintenance)	1.16+02	7.46+00	9.52+01	2.91+02
ZMGNED	Type E	5.56+00	3.20+00	5.68+00	7.50+00
ZMGNFD	Type F	1.16+00	7.13-01	1.14+00	1.48+00
ZMGNGD	Type G	3.54+00	2.58+00	3.49+00	4.13+00
ZMGNHD	Type H	3.17+03	1.46+03	3.16+03	4.88+03
ZMHXND	Heat Exchangers (No Technical Specifications)	5.83+02	6.34+01	3.68+02	1.53+03
ZMOLSD	Other Equipment (Long Technical Specifications)	3.72+01	8.20+00	2.75+01	7.41+01
ZMOMSD	Other Equipment (48- And 72-Hour Technical Specifications)	1.31+01	7.84-01	6.01+00	4.04+01
ZMONSD	Other Equipment (No Technical Specifications)	3.85+01	1.37+00	1.37+01	1.17+02
ZMOSSD	Other Equipment (24-Hour Technical Specifications)	6.26+00	5.46-01	3.42+00	2.02+01
ZMPLSD	Pumps (168-Hour Technical Specifications)	2.87+01	2.58+00	1.57+01	7.27+01
ZMPMSD	Pumps (72-Hour Technical Specifications)	1.11+01	1.16+00	6.20+00	3.08+01
ZMPNSD	Pumps (No Technical Specifications)	2.66+02	1.99+00	4.72+01	8.15+02
ZMPSSD	Pumps (Short Technical Specifications)	7.47+00	1.24+00	5.43+00	1.82+01
ZMVLSD	Valves (Long Technical Specifications)	1.89+01	1.54+00	1.01+01	5.13+01
ZMVNSD	Valves (No Technical Specifications)	1.32+02	7.23-01	1.69+01	4.10+02
ZMVSSD	Valves (Short Technical Specifications)	4.05+00	6.83-01	2.70+00	9.52+00

Note: Exponential notation is indicated in abbreviated form; e.g., 4.70+02 = 4.70×10^{02}.

Table 3.3.1-4 (Page 1 of 2). Summary of Initiating Events and Precursors to Initiating Events for Browns Ferry PRA

Designator	Description	Frequency (events per calendar year)			
		Mean	5th Percentile	Median	95th Percentile
ZIETWB	Turbine Trip with Bypass	1.59+00	9.03-01	1.50+00	2.25+00
ZIETNB	Turbine Trip without Bypass	3.13-01	6.32-02	2.15-01	6.98-01
ZIESCI	Inadvertent Scram at Power	1.58+00	3.99-01	1.19+00	3.27+00
ZIELCV	Loss of Condenser Vacuum	3.28-01	8.85-02	2.59-01	6.34-01
ZIEMVC	Inadvertent Closure of One or More MSIVs	5.60-01	1.41-01	4.56-01	1.05+00
ZIEPRO	Pressure Regulator Failure — Open	4.61-02	4.28-03	2.34-02	1.22-01
ZIESR1	One SRV Inadvertently Opens (Two-Stage T.R. Valves)	4.15-02	2.24-03	1.94-02	1.26-01
ZIESR2	Two SRVs Inadvertently Open (Two-Stage T.R. Valves)	5.87-03	2.25-04	1.96-03	1.68-02
ZIESBK	Small Break LOCA Inside Containment	4.15-03	1.50-04	1.50-03	1.13-02
ZIELPA	Loss of Plant Air	7.87-02	7.07-03	4.28-02	2.03-01
ZIESCR	Events with Scram Required	3.86-01	6.67-02	2.64-01	9.05-01
ZIEPL1	Partial Loss of Feedwater — Condensate Events	5.46-02	4.18-03	2.72-02	1.41-01
ZIEPL2	Partial Loss of Feedwater — Feedwater Events	2.86-01	5.98-02	2.10-01	5.93-01
ZIEFWR	Feedwater Ramp-Up	1.60-01	5.54-02	1.36-01	3.14-01
ZIETL1	Total Loss of Feedwater — Condensate Events	3.99-02	5.29-03	2.55-02	9.50-02
ZIETL2	Total Loss of Feedwater — Feedwater Events	5.06-01	1.05-01	3.79-01	1.07+00
ZIESR3	Three or More SRVs Inadvertently Open	8.79-04	2.78-06	8.23-05	2.37-03
ZIEVSL	Very Small LOCA (recirculation pump seal leaks)	2.34-02	1.41-03	1.06-02	6.18-02
ZIEML1	Medium LOCA	3.33-04	1.17-05	1.21-04	1.21-03
ZIELL1	Other Large LOCA	1.06-04	1.48-05	6.86-05	3.07-04
ZIERD1	Recirculation Discharge Line Break	3.13-04	7.74-06	9.68-05	1.16-03
ZIEEL1	Excessive LOCA	9.39-09	2.32-10	2.90-09	3.48-08
ZIECS1	Core Spray Line Break	8.28-05	1.15-06	1.93-05	3.09-04
ZIERS1	Recirculation Suction Line Break	9.19-05	8.03-07	1.68-05	3.38-04
ZIEIAU	Instrument Tap Anomalies (upper reference leg)	1.32-03	6.68-05	5.84-04	3.55-03

Table 3.3.1-4 (Page 2 of 2). Summary of Initiating Events and Precursors to Initiating Events for Browns Ferry PRA

Designator	Description	Frequency (events per calendar year)			
		Mean	5th Percentile	Median	95th Percentile
ZIEIAL	Instrument Tap Anomalies (lower reference leg)	2.36-02	8.19-04	8.41-03	7.59-02
ZIESLO	Steamline Break Outside the Containment	6.69-04	5.08-05	3.41-04	2.21-03
BELOSP*	Loss of Offsite Power Frequency	4.40-02	6.87-03	3.15-02	9.81-02
LICA**	Loss of I&C Board 2A	3.53-03	6.10-04	2.40-03	8.21-03
LICB**	Loss of I&C Board 2B	3.54-03	5.82-04	2.40-03	8.11-03
LUPS**	Loss of Unit 2 120V Preferred Power	1.43-02	9.50-04	3.56-03	2.21-02
LRCW**	Loss of Raw Cooling Water	3.53-03	1.21-04	7.71-04	7.42-03

*The frequency for loss of offsite power is developed as events per site-year. The frequency includes events that may happen when the Browns Ferry unit is shut down. The above value must be multipled by the availability factor for Browns Ferry: = 0.8. Plant-specific data are 0 events in 17.5 years. The data sources are References 3.3.1-17 and 3.3.1-18.
**System-specific analysis.

Table 3.3.1-5 (Page 1 of 2). ZIEIAU — Instrument Tap Anomalies (upper reference leg)

I N P U T D A T A

EMPIRICAL EXPERIENCE			MESH SPECIFICATIONS		
PLANT NAME	NO. OF OCCURRENCES	TIME UNITS OR DEMANDS	R.F.	MEDIAN	LAMBDA
1) BFN1	0	8.4200E+00	1) 1.2000E+00	1) 2.0000E-04	1) 4.0000E-06
2) BFN2	0	7.2000E+00	2) 3.0000E+00	2) 4.0000E-04	2) 1.0000E-05
3) BFN3	0	7.0300E+00	3) 5.0000E+00	3) 6.0000E-04	3) 2.0000E-05
4) BRUNSWK 1	0	1.3300E+01	4) 7.0000E+00	4) 8.0000E-04	4) 3.0000E-05
5) BRUNSWK 2	0	1.5700E+01	5) 9.0000E+00	5) 1.0000E-03	5) 4.0000E-05
6) COOPER	0	1.6000E+01	6) 1.1000E+01		6) 5.0000E-05
7) DRESDEN 2	0	2.0100E+01			7) 6.0000E-05
8) DRESDEN 3	0	1.8600E+01			8) 8.0000E-05
9) DUANE ARLD	0	1.5400E+01			9) 1.0000E-04
10) FERMI 2	0	2.4000E+00			10) 1.5000E-04
11) FITZPTRICK	0	1.4900E+01			11) 2.0000E-04
12) GRND GLF 1	0	5.0000E+00			12) 2.5000E-04
13) HATCH 1	0	1.0900E+01			13) 3.0000E-04
14) HATCH 2	0	1.4500E+01			14) 4.0000E-04
15) HOPE CRK 1	0	3.5000E+00			15) 5.0000E-04
16) LASALLE 1	0	6.5000E+00			16) 6.0000E-04
17) LASALLE 2	0	5.7000E+00			17) 7.0000E-04
18) LIMERICK	0	4.4000E+00			18) 8.0000E-04
19) MILLSTONE	0	1.9300E+01			19) 9.0000E-04
20) MONTICELLO	1	1.9000E+01			20) 1.0000E-03
21) NMP 1	0	2.0600E+01			21) 1.2000E-03
22) NMP 2	0	2.3000E+00			22) 1.5000E-03
23) OYSTR CREK	0	2.0500E+01			23) 2.0000E-03
24) PCH BTTM 2	0	1.4400E+01			24) 3.0000E-03
25) PCH BTTM 3	0	1.2800E+01			25) 5.0000E-03
26) PERRY 1	0	2.6000E+00			26) 8.5000E-03
27) PILGRM 1	0	1.2360E+01			27) 1.0000E-02
28) QUAD CTS 1	0	1.3450E+01			28) 2.5000E-02
29) QUAD CTS 2	0	1.7300E+01			
30) RIVER BEND	0	4.0000E+00			
31) SUSQHNNA 1	0	7.1000E+00			
32) SUSQHNNA 2	0	5.4000E+00			
33) VT YANKEE	0	1.7600E+01			
34) WNP 2	0	5.5000E+00			
SUM	1	3.8376E+02			

S P E C I F I C E X P E R I E N C E = 0 OCCURRENCES IN 0.0000E+00 TIME UNITS OR DEMANDS

Table 3.3.1-5 (Page 2 of 2). ZIEIAU — Instrument Tap Anomalies (upper reference leg)

O U T P U T D A T A

	MEAN	VARIANCE	5TH PERCENTILE	MEDIAN	95TH PERCENTILE
PRIOR	1.32E-03	6.07E-06	6.89E-05	6.09E-04	3.66E-03
POSTERIOR	1.32E-03	6.07E-06	6.89E-05	6.09E-04	3.66E-03

Table 3.3.1-6 (Page 1 of 2). ZIEIAL — Instrument Tap Anomalies (lower reference leg)

I N P U T D A T A

EMPIRICAL EXPERIENCE

PLANT NAME	NO. OF OCCURRENCES	TIME UNITS OR DEMANDS
1) BFN1	0	8.4200E+00
2) BFN2	0	7.2000E+00
3) BFN3	0	7.0300E+00
4) BRUNSWK 1	1	1.3300E+01
5) BRUNSWK 2	1	1.5700E+01
6) COOPER	0	1.6000E+01
7) DRESDEN 2	0	2.0100E+01
8) DRESDEN 3	0	1.8600E+01
9) DUANE ARLD	0	1.5400E+01
10) FERMI 2	2	2.4000E+00
11) FITZPTRICK	0	1.4900E+01
12) GRND GLF 1	0	5.0000E+00
13) HATCH 1	0	1.0900E+01
14) HATCH 2	0	1.4500E+01
15) HOPE CRK 1	0	3.5000E+00
16) LASALLE 1	0	6.5000E+00
17) LASALLE 2	0	5.7000E+00
18) LIMERICK 1	0	4.4000E+00
19) MILLSTONE	0	1.9300E+01
20) MONTICELLO	0	1.9000E+01
21) NMP 1	0	2.0600E+01
22) NMP 2	0	2.3000E+00
23) OYSTR CREK	0	2.0500E+01
24) PCH BTTM 2	0	1.4400E+01
25) PCH BTTM 3	0	1.2800E+01
26) PERRY 1	1	2.6000E+00
27) PILGRIM 1	0	1.2360E+01
28) QUAD CTS 1	0	1.3450E+01
29) QUAD CTS 2	0	1.7300E+01
30) RIVER BEND	0	4.0000E+00
31) SUSQHNNA 1	0	7.1000E+00
32) SUSQHNNA 2	0	5.4000E+00
33) VT YANKEE	0	1.7600E+01
34) WNP 2	2	5.5000E+00
SUM	7	3.8376E+02

MESH SPECIFICATIONS

R.F.	MEDIAN	LAMBDA
1) 1.2000E+00	1) 3.0000E-03	1) 9.0000E-05
2) 3.0000E+00	2) 6.0000E-03	2) 1.0000E-04
3) 5.0000E+00	3) 9.0000E-03	3) 1.5000E-04
4) 7.0000E+00	4) 2.0000E-02	4) 2.0000E-04
5) 9.0000E+00		5) 2.5000E-04
6) 1.1000E+01		6) 4.0000E-04
		7) 5.0000E-04
		8) 7.0000E-04
		9) 1.0000E-03
		10) 1.4000E-03
		11) 2.5000E-03
		12) 3.0000E-03
		13) 4.0000E-03
		14) 5.5000E-03
		15) 6.8000E-03
		16) 8.0000E-03
		17) 9.0000E-03
		18) 1.0000E-02
		19) 1.1500E-02
		20) 1.3000E-02
		21) 1.6000E-02
		22) 2.0000E-02
		23) 2.5000E-02
		24) 3.0000E-02
		25) 5.0000E-02
		26) 8.0000E-02
		27) 2.5000E-01

S P E C I F I C E X P E R I E N C E = 0 OCCURRENCES IN 0.0000E+00 TIME UNITS OR DEMANDS

Table 3.3.1-6 (Page 2 of 2). ZIEIAL — Instrument Tap Anomalies (lower reference leg)

O U T P U T   D A T A

DISCRETE DISTRIBUTION PARAMETERS

	MEAN	VARIANCE	5TH PERCENTILE	MEDIAN	95TH PERCENTILE
PRIOR	2.36E-02	1.58E-03	8.07E-04	9.46E-03	7.62E-02
POSTERIOR	2.36E-02	1.58E-03	8.07E-04	9.46E-03	7.62E-02

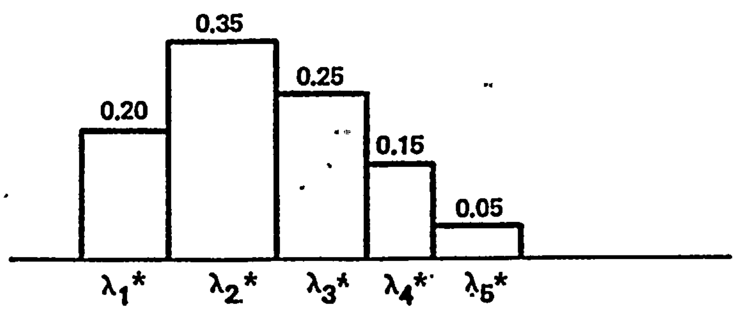

Figure 3.3.1-1. Population Variability of the Failure Rate

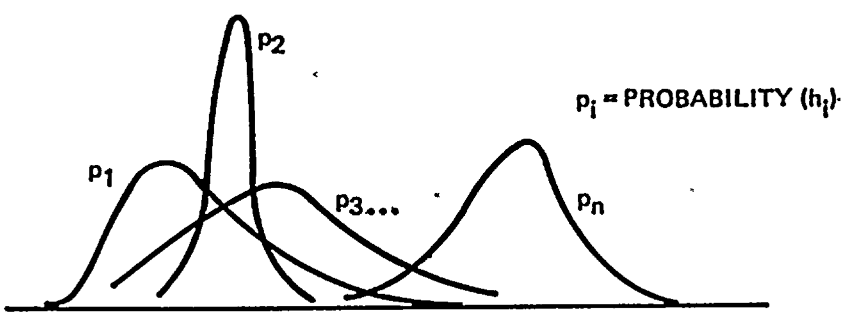

Figure 3.3.1-2. State-Of-Knowledge Distribution Over the Set of Frequency Distributions

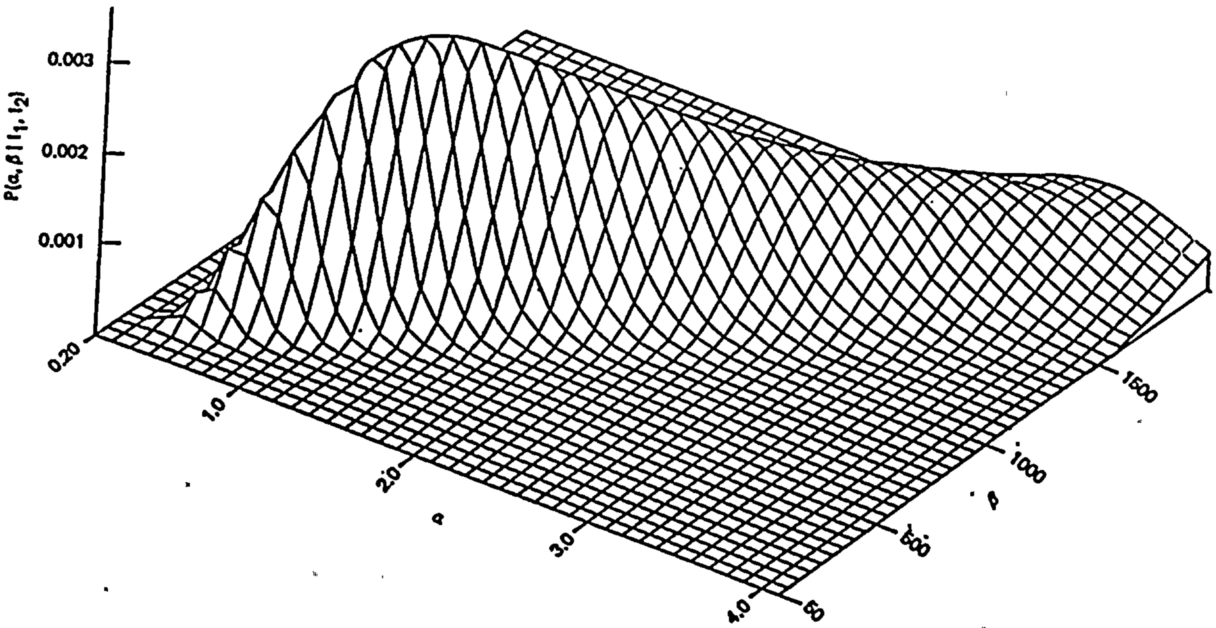

Figure 3.3.1-3. Posterior Distribution for the Parameters of the Distribution of Pumps' Failure To Start on Demand Rates

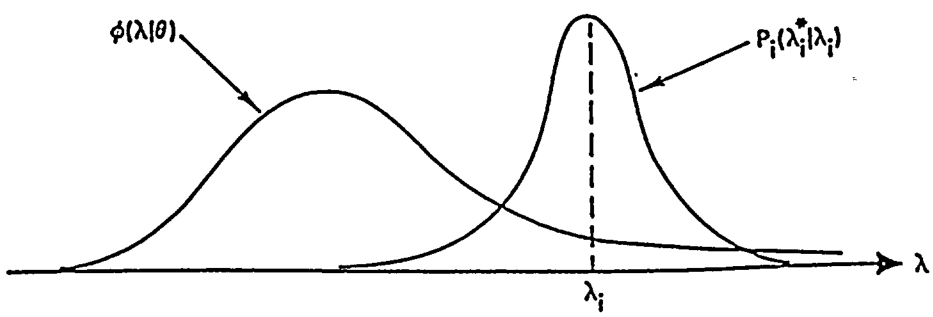

Figure 3.3.1-4. The Relation Between the Variability Curve and Uncertainty about Individual Estimates

EVIDENCE COLLECTED FOR FAILURE RATE				
SOURCE	DATA			
	NUMBER OF FAILURES	NUMBER OF DEMANDS	ESTIMATE	ASSIGNED RANGE FACTOR
TYPE 1				
PLANT A	10	1.65+3		
PLANT B	14	1.13+4		
PLANT C	7	1.73+3		
PLANT D	42	6.72+3		
PLANT E	3	1.26+3		
PLANT F	31	9.72+3		
TYPE 2				
EXPERT 1			1.00-3	5
EXPERT 2			5.60-3	3
EXPERT 3			1.00-3	10

NOTE: EXPONENTIAL NOTATION IS INDICATED IN ABBREVIATED FORM; e.g., 1.65+3 = 1.65 x 10^{+3}

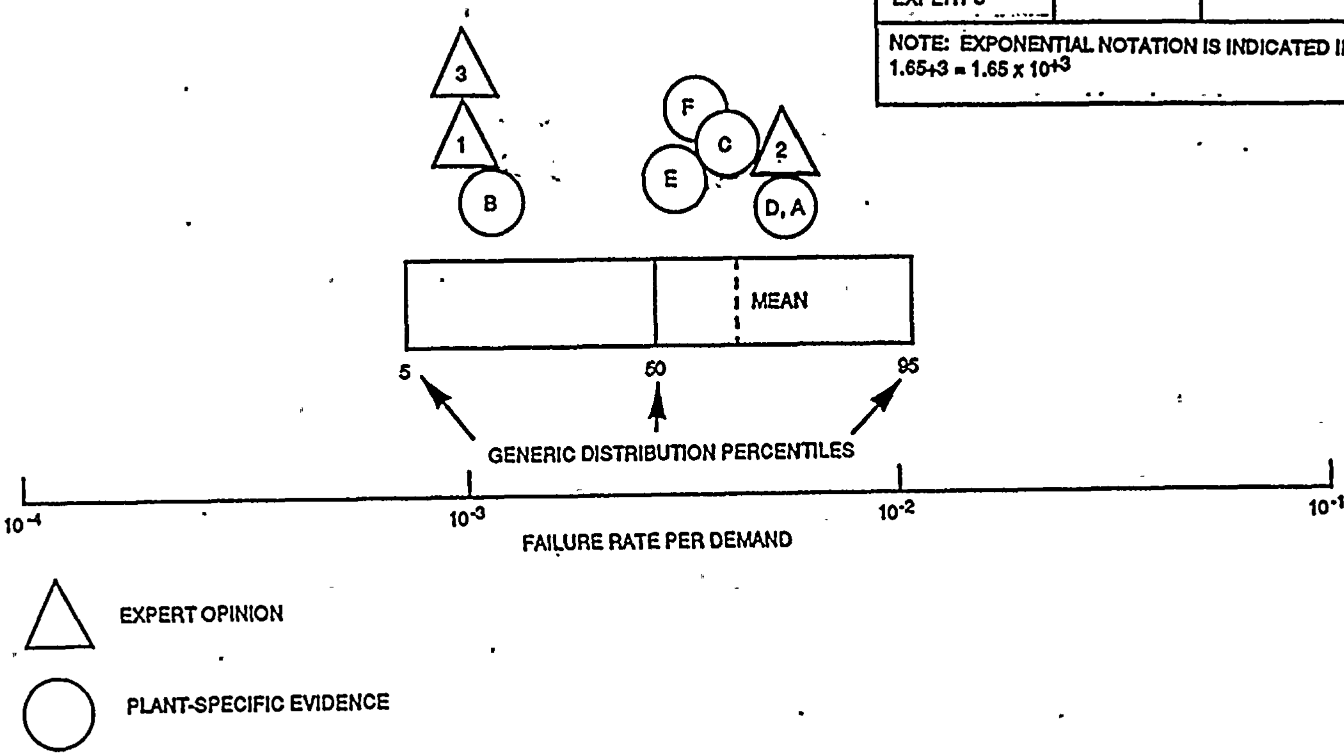

Figure 3.3.1-5. Application of RISKMAN To Develop Generic Distribution for MOV Failure Rates

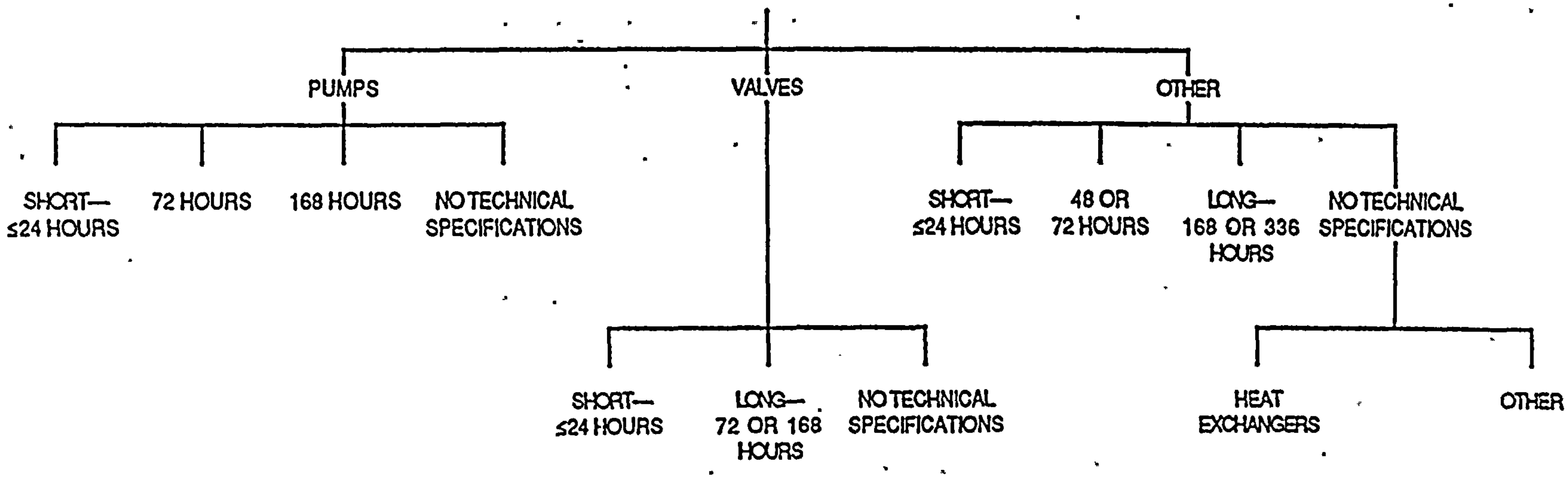

Figure 3.3.1-6. Categorization of Component Types for Generic Maintenance Frequency Distributions

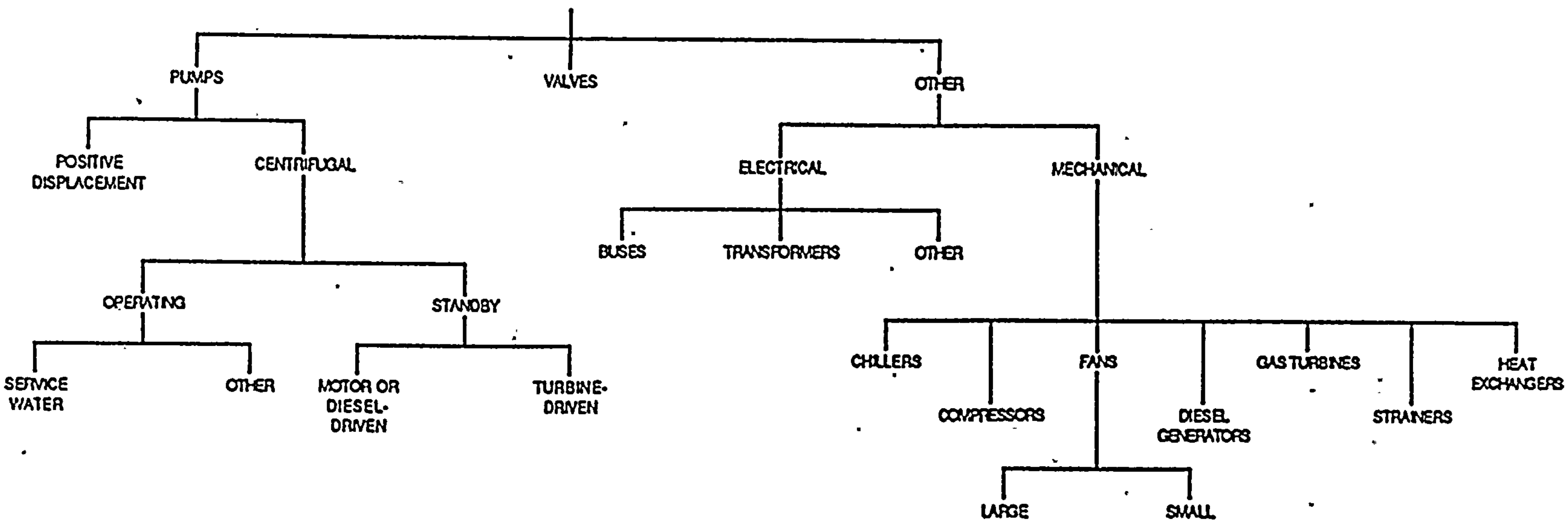

Figure 3.3.1-7. Categorization of Component by Technical Specification for Generic Mean Maintenance Duration Distributions

3.3.2 INCORPORATION OF PLANT-SPECIFIC EVIDENCE

This section discusses the incorporation of plant-specific data with generic data. This was not performed for Browns Ferry; this section is included for completeness of TVA's approach to PRA.

This section describes an approach for incorporating plant-specific evidence. The approach for updating initiating event frequencies, failure rates, and maintenance frequencies with plant-specific evidence is described in Section 3.3.2.1. The approach for updating maintenance durations is described in Section 3.3.2.2. Common cause failure parameters are described in Section 3.3.4.

3.3.2.1 Failure and Maintenance Frequency Update

When plant-specific data become available from the accumulation of Browns Ferry operating experience, data specialization (or the development of plant-specific failure rate distributions and maintenance frequency distributions) is achieved by applying Bayes' theorem as follows:

$$P(\lambda|E_2) = F^{-1} L(E_2|\lambda) P_0(\lambda) \qquad (3.3.2.1)$$

where $P(\lambda|E_2)$ is the plant-specific failure rate distribution reflecting the plant-specific experience E_2, and the generic distribution $P_0(\lambda)$ (i.e., the generic prior) is the prior state of knowledge about the failure rate of the component in question. The likelihood term, $L(E_2|\lambda)$, takes the form of a Poisson distribution when λ is the rate of failure per unit time and the evidence E_2 is k failures in T time units

$$P(k_1T|\lambda) = \frac{(\lambda T)^K}{k!} e^{-\lambda T} \qquad (3.3.2.2)$$

If λ is a demand failure frequency and E_2 is k failures in D demands, then $L(E_2|\lambda)$ is a binomial distribution

$$P(k_1D|\lambda) = \frac{D!}{(D-k)!\,k!} (1-\lambda)^{D-k} \lambda^k \qquad (3.3.2.3)$$

The magnitude of the effect of adding plant-specific data depends on the relative strength of the data compared with the prior level of confidence expressed in the form of the spread of the prior distribution. Typically, both the location and the spread of the posterior or updated distribution are affected by the plant-specific evidence. The mean value of the updated distribution could be higher or lower than the mean of the generic prior, but adding the plant-specific data normally reduces the spread of the distribution, as shown in the following example. In this example, the generic distribution for the MOV demand failure frequency presented in the example of the previous section was updated with 15 failures in 5,315 demands. Calculations were performed using RISKMAN. The following table compares some basic characteristics for the generic prior and updated distributions:

Distribution	Mean (per demand)	5th Percentile	Median	95th Percentile
Generic	4.27×10^{-3}	7.28×10^{-4}	2.96×10^{-3}	1.01×10^{-2}
Updated	2.88×10^{-3}	1.74×10^{-3}	2.70×10^{-3}	3.82×10^{-3}

Another example of how the two-stage Bayesian procedure employed by RISKMAN is used to incorporate plant-specific data is illustrated in Figure 3.3.2-1. In this example, for motor-operated valves, suppose that the plant-specific evidence revealed that there was 1 failure in 1,000 demands at the specific plant being analyzed. The RISKMAN analyst would call up the generic distribution for the failure mode that had been developed previously in the first-stage Bayesian procedure in Figure 3.3.1-1, and input the plant-specific evidence to produce the updated distribution, denoted in Figure 3.3.2-1 as "Posterior 1." As can be seen in this figure, the weight of this evidence pulls down the mean of the posterior distribution toward 1.0×10^{-3}, the point estimate of the plant-specific evidence.

One useful property of Bayes' theorem is that it automatically weights the respective roles of the prior distribution and the evidence according to the amount of evidence applied. So, for example, if five times as much data that happen to be consistent with a point estimate of 1.0×10^{-3} (i.e., 5 failures in 5,000 demands) were collected from the specific plant being analyzed, the updated distribution (Posterior 2) would become very peaked about the point estimate of the evidence such that the role of the prior distribution becomes unimportant. The use of this approach eliminates the need to make and to document difficult and arbitrary decisions about when to use generic and when to use plant-specific data. Even for a plant with much experience, there are insufficient data for some of the rare events that are important (e.g., small loss of coolant accident frequency) to eliminate the need for both sources of data.

Another useful property of Bayes' theorem is that it provides a consistent treatment of any type of evidence, even when that evidence is made up from experience data in which no failures were observed. Suppose that we are using Bayes' theorem to evaluate the failure rate of a pump, λ, at a specific plant that tests the pump N times and observes no failures. Using Bayes' theorem, the probability that the failure rate of the pump is equal to any particular value, say, $\lambda = \lambda^*$, is given by

$$p(\lambda^*|E) = F^{-1}L(E|\lambda^*)p_o(\lambda^*) \qquad (3.3.2.4)$$

where

$F = \int_0^\infty L(E|\lambda)p_o(\lambda)d\lambda$

$L(E|\lambda^*)$ = likelihood of observing evidence E, given that the failure rate is λ^*.

If we are quantifying a demand-based failure rate, the appropriate likelihood function is the binomial distribution. If the failure rate on demand is λ, the likelihood of observing exactly K failures in N demands is

$$L(\text{k failures in N demands}) = \binom{N}{k} \lambda^k (1-\lambda)^{N-k} \qquad (3.3.2.5)$$

So, for zero failures in N demands,

$$L(\text{0 failures in N demands}) = (1-\lambda)^N \qquad (3.3.2.6)$$

This likelihood function is plotted in Figure 3.3.2-2 for different values of N and λ. To see how Bayes' theorem works for this kind of evidence, assume that λ can take on only one of five discrete values: {1, .03, .01, .003, or .001} and that the prior distribution is uniform over these values; i.e., a "flat distribution." Application of Bayes' theorem for zero failures in N demands is illustrated in Table 3.3.2-1. As can be seen in this table, the posterior distribution is heavily influenced by the prior distribution for N = 10 demands, indicating rather weak evidence. However, for N = 1,000 demands, the posterior essentially vanishes for values of λ in excess of 3×10^{-3} because of the influence of the likelihood function. Thus, zero failures does not pose any problems for the Bayesian approach, and the results are a strong function of the quantity of evidence; i.e., the number of successful demands.

3.3.2.2 Maintenance Duration Update

To use the RISKMAN software to update maintenance duration distributions, the raw plant-specific data have to be processed to a form that is compatible with event frequency updating formulae of Section 3.3.1.2. The plant data must be converted to equivalent values of a number of events, k, and a time period, T. We make use of the fact that according to the Poisson model for component failures, the mean value of a failure rate, λ, can be estimated by

$$\hat{\lambda} = \frac{k}{T} \qquad (3.3.2.7)$$

where k is the number of failures observed in T time units. The variance of this estimator is given by

$$\mathrm{Var}(\hat{\lambda}) = \mathrm{Var}\left(\frac{k}{T}\right) = \frac{1}{T^2} \bullet \mathrm{Var}(k) \qquad (3.3.2.8)$$

If k has a Poisson distribution, then

$$\mathrm{Var}(k) = \lambda T \approx \hat{\lambda} T = k \qquad (3.3.2.9)$$

so Equation (3.3.1.63) can be rewritten as

$$Var(\hat{\lambda}) = \frac{1}{T^2} \bullet Var(k) \approx \frac{k}{T^2} \qquad (3.3.2.10)$$

By substituting $\overline{m}$ (the mean observed maintenance duration at Browns Ferry for $\hat{\lambda}$ in Equations (3.3.2.7) and (3.3.2.10), we then compute appropriate values of k and T by solving the following equations:

$$\frac{k}{T} = \hat{\lambda} = \overline{m} \qquad (3.3.2.11)$$

and

$$\frac{k}{T^2} = Var(\hat{\lambda}) = Var(\overline{m}) \qquad (3.3.2.12)$$

In these equations, the mean observed maintenance duration, $\overline{m}$, is simply the average of the durations of all maintenance events for a particular type of component at Browns Ferry:

$$\overline{m} = \frac{\left(\sum_{i=1}^{n} m_i\right)}{n} \qquad (3.3.2.13)$$

where m_i is the actual duration of the ith maintenance event for the particular component type being considered and n is the number of such events observed at Browns Ferry. The variance of $\overline{m}$ is given by

$$Var(\overline{m}) = Var\left[\frac{\left(\sum_{i=1}^{n} m_i\right)}{n}\right] = \frac{1}{n^2} \bullet Var\left(\sum_{i=1}^{n} m_i\right)$$

$$= \frac{1}{n^2} \bullet \sum_{i=1}^{n} Var(m_i) = \frac{1}{n} \bullet \sigma_m^2 \qquad (3.3.2.14)$$

where σ_m^2 is the observed variance of the maintenance duration m_1, m_2, ... m_n.

Now, solving for k and T in Equations (3.3.2.9) and (3.3.2.10), we get:

$$T = \frac{\overline{m}}{Var(\overline{m})} = \frac{\overline{m}}{1/n \bullet \sigma_m^2} = \frac{n \bullet \overline{m}}{\sigma_m^2} \qquad (3.3.2.15)$$

and

$$k = T \bullet \overline{m} = \frac{n \bullet (\overline{m})^2}{\sigma_m^2} \qquad (3.3.2.16)$$

The values given by Equations (3.3.2.15) and (3.3.2.16) can be used in a Poisson likelihood function to update generic maintenance durations.

Table 3.3.2-1. Application of Bayes' Theorem for Case of Zero Failures

λ	Prior Distribution $p_0(\lambda)$	Binomial Likelihood Function for Zero Failures $(1-\lambda)^N$			Posterior Distribution $p(\lambda \mid 0$ failure in N demands)		
		N = 10	N = 100	N = 1,000	N = 10	N = 100	N = 1,000
.1	.2	.35	2.6×10^{-5}	1.8×10^{-46}	.088	1.3×10^{-5}	4.2×10^{-46}
.03	.2	.74	.047	5.9×10^{-14}	.187	.023	1.4×10^{-13}
.01	.2	.90	.37	4.3×10^{-5}	.229	.178	1.0×10^{-4}
.003	.2	.97	.74	.049	.246	.36	.12
.001	.2	.99	.90	.37	.251	.44	.88

LEGEND:

DISTRIBUTION	EVIDENCE (EVENTS/DEMANDS)	MEAN VALUE
GENERIC	NOT APPLICABLE	4.3×10^{-3}
POSTERIOR 1	1/1,000	2.0×10^{-3}
POSTERIOR 2	5/5,000	1.3×10^{-3}

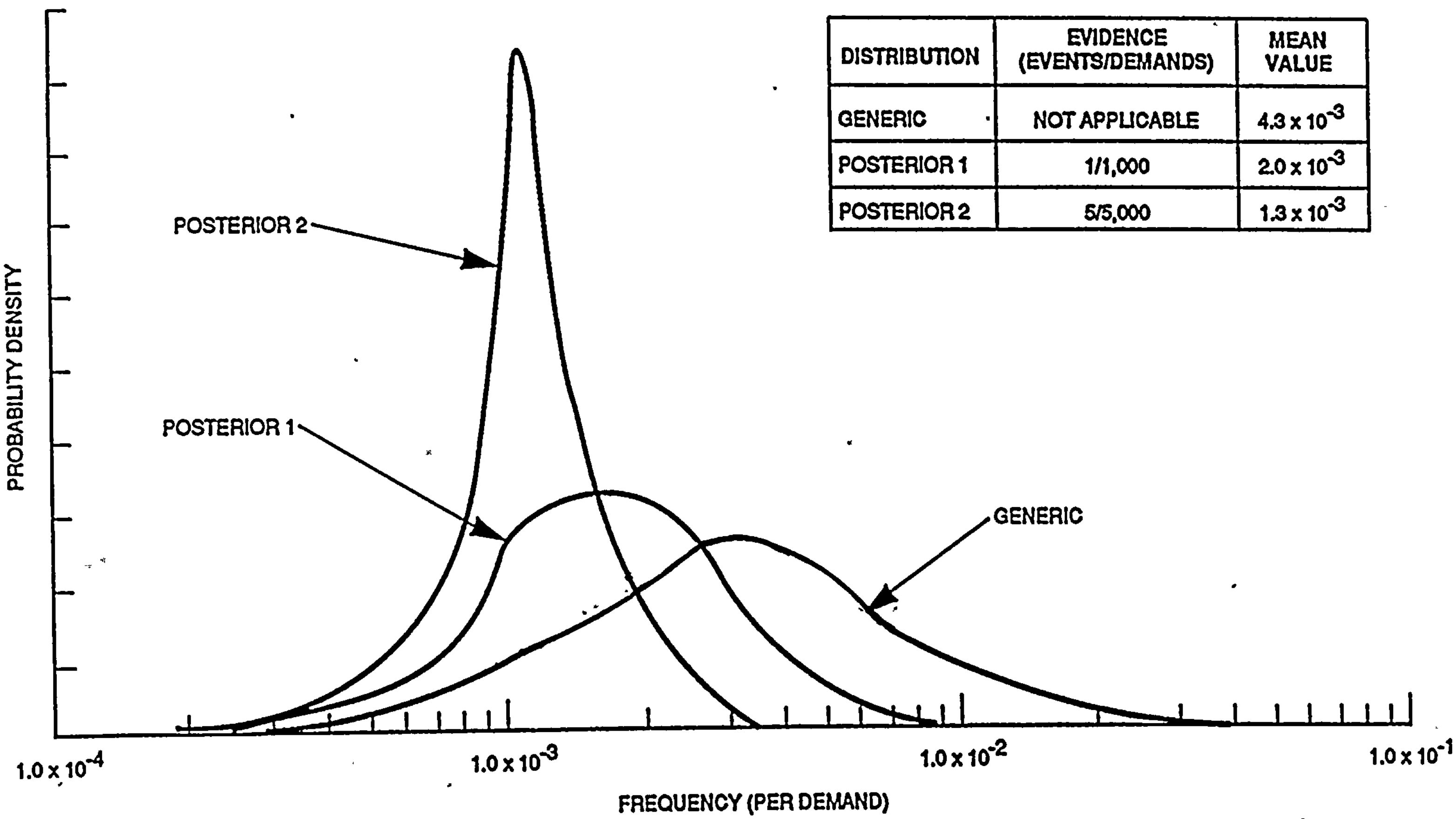

Figure 3.3.2-1. Updating Generic Distributions with Plant-Specific Evidence Using RISKMAN

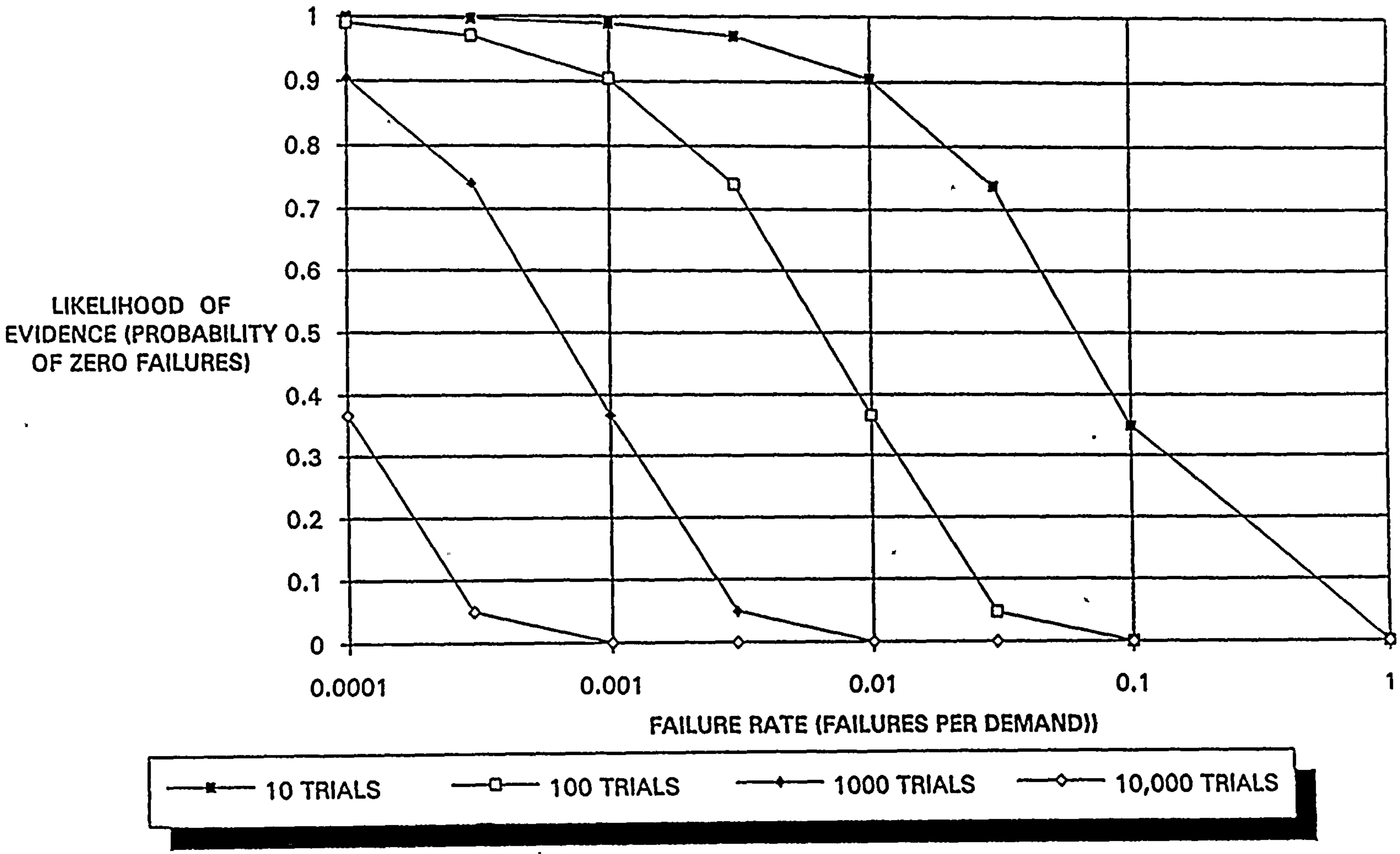

Figure 3.3.2-2. Treatment of Zero Failures Using Binomial Likelihood Function

3.3.3 HUMAN ACTION DATA

This section summarizes the results of the human actions evaluations performed in the Browns Ferry Unit 2 Probabilistic Risk Assessment (PRA). Section 3.3.3.1 addresses errors during normal maintenance and testing that leave systems unavailable to perform their functions if an initiating event should occur. Section 3.3.3.2 presents the evaluation of errors by the operating crew as they dynamically respond to the plant conditions during the sequence of events following an initiating event. Finally, Sections 3.3.3.3 and 3.3.3.4 address their actions to recover functions through alternate alignments or restoration of failed systems to service. Section 3.3.3.3 addresses those actions identified by a review of the quantification of the plant model, while Section 3.3.3.4 addresses recovery of electric power.

A summary of the methodology used to accomplish the assessment of individual actions is presented in Section 2.3.5.2. A detailed description of the methodology, summaries of the actions evaluated, and calculation packages leading to the results are presented in Appendix B.

3.3.3.1 Results Of Routine Action Evaluation

The routine action evaluation addresses errors during normal maintenance and testing that leave systems in an undetected unavailable state that prevents them from performing their functions should an initiating event occur. As a surveillance test is performed to verify operability after maintenance, the screening process addresses the surveillance tests accomplished on each system. Each system analyst follows the guidance contained in Appendix B, Section B.2, to identify tests that have a potential to leave components in an undetected unavailable state. The analyst quantifies the unavailability created by those tests meeting the screening criteria using the screening error rates summarized in Table 3.3.3-1 (References 3.3.3-1 and 3.3.3-2) for evaluation of risk significance in the plant model.

Based on the results of the systems analyses, the surveillance tests summarized in Table 3.3.3-2 have significant potential to leave a component in an undetected unavailable state to warrant quantification for inclusion in the plant model. The table lists the system in which the component is modeled, the top events impacted by the test, the name and number of the test, a short description of error that could lead to the undetected unavailability, and the database variable use to quantify the unavailability.

3.3.3.2 Results Of Dynamic Human Actions Analysis

The event sequence and systems evaluations identified the operator actions listed in Table 3.3.3-3 as being a potentially important influence for the mitigation of severe core damage sequences. The reasoning for their explicit inclusion in the event sequence models is found in the definition of the event tree top events in Sections 3.1.2 through 3.1.4. This section presents the

- Qualitative description of the tasks required to accomplish the actions successfully, and the conditions under which they must be accomplished.

- Quantitative evaluation of performance-shaping factors (PSF) reflecting the operators' judgments regarding the degree of difficulty for successfully accomplishing the actions.

- Distributions of the human error rates derived from the quantification evaluation using the adaption of the SLIM methodology, as summarized in Section 2.3.5.2 and presented in Section B.4.

3.3.3.2.1 Qualitative Description of the Dynamic Human Actions

A short description of each action evaluated for the Browns Ferry Unit 2 PRA is given in Table 3.3.3-3. Appendix B, Table B-8, presents the Operator Response Forms for each evaluated dynamic human action. The forms are written in accordance with the guidelines contained in Section B.4.1, as summarized in Table 3.3.3-4. The descriptions on the forms were developed by the human action analyst and licensed operators serving on the PRA team, with information provided by the event sequence analysts regarding the conditions under which each action is demanded.

An example of a completed Operator Response Form is given in Table 3.3.3-5. Sufficient detail is provided to permit the operator groups evaluating the actions to recognize the context of the action. However, detailed evaluation of the performance-shaping factors is purposely omitted so that the operators can form their own judgments. The justifications of the time windows for the actions are presented in the top event definitions and Appendix C.

The dynamic human actions were also qualitatively evaluated by the three groups of licensed plant operators who performed the quantitative evaluation. These groups discussed the context of each action among themselves before quantitatively evaluating it. In some cases, the groups provided practical comments that assisted the event sequence analyst to improve the plant model. Those found to be useful for clarifying the evaluations were either incorporated into the Operator Response Forms or included in the group comparison and trend analysis presented in Appendix B, Sections B.5.4 and B.5.5.

3.3.3.2.2 Quantitative Evaluations

The quantitative evaluations of the licensed plant operators are elicited and converted to human error rates using an adaptation of the SLIM methodology (References 3.3.3-3 through 3.3.3-5). Three operator groups quantitatively assessed the weight and degree of difficulty score of the seven performance-shaping factors in accordance with the guidelines in Appendix B, Section B.4.2, as summarized in Table 3.3.3-6. These evaluations are summarized in Appendix B, Tables B-10 and B-11.

The failure likelihood index (FLI) evaluations of each group are converted into human error rate estimates independently of the other two groups in accordance with the procedures outlined in Appendix B, Section B.4.3. After the failure rates for the individual groups are obtained, they are merged together, giving equal weight to each evaluation group. The individual actions are grouped by similarity of weights into groups for quantitative evaluation against calibration actions. Calibration actions obtained from evaluations in other PRAs are used to benchmark the failure rates of each group. The identification of each calibration action, the basis for its failure frequency, and the source of the calibration

PSF weights and scores are documented in a calibration action database (Reference 3.3.3-6). To keep the differences in judgments explicit, no adjustment is made to the normalized weights or individual PSF rating of either the rated actions or the calibration actions during this process. The resulting evaluations are given by individual rating group in Appendix B, Tables B-12 through B-14.

The human error rates used in the PRA are obtained from merging the individual groups of operator evaluations into composite quantitative estimates by assigning equal weights to the evaluations of each operator group. This is done using the MERGE function of the BARP software program (Reference 3.3.3-7), as outlined in Appendix B, Section B.4.4. These composite error rates are given in Appendix B, Table B-15.

Some estimates have large range factors. This is due to both the assignment of uncertainty to the derived error rate of each group and the variability of ratings among the groups. Based on the recommendations of Swain and Guttman, the range factor for any individual failure rate must be at least 10 if any of the estimates derived from the group evaluations have a median value of less than 10^{-3} per demand, and 5, otherwise. Therefore, the composite estimates must have at least those range factors. When the estimates derived from the group evaluations diverge, the merging process produces broad distributions whose mean values tend to reflect the most conservative of the group evaluations. However, the entire distribution is retained so that the uncertainty can be accounted for explicitly if the human action appears in risk-dominant sequences that are subjected to uncertainty analysis.

3.3.3.2.3 Discussion Of Results

The average and the range of the FLIs assessed by the three operator groups are as follows:

Group	Average FLI	Highest FLI	Lowest FLI
1	3.64	7.11	1.11
2	3.95	7.57	1.93
3	2.73	6.00	1.58

Although not subjected to statistical tests, it appears that Group 3 was more optimistic regarding the difficulty of the actions. A comparison of the trends in the evaluations indicates that this group rated the PSF for previous and concurrent actions more heavily than the other two groups, as shown below.

Group Weight	Score	
1	0.15	4.3
2	0.13	4.0
3	0.17	2.4

With the higher weight, group 3 also scored this PSF as strongly helping it to recognize the need to accomplish the action. In essence, group 3 was quite confident that the context of the various scenarios would drive it to the correct actions. It maintained this opinion when the human action analysts described the implications of their ratings to them during the elicitation process.

Each operator group brought its own perspective to the evaluation process. For some actions, this perspective produced a wide divergence among the error rates derived from the group evaluations. Appendix B addresses those actions that revealed a divergence of opinion among the groups sufficient enough to produce a range factor of greater than 30 in the composite distribution.

In addition to the discussion of significant differences in the evaluations, Appendix B, Section B.5, discusses trends observed in the evaluations, and summarizes some of the observations and suggestions made by the operator groups during the evaluation sessions.

Differences in evaluations, trends, and comments found to be applicable to event sequences that are found to be important during the quantification of the plant model are discussed in Section 6.1.

3.3.3.3 Results of Recovery Analysis

The quantification of the plant model and the subsequent analysis of the dominant sequences produced a number of opportunities for operator dynamic and recovery actions, as summarized in Table 3.3.3-7. The reasoning for their explicit inclusion in the event sequence models is discussed in the description of the support system and frontline event trees in Sections 3.1.2 through 3.1.4. Appendix B, Section B.7, presents the recovery action evaluation in detail.

The actions listed in Table 3.3.3-7 exclude those actions accomplished to recover offsite power. Those actions are accounted for directly in the model used to quantify the recovery, which is presented in Section 3.3.3.4.

Table B-18 of Appendix B presents the Operator Response Forms for each evaluated recovery action. They follow the same pattern as those shown in Tables 3.3.3-4 and 3.3.3-5. The descriptions on the forms were developed by the human action analyst and licensed operators serving on the PRA team, with information provided the event sequence analysts regarding the conditions under which each action is demanded.

The recovery actions were qualitatively evaluated by the group of licensed plant operators who performed the quantitative evaluation. This group discussed the context of each action among themselves before quantitatively evaluating it. In some cases, the group provided practical comments that assisted the event sequence analyst to improve the plant model. This included both eliminating some potential recovery actions as being impractical or impossible and offering alternate methods of recovery, where suitable. Wherever appropriate to clarify the evaluations, the operator comments are discussed in the Operator Response Forms.

One group of licensed operators assessed the actions using the same procedure followed for the dynamic human actions. These evaluations are summarized in Table B-19 of Appendix B. The FLI evaluations of the group are converted to human error rate estimates in accordance with the procedures outlined in Section B.4.3 of Appendix B, which follows that of the dynamic actions discussed in Section 3.3.3.2. The resulting distributions are given in Appendix B, Table B-21. Appendix B, Section B.7.3, discusses these results.

3.3.3.4 Electric Power Recovery

3.3.3.4.1 Introduction

Two top events are developed to analyze the likelihood of recovering offsite power. Top Event EPR30 evaluates the likelihood of recovering offsite power within 30 minutes, and Top Event EPR6 assesses the likelihood of recovering offsite power within 6 hours, given that power was not recovered in 30 minutes.

3.3.3.4.2 Offsite Grid Recovery Model

The recovery model used to derive the split fractions used in the recovery top events for Browns Ferry employs the results of an analysis (Reference 3.3.3-8) that combines the results of six different offsite grid analyses. The offsite power connections that these plants have range from a minimum of 2 offsite circuits to a maximum of 12. Each specific plant analysis develops a probabilistic distribution for offsite power recovery. Each distribution includes the historical transmission line recovery data combined with a site-specific uncertainty model that accounts for the redundancy and coupling among the separate offsite power supplies. For a given point in time, the lower bound is the 10th probability percentile of the power recovery distribution. The upper bound is the 90th probability percentile calculated from Equation (3.3.3.2) that accounts for the number of independent power lines. The equation is as follows:

f = fraction of single line outages recovered by time t.

$1 - f$ = fraction of single line outages not recovered by time t.

If x lines are completely independent, then the fraction of outages not recovered, NR, by time t is

$$NR = (1 - f)^x \qquad (3.3.3.1)$$

while the fraction of outages that are recovered is

$$R = 1 - NR = 1 - (1 - f)^x \qquad (3.3.3.2)$$

3.3.3.4.3 Recovery Factor Derivation

Two families of distributions are derived for the Browns Ferry recovery analysis. The first set of distributions evaluates the likelihood of power recovery within 30 minutes. The MAAP code was used to determine vessel water level as a function of time, given successful scram but no high pressure vessel injection. Specifically, following the LOSP, diesel generators fail to start and vessel makeup was considered not to be available from reactor feedwater, HPCI, RCIC, or the control rod drive hydraulic system. That calculation indicated that a vessel level equivalent to one-third core height is reached in approximately 45 minutes. The 30-minute recovery window was defined to allow sufficient time (approximately 15 minutes) to permit realignment of power supplies after offsite power is recovered.

The second set of distributions evaluates the likelihood of offsite power recovery within 6 hours, given that power was not successfully recovered in the first 30 minutes. The ability of HPCI or RCIC to maintain vessel level is limited to the 4-hour life of their respective batteries. A MAAP analysis was performed to determine vessel level as a function of time. In that analysis, vessel injection was terminated at 4 hours. The calculation indicated that a vessel level equivalent to one-third core height is reached in an additional approximate 2½ hours. The 6-hour recovery window was defined to allow sufficient time (20 to 30 minutes) to permit realignment of power supplies after offsite power is recovered.

For the two time intervals, four split fractions or nonrecovery values are developed corresponding to the number of diesels that have failed. In general, the nonrecovery factor is the result of a time-integrated model involving the failure of onsite power; i.e., the diesel generators, and the recovery of offsite power. The model result is then normalized so that the nonrecovery factor is appropriate to the family of sequences or scenarios for which it is to be used.

The model is a mathematical approximation of the integral evaluated over the time interval from zero to 24 hours of the unavailability of onsite power, times the frequency of not recovering offsite power. The equation for the unavailability of both offsite and onsite AC power is then

$$Q_U = \int_0^{24} \varphi_f(t)[1 - \Phi_R(t,\tau)]dt \tag{3.3.3.3}$$

where

Q_u = fraction of LOSP sequences in which both offsite and onsite power is unavailable for τ hours or more.

$\varphi_f(t)$ = frequency of onsite emergency AC failure between times of t and t + dt.

$\Phi_R(t,\tau)$ = frequency of offsite power recovery within τ hours after failure of onsite power at time t.

The electric power nonrecovery factor for the 30-minute case is then expressed as

$$RE = \frac{\int_0^{24} \varphi_f(t)[1 - \Phi_R(t,\tau\ 0.5)]dt}{\int_0^{24} \varphi_f(t)dt} \qquad (3.3.3.4)$$

Equation (3.3.3.4) takes on this form because the nonrecovery factor applied to a specific sequence must mathematically cancel out the diesel unavailability value that is already contained in that sequence. The diesel unavailability value in the base sequence is the factor in the denominator of Equation (3.3.3.4). The numerator of the nonrecovery factor applies the unavailability of both offsite and onsite AC power found in Equation (3.3.3.3). In other words, for a sequence involving the failure of two diesel generators, the nonrecovery factor is the unavailability of both offsite and onsite AC power, Equation (3.3.3.3), divided by the unavailability of two diesel generators. So, when the sequence has the nonrecovery factor appended, the diesel unavailabilities cancel, and the result is the sequence value multiplied by the unavailability of both offsite and onsite AC power. An implicit assumption contained in this model is that once power is restored from the offsite grid, the probability of subsequent power failure within the 24-hour period that would be sufficient in duration to result in core uncovery is extremely low and can be neglected.

For the case of the nonrecovery term at 6 hours, the form of the equation is as follows:

$$RE = \frac{\int_0^{24} \varphi_f(t)[1 - \Phi_R(t,\tau_6)]dt}{\int_0^{24} \varphi_f(t)dt * \int_0^{24} \varphi_f(t)[1 - \Phi_R(t,\tau_{0.5})]dt} \qquad (3.3.3.5)$$

where

τ_6 = offsite recovery within 6 hours.

$\tau_{0.5}$ = offsite recovery within 0.5 hours.

The construction of the 6-hour term is similar to the term for nonrecovery term at 30 minutes. To correct for the nonrecovery term applied at 30 minutes, the value of the 30-minute nonrecovery term is in the denominator of the nonrecovery term at 6 hours. Sequences that have the 30-minute term applied has a corrected term applied so that the resulting sequence only has the offsite power recovery term multiplied by the appropriate diesel unavailability. In other words, the resultant sequence that contains failures split fractions of both diesels and EPR30 are multiplied by a factor such that the resultant sequence has the term for the unavailability of AC power appended, Equation (3.3.3.3). The diesel and the EPR30 terms are canceled out.

3.3.3.4.4 Offsite Grid Recovery Factor Quantification

The calculation of these nonrecovery values employs the use of the Monte Carlo simulation code STADIC (Reference 3.3.3-9). This code uses three input files to perform the integration over time. One input file sets up the process by declaring, among other things, the number of random database samples taken, and the number of output variables, or answers. The second input file contains the subroutine that STADIC uses. This subroutine, in the case of calculating electric power nonrecovery, performs the piecewise integration of Equation (3.3.3.4). The third input file contains the Browns Ferry database variables that are used in the quantification of the emergency diesel generator system unavailability.

STADIC solves the integral by evaluating the two functions in the integral at time steps of 15 minutes. After the total elapsed time has reached 8 hours (33 time steps), the functions are then evaluated at 1-hour time steps. Because the offsite power recovery curve flattens out (see Figure 3.3.3-1) for the time greater than 8 hours, the time step can be lengthened.

The emergency diesel generator system equations are found in the subroutine that STADIC uses. Depending on the number of diesel generators that have failed, the appropriate set of equations in the subroutine is evaluated. The frequency of onsite power failure, $\varphi_f(t)$, is determined for the time interval between t and dt by evaluating the system failure equations for both mission times t and t+dt. The two results are then subtracted to obtain the probability of failure within the time interval.

3.3.3.4.5 Results

The frequency of offsite power recovery, $\Phi_R(t,\tau)$, is obtained or interpolated from the values in Table 3.3.3-8. The result, subtracted from 1, is then multiplied with the diesel system unavailability result. The STADIC computer code uses Monte Carlo simulation of the input distributions to create the resultant distributions. Two thousand random samples of the input distributions and one thousand of the results were used to create the binning boundaries of the resultant distribution. The eight cases are shown in Table 3.3.3-9.

3.3.3.5 <u>References</u>

3.3.3-1. Dykes, A. A., PLG, Letter to Richard J. McMahon, Tennessee Valley Authority, "Derivation of Screening Human Error Rates for Undetected System Unavailability Following Surveillance Testing," TVA-1418-PLG-24, August 27, 1992.

3.3.3-2. Swain, A. D., and H. E. Guttman, "Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications," prepared for U.S. Nuclear Regulatory Commission, NUREG/CR-1278, August 1983.

3.3.3-3. Embrey, D. E., "The Use of Performance Shaping Factors and Quantified Expert Judgement in the Evaluation of Human Reliability: An Initial Appraisal," Brookhaven National Laboratory, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-2986, May 1983.

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3.3.3-5. Rosa, E. A., et al., "Application of SLIM-MAUD: A Test of an Interactive Computer-Based Method for Organizing Expert Assessment of Human Performance and Reliability," Brookhaven National Laboratory, prepared for U.S. Nuclear Regulatory Commission, NUREG/CR-4016, September 1985.

3.3.3-6. Dykes, A. A., PLG, Letter to Richard J. McMahon, Tennessee Valley Authority, "Calibration Database for Dynamic Human Action Analysis," TVA-1418-PLG-25, August 27, 1992.

3.3.3-7. PLG, Inc., "BARP (Bayesian Reliability Program)," PLG-0625, Release 2, May 1991.

3.3.3-8. Pickard, Lowe and Garrick, Inc., "Data for the Frequency and Duration of Loss of Offsite Power Events at Seabrook Station," prepared for Public Service Company of New Hampshire, PLG-0726, December 1989.

3.3.3-9. PLG, Inc., "STADIC Computer Code User Manual," Revision 0/PC, PLG-0689, October 1990.

Table 3.3.3-1 (Page 1 of 2). Generic Database Variables Used for System Analysis Screening of Preinitiating Event, Routine Human Error Caused, Undetected Unavailability following Maintenance and Testing

Location of Surveillance	Complexity (See Note 1 on Page 2)	Verification (See Note 2 on Page 2)	Type of Action: Realignment Using Manual Controls and Switches Provided by the Design		Realignment from Jumpered Circuits or Other Temporary Plant Modification		Calibrations Left Misaligned or at Unresponsive Setpoints	
			Variable (Note 3)	Mean	Variable	Mean	Variable	Mean
Control Room Area (Includes backs of panels and/or associated equipment)	Low	Yes	ZHERCL	2.0-3	ZHEJCL	1.8-3	ZHECCL	4.9-3
		No	*		*		*	
	Medium	Yes	ZHERCM	5.9-3	ZHEJCM	4.9-3	*	
		No	*		*		*	
	High	Yes	*		*		*	
		No	*		*		*	
Local (single location exterior to the control room area)	Low	Yes	ZHERLL	3.4-3	ZHEJLL	3.2-3	ZHECLL	6.2-3
		No	*		*		*	
	Medium	Yes	ZHERLM	1.5-2	ZHEJLM	1.2-2	*	
		No	*		*		*	
	High	Yes	*		*		*	
		No	*		*		*	
Multiple Locations (excluding the control room area)	Low	Yes	ZHERML	1.0-2	ZHEJML	9.6-3	ZHECML	1.6-2
		No	*		*		*	
	Medium	Yes	ZHERMM	3.2-2	ZHEJMM	2.7-2	*	
		No	*		*		*	
	High	Yes	*		*		*	
		No	*		*		*	

*Refer assessments not having a generic variable associated with it to the human action analyst for a system-specific evaluation. The bases and derivation of the distribution of each generic database variable is contained in Reference 3.3.3-1.

Note: Exponential notation is indicated in abbreviated form; 2.0-3 = 2.0×10^{-3}.

Table 3.3.3-1 (Page 2 of 2). Generic Database Variables Used for System Analysis Screening of Preinitiating Event, Routine Human Error Caused, Undetected Unavailability following Maintenance and Testing

Notes:

1. Complexity Guidance:

   Select low complexity only if it is clear that all criteria are satisfied.
   Select medium complexity only if no more than two low complexity criteria are out of tolerance.

   Low:
   - Single objective.
   - Very clear procedures (one action/step with individual checkoff, outline or columnar form, easy to interpret).
   - Less than 10 closely associated calibrations and/or restorations.
   - Items clearly marked and separated.
   - Small team working directly with each other.

   Medium:
   - Repetitive or coordinated objectives.
   - Clear procedures (one action/step, "critical steps" having checkoff, narrative form, easy to interpret).
   - Less than 10 restorations of varying types.
   - Items clearly marked in same general area.
   - Team in more than one location with dedicated communication.

   High:*
   - Diverse objectives.
   - More than 10 restorations.
   - Items ambiguously marked or in close proximity.
   - Team in multiple locations with intermittent communication.
   - Any consideration that make assignment of either low or medium complexity uncertain.

2. Verification Guidance:

   Yes: Second person verifies and signs off in a separate space provided for that purpose (low dependency between checker and testers).
   No: Two people working together verify realignment, or less. (Moderate or high dependency between checker and testers.)

3. Legend:

   ZHERLL
   - L — Complexity (low)
   - L — Location (single local)
   - R — Type of Action (realignment with controls)

*Refer assessments not having a generic variable associated with it to the human action analyst for a system-specific evaluation.

Table 3.3.3-2 (Page 1 of 2). Summary of Routine Human Errors Included in the Systems Analyses To Account for Preinitiating Event, Routine Human Error Caused, Undetected Unavailability following Maintenance and Testing

System Notebook	Top Event	Test Number	Test Name	Database Variable	Description of Error
Core Spray	CS	2-SI-4.2.B-39AI(II)	Core Spray System Logic Functional Test Loop I (II)	ZHEJLL	Breaker left in racked out position.
Core Spray	CS	2-SI-4.2.B-39B	Core Spray System Logic Time Delay Relay Calibration	ZHEJLL	Failure to remove jumpers.
Core Spray	CS	2-SI-4.5.A.1.dI(II)	Core Spray Flow Rate Loop I (II)	ZHERCL	Failure to remotely restore valves to their normal position.
EECW	EE	0-SI-3.11	EECW Pump Baseline Data Acquistion and Evaluation	ZHERLL	Failure to fully reopen the pump manual discharge valve after completing the test.
EPS	DIES1	0-SI-4.9.A.1.a(A) also (B,C,D)	Diesel Generator A(B,C,D) Monthly Operability Test	ZHERCL	Failure to realign diesel exhaust fans.
EPS	DIES2	3-SI-4.9.A.1.a(3A) also (3B,3C,3D)	Diesel Generator 3A (3B,3C,3D) Monthly Operability Test	ZHERCL	Failure to realign diesel exhaust fans.
HPCI	HPI/HPCIS	2-SI-4.2.B-26	CSCS-Condensate Header Low Level Calibration	ZHEJLL	Failure to remove inhibits/boots from relay contacts.
HPCI	HPI/HPCIS	2-SI-4.2.B-26FT	CSCS-Condensate Header Low Level Functional Test	ZHEJLL	Failure to remove inhibits/boots from relay contacts.
HPCI	HPI/HPCIS	2-SI-4.2.B-27	HPCI Suppression Chamber High Level Instrumentation Calibration	ZHEJLL	Failure to remove inhibits/boots from relay contacts.
HPCI	HPI/HPCIS	2-SI-4.2.B-27FT	HPCI System Suppression Chamber High Level Instrumentation Functional Test	ZHEJLL	Failure to remove inhibits/boots from relay contacts.
HPCI	HPI/HPCIS	2-SI-4.2.B-42B	HPCI System Time Delay Relay Calibration	ZHEJLL	Failure to remove inhibits/boots from relay contacts.
HPCI	HPI/HPCIS	2-SI-4.5.E.1.C	HPCI System Moter Operated Valve Operability	ZHERCL	Failure to realign valves from the control room.
RCIC	See System Notebook	2-SI-4.5.F.1.C	RCIC System Motor Operated Valve Operability	ZHERLL	Failure to realign valves.
RHR	RP	2-SI-4.2.B-45AI (II)	Loop I (II) RHR Logic System Functional Test	ZHEJML	Failure to remove inhibits/boots from relays.

Table 3.3.3-2 (Page 2 of 2). Summary of Routine Human Errors Included in the Systems Analyses To Account for Preinitiating Event, Routine Human Error Caused, Undetected Unavailability following Maintenance and Testing

System Notebook	Top Event	Test Number	Test Name	Database Variable	Description of Error
RHR	RP	2-SI-4.2.B-45BI (II)	Division I (II) RHR System Logic (LPCI) Mode Time Delay Relay Calibration	ZHEJML	Failure to Remove Inhibits/Boots from Relays.
Sec. Cont. Isol.	RBI	2-SI-4.2.A.9A,B	Reactor Building Ventilation Radiation Monitor 2-RM-90-142 (143) Calibration and Functional Test	ZHEJLL	Failure to remove banana jumpers that disable the reactor building isolation signal.
Sec. Cont. Isol.	RBI	2-SI-4.2.A.10FT	Reactor Building Ventilation Radiation Monitors RM-90-140, 141, 142, 143 Instrument Functional Test	ZHEJLL	Failure to remove banana jumpers that disable the reactor building isolation signal.
Sec. Cont. Isol.	RBI	2-SI-4.2.A.10A, B	Reactor Building Ventilation Radiation Monitors RM-90-140 (141) Calibration and Functional Test	ZHEJLL	Failure to remove banana jumpers that disable the reactor building isolation signal.

Table 3.3.3-3 (Page 1 of 4). Summary Descriptions of Dynamic Human Actions Evaluated for the Browns Ferry PRA

Top Event	Database Variable	Definition of Action	Time Constraints	Mean HER /Demand
OAD	HOAD1	Inhibit ADS actuation, Given ATWS with an Unisolated Vessel	Time to -122" dependent on suppression pool heatup, but approx. 10 min. Four min. provided by timer after reaching -122" for 14 min.	0.001460
OAD	HOAD2	Inhibit ADS Actuation, Given ATWS with an Isolated Vessel	Level drops to -122" within 2 minutes without injection, Cont. Press > 2.45 psig when RPV is isolated. Must inhibit prior to 95 sec-timeout.	0.001460
OAL	HOAL1	Allow RPV Level To Drop and Control at Top of Active Fuel, Given ATWS with Unisolated Vessel	Initiate when required in the event. Initiate and gain control of injection within 1 min of reaching -162" to avoid going below -190".	0.017100
OAL	HOAL2	Lower and Control RPV Level at Top of Active Fuel, Given ATWS with Isolated Vessel	Initiate and gain control of injection within 1 minute of reaching -162" to avoid going below -190".	0.018700
OBC	HOBC1	Cooldown with Turbine Bypass Valves, Given Either HPCI or RCIC Available	Not time sensitive - do as required during first 6 hours.	0.000792
OBD	HOBD1	Depressurize with TBVs after Loss of HPCI/RCIC	Approximately 15 minutes to boil down from -45" to -122" at 2% decay heat.	0.128000
CRD	HOCRD1	Align Enhanced Flow CRDHS, Given HPCI/RCIC Fail after 6 Hours	Not time sensitive - more than 90 minutes available to align second pump.	0.001310
CRD	HOCRD2	Align and Operate Enhanced Flow CRDHS, Given Enhanced Mode Is Required (HPCI/RCIC Failed)	More than 45 minutes to reach top of active fuel with no injection at 2% decay heat.	0.001010
ODWS	HODWS1	Initiate Drywell Spray	Assume 20 to 60 minutes to avoid containment conditions that could result in release of radioactive materials into the environment.	0.009800
ODWS	HODWS2	Initiate Drywell Spray, Given ATWS	Assume 10 to 40 minutes to avoid containment conditions that could result in release of radioactive materials into the environment.	0.026800
OF	HOF1	Control One Feedwater Pump and Hotwell Level, Given Autocontrol was Successful	Monitor during cooldown (up to 24 hours). Respond to alarm within 5 minutes to avoid automatic trip.	0.000363
OF	HOF2	Control One Feedwater Pump and Hotwell Level, Given Autocontrol Fails	Continuous requirement during cooldown (up to 24 hours). Respond to alarm within 5 minutes to avoid automatic trip.	0.002630

Table 3.3.3-3 (Page 2 of 4). Summary Descriptions of Dynamic Human Actions Evaluated for the Browns Ferry PRA

Top Event	Database Variable	Definition of Action	Time Constraints	Mean HER /Demand
OF	HOF3	Control Feedwater Pumps and Hotwell Level, Given Autocontrol is Successful, but Operators Initially Failed to Trip 2 Feedwater Pumps	Respond to alarm within approximately 2 minutes to avoid automatic trip.	0.331000
OF	HOF4	Restore and Control RPV Level with Feedwater Following Shutdown from ATWS	Continuous control during refill/cooldown (to 24 hours). Once normal level achieved, respond to alarm within 5 minutes to avoid auto trip at +55".	0.007580
OFT	HOFT1	Trip Two of Three Feedwater Pumps To Limit Feedwater Flow	Respond in approximately 2 minutes to avoid automatic trip of all 3 pumps.	0.001840
OHC	HOHC1	Control RPV Level and Pressure with HPCI and/or RCIC during First 6 Hours	Continuous requirement - react within 5 minutes of high level alarm to prevent automatic HPCI trip at +55".	0.000990
OHC	HOHC2	Control RPV Level and Press with HPCI during First 6 Hours, Given RCIC Failed or Insufficient	Continuous requirement - react within 5 minutes of high level alarm to prevent automatic HPCI trip at +55".	0.000972
OHC	HOHC3	Control RPV Level and Pressure with RCIC during First 6 Hours, Given HPCI Failed	Continuous requirement - react within 8 minutes after alarm to prevent automatic RCIC trip at +55".	0.000752
OHC	HOHC4	Control RPV Level with HPCI Following Shutdown from ATWS	Continuous requirement - after recovery of RPV level react within 5 minutes after alarm to prevent automatic HPCI trip at +55".	0.010300
OHL	HOHL1	Control RPV Level and Pressure with HPCI and/or RCIC 6 to 24 hours, Given Short Term Control Successful	Monitor cooldown. React to alarm within 15 minutes of indication to prevent automatic trip at +55".	0.001450
OHL	HOHL2	Recover and Control RPV Level and Pressure with HPCI and/or RCIC up to 24 hours, Given Short Term Control Failed	Continuous requirement - react to alarm within 15 minutes of indication to prevent automatic trip at +55".	0.004390
OHS	HOHS1	Initiate HPCI Following FW Failure, Given two Stuck Open Relief Valves	Estimate 10 to 15 minutes before MSIV closure at -122".	0.008500
OHS	HOHS2	Initiate HPCI/RCIC Following FW Failure, Given One or No Stuck-Open Relief Valves	Estimate 10 to 15 minutes before MSIV closure at -122".	0.000769

Table 3.3.3-3 (Page 3 of 4). Summary Descriptions of Dynamic Human Actions Evaluated for the Browns Ferry PRA

Top Event	Database Variable	Definition of Action	Time Constraints	Mean HER /Demand
OHS	HOHS3	Initiate HPCI Following FW Failure during Recovery after ATWS	Restart within 5 minutes if RPV level is at top of active fuel to avoid falling to -190".	0.005320
OJC	HOJC1	Control RPV Level with Condensate by Alternate Means, Given Startup Bypass Valve Fails	Assume 30 minutes before other means of level control would be sought. Approx 2 hours to core uncovery if no means to cool core found.	0.032400
OLA	HOLA1	Control LPCI to Maintain Vessel Level at Top of Fuel, Given ATWS	Continuous requirement for close control until subcriticality and refill.	0.078100
OLC	HOLC1	Transfer to Condensate in Startup Bypass Mode, Feedwater is Available during Cooldown	Assume 30 minutes before other means of level control would be sought. Approx 2 hours to core uncovery if no means to cool core found.	0.000508
OLC	HOLC2	Place Condensate in Startup Bypass Mode, Given it was Maintained Operational during Cooldown and FW Failed	Assume 30 minutes before other means of level control would be sought. Approx 2 hours to core uncovery if no means to cool core found.	0.000700
OLP	HOLP1	Control RPV Level Using LPCI Mode of RHR or the Core Spray System	Initiate after cooldown. Not time sensitive - over two hours to core uncovery from normal RPV level with no injection.	0.001500
OPTR	HOPTR1	Terminate Feedwater Flow, Given Feedwater Rampup	One to two minutes after alarm to avoid RPV overfill to +114".	0.001870
ORF	HORF1	Restart and Control One Feedwater Pump Following +55" Trip	Approximately 30 minutes at 2% decay heat.	0.000421
ORP	HORP1	Start RHR and/or CS Pumps for LPI, Given High Pressure Injection Successful	Not time sensitive - at least 2 hours to boil down from normal level after normal cooldown.	0.000097
ORP	HORP2	Start RHR and/or CS Pumps for LPI, Given High Pressure Injection Fails	At least 20 minutes to align as level declines.	0.025600
RPS	HORPS1	Backup Automatic SCRAM Function with Pushbuttons and Manual ARI	Within one minute.	0.001200
RVD	HORVD1	Open One SRV To Assist HPCI or RCIC Cooldown	Not time sensitve - do as required.	0.001530
RVD	HORVD2	Emergency Depressurize by Manually Opening MSRVs, Given HPCI and RCIC Hardware Failed	5 to 10 minutes to recognize need to emergency depressurize. 3 to 5 minutes to -190" once -162" reached.	0.006700

Table 3.3.3-3 (Page 4 of 4). Summary Descriptions of Dynamic Human Actions Evaluated for the Browns Ferry PRA

Top Event	Database Variable	Definition of Action	Time Constraints	Mean HER /Demand
RVD	HORVD3	Emergency Depressurize by Manually Opening MSRVs, Given HPCI/RCIC Control Failed	5 to 10 minutes to recognize need to emergency depressurize. 3 to 5 minutes to -190" once -162" reached.	0.055400
OSD	HOSD1	Align RHR for Shutdown Mode of Cooling	Not time sensitive - can be done over the course of hours.	0.000999
OSD	HOSD2	Align RHR for Shutdown Mode of Cooling, Given 1 Loop Unavailable	Not time sensitive - can be done over the course of hours.	0.001500
OSL	HOSL1	Actuate SLC, Given ATWS with Vessel Unisolated	3 to 5 minutes available to avoid level/power control requirement. Suppression pool reaches 170 degrees F in 20 minutes.	0.005530
OSL	HOSL2	Actuate SLC, Given ATWS with Vessel Isolated	At 50% power the suppression pool reaches 110 deg F in approximately 2 minutes and 170 deg F in 7 minutes.	0.012200
OSP	HOSP1	Align RHR for Suppression Pool Cooling	Not time sensitive - approximately 1 1/2 hours before SP temperature exceeds 140 degrees F.	0.000077
OSP	HOSP2	Align RHR for Suppression Pool Cooling, Given ATWS	Approximately 10 minutes until HCTL if unit at 50% power.	0.005890
OSP	HOSP3	Align RHR for Suppression Pool Cooling, Given One Path Unavailable	Not time sensitive - much more than 1 hour before SP temperature exceeds 140 degrees F.	0.000069
OSV	HOSV1	Defeat MSIV Closure Logic, Given ATWS with Turbine Trip	Accomplish in first 10 minutes of transient - approximately 7 minutes before SP reaches 110 degrees F, forcing lowering of level.	0.002300
OSW	HOSW1	Transfer Mode Switch To Refuel/Shut Down in Response to Scram	Not time significant for typical pressure reduction rates.	0.000726
TB	HOTB1	Backup Main Turbine Trip	Do within 1 minute to avoid MSIV closure.	0.001490

Table 3.3.3-4. Guidance Regarding Information To Include in Operator Response Forms

TASK IDENTIFIER with the summary reproduced from operation action summary table.

PRECEDING EVENTS
- List initiating events after which action may be required.
- Briefly summarize sequence of events leading to action.
  - Base the sequences on event tree descriptions.
  - Bound the range of possibilities (identify if influenced by initiating event).
- Identify any abnormal plant responses that may complicate the situation.

INDICATIONS OF PLANT CONDITION
- List what the operating crew sees that permits diagnosis that the action is required.
- Estimate how long the condition could exist before indications sufficient for diagnosis are available to the operators.
- Describe parallel indications that can mask the action requirement.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Reference the procedure and steps that will be followed.
- State whether the task is an immediate memorized action.
- Briefly summarize the aspects of the action that could influence the operators' ability to diagnose and accomplish it.
- Identify considerations in addition to procedures that could influence likelihood of success.

CONCURRENT ACTIONS/COMPETING FACTORS
- Identify concurrent actions that could compete for attention.
- Briefly describe alarms, environmental conditions, and other distractions that could impact the operating shift's concentration and produce stress.
- Discuss important aspects of the operator team interactions.

INDICATION OF SUCCESSFUL COMPLETION/SUCCESS IMPACT
- Characterize plant state upon completion based on event tree success criteria.
- Describe how the operators can determine they have been successful.

FAILURE IMPACT
- Characterize the plant condition following failure to accomplish based on event tree success criteria.
- Identify later actions the operators have available to respond with once the plant has made a transition to the failed condition.

TIME CONSTRAINTS
- List thermal/hydraulic and physical/equipment response considerations that influence time available before transition to failed condition.
- Summarize what is known about time required to both diagnose and accomplish the tasks.

Table 3.3.3-5. Qualitative Descriptions of Dynamic Human Actions
HORF1: Restart and Control One Reactor Feedwater Pump following a +55" Trip __PRECEDING EVENTS__ • Reactor scram for "other" reasons. • One or more RFPTS not tripped (OFT=F) with subsequent control failure (OF=F). • RPV level rises to +55", resulting in trip of all running RFPTs (L8F=S). __INDICATIONS OF PLANT CONDITION__ • RPV pressure remains > 300 psig. • RPV level = +55". • Panel 2-9-5 indicates 2 of 3 hi-hi level relays have tripped (red lights lit). • MSIVs open. __PROCEDURAL GUIDANCE/REQUIRED ACTIONS__ • 2-AOI-3-1; 2-OI-3; GOI-100-12. • Reset at least 2 of 3 level trips on Panel 2-9-5. • Run MSC & MGU of the tripped RFPT to min stop. • Wait and observe the RPV level decrease to <55". • Restart RFPT. __CONCURRENT ACTIONS/COMPETING FACTORS__ • Normal post trip 2-GOI-100-12 activities. __INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT__ • RFPT trip is cleared. • RFP supplying water to RPV with level maintained at +33". __FAILURE IMPACT__ • Makeup required from HPCI/RCIC. __TIME CONSTRAINTS__ • Time available from +55" to -45" RPV level is approx 30 minutes.

Table 3.3.3-6. Summary of the Relationship between the Scoring and Weighting Processes

Score: With respect to the things addressed by this PSF, are the conditions under which the action must be accomplished helping or hindering us to successfully complete it? In other words, we are rating the impact of the conditions on our ability to succeed in accomplishing the action. Interpretation of the range of scores

0-3 Helps

4-6 Is Neutral

7-10 Hinders

Weight: Does a variation between helping and hindering have more influence on the probability that we will successfully complete it than other PSFs? In other words, is this PSF a focus of the action? Do we key in on the things addressed by this PSF?

0 Insignificant compared to other PSFs.

1 Low: unimportant compared to other PSFs.

2 Normal: about the same as other PSFs.

4 High: much more important than other PSFs.

Weighting Thought Process

1. Initially set the weights of every PSF equal to 2.

2. Adjust weights of the PSFs only if you believe that their importance for judging the ease or difficulty of accomplishing the action is significantly (a factor of 2) greater or less than the other PSFs. The weights will be normalized so that the maximum overall failure likelihood index will be a 10, so the effect of increasing all of the weights is the same as increasing none.

3. Generally, actions requiring similar types of skills have the same PSF weights. Some examples of groups of actions where differences in the focus may require different PSF weights are as follows:

   - Immediate recognition and reaction.
   - Actions where diagnosis of need would dominate success.
   - Actions requiring a long sequence of manipulations.
   - Local actions involving coordination of activities.
   - Adjusting or controlling against indications.

Impact of Weight on How the Failure Likelihood Index Changes

Weight	Rating Change Producing the Same Change in the FLI
1	1 → 9
2	3 → 7
4	4 → 6

Table 3.3.3-7 (Page 1 of 2). Summary of Browns Ferry Recovery Actions Incorporated into the Plant Model

Top Event	Database Variable	Definition of Action	Time Constraints	Mean HER /Demand
CIS	HOCIS1	Ensure That Various Normally Closed Valves are Closed, Given Group 6 Isolation is Required	At least one hour available after Group 6 isolation before release of radioactive materials in containment begins.	0.003620
OEE	HOEE1	Align and Start One RHRSW Swing Pump, Given LOSP and Insufficient EECW to Diesel Generators	Five minutes available before diesel generator exceeds design temperature.	0.000506
OEE	HOEE2	Align and Start One RHRSW Swing Pump, Given LOSP, ATWS, and Insufficient EECW to Diesel Generators	Five minutes available before diesel generator exceeds design temperature.	0.016100
OFLRB	HOFLRB	Identify and Isolate Leak in Either North or South EECW Header	20 to 30 minutes to avoid flooding RHR, CS, HPCI and RCIC.	0.003020
PCA	HOPCA1	Manually Start Two Air Compressors, Given Loss of Offsite Power	One hour before MSRV air reservoir is depleted.	0.001150
OR480	HOR480	Align 480V RMOV Board 2A (2B) to Alternate Source	More than 2 hours after RHR needed for core cooling, depending on cooldown rate.	0.001090
ORP	HORP3	Start RHR/Core Spray Pumps for Low Pressure Injection, Given LOSP, Loss of D/Gs, and Power Recovered within 6 Hours	Core uncovery within 30 minutes if the AC power were not recovered.	0.043600
OSPR	HOSPRC	Manually Close LPCI Injection Valves To Restore Suppression Pool Cooling	First indication of requirement 2 to 4 hours into transient. Suppression pool rises from 95 deg. F to 140 deg. F in 4 hours at 1% decay heat.	0.000226
OSPR	HOSPRO	Manually Open Valves To Align RHR for Suppression Pool Cooling	First indication of requirement 2 to 4 hours into transient. Suppression pool rises to unacceptable temperature in 12 additional hours.	0.000480
U1	HOU11	Crosstie Unit 1 Pumps and Heat Exchanger to Unit 2 Torus, Given Flood in Reactor Building Basement, Unit 2 Condenser Unavailable	Thirty minutes to avoid core uncovery if injection into RPV lost during the initial phase of the flood.	0.016100
U1	HOU12	Align Alternate Sources of Water To Maintain RPV Level, Given a Leak in the Torus Ring Header and Condensate/Feedwater Lost in Unit 2	Thirty minutes if injection into RPV lost during initial phase of flood.	0.043600
UB	HOUB1	Restore Power to Both Units 1 and 2 Unit Board (4 kv), Given Loss of Main Electrical Feed to that Unit	15 to 20 minutes available before diesel generators required.	0.002820

Table 3.3.3-7 (Page 2 of 2). Summary of Browns Ferry Recovery Actions Incorporated into the Plant Model

Top. Event	Database Variable	Definition of Action	Time Constraints	Mean HER /Demand
UB	HOUB2	Restore Power to Both Units 1 and 2 Unit Boards (4 kV), Given Loss of 500 kV Grid	15 to 20 minutes available before diesel generators required to operate in the model.	0.005030
OVS	HOVS1	Close a Valve To Isolate a High/Low Pressure Leak that Occurs during Surveillance Testing of a CS or LPCI Injection Line	Assume 2 minutes for failure mechanisms in low pressure line to propagate sufficiently to require reactor SCRAM and safety system actuation.	0.001600
OVS	HOVS2	Respond To Inadvertent Failure of High/Low Pressure Interface Valve in the CS or LPCI Injection Lines during Normal Operations	Assume 2 minutes for failure mechanisms in low pressure line to propagate sufficiently to require reactor SCRAM and safety system actuation.	0.004230

Table 3.3.3-8. Generic Offsite Power Recovery Model				
Time To Recover (hours)	10th Percentile	Median	90th Percentile	Error Factor
0.25	.269	.407	.616	1.513
0.50	.360	.510	.723	1.417
0.75	.409	.562	.773	1.375
1.0	.468	.624	.831	1.332
1.5	.548	.694	.879	1.267
2.0	.608	.749	.922	1.231
3.0	.663	.788	.936	1.188
4.0	.706	.818	.948	1.159
5.0	.745	.848	.966	1.139
6.0	.771	.868	.977	1.126
8.0	.803	.889	.984	1.107
10.0	.838	.911	.990	1.087
12.0	.854	.921	.993	1.078
14.0	.871	.930	.993	1.068
16.0	.883	.937	.994	1.061
18.0	.894	.943	.995	1.055
20.0	.905	.949	.996	1.049
22.0	.912	.954	.998	1.046
24.0	.923	.961	1.000	1.041

Table 3.3.3-9. Electric Power Recovery Results

Number of Diesels Failed	Time to Core Damage (hour)	Offsite Power Nonrecovery Factor	Diesel System Unavailability	AC Power Nonrecovery Factor
1	0.5*	0.475*	1.0-01	5.0-02
2	0.5	0.473*	1.7-02	8.1-03
3	0.5	0.472*	4.7-03	2.2-03
4	0.5	0.470*	2.0-03	9.2-04
1	6	0.272**	1.0-01	1.3-02
2	6	0.273**	1.7-02	2.2-03
3	6	0.269**	4.7-03	6.004
4-8	6	0.268**	2.0-03	2.5-04

*Likelihood of not recovering offsite power within first 30 minutes.
**Likelihood of not recovering offsite power between 30 minutes and 6 hours, given power was not recovered within the first 30 minutes.

Note: Exponential notation is indicated in abbreviated form; e.g., 1.0-01 = 1.0×10^{-01}.

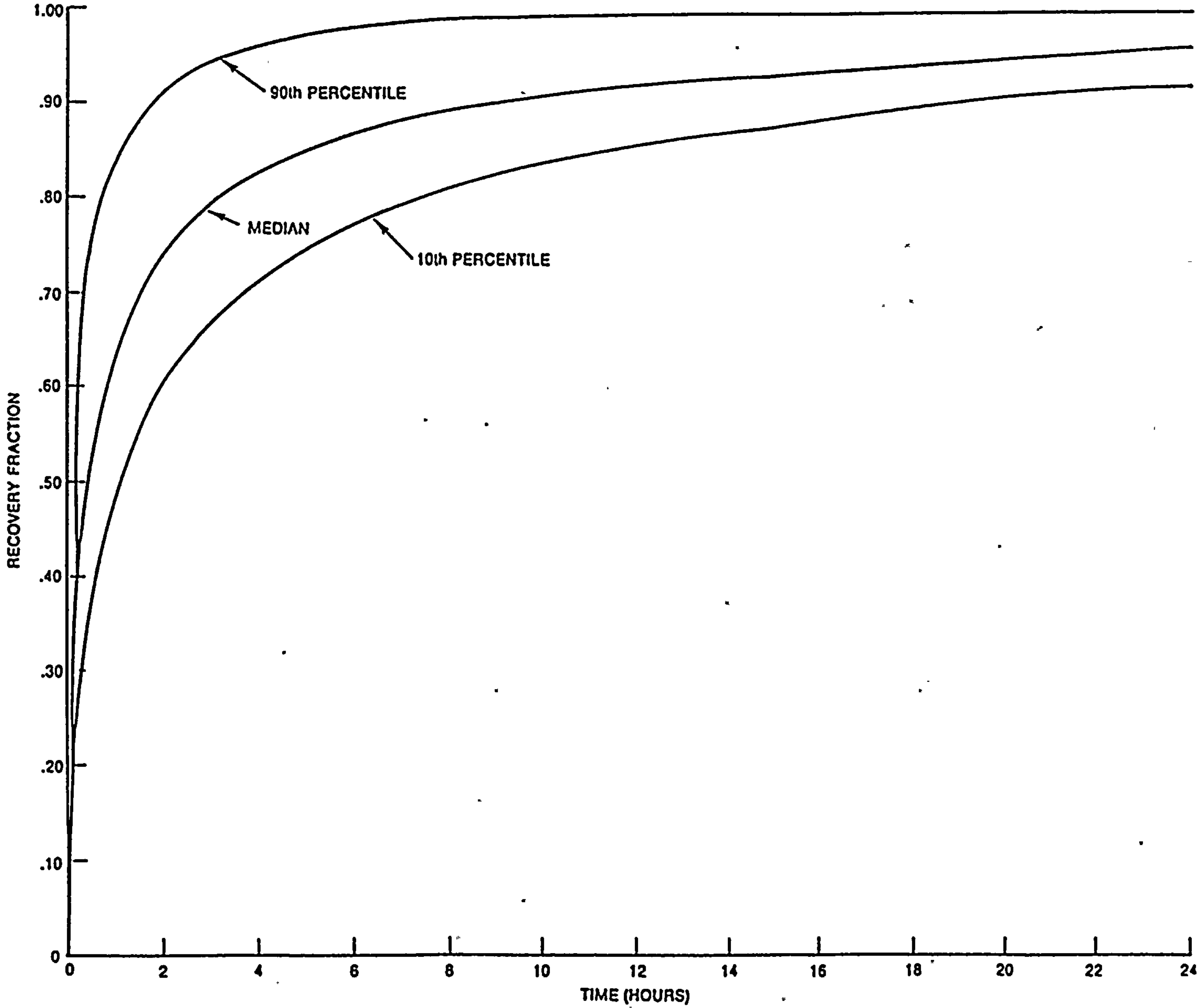

Figure 3.3.3-1. Generic Offsite Power Recovery Model

3.3.4 COMMON CAUSE FAILURE PARAMETERS

3.3.4.1 Introduction

Dependent failures such as common cause failures at the systems level are treated either explicitly by means of identifying causes of dependent failure and incorporating them into the systems or event sequence models, or implicitly by using certain parameters to account for their contribution to the unavailability of the systems. Examples of the first category are the sharing of common components, internal floods, and certain types of human error during test and maintenance. This section deals with the second category, addressing common cause failures that are not covered in the first category, such as design errors, construction errors, procedural deficiencies, and unforeseen environmental variations.

The parametric model used in this study to quantify the effect of the second category of dependent failures is known as the multiple Greek letter (MGL) method (Reference 3.3.4-1). The following is an overview of the method and the Bayesian technique used in developing state of knowledge distributions reflecting various sources of uncertainty in estimating its parameters. Due to the relatively low frequency of these events, there are insufficient data available to justify the use of the two-stage Bayesian procedure described in Section 3.3.1.2 for failure rates; thus, a modified technique is used as described below.

3.3.4.2 Multiple Greek Letter Model

The MGL parameters consist of the total component failure probability, Q_t, which includes the effects of independent and common cause contributions to that component failure, and failure fractions, which are used to quantify the conditional probabilities of the possible ways that a common cause failure of a component can be shared with other components in the same group, given component failure has occurred. For a group of m redundant components and for each given failure mode, m different parameters are defined. For example, the first four parameters of the MGL model are

Q_t = total failure probability of each component due to independent and common cause events.

plus

β = conditional probability that the cause of a component failure will be shared by one or more additional components, given that a specific component has failed.

γ = conditional probability that the cause of a component failure that is shared by one or more components will be shared by two or more additional components, given that two specific components have failed.

δ = conditional probability that the cause of a component failure that is shared by two or more components will be shared by three or more additional components, given that three specific components have failed.

The general equation that expresses the probability of k specific component failures due to common cause, Q_k, in terms of the MGL parameters, is consistent with the above definitions.

The MGL parameters are defined in terms of the basic parameter model parameters for a group of three similar components as:

$$Q_t = Q_1^{(3)} + 2\,Q_2^{(3)} + Q_3^{(3)} \qquad (3.3.4.1)$$

$$\beta^{(3)} = \frac{2Q_2^{(3)} + Q_3^{(3)}}{Q_1^{(3)} + 2Q_2^{(3)} + Q_3^{(3)}}$$

$$\gamma^{(3)} = \frac{Q_3^{(3)}}{2Q_2^{(3)} + Q_3^{(3)}} \qquad (3.3.4.2)$$

δ and higher order terms are identically zero.

For a group of four similar components, the MGL parameters are as follows:

$$Q_t = Q_1^{(4)} + 3Q_2^{(4)} + 3Q_3^{(4)} + Q_4^{(4)} \qquad (3.3.4.3)$$

$$\beta^{(4)} = \frac{3Q_2^{(4)} + 3Q_3^{(4)} + Q_4^{(4)}}{Q_1^{(4)} + 3Q_2^{(4)} + 3Q_3^{(4)} + Q_4^{(4)}}$$

$$\gamma^{(4)} = \frac{3Q_3^{(4)} + Q_4^{(4)}}{3Q_2^{(4)} + 3Q_3^{(4)} + Q_4^{(4)}} \qquad (3.3.4.4)$$

$$\delta^{(4)} = \frac{Q_4^{(4)}}{3Q_3^{(4)} + Q_4^{(4)}}$$

It is important to note that the integer coefficients in the above definitions are a function of m, the number of components in the common cause group. Therefore, it is generally inappropriate to use MGL parameters that were quantified for an m unit group in an ℓ unit group, when $m \neq \ell$. The same comment applies to the other similar multiparameter methods.

The following equations express the probability of multiple component failures due to common cause, Q_k, in terms of the MGL parameters for a three-component common cause group:

$$Q_1 = (1-\beta)\,Q_t$$

$$Q_2 = \frac{1}{2}\,\beta\,(1-\gamma)\,Q_t \qquad (3.3.4.5)$$

$$Q_3 = \gamma\,\beta\,Q_t$$

For a four-component group, the equations are

$$Q_1 = (1-\beta)\, Q_t$$

$$Q_2 = \frac{1}{3}\beta\,(1-\gamma)\, Q_t$$

$$Q_3 = \frac{1}{3}\beta\gamma\,(1-\delta)\, Q_t$$

$$Q_4 = \beta\gamma\delta\, Q_t \qquad (3.3.4.6)$$

The generalization of this is given by

$$Q_k = \frac{1}{\binom{m-1}{k-1}}\left(\prod_{i=1}^{k} \rho_i\right)(1-\rho_{k+1})\, Q_t\ (k=1,\ldots,m) \qquad (3.3.4.7)$$

where $\rho_1 = 1, \rho_2 = \beta, \rho_3 = \gamma, \ldots, \rho_{m+1} = 0$.

3.3.4.2.1 Point Estimators for the MGL Parameters

The following are simple point estimators for the first three of the MGL parameters:

$$\hat{\beta} = \frac{\sum_{k=2}^{m} kn_k}{\sum_{k=1}^{m} kn_k} \qquad (3.3.4.8)$$

$$\hat{\gamma} = \frac{\sum_{k=3}^{m} kn_k}{\sum_{k=2}^{m} kn_k} \qquad (3.3.4.9)$$

$$\hat{\delta} = \frac{\sum_{k=4}^{m} kn_k}{\sum_{k=3}^{m} kn_k} \qquad (3.3.4.10)$$

where n_k is defined as the number of events involving k components in failed state.

For instance, for a three-unit system (m = 3), we have

$$\hat{\beta} = \frac{2n_2 + 3n_3}{n_1 + 2n_2 + 3n_3} \tag{3.3.4.11}$$

Similarly,

$$\hat{\gamma} = \frac{3n_3}{2n_2 + 3n_3} \tag{3.3.4.12}$$

As can be seen from the above estimators, the MGL parameters are essentially the ratios of the number of component failures in various basic events. For instance, in Equation (3.3.4.9), the numerator ($3n_3$) is the total number of components failed in common cause basic events that fail three components (n_3).

3.3.4.2.2 Uncertainty Distribution of the MGL Parameters

The uncertainty distribution of the MGL parameters can be approximated with simple parametric distributions if the observed events are assumed to be independent component failures within different categories of common cause events. In other words, the set {n_k k = 1, ..., m} where n_k is the number of events involving failure of k components due to common cause will be interpreted as {kn_k; k = 1, ..., m} where kn_k is the number of components failed in common cause events involving k component failures, and kn_k events will be assumed to have occurred independently.

With the above assumption, let us define the following conditional probabilities (for a system of these components):

$Z_1 \equiv 1 \sim \beta$ = conditional probability of component failure being a single failure.

$Z_2 \equiv \beta(1 \sim \gamma)$ = conditional probability of a component being involved in a double failure.

$Z_3 \equiv \beta\gamma$ = conditional probability of a component being involved in a triple failure.

Note that

$$Z_1 + Z_2 + Z_3 = 1$$

The likelihood of observing n_1 single failures, $2n_2$ component failures due to double failures, and $3n_3$ component failures due to triple failures can be modeled by a multinomial distribution for Z_i's.

$$P(n_1, 2n_2, 3n_3 | Z_1, Z_2. Z_3) = \frac{(n_1 + 2n_2 + 3n_3)!}{(n_1)!(2n_2)!(3n_3)!} Z_1^{n_1} Z_2^{2n_2} Z_3^{3n_3} \tag{3.3.4.13}$$

Rewriting Equation (3.3.4.13) in terms of β and γ gives

$$P(n_1, 2n_2, 3n_3|\beta, \gamma) = M\, \beta^{2n_2+3n_3}\, (1-\beta)^{n_1}\, \gamma^{3n_3}\, (1-\gamma)^{2n_2} \tag{3.3.4.14}$$

where M is the multinomial multiplier, as in Equation (3.3.4.13).

We can now write Bayes' theorem as

$$\pi(\beta, \gamma|n_1, 2n_2, 3n_3) = \frac{1}{C} P(n_1, 2n_2, 3n_3|\beta, \gamma)\pi_0(\beta, \gamma) \tag{3.3.4.15}$$

where π_0 and π are the prior and posterior distribution of β and γ, and C is a normalizing factor defined as

$$C = \int_0^1 \int_0^1 P(n_1, 2n_2, 3n_3|\beta, \gamma)\pi_0(\beta, \gamma)d\beta\, d\gamma \tag{3.3.4.16}$$

As the prior, a multinomial distribution can be used

$$\pi_0(\beta, \lambda) = h\, \beta^{A_0-1}\, (1-\beta)^{B_0-1}\, \gamma^{C_0-1}\, (1-\gamma)^{D_0-1} \tag{3.3.4.17}$$

where h is given by

$$h = \frac{\Gamma(A_0 + B_0 + C_0 + D_0)}{\Gamma(A_0)\Gamma(B_0)\Gamma(C_0)\Gamma(D_0)} \tag{3.3.4.18}$$

A flat prior distribution is obtained by setting $A_0 = B_0 = C_0 = D_0 = 1$.

Using Equation (3.3.4.17) in Equation (3.3.4.15) results in a posterior distribution for β and γ that is also multinomial, with parameters

$$\begin{aligned} A &= A_0 + 2n_2 + 3n_3 \\ B &= B_0 + n_1 \\ C &= C_0 + 3n_3 \\ D &= D_0 + 2n_2 \end{aligned} \tag{3.3.4.19}$$

The mode of the posterior distribution occurs at

$$\beta = \frac{A-1}{A+B-2} \tag{3.3.4.20}$$

$$\gamma = \frac{C-1}{C+D-2} \tag{3.3.4.21}$$

The mean values are calculated from

$$\bar{\beta} = \frac{A}{A+B} \tag{3.3.4.22}$$

$$\bar{\gamma} = \frac{C}{C+D} \tag{3.3.4.23}$$

Note that, for the flat prior, the mode of the posterior distribution is

$$\beta = \frac{2n_2 + 3n_3}{n_1 + 2n_2 + 3n_3} \tag{3.3.4.24}$$

$$\gamma = \frac{3n_3}{2n_2 + 3n_3} \tag{3.3.4.25}$$

which corresponds to the point estimates presented earlier for a component common cause group of size $m=3$. As can be seen, the approximate method results in estimators that are similar to the commonly used estimators for the MGL parameters. The commonly used estimators therefore are not exact and should be used only if the magnitude of error introduced is judged to be insignificant compared with other sources of error and uncertainty. More accurate estimators are found in Reference 3.3.4-2.

3.3.4.3 Data Classification and Screening

Based on the above discussion, the MGL parameters and the associated uncertainty distributions can be assessed if the values of n_k's are known. Ideally, the numerical value of the parameters of the common cause failure models should be estimated in a manner that makes the maximum possible use of event data; i.e., reports of operating experience. This requires review, evaluation, and classification of the available information to obtain specialized failure data. Because common cause failures can dominate the results of reliability and safety analysis, it is extremely important that this analysis of data be performed within a context that represents the engineering and operational aspects of the plant and system being modeled.

Due to the rarity of common cause events and the limited experience of individual plants, the amount of plant-specific data for common cause analysis is very limited. Therefore, in most cases, we need to use data from the industry experience and a variety of sources to make statistical inferences about the frequencies of the common cause events. However, because there is a significant variability in plants, especially with regard to the coupling mechanisms and defenses against common cause events, the industry experience is not, in most cases, directly applicable to the specific plant being analyzed although much of it may be indirectly applicable. Also, and perhaps equally important, the analysis boundary conditions that dictate what category of components and causes should be analyzed, requires careful review and screening of events to ensure consistency of the database with the assumptions of the system model, its boundary conditions, and other qualitative aspects delineated in the analysis.

The significance of this step has also been emphasized by Reference 3.3.4-3 since an important conclusion of the Common Cause Failure Reliability Benchmark Exercise (CCF-RBE) was that the most important source of uncertainty and variation in the numerical results is data interpretation.

Given the raw data (event reports), a major step is the review and classification of the events to identify where each event fits in a set of predefined categories that describes the type of the event, its cause(s), and its impact; e.g., number of components failed.

The classification of event reports is a rather subjective exercise, particularly in light of the quality of many of the event reports. In an attempt to reduce subjectivity in the screening of event data to identify common cause failures, the CCF-RBE (Reference 3.3.4-3) identified the following rules, which have been somewhat modified:

1. Component-caused functional unavailabilities are screened out since this kind of dependency is normally modeled explicitly.

2. If a specific defense exists that clearly precludes a class of events, specific events belonging to that class are screened out.

3. If the cause of the reported event is a division interconnection that, in the plant under consideration, does not exist, the event is considered as an independent failure of one division.

4. Events related to inapplicable plant conditions (e.g., preoperational testing, etc.) are screened out unless they reveal general causal mechanisms capable of occurring during power operation.

5. If the event occurred during shutdown and would be restored before resuming power operation because of preservice testing or if it cannot occur during power operation, the event is screened out.

6. If a second failure in an event happened after the restoration of the first, both failures are considered as independent failures.

7. Events regarding incipient failure modes (e.g., packing leak, etc.) that clearly do not violate component success criteria are screened out.

8. The events regarding the failure modes of interest are taken into consideration; events regarding failure modes that are irrelevant to the system logic model are screened out.

3.3.4.4 Event Impact Assessment

A useful tool in developing statistical data from event descriptions is to summarize the outcome of the event classification process up to this point in a form similar to the example given in Table 3.3.4-1.

To complete the description of the event impact at the original plant, the analyst needs to identify the following:

1. **Component Group Size.** The number (m) of (typically similar) components that are believed to have been exposed to the root cause and coupling mechanism of the event.

2. **Number of Components Affected.** The number of components within the component group that were affected (e.g., failed) in the event.

3. **Shock Type.** Whether the cause(s) and coupling mechanism(s) involved were of the type that typically results in the failure of all components within the component group (lethal shock) or not (nonlethal shock).

4. **Failure Mode.** The particular component function affected; e.g., failure to open on demand.

Table 3.3.4-2 summarizes the information about the event for the example event described in Table 3.3.4-1 and introduces the representation called the impact vector (Reference 3.3.4-2).

The binary impact vector of an event that has occurred in a common cause component group of size m has m + 1 elements.*

Each element represents the number of components that can fail in an event. If, in an event, k components are failed, then a 1 is placed in the F_k Position of the binary impact vector, with 0 in other positions. In the example of Table 3.3.4-1, the component group size is 2; therefore, the binary impact vector has three elements: $\{F_0, F_1, F_2\}$. Since two components were failed, we have $F_0 = F_1 = 0$ and $F_2 = 1$. A condensed representation is

$$I = \{0, 0, 1\} \qquad (3.3.4.26)$$

Most of the time, however, the event descriptions are not clear, the exact states of components are not always known, and root causes are seldom identified. Therefore, the interpretation of the event (i.e., the translation of the event descriptions into a form similar to the example in Tables 3.3.4-1 and 3.3.4-2) may require establishing several hypotheses, each representing a different interpretation of the event.

As an example, consider the event classified in Table 3.3.4-3. Since it is not clear whether the third diesel was also actually failed, the binary impact vector is assessed under two different hypotheses (Table 3.3.4-4). Under the first hypothesis, only two diesels are considered failed, while, according to the second hypothesis, three diesels were failed. The analyst, at this point, needs to assess his or her degree of confidence in each of the two hypotheses. In the example of Table 3.3.4-4, a weight of 0.9 is given to the

*Common cause component group is defined as a group of (usually similar) components that are considered to have a high potential of failing due to the same cause (Reference 3.3.4-2).

first hypothesis, reflecting a very high degree of confidence that only two diesels were actually failed. The weight for the second hypothesis is obviously 0.1 since the weight should add up to 1. This property of the weighting factors assumes that all reasonable hypotheses are accounted for.

The expectation values for the impact vectors, taken over the two hypotheses, are

$$\bar{I} = (P_0, P_1, P_2) = (0.9)I_1 + (0.1)I_2 = \{0, 0.9, 0.1\} \qquad (3.3.4.27)$$

which is also shown in Table 3.3.4-4. Note that F_i refers to a single binary impact vector, and P_i refers to an average impact vector. The appendix contains the event description and the impacts for each of the common cause events in the PLG generic database.

3.3.4.5 Reinterpretation of Common Cause Events: Creation of a "Plant-Specific Generic" Database

As explained in Section 3.3.4, the common cause events in the PLG database (Reference 3.3.4-4) have been analyzed for the original plant. The first step to creating a "plant-specific generic" database is to determine what that event implies for Browns Ferry; i.e., what would have happened at Browns Ferry if a similar event had occurred. As was mentioned earlier, the same event may not be directly applicable to the plant and system of interest due to several reasons, such as differences in design, operation, common cause defenses, etc. It is therefore essential to reinterpret the event in light of the specific characteristics of the system under consideration.

In general, the differences between the system in which the data originated and the system being analyzed arise in two ways: first, even for systems of the same size, there are physical differences in system design, component type, operating conditions, environment, etc.; second, there can be a difference in system size (degree of redundancy).

In the following discussion, a framework is described with which these two types of differences can be taken into account explicitly in reinterpretation of the event and the assessment of the impact vector for the system of interest.

3.3.4.6 Systems of the Same Size

First, we consider the differences, given the assumption that the system size is the same. The question to be answered is the following: Given the qualitative differences between the two systems, could the same root cause(s) and coupling mechanism(s) occur in the system being analyzed?

In reality, this step involves a considerable amount of judgment. There are a number of sources of uncertainty. These include the lack of detailed information about the event, its circumstances, the nature of its causes, the nature of defenses in the original system, and the effectiveness of defenses in the system being analyzed. Due to the uncertainties involved and the important implications of screening events from the database by declaring them inapplicable, the analyst must have a concrete reason for his judgment. In the cases in which the analyst is uncertain about whether an event is applicable or not, the impact vector of the original system may be modified by a weight reflecting the degree of applicability of the event, as viewed by the analyst. This is similar to the multiple hypothesis situation discussed earlier. Thus, the alternative hypotheses are (1) applicable with probability p, and (2) not applicable with probability (1 - p).

3.3.4.7 Adjustments for Size Difference

The next step is to consider the system size differences. The objective is to estimate or infer what the database of applicable events would look like if it all was generated by systems of the same size (i.e., the number of components in each common cause group) as the system being analyzed. This is done by simulating, in a thought experiment, the occurrence of causes of failures (both independent and dependent) in the system of interest and observing how the impact of these causes changes due to difference in system size. Reference 3.3.4-2 provides a detailed discussion of the background and justification of the need for adjustment in an impact assessment based on system size differences. Reference 3.3.4-2 also develops a set of rules and equations for changing the event impact vectors of the original system to a corresponding set for the system being analyzed.

The rules are presented for the following cases:

1. **Mapping Down.** The case in which the component group size in the original system is larger than in the system being analyzed.

2. **Mapping Up.** The case in which the component group size in the original system is smaller than in the system being analyzed.

3.3.4.8 Mapping Down Impact Vectors

Formulas for mapping down data from systems having four, three, or two components to any identical system having fewer components are presented in Table 3.3.4-5. In this table, $P_k^{(m)}$ represents the kth element of the average impact vector in a system (or component group) of size m. The formulas show how to obtain the elements of the impact vector for smaller size systems when the elements of the impact vector of a larger system are known.

3.3.4.9 Mapping Up Impact Vectors

It can be seen from the results presented above that downward mapping is deterministic; i.e., given an impact vector for an identical system having more components than the system being analyzed, the impact vector for the same size system can be calculated without introducing any new uncertainties. Mapping up, however, as shown in Reference 3.3.4-2, is not deterministic.

To reduce the uncertainty inherent in upward mapping of impact vectors, use is made of a powerful concept that is the basis of the binomial failure rate (BFR) common cause model

(Reference 3.3.4-5). This concept is that events can be classified into one of three categories:

1. **Independent Events.** Causal events that act on components singly and independently.

2. **Nonlethal Shocks.** Causal events that act on the system as a whole with some chance that any number of components within the system can fail. Alternatively, nonlethal shocks can occur when a causal event acts on a subset of the components in the system.

3. **Lethal Shocks.** Causal events that always fail the components in the system.

When enough is known about the cause (i.e., root cause and coupling mechanism) of a given event, it can usually be classified without difficulty into one of the above categories. If an event is identified as being either an independent event or a lethal shock, the impact vectors can be mapped upward deterministically, as shown below. It is only in the case of nonlethal shocks that an added element of uncertainty is introduced on mapping upward. How each event is handled is separately summarized in the following sections.

3.3.4.9.1 Mapping Up Independent Events

In this case, since the number of independent events in the database is simply proportional to the number of components in the system, it can be shown that $P_I^{(\ell)}$ and $P_I^{(k)}$, the number of independent events in systems with sizes ℓ and k, respectively, are related by the following equation:

$$P_I^{(\ell)} = \frac{\ell}{k} P_I^{(k)} \qquad (3.3.4.28)$$

3.3.4.9.2 Mapping Up Lethal Shocks

By definition, a lethal shock fails the redundant components present within a common cause group. From it follows the simple relationship

$$P_\ell^{(\ell)} = P_j^{(j)} \qquad (3.3.4.29)$$

Thus, for lethal shocks, the impact vector is mapped directly.

3.3.4.9.3 Mapping Up Nonlethal Shocks

Nonlethal shock failures are viewed as the result of a nonlethal shock that acts on the system at a rate that is independent of the system size. For each shock, there is a constant probability, ρ, that each component fails. The quantity ρp is the conditional probability of each component failure, given a shock.

Table 3.3.4-6 includes formulas to cover the upward mapping possibilities with system sizes up to four. In the limiting cases of ρ = 0 and ρ = 1, the formulas in Table 3.3.4-6 became identical to Equation (3.3.4.28) (mapping up independent events) and Equation (3.3.4.29) (mapping up lethal shocks), respectively.

The following guidelines assist in quantification.

- If an event is classified as a nonlethal shock and it fails only one component of a group of three or more components, it is reasonable to expect that ρ is small ($\rho < .5$).

- If a nonlethal shock fails a number of components intermediate to the number present, it is unreasonable to expect that ρ is either very small ($\rho \rightarrow 0$) or very large ($\rho \rightarrow 1$).

- If a nonlethal shock fails the components present in a system, it is reasonable to expect that p is large ($\rho > .5$).

3.3.4.10 Development of Event Statistics from Impact Vectors

Once the impact vectors of the events in the database are assessed for the system being analyzed, the number of events in each impact category can be calculated by adding the impact vectors; that is,

$$n_k = \sum_{i=1}^{m} F_k^{(i)} \qquad (3.3.4.30)$$

where

n_k = total number of basic events* involving failure of k similar components.

$F_k^{(i)}$ = the kth element of the ith impact vector.

The n_k's are used to develop estimates of model parameters.

3.3.4.11 Estimation of the MGL Parameters

The procedure described in the preceding sections was used to develop a Browns Ferry-specific generic database for estimating the MGL parameters. The source of data for generic event descriptions and classification was the generic common cause database (Reference 3.3.4-6). The generic events database covers several hundreds of events from PWR and BWR operating experience for the components of interest in Browns Ferry PRA. The screening of events for applicability to Browns Ferry and the assessment of Browns Ferry-specific impact vectors were performed by analysts who were familiar with the specific systems. The details of this screening are documented in Table 3.3.4-7.

*A common cause basic event is defined as an event involving common cause failure of a specific subset of components within a common cause component group (Reference 3.3.4-2).

The impact vector for each applicable event was mapped, if needed, to adjust for system size differences between Browns Ferry and the plants in the generic database. The number of components in Browns Ferry was based on determination of the combination of components assumed to be susceptible to common cause failures. Obviously, the first criteria to apply were to identify components that were modeled in the systems and to determine if those components could be further divided into subgroups of similar components with high susceptibility to common cause failures. As the result of this process, a number of common cause component groups were identified and used as the basis for system size adjustment or mapping of impact vectors.

The maximum number of redundancies modeled for common cause failures is four. The underlying assumption is that the conditional frequency that five or more components have failed given the failure of four is 1.0. In other words, if four components have failed due to common cause, then all the components in that population are considered failed. Table 3.3.4-7 presents impacts only up to n_4, even for components that have populations of greater than four. For example, the RCW system has seven pumps in the analysis, the common cause screening is carried out for four pumps. This model is certainly conservative. The uncertainty in the frequency of events involving more than four components is large.

The result of impact vector assessment and mapping is summarized in Table 3.3.4-8, where for each category of components or set of n_k (k = 1, 2, 3, 4), values are listed. Also provided in the table is the number of independent events adjusted for system size difference between Browns Ferry and the plants in the generic population according to Equation (3.3.4.28). This was done by developing an average number of components for the generic plant, P_{PG}, and using it to scale up or down the total number of independent events in the generic population:

$$N_I = N_{BFN} = \frac{P_{BFN}}{P_{GN}} \times N_{GN} \qquad (3.3.4.31)$$

where

P_{BFN} = population of the component in the Browns Ferry PRA model.

P_{GN} = average population of the component in the nuclear power plants from which the data are collected.

N_{GN} = number of independent events for the component failure modes in the generic database.

The average population of a component in the generic population was obtained by first tabulating the numbering of the component in each power plant from which the failure data are collected. These are power plants with commercial operating experience. The average population of the component is simply the total number of the components in the plants divided by the number of the plants. For components that are common to both PWRs and BWRs, the average population would be based on the total number of the components in both types of plants. For example, diesel generators and component cooling water pumps are equipment that are common to both PWRs and BWRs, whereas auxiliary feedwater pumps are unique to PWRs.

Table 3.3.4-9 shows the average number of components per plant for each component type of interest and the type(s) of nuclear power plants considered in the calculation. The component population and the corresponding common cause component group for each component type in Browns Ferry are provided in Table 3.3.4-8. Given the number of independent events for each component failure mode in the generic database, the average number of components per plant, and the number of components in Browns Ferry, the number of independent events for a component failure mode appropriate for the calculation of Browns Ferry-specific component common cause failure parameters can be obtained.

Table 3.3.4-8 summarizes the common cause event statistics developed for Browns Ferry. It also provides the parameters of the prior distributions used in the Bayesian updating of the data. These parameters, together with the event statistics, provide the parameters of the corresponding posterior distributions according to a generalization of Equation (3.3.4.15) for a four-component system:

- For β-factors,

$$A = A_0 + 2n_2 + 3n_3 + 4n_4$$

$$B = B_0 + n_1$$

- For γ-factors,

$$C = C_0 + 3n_3 + 4n_4$$

$$D = D_0 + 2n_2$$

- For δ-factors,

$$E = E_0 + 4n_4$$

$$F = F_0 + 3n_3$$

The values of n_i include not only the mapped impacts but also the plant-specific experience. Values of A_0, B_0, C_0, D_0, E_0, and F_0 were derived based on characteristics of prior distributions assessed for the category for each component. These distributions reflect the estimate of the likely range of variation of MGL parameters and are provided to supplement the incompleteness of the generic event database with respect to failure modes and causes potentially applicable to Browns Ferry but not yet observed in the generic population.

The posterior distributions for all MGL parameters are listed in Table 3.3.4-10.

3.3.4.12 References

3.3.4-1. Fleming, K. N., and A. M. Kalinowski, "An Extension of the Beta Factor Method to Systems with High Levels of Redundancy," Pickard, Lowe and Garrick, Inc., PLG-0289, June 1983.

3.3.4-2. Mosleh, A., et al., "Procedures for Treating Common Cause Failures in Safety and Reliability Studies," prepared for Electric Power Research Institute and U.S. Nuclear Regulatory Commission, NUREG/CR-4780, Vols. I and II, 1988.

3.3.4-3. Poucet, A., A. Amendola, and P. C. Cacciabue, "Summary of the Common Cause Failure Reliability Benchmark Exercise," Joint Research Centre Report, PER 1133/86, Ispra, Italy, April 1986.

3.3.4-4. Pickard, Lowe and Garrick, Inc., "Database for Probabilistic Risk Assessment for Light Water Nuclear Power Plants," proprietary, PLG-0500, July 1989.

3.3.4-5. Atwood, C. L., "Common Cause Fault Rates for Pumps," EG&G Idaho, Inc., prepared for U.S. Nuclear Regulatory Commission, NUREG/CR-2098, EGG-EA-5289.

3.3.4-6. PLG, Inc., "A Database of Common Cause Events for Risk and Reliability Evaluations," prepared for Electric Power Research Institute, PLG-0866, March 1992.

Table 3.3.4-1. Example of Event Classification and Impact Assessment -- Event Classification		
Plant (date)	Status	Event Description
Pilgrim (September 1976)	95% Power	Two RHR torus cooling valves failed to operate. It was found that the failure was due to excessive pressure differential across the valves, which exceeded the capacity of the valve motors.

Table 3.3.4-2. Example of Event Classification and Impact Assessment -- Event Impact Assessment					
Component Group Size	Impact Vector			Shock Type	Fault Mode
	F_0	F_1	F_2		
2	0	0	01	Nonlethal (L)	Fail to Open on Demand

Table 3.3.4-3. Example of the Assessment of Impact Vectors Involving Multiple Interpretation of Event -- Event Classification		
Cause-Effect Diagram		
Plant (date)	Status	Event Description
Maine Yankee (August 1977)	Power	Two diesel generators failed to run due to plugged radiator. The third unit radiator was also plugged.

Table 3.3.4-4. Example of the Assessment of Impact Vectors Involving Multiple Interpretation of Events -- Multiple Hypothesis Impact Vector Assessment								
Component Group Size	Hypothesis	Probability	F_0	F_1	F_2	F_3	Shock Type	Fault Mode
3	I_1	0.9	0	0	1	0	Nonlethal (N)	Failure during Operation
	I_2	0.1	0	0	0	1		
	Average Impact Vector (I)		P_0	P_1	P_2	P_3		
			0	0	0.9	0.1		

Table 3.3.4-5. Formulas for Mapping Down Impact Vectors

SIZE OF SYSTEM MAPPING FROM:	SIZE OF SYSTEM MAPPING TO (NUMBER OF IDENTICAL TRAINS) 3	2	1
4	$P_0^{(3)} = \frac{1}{4} P_1^{(4)} + P_0^{(4)}$* $P_1^{(3)} = \frac{3}{4} P_1^{(4)} + \frac{1}{2} P_2^{(4)}$ $P_2^{(3)} = \frac{1}{2} P_2^{(4)} + \frac{3}{4} P_3^{(4)}$ $P_3^{(3)} = \frac{1}{4} P_3^{(4)} + P_4^{(4)}$	$P_0^{(2)} = \frac{1}{2} P_1^{(4)} + \frac{1}{6} P_2^{(4)}$ $P_1^{(2)} = \frac{1}{2} P_1^{(4)} + \frac{2}{3} P_2^{(4)} + \frac{1}{2} P_3^{(4)}$ $P_2^{(2)} = \frac{1}{6} P_2^{(4)} + \frac{1}{2} P_3^{(4)} + P_4^{(4)}$	$P_0^{(1)} = \frac{3}{4} P_1^{(4)} + \frac{1}{2} P_2^{(4)} + \frac{1}{4} P_3^{(4)}$ $P_1^{(1)} = \frac{1}{4} P_1^{(4)} + \frac{1}{2} P_2^{(4)} + \frac{3}{4} P_3^{(4)} + P_4^{(4)}$
3		$P_0^{(2)} = P_0^{(3)} + \frac{1}{3} P_1^{(3)}$ $P_1^{(2)} = \frac{2}{3} P_1^{(3)} + \frac{2}{3} P_2^{(3)}$ $P_2^{(2)} = \frac{1}{3} P_2^{(3)} + P_3^{(3)}$	$P_0^{(1)} = P_0^{(3)} + \frac{2}{3} P_1^{(3)} + \frac{1}{3} P_2^{(3)}$ $P_1^{(1)} = \frac{1}{3} P_1^{(3)} + \frac{2}{3} P_2^{(3)} + P_3^{(3)}$
2			$P_0^{(1)} = P_0^{(2)} + \frac{1}{2} P_1^{(2)}$ $P_1^{(1)} = \frac{1}{2} P_1^{(2)} + P_2^{(2)}$

*THE TERM $P_0^{(4)}$ IS INCLUDED FOR COMPLETENESS, BUT IN PRACTICE, ANY EVIDENCE THAT MIGHT EXIST ABOUT CAUSES THAT IMPACT NO COMPONENTS IN A FOUR-TRAIN SYSTEM WOULD BE "UNOBSERVABLE."

Table 3.3.4-6. Formulas for Upward Mapping of Events Classified as Nonlethal Shocks

SIZE OF SYSTEM MAPPING FROM		SIZE OF SYSTEM MAPPING TO		
		2	3	4
	1	$P_1^{(2)} = 2(1-\rho)P_1^{(1)}$ $P_2^{(2)} = \rho P_1^{(1)}$	$P_1^{(3)} = 3(1-\rho)^2 P_1^{(1)}$ $P_2^{(3)} = 3\rho(1-\rho)P_1^{(1)}$ $P_3^{(3)} = \rho^2 P_1^{(1)}$	$P_1^{(4)} = 4(1-\rho)^3 P_1^{(1)}$ $P_2^{(4)} = 6\rho(1-\rho)^2 P_1^{(1)}$ $P_3^{(4)} = 4\rho^2(1-\rho)P_1^{(1)}$ $P_4^{(4)} = \rho^3 P_1^{(1)}$
	2		$P_1^{(3)} = (3/2)(1-\rho)P_1^{(2)}$ $P_2^{(3)} = \rho P_1^{(2)} + (1-\rho)P_2^{(2)}$ $P_3^{(3)} = \rho P_2^{(2)}$	$P_1^{(4)} = 2(1-\rho)^2 P_1^{(2)}$ $P_2^{(4)} = (5/2)\rho(1-\rho)P_1^{(2)} + (1-\rho)^2 P_2(2)$ $P_3^{(4)} = \rho^2 P_1^{(2)} + 2\rho(1-\rho)P_2^2$ $P_4^{(4)} = \rho^2 P_2^{(2)}$
	3			$P_1^{(4)} = (4/3)(1-\rho)P_1^{(3)}$ $P_2^{(4)} = \rho P_1^{(3)} + (1-\rho)P_2^{(3)}$ $P_3^{(4)} = \rho P_2^{(3)} + (1-\rho)P_3^{(3)}$ $P_4^{(4)} = \rho P_3^{(3)}$

Table 3.3.4-7 (Page 1 of 9). Common Cause Events Impact Vectors for Browns Ferry Components

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	P2	P3	P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4	REMARKS	RHO
DIESEL/GENERATORS POPULATION 8																		
1	BWR XI.A.208	4	1.000	0.000	0.000	0.000	RUN	N					0.000	0.000	0.000	0.000	NA - OIL STORED INDOORS, OIL USED AFTER SAMPLING	
2	BWR XI.A.289	8	0.930	0.070	0.000	0.000	RUN	N					0.930	0.070	0.000	0.000		
3	PWR X1.A.57	3	1.970	0.017	0.000		RUN	N					0.657	1.482	0.013	0.000		0.75
4	PWR XI.C.9	3	0.000	0.000	1.000		RUN	L					0.000	0.000	0.000	0.000	DIESELS ARE NOT ALIGNED IN PARALLEL	
5	PWR XI.A.217	2	0.010	0.070			RUN	N					0.000	0.000	0.000	0.000	DIESELS ARE WELL PROTECTED FROM THE WEATHER	
6	PWR X1.A.339	3	0.000	0.900	0.100		RUN	N					0.000	0.225	0.700	0.075		0.75
7	PWR XI.A.337	2	0.000	1.000			RUN	N					0.000	0.063	0.375	0.563		0.75
8	BWR XVI.C.32	5	0.000	1.000	0.000	0.000	START	N	0.000	0.000	0.000	0.000					COOLING WATER IS NOT REALIGNED FOR ANY REASON	
9	NUREG/CR-1362	3	0.000	0.890	0.110		START	N	0.000	0.223	0.695	0.083						0.75
10	NUREG/CR-1362	2	0.000	1.000			START	N	0.000	0.000	0.000	0.000					NA - OIL TANKS NOT ISOLATED FOR ANY REASON	0.75
11	PWR XI.A.230	2	0.000	1.000			START	N	0.000	0.000	0.000	0.000					TRIP BYPASSED ON AUTO START	
12	BWR XI.A.29	3	0.983	0.000	0.017		START	N	0.328	0.737	0.004	0.013						0.75
13	BWR X1.A.159	4	0.000	0.900	0.100	0.000	START	N	0.000	0.000	0.000	0.000					TRIP BYPASSED ON AUTO START	
14	PWR XI.A.25	3	0.000	1.000	0.000		RESTART	N	0.000	0.000	0.000	0.000					RESTART OF DIESELS NOT MODELED	
							TOTAL IMPACT AT BFN		0.328	0.960	0.699	0.095	1.587	1.839	1.088	0.638		
									Z_DGSS*				Z_DGSR					
STANDBY PUMPS (CORE SPRAY) POPULATION 4																		
1	PWR VII.A.233	4	0.770	0.200	0.030	0.000	START	N	0.000	0.000	0.000	0.000					BOTH PUMPS ON A HEADER ALWAYS STARTED TOGETHER	
2	PWR VIII.A.316	3	0.000	0.000	1.000		START	N	0.000	0.000	0.000	0.000					PUMPS ARE NOT P.D. PUMPS	
3	PWR XVI.C.1624	3	0.000	1.000	0.000		START	N	0.000	1.000	0.000	0.000					APPLIES TO TWO PUMPS ONLY	
4	PWR XVI.C.778	3	0.000	0.000	1.000		START	N	0.000	0.000	0.000	0.000					PUMPS DO NOT HAVE THIS TYPE OF LOGIC	
5	PWR XVI.C.801	3	0.000	0.000	1.000		START	L	0.000	0.000	0.000	1.000					APPLICABLE	1
6	PWR XVI.C..58	3	0.000	1.000	0.000		START	N	0.000	0.250	0.750	0.000					APPLICABLE	0.75
7	PWR V11.A.176	4	0.830	0.000	0.000	0.000	RUN	N					0.830	0.000	0.000	0.000	PUMPS ARE VERTICAL PUMPS	
8	BWR VII.D.15	4	0.997	0.003	0.000	0.000	RUN	N					0.000	0.000	0.000	1.000	STANDBY PUMPS HAVE EQUAL EXPERIENCE	
9	BWR VII.D.124	4	0.235	0.765	0.000	0.000	RUN	N					0.235	0.765	0.000	0.000	TWO PUMPS IN EACH ROOM	
10	PWR VII.A.289	2	0.000	1.000			START	L	0.000	0.000	0.000	0.000					NO RECIRC LINES IN EXTREMELY COLD AREAS	
11	BWR XVI.C.411	4	0.000	1.000	0.000	0.000	START	N	0.000	1.000	0.000	0.000					APPLICABLE	
12	BWR XVI.C.488	4	0.000	1.000	0.000	0.000	START	N	0.000	1.000	0.000	0.000					APPLICABLE	
13	BWR XI.B.207	4	0.000	1.000	0.000	0.000	START	N	0.000	1.000	0.000	0.000						
14	PWR VII.B.51	2	0.000	0.970			START	L	0.000	0.000	0.000	0.000					NA - CS SYSTEM HAS KEEP-FILL SYSTEM	
15	PWR XVI.C.188	2	0.000	1.000			START	L	0.000	0.000	0.000	1.000					APPLICABLE	
16	PWR XVI.C.559	2	0.000	1.000			START	L	0.000	0.000	0.000	1.000					APPLICABLE	
17	PWR XVI.C.623	2	0.000	1.000			START	L	0.000	0.000	0.000	1.000					APPLICABLE	
18	PWR XVI.C.669	2	0.000	1.000			START	L	0.000	0.000	0.000	0.000					OPERATORS NOT LIKELY TO TAG OUT PUMPS DURING POWER OPERATION	
19	PWR XVI.C.801	2	0.000	1.000			START	L	0.000	0.000	0.000	1.000					APPLICABLE	
20	PWR VII.B.91	2	0.000	1.000			START	N	0.000	0.063	0.375	0.563						0.75
21	PWR VI.E.80	2+1	0.000	0.000	0.440		RUN	N					0.000	0.000	0.000	0.000	NA - STRAINER FAILURES MODELED SEPARATELY	
22	PWR VI.E.36	2+1	0.000	1.000			START	N	0.000	0.000	0.000	0.000					CS PUMPS TAKE SUCTION FROM BOTTOM OF RING HEADER	
23	PWR VI.E.49	2+1	0.000	1.000			START	N	0.000	0.000	0.000	0.000					NA- PUMP RUN TEST REQUIRED AFTER TIGHTENING PACKING	

Table 3.3.4-7 (Page 2 of 9). Common Cause Events Impact Vectors for Browns Ferry Components

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	ORIGINAL IMPACTS P2	ORIGINAL IMPACTS P3	ORIGINAL IMPACTS P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4.	REMARKS	RHO
24	PWR VI.E.46	2+2	0.000	0.500	0.000	0.000	START	N	0.000	0.000	0.000	0.000					STRAINER FAILURES MODELED SEPARATELY	
25	PWR VI.E.374	2	0.000	1.000			START	L	0.000	0.000	0.000	1.000					APPLICABLE	1
26	PWR IX.D.205	4+2	0.000	0.000	0.000	1.000	START	N	0.000	0.000	0.000	0.000					NA- NO LOW SUCTION PRESSURE TRIPS	
27	PWR IX.D.205	4+2	0.000	1.000			START	N	0.000	0.000	0.000	0.000					NA- NO LOW SUCTION PRESSURE TRIPS	
28	PWR XVI.C.984	2	0.000	1.000			START	L	0.000	0.000	0.000	0.000					CS PUMPS DESIGNED FOR SUFFICIENT NPSH	
29	PWR XVI.C.300	2	0.000	1.000			START	L	0.000	0.000	0.000	1.000					APPLICABLE	
							TOTAL IMPACT AT BFN		0.000	4.313	1.125	7.563	1.065	0.765	0.000	1.000		
									Z_PCSS				Z_PCSR					
STANDBY PUMPS (RHR, RHR SW) POPULATION 4																		
1	PWR VII.A.233	4	0.770	0.200	0.030	0.000	START	N	0.770	0.200	0.030	0.000					APPLICABLE	
2	PWR VIII.A.316	3	0.000	0.000	1.000		START	N	0.000	0.000	0.000	0.000					PUMPS ARE NOT P.D. PUMPS	
3	PWR XVI.C.1624	3	0.000	1.000	0.000		START	N	0.000	1.000	0.000	0.000					APPLIES TO TWO PUMPS ONLY	
4	PWR XVI.C.778	3	0.000	0.000	1.000		START	N	0.000	0.000	0.000	0.000					PUMPS DO NOT HAVE THIS TYPE OF LOGIC	
5	PWR XVI.C.801	3	0.000	0.000	1.000		START	L	0.000	0.000	0.000	1.000					APPLICABLE	1
6	PWR XVI.C..58	3	0.000	1.000	0.000		START	N	0.000	0.250	0.750	0.000					APPLICABLE	0.75
7	PWR VII.A.176	4	0.830	0.000	0.000	0.000	RUN	N					0.830	0.000	0.000	0.000	PUMPS ARE VERTICAL PUMPS	
8	BWR VII.D.15	4	0.997	0.003	0.000	0.000	RUN	N					0.000	0.000	0.000	1.000	PUMPS HAVE SAME OPERATING EXPERIENCE	
9	BWR VII.D.124	4	0.235	0.765	0.000	0.000	RUN	N					0.235	0.765	0.000	0.000	BOTH PUMPS IN A TRAIN ARE IN SAME ROOM	
10	PWR VII.A.289	2	0.000	1.000			START	L	0.000	0.000	0.000	0.000					NO RECIRC LINES IN EXTREMELY COLD AREAS	
11	BWR XVI.C.411	4	0.000	1.000	0.000	0.000	START	N	0.000	1.000	0.000	0.000					APPLICABLE	
12	BWR XVI.C.488	4	0.000	1.000	0.000	0.000	START	N	0.000	1.000	0.000	0.000					APPLICABLE	
13	BWR XI.B.207	4	0.000	1.000	0.000	0.000	START	N	0.000	1.000	0.000	0.000					APPLICABLE	
14	PWR VII.B.51	2	0.000	0.970			START	L	0.000	0.000	0.000	0.000					BOTH SYSTEMS HAVE KEEP-FILL SYSTEMS	
15	PWR XVI.C.188	2	0.000	1.000			START	L	0.000	0.000	0.000	0.000					BOTH SYSTEMS REQUIRED DURING REFUELING AND STARTUP	
16	PWR XVI.C.559	2	0.000	1.000			START	L	0.000	0.000	0.000	0.000					BOTH SYSTEMS REQUIRED DURING REFUELING AND STARTUP	
17	PWR XVI.C.623	2	0.000	1.000			START	L	0.000	0.000	0.000	0.000					BOTH SYSTEMS REQUIRED DURING REFUELING AND STARTUP	
18	PWR XVI.C.669	2	0.000	1.000			START	L	0.000	0.000	0.000	0.000					OPERATORS NOT LIKELY TO TAG OUT PUMPS DURING POWER OPERATION	
19	PWR XVI.C.801	2	0.000	1.000			START	L	0.000	0.000	0.000	0.000					BOTH SYSTEMS REQUIRED DURING REFUELING AND STARTUP	
20	PWR VII.B.91	2	0.000	1.000			START	N	0.000	0.063	0.375	0.563					APPLICABLE	0.75
21	PWR VI.E.80	2+1	0.000	0.000	0.440		RUN	N					0.000	0.000	0.000	0.000	STRAINER FAILURES MODELED SEPARATELY	
22	PWR VI.E.36	2+1	0.000	1.000			START	N	0.000	0.000	0.000	0.000					RHR PUMPS TAKE SUCTION FROM BOTTOM OF RING HEADER	
23	PWR VI.E.49	2+1	0.000	1.000			START	N	0.000	0.000	0.000	0.000					PUMP RUN TEST REQUIRED AFTER TIGHTENING PACKING	
24	PWR VI.E.46	2+2	0.000	0.500	0.000	0.000	START	N	0.000	0.000	0.000	0.000					STRAINER FAILURES MODELED SEPARATELY	
25	PWR VI.E.374	2	0.000	1.000			START	L	0.000	0.000	0.000	1.000					APPLICABLE	1
26	PWR IX.D.205	4+2	0.000	0.000	0.000	1.000	START	N	0.000	0.000	0.000	0.000					NA - NO LOW SUCTION PRESSURE TRIPS	
27	PWR IX.D.205	4+2	0.000	1.000			START	N	0.000	0.000	0.000	0.000					NA - NO LOW SUCTION PRESSURE TRIPS	
28	PWR XVI.C.984	2	0.000	1.000			START	L	0.000	0.000	0.000	0.000					RHR PUMPS DESIGNED FOR SUFFICIENT NPSH, NO HOT WATER SOURCE FOR ERCW	
29	PWR XVI.C.300	2	0.000	1.000			START	L	0.000	0.000	0.000	0.000					APPLICABLE	
							TOTAL IMPACT AT BFN		0.770	4.513	1.155	2.563	1.065	0.765	0.000	1.000		
									Z_PRHS, Z_PRSS				Z_PRHR, Z_PRSR					

Table 3.3.4-7 (Page 3 of 9). Common Cause Events Impact Vectors for Browns Ferry Components

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	P2	P3	P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4	REMARKS	RHO
OPERATING PUMPS (RBCCW) POPULATION 2.																		
1	PWR VIII.B.218	10	0.180	0.000	0.000	0.000	RUN	N					0.000	0.000			PUMPS ARE SUPPLIED CLEAN WATER FOR SEAL/BEARING COOLING	
2	PWR VIII.B.159	3	0.000	1.000	0.000		RUN	N					0.667	0.333			APPLICABLE	
3	PWR VI.F.85	2	1.170	0.000			RUN	N					1.170	0.000			APPLICABLE	
4	BWR VIII.C.78	5	1.840	0.076	0.000	0.000	RUN	N					0.000	0.000			PUMPS NOT OPERATING BEYOND CAPACITY	
5	BWR VIII.C.45	5	0.000	0.170	0.000	0.000	RUN	N					0.000	0.000			PUMPS NOT OPERATING BEYOND CAPACITY	
6	BWR VIII.C.33	5	1.170	0.440	0.080	0.000	RUN	N					0.000	0.000			PUMPS NOT OPERATING BEYOND CAPACITY	
7	PWR XVI.C.642	2	0.000	1.000			START	N	0.000	0.000							NA - NO SELECTOR SWITCHES	
8	BWR XI.B.196	2	0.000	1.000			TRIP	N									FAILURE MODE NOT MODELED	
9	PWR VIII.B.516	3	2.000	0.000	0.000		RUN	N					1.333	0.000			APPLICABLE	
							TOTAL IMPACT AT BFN		0.000	0.000			3.170	0.333				
									ZBPRBS				ZBPRBR					
OPERATING PUMPS (EECW, RCW) POPULATION 4																		
1	PWR VIII.B.218	10	0.180	0.000	0.000	0.000	RUN	N					0.180	0.000	0.000	0.000	APPLICABLE	
2	PWR VIII.B.159	3	0.000	1.000	0.000		RUN	N					0.000	0.250	0.750	0.000	APPLICABLE	0.75
3	PWR VI.F.85	2	1.170	0.000			RUN	N					2.340	0.000	0.000	0.000	APPLICABLE	0
4	BWR VIII.C.78	5	1.840	0.076	0.000	0.000	RUN	N					0.000	0.000	0.000	0.000	PUMPS NOT OPERATING BEYOND CAPACITY	
5	BWR VIII.C.45	5	0.000	0.170	0.000	0.000	RUN	N					0.000	0.000	0.000	0.000	PUMPS NOT OPERATING BEYOND CAPACITY	
6	BWR VIII.C.33	5	1.170	0.440	0.080	0.000	RUN	N					0.000	0.000	0.000	0.000	PUMPS NOT OPERATING BEYOND CAPACITY	
7	PWR XVI.C.642	2	0.000	1.000			START	N	0.000	0.063	0.375	0.563					APPLICABLE	0.75
8	BWR XI.B.196	2	0.000	1.000			TRIP	N									FAILURE MODE NOT MODELED	
9	PWR VIII.B.516	3	2.000	0.000	0.000		RUN	N					2.667	0.000	0.000	0.000	APPLICABLE	0
							TOTAL IMPACT AT BFN		0.000	0.063	0.375	0.563	5.187	0.250	0.750	0.000		
									Z_PEES, Z_PERS				Z_PEER, Z_PERR					
OPERATING PUMPS (CONDENSATE, CONDENSATE BOOSTER) POPULATION 3																		
1	PWR VIII.B.218	10	0.180	0.000	0.000	0.000	RUN	N					0.000	0.000	0.000		PUMPS ARE SUPPLIED CLEAN WATER FOR SEAL/BEARING COOLING	
2	PWR VIII.B.159	3	0.000	1.000	0.000		RUN	N					0.000	1.000	0.000		APPLICABLE	
3	PWR VI.F.85	2	1.170	0.000			RUN	N					1.755	0.000	0.000		APPLICABLE	0
4	BWR VIII.C.78	5	1.840	0.076	0.000	0.000	RUN	N					0.000	0.000	0.000		PUMPS NOT OPERATING BEYOND CAPACITY	
5	BWR VIII.C.45	5	0.000	0.170	0.000	0.000	RUN	N					0.000	0.000	0.000		PUMPS NOT OPERATING BEYOND CAPACITY	
6	BWR VIII.C.33	5	1.170	0.440	0.080	0.000	RUN	N					0.000	0.000	0.000		PUMPS NOT OPERATING BEYOND CAPACITY	
7	PWR XVI.C.642	2	0.000	1.000			START	N	0.000	0.000	0.000						NA- PUMPS NOT SELECTED FOR AUTO ACTUATION	
8	BWR XI.B.196	2	0.000	1.000			TRIP	N									FAILURE MODE NOT MODELED	
9	PWR VIII.B.516	3	2.000	0.000	0.000		RUN	N					2.000	0.000	0.000		APPLICABLE	
							TOTAL IMPACT AT BFN		0.000	0.000	0.000		3.755	1.000	0.000			
									Z_PCDS, Z_PCBS				Z_PCDR, Z_PCBR					
STANDBY VENTILATION FANS POPULATION 4																		

Table 3.3.4-7 (Page 4 of 9). Common Cause Events Impact Vectors for Browns Ferry Components

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	P2	P3	P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4	REMARKS	RHO
1	PWR XIV.B.115	4	2.000	0.000	0.000	0.000	RUN	N					2.000	0.000	0.000	0.000		
2	PWR XVI.B.330	6	0.000	1.000	0.000	0.000	RUN	N					0.000	1.000	0.000	0.000		
3	BWR XVI.B.77	3	0.000	0.000	1.000		RUN	L					0.000	0.000	0.000	0.000	NOT APPLICABLE TO ROOM COOLING FANS	
4	PWR IX.E.615	2	0.000	1.000			RUN	L					0.000	0.000	0.000	0.000	FANS HAVE NO OTHER SYSTEM INTERLOCK SIGNALS	
5	BWR XVI.B.1104	2	1.000	0.000			RUN	N					2.000	0.000	0.000	0.000		
6	PWR XVI.B.314	4	0.000	0.000	0.000	1.000	RUN	L					0.000	0.000	0.000	1.000		
7	BWR XVI.B.193	N	0.000	0.000	0.000	1.000	RUN	N					0.000	0.000	0.000	1.000		
8	PWR XVI.C.1112	4	0.000	0.000	0.000	1.000	RUN	L					0.000	0.000	0.000	0.000	FANS HAVE NO OTHER SYSTEM INTERLOCK SIGNALS	
9	PWR XVI.B.186	2	1.240	0.380			RUN	N					0.155	0.605	0.84	0.214		0.75
10	PWR IX.F.84	4	0.000	0.000	0.000	1.000	RUN	L					0.000	0.000	0.000	0.000	NO LOW FLOW TRIPS	
11	PWR VII.C.34	3	2.000	0.000	0.000		RUN	N					2.667	0.000	0.000	0.000		
12	BWR XVI.B.510	N	0.000	0.000	0.000	1.000	RUN	L					0.000	0.000	0.000	0.000	NOT APPLICABLE TO INDIVIDUAL ROOM COOLING FANS	
13	PWR IX.E.675	4	2.000	0.000	0.000	0.000	START	N	2.000	0.000	0.000	0.000						
14	PWR XVI.C.269	2	0.000	1.000			START	N	0.000	0.000	0.000	0.000					FANS NOT INTERLOCKED WITH ANY OTHER SYSTEM	
15	BWR XVI.B.501	6	2.000	0.000	0.000	0.000	START	N	2.000	0.000	0.000	0.000						
16	BWR XI.B.185	8	0.000	0.000	0.000	1.000	START	N	0.000	1.000	0.000	0.000					EACH RELAY ASSOCIATED WITH ONE FAN	
17	PWR XVI.C.2267	2	0.000	1.000			START	N	1.000	0.000	0.000	0.000					ONLY ONE FAN IN EACH TRAIN	
							TOTAL IMPACT AT BFN		5.00	1.00	0.00	0.00	6.82	1.61	0.84	2.21		
									Z_FNSS				Z_FNSR					

OPERATING VENTILATION FANS POPULATION 4

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	P2	P3	P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4	REMARKS	RHO
1	PWR XIV.B.115	4	2.000	0.000	0.000	0.000	RUN	N					2.000	0.000	0.000	0.000		
2	PWR XVI.B.330	6	0.000	1.000	0.000	0.000	RUN	N					0.000	0.000	0.000	0.000	NOT APPLICABLE TO NORMALLY OPERATING FANS	
3	BWR XVI.B.77	3	0.000	0.000	1.000		RUN	L					0.000	0.000	0.000	0.000	NOT APPLICABLE TO SMALL ROOM COOLING FANS	
4	PWR IX.E.615	2	0.000	1.000			RUN	L					0.000	0.000	0.000	0.000	FANS HAVE NO OTHER SYSTEM INTERLOCK SIGNALS	
5	BWR XVI.B.1104	2	1.000	0.000			RUN	N					2.000	0.000	0.000	0.000		0.75
6	PWR XVI.B.314	4	0.000	0.000	0.000	1.000	RUN	L					0.000	0.000	0.000	0.000	ELEC BLDG FANS ARE NORMALLY OPERATING	
7	BWR XVI.B.193	N	0.000	0.000	0.000	1.000	RUN	N					0.000	0.000	0.000	1.000		
8	PWR XVI.C.1112	4	0.000	0.000	0.000	1.000	RUN	L					0.000	0.000	0.000	0.000	FANS HAVE NO OTHER SYSTEM INTERLOCK SIGNALS	
9	PWR XVI.B.186	2	1.240	0.380			RUN	N					0.155	0.605	0.84	0.214		0.75
10	PWR IX.F.84	4	0.000	0.000	0.000	1.000	RUN	L					0.000	0.000	0.000	0.000	NO LOW FLOW TRIPS	
11	PWR VII.C.34	3	2.000	0.000	0.000		RUN	N					2.667	0.000	0.000	0.000		
12	BWR XVI.B.510	N	0.000	0.000	0.000	1.000	RUN	L					0.000	0.000	0.000	0.000	NOT APPLICABLE TO INDIVIDUAL ROOM COOLING FANS	
13	PWR IX.E.675	4	2.000	0.000	0.000	0.000	START	N	2.000	0.000	0.000	0.000						
14	PWR XVI.C.269	2	0.000	1.000			START	N	0.000	0.000	0.000	0.000					FANS NOT INTERLOCKED WITH ANY OTHER SYSTEM	
15	BWR XVI.B.501	6	2.000	0.000	0.000	0.000	START	N	2.000	0.000	0.000	0.000						
16	BWR XI.B.185	8	0.000	0.000	0.000	1.000	START	N	0.000	1.000	0.000	0.000					EACH RELAY STARTS ONE FAN	
17	PWR XVI.C.2267	2	0.000	1.000			START	N	1.000	0.000	0.000	0.000					ONLY ONE FAN IN EACH TRAIN	
							TOTAL IMPACT AT BFN		5.00	1.00	0.00	0.00	6.82	0.61	0.84	1.21		
									Z_FNOS				Z_FNOR					

STANDBY GAS TREATMENT FANS POPULATION 3

Table 3.3.4-7 (Page 5 of 9). Common Cause Events Impact Vectors for Browns Ferry Components

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	P2	P3	P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4	REMARKS	RHO
1	PWR XIV.B.115	4	2.000	0.000	0.000	0.000	RUN	N					1.500	0.000	0.000			
2	PWR XVI.B.330	6	0.000	1.000	0.000	0.000	RUN	N					0.500	0.500	0.000			
3	BWR XVI.B.77	3	0.000	0.000	1.000		RUN	L					0.000	0.000	0.000		NOT APPLICABLE TO SGT FANS	
4	PWR IX.E.615	2	0.000	1.000			RUN	L					0.000	0.000	0.000		NOT APPLICABLE TO SGT FANS	
5	BWR XVI.B.1104	2	1.000	0.000			RUN	N					0.375	0.750	0.000			0.75
6	PWR XVI.B.314	4	0.000	0.000	0.000	1.000	RUN	L					0.000	0.000	1.000			
7	BWR XVI.B.193	N	0.000	0.000	0.000	1.000	RUN	N					0.000	0.000	1.000			
8	PWR XVI.C.1112	4	0.000	0.000	0.000	1.000	RUN	L					0.000	0.000	0.000		NOT APPLICABLE TO SGT FANS	
9	PWR XVI.B.186	2	1.240	0.380			RUN	N					0.465	1.025	0.285			0.75
10	PWR IX.F.84	4	0.000	0.000	0.000	1.000	RUN	L					1.000	0.000	0.000		ALL FANS INDEPENDENT & INTERLOCKED WITH SUCTION DAMPER	
11	PWR VII.C.34	3	2.000	0.000	0.000		RUN	N					2.000	0.000	0.000			
12	BWR XVI.B.510	N	0.000	0.000	0.000	1.000	RUN	L					0.000	0.000	0.000		NOT APPLICABLE TO SGT FANS	
13	PWR IX.E.675	4	2.000	0.000	0.000	0.000	START	N	1.500	0.000	0.000							
14	PWR XVI.C.269	2	0.000	1.000			START	N	0.000	0.000	0.000						NOT APPLICABLE TO SGT FANS	
15	BWR XVI.B.501	6	2.000	0.000	0.000	0.000	START	N	2.000	0.000	0.000							
16	BWR XI.B.185	8	0.000	0.000	0.000	1.000	START	N	0.000	1.000	0.000						EACH RELAY STARTS ONE FAN	
17	PWR XVI.C.2267	2	0.000	1.000			START	N	1.000	0.000	0.000						ONLY ONE FAN IN EACH TRAIN	
							TOTAL IMPACT AT BFN		4.50	1.00	0.00		5.84	2.28	2.29			
									Z_FN1S				Z_FN1R					

MOTOR-OPERATED VALVES POPULATION 4

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	P2	P3	P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4	REMARKS	RHO
1	PWR VIII.A.548	6	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.000	1.000	0.000	0.000						
2	PWR VI.E.210	3	0.000	0.500	0.000		OPEN/CLOSE	N	0.000	0.125	0.375	0.000						0.75
3	PWR VI.E.276	10	0.930	0.460	0.000	0.000	OPEN/CLOSE	N	0.930	0.460	0.000	0.000						
4	PWR VII.A.99	9	0.711	0.186	0.070	0.003	OPEN/CLOSE	N	0.711	0.186	0.070	0.003						
5	PWR VII.A.137	4	1.000	0.000	0.000	0.000	OPEN/CLOSE	N	1.000	0.000	0.000	0.000						
6	PWR VII.C.16	3	0.045	0.123	0.188		OPEN/CLOSE	N	0.015	0.065	0.078	0.141						0.75
7	PWR VIII.A.26	2	0.820	0.180			OPEN/CLOSE	N	0.000	0.000	0.000	0.000					NO VALVES AT BFN EXPOSED TO THE WEATHER	
8	BWR VII.D.86	2	0.000	1.000			OPEN/CLOSE	N	0.000	0.063	0.375	0.563						0.75
9	BWR VII.D.49	4	0.627	0.272	0.100	0.000	OPEN/CLOSE	N	0.627	0.272	0.100	0.000						
10	BWR VII.D.46	2	0.000	1.000			OPEN/CLOSE	N	0.000	0.250	0.750	0.000						0.75
11	PWR XVI.C.539	8	0.000	0.000	1.000	0.000	OPEN/CLOSE	N	0.000	0.000	1.000	0.000						
12	PWR VII.C.12	4	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.000	1.000	0.000	0.000						
13	PWR VII.A.130	30	0.000	0.010	0.010	0.510	OPEN/CLOSE	N	0.000	0.010	0.010	0.510						
14	PWR VII.A.2	4	0.998	0.000	0.000	0.002	OPEN/CLOSE	N	0.998	0.000	0.000	0.002						
15	PWR VII.A.180	45	0.330	0.610	0.000	0.000	OPEN/CLOSE	N	0.330	0.610	0.000	0.000						
16	PWR VIII.B.100	4	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.000	1.000	0.000	0.000						
17	PWR VI.E.194	12	0.100	0.235	0.665	0.000	OPEN/CLOSE	N	0.100	0.235	0.665	0.000						
18	BWR V.D.4	25	0.536	0.222	0.114	0.128	OPEN/CLOSE	N	0.536	0.222	0.114	0.128						
19	BWR V.D.40	150	0.950	0.050	0.000	0.000	OPEN/CLOSE	N	0.950	0.050	0.000	0.000						
20	PWR XVI.C.1253	4	1.000	0.000	0.000	0.000	OPEN/CLOSE	N	1.000	0.000	0.000	0.000						
21	PWR XVI.C.1428	N	0.000	1.000			OPEN/CLOSE	N	0.000	1.000	0.000	0.000						
22	BWR VIII.D.23	28	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.000	1.000	0.000	0.000						

Table 3.3.4-7 (Page 6 of 9). Common Cause Events Impact Vectors for Browns Ferry Components

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	P2	P3	P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4	REMARKS	RHO
23	BWR VII.D.97, & BWR VII.C.24, 50	76	0.170	0.218	0.243	0.369	OPEN/CLOSE	N	0.170	0.218	0.243	0.369						
24	BWR VII.D.104	2	1.000	0.000			OPEN/CLOSE	N	0.125	0.469	0.063	0.000						0.75
25	BWR VII.D.165	4	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.000	1.000	0.000	0.000						
26	BWR VII.D.193	4	4.000	0.000	0.000	0.000	OPEN/CLOSE	N	4.000	0.000	0.000	0.000						
27	BWR VII.D.219	81	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.000	1.000	0.000	0.000						
28	BWR VII.D.220	3	0.000	1.000	0.000		OPEN/CLOSE	N	0.000	0.250	0.750	0.000						0.75
29	BWR VIII.C.53	2	0.000	1.000			OPEN/CLOSE	N	0.000	0.063	0.375	0.563						0.75
30	BWR IX.E.236	2	0.015	0.002			OPEN/CLOSE	N	0.000	0.000	0.000	0.000					ALL VALVES MODELED WITH A SINGLE SIGNAL	
31	BWR XI.B.35	13	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.000	1.000	0.000	0.000						
32	BWR XVI.C.35	4	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.000	1.000	0.000	0.000						
							TOTAL IMPACT AT BFN		11.49	12.55	4.97	2.28						
									Z_MOVD									

MOTOR-OPERATED VALVES POPULATION 3

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	P2	P3	P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4	REMARKS	RHO
1	PWR VIII.A.548	6	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.500	0.500	0.000							
2	PWR VI.E.210	3	0.000	0.500	0.000		OPEN/CLOSE	N	0.000	0.500	0.000							0.75
3	PWR VI.E.276	10	0.930	0.460	0.000	0.000	OPEN/CLOSE	N	0.928	0.230	0.000							
4	PWR VII.A.99	9	0.711	0.186	0.070	0.003	OPEN/CLOSE	N	0.626	0.146	0.021							
5	PWR VII.A.137	4	1.000	0.000	0.000	0.000	OPEN/CLOSE	N	0.750	0.000	0.000							
6	PWR VII.C.16	3	0.045	0.123	0.188		OPEN/CLOSE	N	0.045	0.123	0.188							0.75
7	PWR VIII.A.26	2	0.820	0.180			OPEN/CLOSE	N	0.000	0.000	0.000						NO VALVES AT BFN EXPOSED TO THE WEATHER	
8	BWR VII.D.86	2	0.000	1.000			OPEN/CLOSE	N	0.000	0.250	0.750							0.75
9	BWR VII.D.49	4	0.627	0.272	0.100	0.000	OPEN/CLOSE	N	0.606	0.211	0.025							
10	BWR VII.D.46	2	0.000	1.000			OPEN/CLOSE	N	0.000	0.250	0.750							0.75
11	PWR XVI.C.539	8	0.000	0.000	1.000	0.000	OPEN/CLOSE	N	0.000	0.750	0.250							
12	PWR VII.C.12	4	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.500	0.500	0.000							
13	PWR VII.A.130	30	0.000	0.010	0.010	0.510	OPEN/CLOSE	N	0.005	0.013	0.513							
14	PWR VII.A.2	4	0.998	0.000	0.000	0.002	OPEN/CLOSE	N	0.749	0.000	0.002							
15	PWR VII.A.180	45	0.330	0.610	0.000	0.000	OPEN/CLOSE	N	0.553	0.305	0.000							
16	PWR VIII.B.100	4	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.500	0.500	0.000							
17	PWR VI.E.194	12	0.100	0.235	0.665	0.000	OPEN/CLOSE	N	0.193	0.616	0.166							
18	BWR V.D.4	25	0.536	0.222	0.114	0.128	OPEN/CLOSE	N	0.513	0.197	0.157							
19	BWR V.D.40	150	0.950	0.050	0.000	0.000	OPEN/CLOSE	N	0.738	0.025	0.000							
20	PWR XVI.C.1253	4	1.000	0.000	0.000	0.000	OPEN/CLOSE	N	0.750	0.000	0.000							
21	PWR XVI.C.1428	N	0.000	1.000			OPEN/CLOSE	N	0.000	1.000	0.000							
22	BWR VIII.D.23	28	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.500	0.500	0.000							
23	BWR VII.D.97, & BWR VII.C.24, 50	76	0.170	0.218	0.243	0.369	OPEN/CLOSE	N	0.237	0.291	0.430							
24	BWR VII.D.104	2	1.000	0.000			OPEN/CLOSE	N	0.375	0.750	0.000							0.75
25	BWR VII.D.165	4	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.500	0.500	0.000							
26	BWR VII.D.193	4	4.000	0.000	0.000	0.000	OPEN/CLOSE	N	3.000	0.000	0.000							
27	BWR VII.D.219	81	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.500	0.500	0.000							
28	BWR VII,D.220	3	0.000	1.000	0.000		OPEN/CLOSE	N	0.000	1.000	0.000							0.75

Table 3.3.4-7 (Page 7 of 9). Common Cause Events Impact Vectors for Browns Ferry Components

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	P2	P3	P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4	REMARKS	RHO
29	BWR VIII.C.53	2	0.000	1.000			OPEN/CLOSE	N	0.000	0.250	0.750							0.75
30	BWR IX.E.236	2	0.015	0.002			OPEN/CLOSE	N	0.000	0.000	0.000						ALL VALVES MODELED WITH SINGLE SIGNAL	
31	BWR XI.B.35	13	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.500	0.500	0.000							
32	BWR XVI.C.35	4	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.000	1.000	0.000							
							TOTAL IMPACT AT BFN		13.57	11.41	4.00							
									Z_MV3D									

MOTOR-OPERATED VALVES POPULATION 2

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	P2	P3	P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4	REMARKS	RHO
1	PWR VIII.A.548	6	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.667	0.167								
2	PWR VI.E.210	3	0.000	0.500	0.000		OPEN/CLOSE	N	0.333	0.167								
3	PWR VI.E.276	10	0.930	0.460	0.000	0.000	OPEN/CLOSE	N	0.772	0.077								
4	PWR VII.A.99	9	0.711	0.186	0.070	0.003	OPEN/CLOSE	N	0.514	0.069								
5	PWR VII.A.137	4	1.000	0.000	0.000	0.000	OPEN/CLOSE	N	0.500	0.000								
6	PWR VII.C.16	3	0.045	0.123	0.188		OPEN/CLOSE	N	0.112	0.229								
7	PWR VIII.A.26	2	0.820	0.180			OPEN/CLOSE	N	0.000	0.000							NO VALVES AT BFN EXPOSED TO THE WEATHER	
8	BWR VII.D.86	2	0.000	1.000			OPEN/CLOSE	N	0.000	1.000								
9	BWR VII.D.49	4	0.627	0.272	0.100	0.000	OPEN/CLOSE	N	0.545	0.095								
10	BWR VII.D.46	2	0.000	1.000			OPEN/CLOSE	N	0.000	1.000								
11	PWR XVI.C.539	8	0.000	0.000	1.000	0.000	OPEN/CLOSE	N	0.500	0.500								
12	PWR VII.C.12	4	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.667	0.167								
13	PWR VII.A.130	30	0.000	0.010	0.010	0.510	OPEN/CLOSE	N	0.012	0.517								
14	PWR VII.A.2	4	0.998	0.000	0.000	0.002	OPEN/CLOSE	N	0.499	0.002								
15	PWR VII.A.180	45	0.330	0.610	0.000	0.000	OPEN/CLOSE	N	0.572	0.102								
16	PWR VIII.B.100	4	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.667	0.167								
17	PWR VI.E.194	12	0.100	0.235	0.665	0.000	OPEN/CLOSE	N	0.539	0.372								
18	BWR V.D.4	25	0.536	0.222	0.116	0.128	OPEN/CLOSE	N	0.473	0.222								
19	BWR V.D.40	150	0.950	0.050	0.000	0.000	OPEN/CLOSE	N	0.508	0.008								
20	PWR XVI.C.1253	4	1.000	0.000	0.000	0.000	OPEN/CLOSE	N	0.500	0.000								
21	PWR XVI.C.1428	N	0.000	1.000			OPEN/CLOSE	N	0.000	1.000								
22	BWR VIII.D.23	28	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.667	0.167								
23	BWR VII.D.97, & BWR VII.C.24, 50	76	0.170	0.218	0.243	0.369	OPEN/CLOSE	N	0.352	0.527								
24	BWR VII.D.104	2	1.000	0.000			OPEN/CLOSE	N	1.000	0.000								
25	BWR VII.D.165	4	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.667	0.167								
26	BWR VII.D.193	4	4.000	0.000	0.000	0.000	OPEN/CLOSE	N	2.000	0.000								
27	BWR VII.D.219	81	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.667	0.167								
28	BWR VII.D.220	3	0.000	1.000	0.000		OPEN/CLOSE	N	0.667	0.333								
29	BWR VIII.C.53	2	0.000	1.000			OPEN/CLOSE	N	0.000	1.000								
30	BWR IX.E.236	2	0.015	0.002			OPEN/CLOSE	N	0.000	0.000							ALL VALVES MODELED WITH SINGLE SIGNAL	
31	BWR XI.B.35	13	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.667	0.167								
32	BWR XVI.C.35	4	0.000	1.000	0.000	0.000	OPEN/CLOSE	N	0.000	1.000								
							TOTAL IMPACT AT BFN		15.07	9.39								
									Z8MV2D									

Table 3.3.4-7 (Page 8 of 9). Common Cause Events Impact Vectors for Browns Ferry Components

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	P2	P3	P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4	REMARKS	RHO
CIRCUIT BREAKERS POPULATION 4																		
1	PWR XI.B.747	4	3.000	0.000	0.000	0.000	DEMAND	N	3.000	0.000	0.000	0.000					APPLICABLE	
2	PWR XI.B.664	2	0.000	1.000			DEMAND	N	0.000	0.063	0.375	0.563					APPLICABLE	0.75
3	PWR XI.B.325	4	0.000	1.000	0.000	0.000	DEMAND	N	0.000	1.000	0.000	0.000					APPLICABLE	
4	PWR XI.A.119	4	0.000	0.000	1.000	0.000	DEMAND	N	0.000	0.000	0.000	0.000					SEQUENCER IS MODELED SEPARATELY	
5	PWR XVI.C.2792	4	0.000	1.000	0.000	0.000	DEMAND	N	0.000	1:000	0.000	0.000					APPLICABLE	
6	BWR V.B.64	2	0.000	1.000			DEMAND	N	0.000	0.063	0.375	0.563					APPLICABLE	0.75
7	BWR XI.A.38	4	0.000	1.000	0.000	0.000	DEMAND	N	0.000	1.000	0.000	0.000					APPLICABLE	
8	BWR XI.A.205	2	0.000	1.000			DEMAND	N	0.000	0.063	0.375	0.563					APPLICABLE	0.75
9	BWR XI.A.217	3	0.000	0.000	1.000		DEMAND	L	0.000	0.000	0.000	1.000					APPLICABLE	
10	BWR XI.A.474	2	1.000	0.000			DEMAND	N	2.000	0.000	0.000	0.000					APPLICABLE	
11	BWR XI.B.7	2	0.000	1.000			DEMAND	N	0.000	0.000	0.000	0.000					NA DUE TO LONG OPERATING EXPERIENCE AT BFN	
12	BWR XI.B.463	4	0.000	1.000	0.000	0.000	DEMAND	N	0.000	1.000	0.000	0.000					APPLICABLE	
13	BWR IX.B.477	4	0.000	0.000	0.000	1.000	DEMAND	N	0.000	0.000	0.000	1.000					APPLICABLE	
14	BWR XI.A.504	3	0.000	0.000	1.000		DEMAND	L	0.000	0.000	0.000	0.000					BFN DOES NOT HAVE SIMILAR LOGIC	
							TOTAL IMPACT AT BFN		5.000	4.188	1.125	3.689						
									Z_CB1D									
CHECK VALVES POPULATION 8									RESEAT									
1	PWR VII.C.126	5	0.000	0.000	0.000	1.000	OPEN	L									FAILURE MODE NOT MODELED FOR COMMON CAUSE	
2	BWR VII.C.42	2	0.000	1.000	0.000	0.000	OPEN	N									FAILURE MODE NOT MODELED FOR COMMON CAUSE	
3	PWR VII.B.53	4	0.000	1.000	0.000	0.000	OPEN	L									FAILURE MODE NOT MODELED FOR COMMON CAUSE	
4	PWR VI.E.278	4	0.000	1.000	0.000	0.000	RESEAT	N	0.000	1.000	0.000	0.000						
5	PWR VI.D.290	4	0.000	0.000	0.000	0.540	RESEAT	N	0.000	0.000	0.000	0.000					NA	
6	PWR VI.D.319	4	0.075	0.290	0.056	0.000	RESEAT	N	0.000	0.000	0.000	0.000					NA	
7	PWR VI.E.630	12	0.000	0.000	0.000	1.000	RESEAT	N	0.000	0.000	0.000	0.000					THIS FAILURE MODE TYPICAL OF STEAM LINE CHECK VALVES	
8	PWR VII.A.315	4	0.000	1.000	0.000	0.000	RESEAT	N	0.000	1.000	0.000	0.000						
							TOTAL IMPACT AT BFN		0.000	2.000	0.000	0.000						
									ZBVCOD									
HPCI AND RCIC PUMPS POPULATION 2																		
1	BWR VI.A 159	2	0.000	1.000			START	N	0.000	1.000								
2	BWR VII.E.193	2	0.000	1.000			START	N	0.000	1.000								
3	BWR XVI.C.646	2	0.000	1.000			START	N	0.000	1.000								
4	BWR VI.A 159	2	1.000	0.000			START	N	1.000	0.000								
							TOTAL IMPACT AT BFN		1.000	3.000			0.000	0.000				
									ZIPTBS				ZIPTBR					

Table 3.3.4-7 (Page 9 of 9). Common Cause Events Impact Vectors for Browns Ferry Components

NO.	EVENT ID	POPULATION IN EVENT	ORIGINAL IMPACTS P1	P2	P3	P4	FAILURE MODE	SHOCK TYPE	MAPPED IMPACTS FAIL TO OPERATE ON DEMAND P1	P2	P3	P4	MAPPED IMPACTS FAIL DURING MISSION TIME P1	P2	P3	P4	REMARKS	RHO
SBLC RELIEF VALVES POPULATION 2																		
1	BWR VII.B.50	2	1.000	0.500			PREM. OPEN	N	1.000	0.500								
							TOTAL IMPACT AT BFN		1.000	0.500								
									ZBVSBO									
2-STAGE TARGET ROCK VALVES POPULATION 13									OVERPRESSURE				SIGNAL					
1	BWR V.C.376	11	0.016	0.009	0.009	0.012	OPEN	N	0.016	0.009	0.009	0.012	0.016	0.009	0.009	0.012		
2	BWR V.C.478	11	0.055	0.055	0.070	0.195	OPEN/ADS, MAN	N					0.055	0.055	0.070	0.195		
3	BWR V.C.362	11	0.070	0.965	0.000	0.000	OPEN/ADS, MAN	N					0.070	0.965	0.000	0.000		
4	BWR V.C.441	4	1.000	0.000	0.000	0.000	OPEN/ADS, MAN	N					1.000	0.000	0.000	0.000		
5	BWR V.C.341	4	0.000	1.000	0.000	0.000	OPEN/OVERPRES	N	0.000	1.000	0.000	0.000						
6	BWR V.C.352, 355	11	0.020	0.008	0.004	0.004	OPEN/OVERPRES	N	0.020	0.008	0.004	0.004						
7	BWR V.C.310	11	0.018	0.011	0.008	0.008	OPEN/OVERPRES	N	0.018	0.011	0.008	0.008						
8	BWR V.C.389	11	0.045	0.022	0.022	0.000	OPEN/OVERPRES	N	0.045	0.022	0.022	0.000						
9	BWR V.C.293	11	0.018	0.011	0.008	0.008	OPEN/OVERPRES	N	0.018	0.011	0.008	0.008						
10	BWR V.C.453	6	0.950	0.021	0.014	0.000	OPEN/OVERPRES	N	0.950	0.021	0.014	0.000						
11	BWR V.C.478	11	0.000	0.000	0.000	1.000	OPEN/OVERPRES	N	0.000	0.000	0.000	1.000						
12	BWR V.C.441	4	0.000	1.000	0.000	0.000	OPEN/OVERPRES	N	0.000	1.000	0.000	0.000						
							TOTAL IMPACT AT BFN		1.067	2.062	0.065	1.032	1.141	1.029	0.079	0.207		
									Z_VR40				Z_VR4S					

* ZBOGGS BETA FACTOR
ZGOGGS GAMMA FACTOR
ZDOGGS DELTA FACTOR

Table 3.3.4-8 (Page 1 of 2). Summary of Common Cause Failure Parameters for Browns Ferry Components

NO.	DATA DESIG.	IMPACT VECTORS N1	N2	N3	N4	NUMBER OF EVENTS AT BFN N1BFN	N2BFN	N3BFN	N4BFN	NO OF INDEPENDENT EVENTS IN DATA BASE NGN	POPULATION IN GENERIC PLANT PGN	POPULATION AT BFN PBFN	PRIOR NI	A0	B0	C0	D0	E0	F0	POSTERIOR A	B	C	D	E	F
1	Z_DGSS*	0.33	0.96	0.70	0.10					392	2.06	4	761	0.42	8.37	0.30	0.87	0.63	0.88	4.81	769.	2.78	2.79	1.01	2.98
2	Z_DGSR	1.59	1.84	1.09	0.64					174	2.06	4	338	0.48	22.9	2.25	5.31	0.79	0.79	9.97	362.	8.06	8.98	3.34	4.06
3	Z_PCSS	0.00	4.31	1.13	7.56					86	**	4	142	1.58	21	3.8	23.3	3.8	9.58	43.8	162.	37.4	31.9	34.0	12.9
4	Z_PCSR	1.07	0.77	0.00	1.00					100	**	4	159	1.58	156.	3.8	23.3	3.8	9.58	7.11	316.	7.8	24.8	7.8	9.58
5	Z_PRHS	0.77	4.51	1.16	2.56					86	**	4	142	1.58	21	3.8	23.3	3.8	9.58	24.3	163.	17.5	32.3	14.0	13.0
6	Z_PRHR	1.07	0.77	0.00	1.00					100	**	4	159	1.58	156.	3.8	23.3	3.8	9.58	7.11	316.	7.8	24.8	7.8	9.58
7	Z_PRSS	0.77	4.51	1.16	2.56					86	**	4	142	1.58	21	3.8	23.3	3.8	9.58	24.3	163.	17.5	32.3	14.0	13.0
8	Z_PRSR	1.07	0.77	0.00	1.00					100	**	4	159	1.58	156.	3.8	23.3	3.8	9.58	7.11	316.	7.8	24.8	7.8	9.58
9	ZBPRBS	0.00	0.00							46	**	2	23	0.25	15.2					0.25	37.7				
10	ZBPRBR	3.17	0.33							81	**	2	41	0.24	30.1					0.90	74.3				
11	Z_PEES	0.00	0.06	0.38	0.56					46	**	4	45	0.42	14.4	1.17	3.8	0.54	0.79	3.92	59.4	4.54	3.92	2.79	1.92
12	Z_PEER	5.19	0.25	0.75	0.00					81	**	4	82	0.37	26.3	1.29	3.91	0.2	0.29	3.12	113.	3.54	4.41	0.2	2.54
13	Z_PERS	0.00	0.06	0.38	0.56					46	**	4	45	0.42	14.4	1.17	3.8	0.54	0.79	3.92	59.4	4.54	3.92	2.79	1.92
14	Z_PERR	5.19	0.25	0.75	0.00					81	**	4	82	0.37	26.3	1.29	3.91	0.2	0.29	3.12	113.	3.54	4.41	0.2	2.54
15	Z_PCDS	0.00	0.00	0.00						46	**	3	34	0.36	15.4	0.72	2.69			0.36	49.1	0.72	2.69		
16	Z_PCDR	3.76	1.00	0.00						81	**	3	62	0.33	28.9	0.8	2.77			2.33	94.3	0.8	4.77		
17	Z_PCBS	0.00	0.00	0.00						46	**	3	34	0.36	15.4	0.72	2.69			0.36	49.1	0.72	2.69		
18	Z_PCBR	3.76	1.00	0.00						81	**	3	62	0.33	28.9	0.8	2.77			2.33	94.3	0.8	4.77		
19	Z_FNSS	5.00	1.00	0.00	0.00					24	4	4	24	1.58	21	3.8	23.3	3.8	9.58	3.58	50	3.8	25.3	3.8	9.58
20	Z_FNSR	6.82	1.61	0.84	2.21					42	4	4	42	1.58	156.	3.8	23.3	3.8	9.58	16.1	205.	15.1	26.5	12.6	12.1
21	Z_FNOS	5.00	1.00	0.00	0.00					24	4	4	24	1.58	156.	3.8	23.3	1.8	8.31	3.58	185.	3.8	25.3	1.8	8.31
22	Z_FNOR	6.82	0.61	0.84	1.21					42	4	4	42	0.84	839	1.58	21	1.8	8.31	9.42	887.	8.95	22.2	6.65	10.8
23	Z_FN1S	4.50	1.00	0.00						24	4	3	18	1.58	21	3.8	23.3			3.58	43.5	3.8	25.3		
24	Z_FN1R	5.84	2.28	2.29						42	4	3	31.5	1.58	156.	3.8	23.3			12.9	193.	10.6	27.8		
25	ZBPTBS	1.00								75	2	2	75	1.58	21					1.58	97				
26	ZBPTBR	0.00								19	2	2	19	1.58	156.					1.58	175.				
27	ZBPSBS	0.00								2	2	2	2	1.58	21					1.58	23				
28	ZBPSBR	0.00								1	2	2	1	1.58	156.					1.58	157.				
29	Z_VMOO	11.5	12.5	5.0	2.3					784	4	4	784	1.58	21	3.8	23.3	1.8	8.31	50.6	816.	27.8	48.3	10.9	23.2
30	Z_MV3O	13.6	11.4	4.0						784	4	3	588	1.58	21	3.8	23.3			36.3	622.	15.8	46.1		
31	ZBMV2O	15.1	9.4							784	4	2	392	1.58	21					20.3	428.				
32	Z_CB1D	5.00	4.19	1.13	3.69					99	4	4	99	1.58	21	3.8	23.3	1.8	8.31	28.0	125	21.9	31.6	16.5	11.6
33	Z_VCOO	0.00	2.00	0.00	0.00					21	4	4	21	1.58	156.	3.8	23.3	3.8	9.58	5.58	177.	3.8	27.3	3.8	9.58
34	ZBVSBO	1.00	0.50							19	2	2	19	1.58	156.					2.58	176.				
35	Z_VR4O	1.07	2.08	0.07	1.03					5	4	4	5	1.58	21	4.44	13.1	3.8	9.58	10.0	27.0	8.76	17.3	7.92	9.77
36	Z_VR4S	1.14	1.03	0.08	0.21					9	4	4	9	1.58	21	4.44	13.1	3.8	9.58	4.70	31.1	5.50	15.2	4.62	9.81
37	Z_PMFS	***												1.58	21	3.8	23.3								
38	Z_PMFR	***												1.58	156.	1.58	21								
39	ZBPEHR	***												1.58	156.										
40	Z_PXRS	***												1.58	21	3.8	23.3	3.8	9.58						
41	Z_PXRR	***												1.58	156.	3.8	23.3	3.8	9.58						
42	Z_CMPS	***												0.42	8.37	0.30	0.87	0.63	0.88						
43	Z_CMPR	***												0.48	22.9	2.25	5.31	0.79	0.79						
44	Z_LC1D	***												0.84	839	1.58	21	3.8	9.58						
45	Z_VAOO	***												1.58	21	3.8	23.3	1.8	8.31						
46	Z_VEMO	***												1.58	21	3.8	23.3	1.8	8.31						

Table 3.3.4-8 (Page 2 of 2). Summary of Common Cause Failure Parameters for Browns Ferry Components

NO.	DATA DESIG.	IMPACT VECTORS N1	N2	N3	N4	NUMBER OF EVENTS AT BFN N1BFN	N2BFN	N3BFN	N4BFN	NO OF INDEPENDENT EVENTS IN DATA BASE NGN	POPULATION IN GENERIC PLANT PGN	POPULATION AT BFN PBFN	NI	PRIOR AO	BO	CO	DO	EO	FO	POSTERIOR A	B	C	D	E	F
47	Z_RL1D	***												1.58	21	1.58	21	3.8	9.58						
48	Z_SWBD	***												1.58	21	1.58	21	3.8	9.58						
49	Z_VSOD	***												1.58	21	3.8	23.3	1.58	21						
50	Z_DMAD	***												1.58	21	3.8	23.3	.1.8	8.31						
51	ZBVSOD	***												1.58	21										
52	Z_MGSS	***												1.58	156.	3.8	23.3	1.8	8.31						
53	Z_MGSR	***												0.84	839	1.58	21	1.8	8.31						

* ZBDGGS BETA FACTOR
ZGDGGS GAMMA FACTOR
ZDDGGS DELTA FACTOR
** POPULATION FOR THESE COMPONENTS IS PRESENTED IN TABLE____
*** GENERIC DATA

Table 3.3.4-9. Average Number of Components per Plant for Each Component Type of Interest

Component	Plant Type	Number of Components	Number of Plants	Average Number per Plant
Diesel Generator	PWR, BWR	138	67	2.06
AFW Motor-Driven Pump	PWR	55	35	1.57
AFW Turbine-Driven Pump	PWR	50	45	1.11
HHSI Pump	PWR	121	45	2.69
HPCI and RCIC Pumps	BWR	44	22	2.0
LHSI, LPCI, RHR Pump	PWR, BWR	193	69	2.80
Containment Spray Pump	PWR	99	42	2.36
CCW Pump	PWR, BWR	187	68	2.75
Service Water	PWR, BWR	300	68	4.41
SBLC Pump	BWR	40	20	2.00
Reactor Trip Breaker	PWR	150	43	3.49
MOV*	PWR, BWR	926	67	13.82
Check Valve*	PWR, BWR	730.8	67	10.91
Reactor Trip Breaker Undervoltage Trip Attachment	PWR	148	42	3.52
Shunt Trip Attachment	PWR	50	7	7.14

*The MOV and check valve populations are the average number of the respective valves per system for each unit. The systems considered in the population data are core spray, HPCI, LPCI, containment spray, HHSI, LHSI, and AFW systems.

Table 3.3.4-10 (Page 1 of 7). Summary of Comon Cause Failure Parameters for Browns Ferry Components

Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZBCB1D	Beta Factor - Circuit Breakers 480V and Above Fail on Demand	1.83-01	1.23-01	1.80-01	2.30-01
ZBCB2D	Beta Factor - Circuit Breakers < 480V Fail on Demand	7.00-02	5.86-04	5.46-02	1.57-01
ZBCMPR	Beta Factor - Air Compressor Fails during Operation	2.07-02	3.58-05	8.40-03	6.82-02
ZBCMPS	Beta Factor - Air Compressor Fails To Start on Demand	4.78-02	3.71-05	1.74-02	1.63-01
ZBCRSD	Beta Factor - CRDs Fail To Insert	7.00-02	5.86-04	5.46-02	1.57-01
ZBDGSR	Beta Factor - Diesel Generators Fail To Operate	2.68-02	1.21-02	2.54-02	3.99-02
ZBDGSS	Beta Factor - Diesel Generators Fail To Start	6.22-03	1.69-03	5.63-03	1.07-02
ZBDMAD	Beta Factor - Motor-/Air-Operated Dampers Fail on Demand	7.00-02	5.86-04	5.46-02	1.57-01
ZBFN1R	Beta Factor - Standby Gas Treatment Fans Fail during Operation	6.27-02	3.22-02	6.02-02	8.88-02
ZBFN1S	Beta Factor - Standby Gas Treatment Fans Fail To Start	7.60-02	1.61-02	6.78-02	1.38-01
ZBFNOR	Beta Factor - Operating Fans Fail during Operation	1.05-02	4.59-03	9.94-03	1.58-02
ZBFNOS	Beta Factor - Operating Fans Fail To Start/Restart	1.90-02	3.75-03	1.67-02	3.50-02
ZBFNSR	Beta Factor - Standby Fans Fail during Operation	7.28-02	4.07-02	7.05-02	9.97-02
ZBFNSS	Beta Factor - Standby Fans Fail To Start	6.68-02	1.40-02	5.95-02	1.21-01
ZBLC1D	Beta Factor - Logic Trip Modules Fail on Demand	1.00-03	1.07-05	5.94-04	2.79-03
ZBMGSR	Beta Factor - Motor-Generator Sets Fail during Operation	1.00-03	1.07-05	5.94-04	2.79-03
ZBPCBR	Beta Factor - Condensate Booster Pumps Fail during Operation	2.41-02	2.07-03	2.00-02	4.95-02
ZBPCBS	Beta Factor - Condensate Booster Pumps Fail To Start	7.28-03	1.80-06	2.03-03	2.61-02
ZBPCDR	Beta Factor - Condensate Pumps Fail during Operation	2.41-02	2.07-03	2.00-02	4.95-02
ZBPCDS	Beta Factor - Condensate Pumps Fail To Start	7.28-03	1.80-06	2.03-03	2.61-02
ZBPCSR	Beta Factor - Core Spray Pumps Fail during Operation	2.20-02	8.21-03	2.05-02	3.49-02

Note: Exponential notation is indicated in abbreviated form; e.g., 1.83-01 = 1.83×10^{-01}.

Table 3.3.4-10 (Page 2 of 7). Summary of Comon Cause Failure Parameters for Browns Ferry Components

Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZBPCSS	Beta Factor - Core Spray Pumps Fail To Start	2.13-01	1.57-01	2.10-01	2.56-01
ZBPEER	Beta Factor - EECW Pumps Fail during Operation	2.69-02	4.39-03	2.33-02	5.11-02
ZBPEES	Beta Factor - EECW Pumps Fail To Start	6.19-02	1.44-02	5.55-02	1.10-01
ZBPEHR	Beta Factor - EHC Pumps Fail during Operation	1.00-02	8.85-04	7.62-03	2.31-02
ZBPERR	Beta Factor - RCW Pumps Fail during Operation	2.69-02	4.39-03	2.33-02	5.11-02
ZBPERS	Beta Factor - RCW Pumps Fail To Start	6.19-02	1.44-02	5.55-02	1.10-01
ZBPMFR	Beta Factor - Main Feedwater Pumps Fail during Operation	1.00-02	8.83-04	7.60-03	2.30-02
ZBPMFS	Beta Factor - Main Feedwater Pumps Fail To Start	7.00-02	5.86-04	5.46-02	1.57-01
ZBPRBR	Beta Factor - RBCCW Pumps Fail during Operation	1.20-02	1.87-04	7.42-03	3.26-02
ZBPRBS	Beta Factor - RBCCW Pumps Fail To Start	6.59-03	5.65-08	9.77-04	2.59-02
ZBPRHR	Beta Factor - RHR Pumps Fail during Operation	2.20-02	8.21-03	2.05-02	3.49-02
ZBPRHS	Beta Factor - RHR Pumps Fail To Start	1.30-01	8.31-02	1.27-01	1.67-01
ZBPRSR	Beta Factor - RHR Service Water Pumps Fail during Operation	2.20-02	8.21-03	2.05-02	3.49-02
ZBPRSS	Beta Factor - RHR Service Water Pumps Fail To Start	1.30-01	8.31-02	1.27-01	1.67-01
ZBPSBR	Beta Factor - SBLC Pumps Fail during Operation	9.96-03	8.80-04	7.57-03	2.29-02
ZBPSBS	Beta Factor - SBLC Pumps Fail To Start	6.43-02	3.83-04	5.00-02	1.45-01
ZBPTBR	Beta Factor - Turbine-Driven HPCI/RCIC Pumps Fail during Operation	8.95-03	7.90-04	6.80-03	2.06-02
ZBPTBS	Beta Factor - Turbine-Driven HPCI/RCIC Pumps Fail To Start	1.60-02	1.42-03	1.22-02	3.68-02
ZBPXRR	Beta Factor - Fuel Oil Transfer Pumps Fail To Operate	1.00-02	8.85-04	7.62-03	2.31-02
ZBPXRS	Beta Factor - Fuel Oil Transfer Pumps Fail To Start	7.00-02	5.86-04	5.46-02	1.57-01
ZBRL1D	Beta Factor - Mechanical Relays Fail on Demand	7.00-02	5.86-04	5.46-02	1.57-01

Note: Exponential notation is indicated in abbreviated form; e.g., 1.83-01 = 1.83×10^{-01}.

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Table 3.3.4-10 (Page 3 of 7). Summary of Comon Cause Failure Parameters for Browns Ferry Components

Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZBSWBD	Beta Factor - Bistables, Switches Fail on Demand	7.00-02	5.86-04	5.46-02	1.57-01
ZBVAOD	Beta Factor - Air-Operated Valves Fail To Open/Close	7.00-02	5.86-04	5.46-02	1.57-01
ZBVCOD	Beta Factor - Check Valves (Population 8) Fail To Reseat	3.06-02	9.63-03	2.81-02	5.08-02
ZBVEHD	Beta Factor - Electrohydraulic Valves Fail To Open/Close	7.00-02	5.86-04	5.46-02	1.57-01
ZBVM2D	Beta Factor - MOVs (Population 2) Fail To Open/Close	4.53-02	2.70-02	4.40-02	6.04-02
ZBVM3D	Beta Factor - MOVs (Population 3) Fail To Open/Close	5.51-02	3.81-02	5.41-02	6.86-02
ZBVMOD	Beta Factor - Motor-Operated Valves Fail To Open/Close	5.84-02	4.29-02	5.76-02	7.04-02
ZBVR4O	Beta Factor - Two-Stage Target Rock Valves Fail To Open on Overpressure	2.70-01	1.35-01	2.62-01	3.81-01
ZBVR4S	Beta Factor - Two-Stage Target Rock Valves Fail To Open on Signal	1.31-01	3.86-02	1.21-01	2.20-01
ZBVSBO	Beta Factor - SBLC Relief Valves Fail Open Prematurely	1.44-02	1.58-03	1.22-02	2.90-02
ZBVSOD	Beta Factor - Solenoid Valves Fail To Operate on Demand	7.00-02	5.86-04	5.46-02	1.57-01
ZBVSQD	Beta Factor - Squibb Valves Fail on Demand	7.00-02	5.86-04	5.46-02	1.57-01
ZGCB1D	Gamma Factor - Circuit Breakers 480V and Above Fail on Demand	4.09-01	2.75-01	4.04-01	5.08-01
ZGCB2D	Gamma Factor - Circuit Breakers < 480V Fail on Demand	1.40-01	3.40-02	1.27-01	2.45-01
ZGCMPR	Gamma Factor - Air Compressor Fails during Operation	2.98-01	4.60-02	2.69-01	5.50-01
ZGCMPS	Gamma Factor - Air Compressor Fails To Start	2.61-01	3.70-05	1.08-01	8.30-01
ZGCRSD	Gamma Factor - CRDs Fail To Insert	2.52-01	7.77-02	2.36-01	4.11-01
ZGDGSR	Gamma Factor - Diesel Generator Fails during Operation	4.73-01	2.38-01	4.64-01	6.48-01
ZGDGSS'	Gamma Factor - Diesel Generators Fail To Start	4.99-01	1.28-01	4.85-01	7.91-01
ZGDMAD	Gamma Factor - Motor-, Air-Operated Dampers Fail To Open/Close	1.40-01	3.40-02	1.27-01	2.45-01
ZGFN1R	Gamma Factor - Standby Gas Treatment Fans Fail during Operation	2.76-01	1.42-01	2.68-01	3.85-01

Note: Exponential notation is indicated in abbreviated form; e.g., 1.83-01 = 1.83×10^{-01}.

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Table 3.3.4-10 (Page 4 of 7). Summary of Comon Cause Failure Parameters for Browns Ferry Components

Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZGFN1S	Gamma Factor - Standby Gas Treatment Fans Fail To Start	1.31-01	3.14-02	1.18-01	2.29-01
ZGFNOR	Gamma Factor - Operating Fans Fail during Operation	2.87-01	1.38-01	2.78-01	4.10-01
ZGFNOS	Gamma Factor - Operating Fans Fail To Start/Restart	1.31-01	3.14-02	1.18-01	2.29-01
ZGFNSR	Gamma Factor - Standby Fans Fail during Operation	3.63-01	2.18-01	3.56-01	4.74-01
ZGFNSS	Gamma Factor - Standby Fans Fail To Start	1.31-01	3.14-02	1.18-01	2.29-01
ZGLC1D	Gamma Factor - Logic Modules Fail on Demand	7.00-02	5.86-04	5.46-02	1.57-01
ZGMGSR	Gamma Factor - Motor-Generator Sets Fail during Operation	7.00-02	5.86-04	5.46-02	1.57-01
ZGMGSS	Gamma Factor - Motor-Generator Sets Fail To Restart	1.40-01	3.40-02	1.27-01	2.45-01
ZGPCBR	Gamma Factor - Condensate Booster Pumps Fail during Operation	1.44-01	1.38-03	9.40-02	3.83-01
ZGPCBS	Gamma Factor - Condensate Booster Pumps Fail To Start	2.11-01	9.67-04	1.41-01	5.57-01
ZGPCDR	Gamma Factor - Condensate Pumps Fail during Operation	1.44-01	1.38-03	9.40-02	3.83-01
ZGPCDS	Gamma Factor - Condensate Pumps Fail To Start	2.11-01	9.67-04	1.41-01	5.57-01
ZGPCSR	Gamma Factor - Core Spray Pumps Fail during Operation	2.39-01	1.05-01	2.29-01	3.53-01
ZGPCSS	Gamma Factor - Core Spray Pumps Fail To Start	5.40-01	4.15-01	5.36-01	6.26-01
ZGPEER	Gamma Factor - EECW Pumps Fail during Operation	4.45-01	1.34-01	4.29-01	6.98-01
ZGPEES	Gamma Factor - EECW Pumps Fail To Start	5.37-01	2.09-01	5.29-01	7.74-01
ZGPERR	Gamma Factor - RCW Pumps Fail during Operation	4.45-01	1.34-01	4.29-01	6.98-01
ZGPERS	Gamma Factor - RCW Pumps Fail To Start	5.37-01	2.09-01	5.29-01	7.74-01
ZGPMFR'	Gamma Factor - Main Feedwater Pumps Fail during Operation	7.00-02	5.86-04	5.46-02	1.57-01
ZGPMFS	Gamma Factor - Main Feedwater Pumps Fail To Start	1.40-01	3.40-02	1.27-01	2.45-01
ZGPRHR	Gamma Factor - RHR Pumps Fail during Operation	2.39-01	1.05-01	2.29-01	3.53-01

Note: Exponential notation is indicated in abbreviated form; e.g., 1.83-01 = 1.83×10^{-01}.

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Table 3.3.4-10 (Page 5 of 7). Summary of Comon Cause Failure Parameters for Browns Ferry Components

Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZGPRHS	Gamma Factor - RHR Pumps Fail To Start	3.51-01	2.20-01	3.45-01	4.52-01
ZGPRSR	Gamma Factor - RHR Service Water Pumps Fail during Operation	2.39-01	1.05-01	2.29-01	3.53-01
ZGPRSS	Gamma Factor - RHR Service Water Pumps Fail To Start	3.51-01	2.20-01	3.45-01	4.52-01
ZGPXRR	Gamma Factor - Fuel Oil Transfer Pumps Fail To Operate	1.40-01	3.40-02	1.27-01	2.45-01
ZGPXRS	Gamma Factor - Fuel Oil Transfer Pumps Fail To Start	1.40-01	3.40-02	1.27-01	2.45-01
ZGRL1D	Gamma Factor - Mechanical Relays Fail on Demand	7.00-02	5.86-04	5.46-02	1.57-01
ZGSWBD	Gamma Factor - Switches, Bistables Fail on Demand	7.00-02	5.86-04	5.46-02	1.57-01
ZGVAOD	Gamma Factor - Air-Operated Valves Fail To Open/Close	1.40-01	3.40-02	1.27-01	2.45-01
ZGVCOD	Gamma Factor - Check Valves (Population 8) Fail To Reseat	1.22-01	2.91-02	1.11-01	2.15-01
ZGVEHD	Gamma Factor - Electrohydraulic Valves Fail To Open/Close	1.40-01	3.40-02	1.27-01	2.45-01
ZGVM3D	Gamma Factor - MOVs (Population 3) Fail To Open/Close	2.55-01	1.50-01	2.49-01	3.39-01
ZGVMOD	Gamma Factor - Motor-Operated Valves Fail To Open	3.65-01	2.56-01	3.61-01	4.47-01
ZGVR4O	Gamma Factor - Two-Stage Target Rock Valves Fail To Open on Overpressure	3.36-01	1.64-01	3.26-01	4.75-01
ZGVR4S	Gamma Factor - Two-Stage Target Rock Valves Fail To Open on Signal	2.66-01	9.67-02	2.52-01	4.14-01
ZGVSOD	Gamma Factor - Solenoid Valves Fail on Demand	7.00-02	5.86-04	5.46-02	1.57-01
ZDCB1D	Delta Factor - Circuit Breakers 480V and Above Fail on Demand	5.87-01	3.94-01	5.83-01	7.19-01
ZDCB2D	Delta Factor - Circuit Breakers < 480V Fail on Demand	1.78-01	1.32-02	1.49-01	3.69-01
ZDCMPR	Delta Factor - Air Compressor Fails during Operation	4.99-01	9.72-03	4.70-01	9.49-01
ZDCMPS	Delta Factor - Air Compressor Fails To Start	4.17-01	1.56-04	3.47-01	9.14-01
ZDCRSD	Delta Factor - CRDs Fail To Insert	2.84-01	7.88-02	2.65-01	4.72-01
ZDDGSR	Delta Factor - Diesel Generator Fails during Operation	4.51-01	1.30-01	4.35-01	7.13-01

Note: Exponential notation is indicated in abbreviated form; e.g., 1.83-01 = 1.83×10^{-01}.

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Table 3.3.4-10 (Page 6 of 7). Summary of Comon Cause Failure Parameters for Browns Ferry Components

Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZDDGSS	Delta Factor - Diesel Generators Fail To Start	2.53-01	5.79-04	1.97-01	5.88-01
ZDDMAD	Delta Factor - Motor-/Air-Operated Dampers Fail on Demand	1.78-01	1.32-02	1.49-01	3.69-01
ZDFNOR	Delta Factor - Operating Fans Fail during Operation	3.81-01	1.66-01	3.69-01	5.53-01
ZDFNOS	Delta Factor - Operating Fans Fail To Start/Restart	1.78-01	1.32-02	1.49-01	3.69-01
ZDFNSR	Delta Factor - Standby Fans Fail during Operation	5.10-01	3.08-01	5.04-01	6.55-01
ZDFNSS	Delta Factor - Standby Fans Fail To Start	2.84-01	7.88-02	2.65-01	4.72-01
ZDLC1D	Delta Factor - Logic Modules Fail on Demand	2.84-01	7.88-02	2.65-01	4.72-01
ZDMGSR	Delta Factor - Motor-Generator Sets Fail during Operation	1.78-01	1.32-02	1.49-01	3.69-01
ZDMGSS	Delta Factor - Motor-Generator Sets Fail To Restart	1.78-01	1.32-02	1.49-01	3.69-01
ZDPCSR	Delta Factor - Core Spray Pumps Fail during Operation	4.49-01	2.20-01	4.39-01	6.23-01
ZDPCSS	Delta Factor - Core Spray Pumps Fail To Start	7.25-01	5.82-01	7.24-01	8.16-01
ZDPEER	Delta Factor - EECW Pumps Fail during Operation	7.30-02	4.72-08	7.74-03	3.11-01
ZDPEES	Delta Factor - EECW Pumps Fail To Start	5.92-01	1.69-01	5.91-01	8.81-01
ZDPERR	Delta Factor - RCW Pumps Fail during Operation	7.30-02	4.72-08	7.74-03	3.11-01
ZDPERS	Delta Factor - RCW Pumps Fail To Start	5.92-01	1.69-01	5.91-01	8.81-01
ZDPRHR	Delta Factor - RHR Pumps Fail during Operation	4.49-01	2.20-01	4.39-01	6.23-01
ZDPRHS	Delta Factor - RHR Pumps Fail To Start	5.19-01	3.24-01	5.13-01	6.57-01
ZDPRSR	Delta Factor - RHR Service Water Pumps Fail during Operation	4.49-01	2.20-01	4.39-01	6.23-01
ZDPRSS	Delta Factor - RHR Service Water Pumps Fail To Start	5.19-01	3.24-01	5.13-01	6.57-01
ZDPXRR	Delta Factor - Fuel Oil Transfer Pumps Fail To Operate	2.84-01	7.88-02	2.65-01	4.72-01
ZDPXRS	Delta Factor - Fuel Oil Transfer Pumps Fail To Start	2.84-01	7.88-02	2.65-01	4.72-01

Note: Exponential notation is indicated in abbreviated form; e.g., 1.83-01 = 1.83×10^{-01}.

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Table 3.3.4-10 (Page 7 of 7). Summary of Comon Cause Failure Parameters for Browns Ferry Components					
Designator	Description	Mean	5th Percentile	Median	95th Percentile
ZDRL1D	Delta Factor - Mechanical Relays Fail on Demand	2.84-01	7.88-02	2.65-01	4.72-01
ZDSWBD	Delta Factor - Switches, Bistables Fail on Demand	2.84-01	7.88-02	2.65-01	4.72-01
ZDVAOD	Delta Factor - Air-Operated Valves Fail To Open/Close	1.78-01	1.32-02	1.49-01	3.69-01
ZDVCOD	Delta Factor - Check Valves (Population 8) Fail To Reseat	2.84-01	7.88-02	2.65-01	4.72-01
ZDVEHD	Delta Factor - Electrohydraulic Valves Fail To Open/Close	1.78-01	1.32-02	1.49-01	3.69-01
ZDVMOD	Delta Factor - Motor-Operated Valves Fail To Open	3.20-01	1.69-01	3.11-01	4.39-01
ZDVR4O	Delta Factor - Two-Stage Target Rock Valves Fail To Open on Overpressure	4.48-01	2.21-01	4.38-01	6.20-01
ZDVR4S	Delta Factor - Two-Stage Target Rock Valves Fail To Open on Signal	3.20-01	1.07-01	3.04-01	5.05-01
ZDVSOD	Delta Factor - Solenoid Valves Fail on Demand	2.84-01	7.88-02	2.65-01	4.72-01

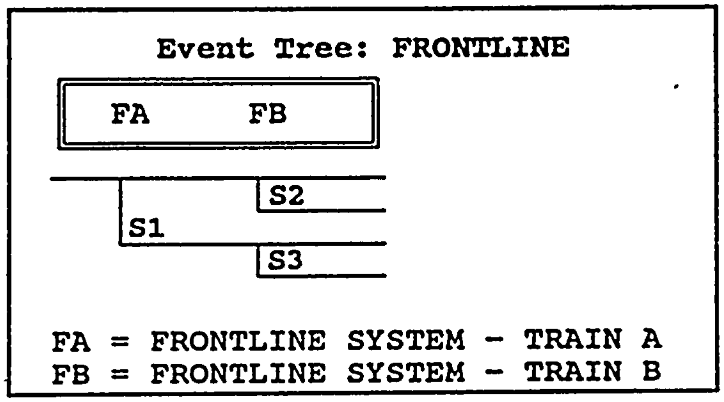
Note: Exponential notation is indicated in abbreviated form; e.g., 1.83-01 = 1.83×10^{-01}.

3.3.5 QUANTIFICATION OF UNAVAILABILITY OF SYSTEMS

The Browns Ferry individual plant examination (IPE) system models are quantified using the RISKMAN probabilistic risk assessment (PRA) Workstation Software and data in the Browns Ferry database (Section 3.3.1). The Monte Carlo option is used and produces uncertainty distributions for the split fraction totals. In addition to histograms representing each uncertainty distribution, the main parameters of each distribution represented are the mean, 5th percentile, median, and 95th percentile. Table 3.3.5-1 displays the mean parameter for each split fraction. This mean value is used as input for the event tree quantification.

Many top events represent redundant divisions of a single system. For example, Top Events AA, AB, AC, and AD represent the four divisions of 4-kV Shutdown Boards. When there are shared dependencies between top events, such as common cause failures, the correct calculation of conditional split fractions requires that the frequency of failure of four divisions be calculated. These failure frequencies for the four divisions are calculated using intermediate fault trees that contain the equipment for four divisions. This method of calculation is used for any system that has been separated into individual divisions for the IPE.

A simple example is used to illustrate the development of the equations for the conditional split fractions. Consider two top events, FA and FB, that are defined such that they are dependent. This could apply to two divisions of a system that share common cause and maintenance or it could apply to two systems sharing a group of components. Also assume that any necessary support required for the Top Events FA and FB is available. The event tree in which these top events appear is shown below.



Let

$P(\overline{FA})$ = the unavailability of division FA.

$P(\overline{FB})$ = the unavailability of division FB.

$P(\overline{FA}\,\overline{FB})$ = the unavailability of division FA and division FB.

The objective is to define the split fractions S1, S2, and S3 in terms of the above probabilities. Note that S1 is not conditional and is simply $P(\overline{FA})$. Also note that S2 and S3 are conditional split fractions and that S2 = $P(\overline{FB} \mid FA)$ and S3 = $P(\overline{FB} \mid \overline{FA})$.

From basic probability theory,

$$P(\overline{FA}\ \overline{FB}) = P(\overline{FA}) * P(\overline{FB} \mid \overline{FA}) \Rightarrow S3 = P(\overline{FB} \mid \overline{FA}) = \frac{P(\overline{FA}\ \overline{FB})}{P(\overline{FA})}$$

The equation for S2 can be obtained as follows:

$$S2 = P(\overline{FB} \mid FA) = \frac{P(FA\ \overline{FB})}{P(FA)}$$

$$= \frac{1 - P(\overline{FA} + FB)}{P(FA)}$$

$$= \frac{1 - P(\overline{FA}) - P(FB) + P(\overline{FA}\ FB)}{P(FA)}$$

$$= \frac{1 - P(\overline{FA}) - P(FB) + P(\overline{FA}) * P(FB \mid \overline{FA})}{P(FA)}$$

$$= \frac{1 - P(\overline{FA}) - P(FB) + P(\overline{FA}) * (1 - P(\overline{FB} \mid \overline{FA})}{P(FA)}$$

$$= \frac{1 - P(\overline{FA}) - P(FB) + P(\overline{FA}) * (1 - P(\overline{FA}\ \overline{FB})/P(\overline{FA}))}{P(FA)}$$

$$= \frac{1 - P(\overline{FA}) - P(FB) + P(\overline{FA}) - P(\overline{FA}\ \overline{FB})}{P(FA)}$$

$$= \frac{1 - P(FB) - P(\overline{FA}\ \overline{FB})}{P(FA)}$$

$$= \frac{P(\overline{FB}) - P(\overline{FA}\ \overline{FB})}{1 - P(\overline{FA})}$$

In summary,

$$S1 = P(\overline{FA})$$

$$S2 = P(FA\ \overline{FB}) = \frac{P(\overline{FB}) - P(\overline{FA}\ \overline{FB})}{1 - P(\overline{FA})}$$

$$S3 = P(\overline{FB} \mid \overline{FA}) = \frac{P(\overline{FA}\ \overline{FB})}{P(\overline{FA})}$$

The term $P(\overline{FA}\ \overline{FB})$ is calculated using an intermediate fault tree. For the case in which FA has failed due to a support failure, the split fraction used for FB is just $P(\overline{FB})$. This approach can be used to develop the conditional split fractions for any number of top events.

Returning to the top events for the 4-kV Shutdown Boards discussed earlier, the methodology described above (using intermediate fault trees) was used to calculate the conditional split fractions for the four top events. The calculated results of the intermediate fault trees are not listed in Table 3.3.5-1; only the calculated values for the individual conditional split fractions are provided. For example, the conditional split fractions for Top Event AB listed in Table 3.3.5-1 are AB1, AB2, AB3, AB4, and AB5.

A complete description of the methodology for the analysis of systems modeled in the Browns Ferry IPE is provided in Section 2.3.5.

Table 3.3.5-1 (Page 1 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
A3EA1	A3EA	9.1230E-04	NORMAL SUPPLY AVAILABLE
A3EA2	A3EA	1.4090E-03	LOSS OF NORMAL SUPPLY, DIESEL AVAILABLE
A3EAF	A3EA	1.0000E+00	G.F.
A3EB1	A3EB	8.9340E-04	NORMAL SUPPLY AVAILABLE, A3EA SUCCESS
A3EB2	A3EB	1.3790E-03	A3EA SUCCESS, NORMAL LOST, ALL DG AVAILABLE
A3EB3	A3EB	2.1620E-02	A3EA FAIL, NORMAL SUPPLY AVAILABLE
A3EB4	A3EB	2.2560E-02	A3EA FAIL, NORMAL SUPPLY LOST
A3EB5	A3EB	1.4090E-03	A3EA BYPASS, NORMAL LOST
A3EBF	A3EB	1.0000E+00	G.F.
A3EC1	A3EC	8.7440E-04	A3EA,A3EB SUCCESS, NORMAL AVAILABLE
A3EC10	A3EC	1.4950E-03	A3EA AND A3EB FAIL, UNIT BD 3B LOST
A3EC11	A3EC	8.5960E-04	A3EA AND A3EB FAIL, UNIT BD 3A LOST
A3EC12	A3EC	2.1860E-01	A3EA AND A3EB FAIL, NORMAL SUPPLIES LOST
A3EC13	A3EC	9.1290E-04	A3EB BY SUPPORT, UNIT BD 3A UNAVAILABLE
A3EC14	A3EC	1.3790E-03	A3EB BY SUPPORT, ALL NORMAL SUPPLIES UNAVAILABLE
A3EC15	A3EC	5.0330E-04	A3EA FAIL, A3EB BY SUPPORT, UNIT BD 3A UNAVAILABLE
A3EC16	A3EC	2.2560E-02	A3EA FAIL, A3EB BY SUPPORT, ALL NORMAL SUPPLIES UNAVAILABLE
A3EC17	A3EC	9.1230E-04	A3EA AND A3EB BY SUPPORT, UNIT BD 3B AVAILABLE
A3EC18	A3EC	1.4090E-03	A3EA AND A3EB BY SUPPORT, ALL NORMAL SUPPLIES UNAVAILABLE
A3EC2	A3EC	1.4100E-03	A3EA, A3EB SUCCESS, UNIT BD 3B LOST
A3EC3	A3EC	9.1350E-04	A3EA, A3EB SUCCESS, UNIT BD 3A LOST
A3EC4	A3EC	1.3560E-03	A3EA, A3EB SUCCESS, NORMAL SUPPLIES LOST
A3EC5	A3EC	2.2070E-02	A3EB FAILS, ALL NORMAL AVAILABLE
A3EC6	A3EC	7.6150E-04	A3EA OR A3EB FAIL, UNIT BD 3B LOST
A3EC7	A3EC	4.9510E-04	A3EA OR A3EB FAIL, UNIT BD 3A LOST
A3EC8	A3EC	1.8040E-02	A3EA OR A3EB FAIL, NORMAL SUPPLIES LOST
A3EC9	A3EC	1.0460E-03	A3EA AND A3EB FAIL, NORMAL SUPPLIES AVAILABLE
A3ECF	A3EC	1.0000E+00	G.F.

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Table 3.3.5-1 (Page 2 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
A3ED1	A3ED	8.5550E-04	ALL NORMAL SUPPLIES AVAILABLE
A3ED10	A3ED	1.8130E-02	ONE PREVIOUS DIVISION FAILS, ALL NORMAL SUPPLIES UNAVAILABLE
A3ED11	A3ED	9.0760E-04	TWO PREVIOUS DIVISIONS FAIL
A3ED12	A3ED	1.4370E-03	A3EA AND A3EB UNAVAILABLE, UNIT BD 3B UNAVAILABLE
A3ED13	A3ED	3.8440E-02	A3EA AND A3EC FAIL, UNIT BD 3B UNAVAILABLE
A3ED14	A3ED	8.2260E-04	A3EA AND A3EB FAIL, UNIT BD 3A UNAVAILABLE
A3ED15	A3ED	4.1490E-02	A3EA AND A3EC FAIL, UNIT BD 3A UNAVAILABLE
A3ED16	A3ED	1.3150E-02	TWO PREVIOUS DIVISIONS FAIL, NO NORMAL SUPPLIES
A3ED17	A3ED	1.3330E-01	A3EA, A3EB, A3EC FAIL, ALL NORMAL SUPPLIES AVAILABLE
A3ED18	A3ED	4.0630E-02	A3EA, A3EB, A3EC FAIL, UNIT BD 3B UNAVAILABLE
A3ED19	A3ED	4.3840E-02	A3EA, A3EB, A3EC FAIL, UNIT BD 3A UNAVAILABLE
A3ED2	A3ED	1.3800E-03	UNIT BD 3B UNAVAILABLE
A3ED20	A3ED	9.5300E-01	A3EA, A3EB, A3EC FAIL, UNIT BD 3A AND 2 UNAVAILABLE
A3ED21	A3ED	1.4100E-03	A3EC BY SUPPORT, UNIT BD 3B UNAVAILABLE
A3ED22	A3ED	8.9400E-04	A3EB BY SUPPORT, UNIT BD 3A UNAVAILABLE
A3ED23	A3ED	1.3560E-03	A3EC BY SUPPORT, NO NORMAL POWER
A3ED24	A3ED	7.6150E-04	A3EC BY SUPPORT, A3EB AND UNIT BD 3B UNAVAILABLE
A3ED25	A3ED	2.1600E-02	A3EB BY SUPPORT, A3EC AND UNIT BD 3A FAIL
A3ED26	A3ED	4.8270E-04	A3EB BY SUPPORT, A3EA AND UNIT BD 3A FAIL
A3ED27	A3ED	1.8040E-02	A3EB BY SUPPORT, A3EA UNIT BD 3A AND UNIT BD 3B FAIL
A3ED28	A3ED	1.4950E-03	A3EC BY SUPPORT, A3EA, A3EB AND UNIT BD 3B FAIL
A3ED29	A3ED	4.1580E-02	A3EB BY SUPPORT, A3EA, A3EC AND UNIT BD 3A FAIL
A3ED3	A3ED	8.9450E-04	UNIT BD 3A UNAVAILABLE
A3ED30	A3ED	2.1860E-01	A3EC BY SUPPORT,A3EA, A3EB, UNIT BD 3A,

Table 3.3.5-1 (Page 3 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			UNIT BD 3B FAIL
A3ED31	A3ED	8.9340E-04	A3EA AND A3EB BY SUPPORT, UNIT BD 3A FAILS
A3ED32	A3ED	1.3790E-03	A3EA AND A3EB BY SUPPORT, UNIT BD 3A AND UNIT BD 3B FAIL
A3ED33	A3ED	2.1620E-02	A3EA AND A3EB BY SUPPORT, A3EC AND UNIT BD 3A FAIL
A3ED34	A3ED	2.2560E-02	A3EA AND A3EB BY SUPPORT, A3EC UNIT BD 3B AND UNIT BD 3A FAIL
A3ED35	A3ED	1.4090E-03	ALL PREVIOUS DIVISIONS BY SUPPORT, AND NO NORMAL POWER
A3ED4	A3ED	1.3330E-03	BOTH NORMAL SUPPLIES UNAVAILABLE
A3ED5	A3ED	2.2550E-02	ONE PREVIOUS DIVISION FAILS
A3ED6	A3ED	7.3280E-04	A3EA OR A3EB FAIL, UNIT BD 3B FAILS
A3ED7	A3ED	2.2550E-02	A3EC FAILS AND UNIT BD 3B UNAVAILABLE
A3ED8	A3ED	4.7480E-04	A3EA OR A3EB FAIL, UNIT BD 3A FAILS
A3ED9	A3ED	2.1590E-02	A3EC FAILS, UNIT BD 3A UNAVAILABLE
A3EDF	A3ED	1.0000E+00	G.F.
AA1	AA	4.8300E-04	NORMAL SUPPLY AVAILABLE
AA2	AA	1.0910E-03	LOSS OF NORMAL SUPPLY, DIESEL AVAILABLE
AAF	AA	1.0000E+00	G.F.
AB1	AB	4.8320E-04	NORMAL SUPPLY AVAILABLE, AA SUCCESS
AB2	AB	1.0260E-03	AA SUCCESS, NORMAL LOST, ALL DG AVAILABLE
AB3	AB	1.8110E-04	AA FAIL, NORMAL SUPPLY AVAILABLE
AB4	AB	6.1260E-02	AA FAIL, NORMAL SUPPLY LOST
AB5	AB	1.0910E-03	AA BYPASS, NORMAL LOST
ABF	AB	1.0000E+00	G.F.
AC1	AC	4.8330E-04	AA,AB SUCCESS, NORMAL AVAILABLE
AC10	AC	8.6120E-04	AA AND AB FAIL, SHUT2 LOST
AC11	AC	4.3750E-04	AA AND AB FAIL, SHUT1 LOST
AC12	AC	5.3050E-01	AA AND AB FAIL, NORMAL SUPPLIES LOST
AC13	AC	4.8320E-04	AB BY SUPPORT, SHUT1 UNAVAILABLE
AC14	AC	1.0260E-03	AB BY SUPPORT, ALL NORMAL SUPPLIES UNAVAILABLE

Table 3.3.5-1 (Page 4 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
AC15	AC	3.6920E-04	AA FAIL, AB BY SUPPORT, SHUT1 UNAVAILABLE
AC16	AC	6.1260E-02	AA FAIL, AB BY SUPPORT, ALL NORMAL SUPPLIES UNAVAILABLE
AC17	AC	4.8300E-04	AA AND AB BY SUPPORT, SHUT2 AVAILABLE
AC18	AC	1.0910E-03	AA AND AB BY SUPPORT, ALL NORMAL SUPPLIES UNAVAILABLE
AC2	AC	1.0920E-03	AA, AB SUCCESS, SHUT 2 LOST
AC3	AC	4.8330E-04	AA, AB SUCCESS, SHUT1 LOST
AC4	AC	9.9520E-04	AA, AB SUCCESS, NORMAL SUPPLIES LOST
AC5	AC	1.8100E-04	AB FAILS, ALL NORMAL AVAILABLE
AC6	AC	8.3420E-04	AA OR AB FAIL, SHUT2 LOST
AC7	AC	3.6480E-04	AA OR AB FAIL, SHUT1 LOST
AC8	AC	3.0640E-02	AA OR AB FAIL, NORMAL SUPPLIES LOST
AC9	AC	3.0430E-04	AA AND AB FAIL, NORMAL SUPPLIES AVAILABLE
ACF	AC	1.0000E+00	G.F.
AD1	AD	4.8350E-04	ALL NORMAL SUPPLIES AVAILABLE
AD10	AD	2.3980E-02	ONE PREVIOUS DIVISION FAILS, ALL NORMAL SUPPLIES UNAVAILABLE
AD11	AD	3.0430E-04	TWO PREVIOUS DIVISIONS FAIL
AD12	AD	7.8220E-04	AA AND AB UNAVAILABLE, SHUT 2 UNAVAILABLE
AD13	AD	7.2590E-02	AA AND AC FAIL, SHUT2 UNAVAILABLE
AD14	AD	4.3760E-04	AA AND AB FAIL, SHUT 1 UNAVAILABLE
AD15	AD	1.8290E-04	AA AND AC FAIL, SHUT 1 UNAVAILABLE
AD16	AD	2.4150E-01	TWO PREVIOUS DIVISIONS FAIL, NO NORMAL SUPPLIES
AD17	AD	4.8220E-04	AA,AB,AC FAIL, ALL NORMAL SUPPLIES AVAILABLE
AD18	AD	9.2480E-02	AA,AB,AC FAIL, SHUT2 UNAVAILABLE
AD19	AD	2.3810E-04	AA,AB,AC FAIL, SHUT1 UNAVAILABLE
AD2	AD	1.0260E-03	SHUT 2 UNAVAILABLE
AD20	AD	7.8620E-01	AA,AB,AC FAIL, SHUT1 AND 2 UNAVAILABLE
AD21	AD	1.0920E-03	AC BY SUPPORT, SHUT2 UNAVAILABLE
AD22	AD	4.8330E-04	AB BY SUPPORT, SHUT1 UNAVAILABLE

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SF Name...	Top.......	SF Value...	Split Fraction Description*...............
AD23	AD	9.9520E-04	AC BY SUPPORT, NO NORMAL POWER
AD24	AD	8.3420E-04	AC BY SUPPORT, AB AND SHUT2 UNAVAILABLE
AD25	AD	1.8110E-04	AB BY SUPPORT, AC AND SHUT1 FAIL
AD26	AD	3.6930E-04	AB BY SUPPORT, AA AND SHUT1 FAIL
AD27	AD	3.0640E-02	AB BY SUPPORT, AA SHUT1 AND SHUT2 FAIL
AD28	AD	8.6120E-04	AC BY SUPPORT, AA, AB AND SHUT2 FAIL
AD29	AD	1.8690E-04	AB BY SUPPORT, AA, AC AND SHUT1 FAIL
AD3	AD	4.8340E-04	SHUT 1 UNAVAILABLE
AD30	AD	5.3050E-01	AC BY SUPPORT,AA, AB, SHUT1, SHUT2 FAIL
AD31	AD	4.8320E-04	AA AND AB BY SUPPORT, SHUT1 FAILS
AD32	AD	1.0260E-03	AA AND AB BY SUPPORT, SHUT1 AND SHUT2 FAIL
AD33	AD	1.8110E-04	AA AND AB BY SUPPORT, AC AND SHUT1 FAIL
AD34	AD	6.1260E-02	AA AND AB BY SUPPORT, AC SHUT2 AND SHUT1 FAIL
AD35	AD	1.0910E-03	ALL PREVIOUS DIVISIONS BY SUPPORT, AND NO NORMAL POWER
AD4	AD	9.7240E-04	BOTH NORMAL SUPPLIES UNAVAILABLE
AD5	AD	1.8100E-04	ONE PREVIOUS DIVISION FAILS
AD6	AD	7.7430E-04	AA OR AB FAIL, SHUT2 FAILS
AD7	AD	6.1250E-02	AC FAILS AND SHUT2 UNAVAILABLE
AD8	AD	3.6480E-04	AA OR AB FAIL, SHUT1 FAILS
AD9	AD	1.8110E-04	AC FAILS, SHUT1 UNAVAILABLE
ADF	AD	1.0000E+00	no description entered
AIF	AI	1.0000E+00	G.F.
BVR1	BVR	1.3770E-02	ALL SUPPORT AVAILABLE
BVRF	BVR	1.0000E+00	G.F.
CD1	CD	1.3961E-03	ALL SUPPORT AVAILABLE
CD2	CD	1.3940E-03	UB42C UNAVAILABLE
CD3	CD	3.0003E-03	UB42B & UB42C UNAVAILABLE
CDA1	CDA	0.0000E+00	CONDENSATE AVAILABLE
CDAF	CDA	1.0000E+00	CONDENSATE NOT AVAILABLE
CDF	CD	1.0000E+00	G.F.

Table 3.3.5-1 (Page 6 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*................
CIL1	CIL	3.6609E-06	PCIS LARGE FAILURE, ALL SUPPORT AVAILABLE
CIL2	CIL	5.5952E-04	PCIS LARGE FAILURE, PLANT CONTROL AIR UNAVAILABLE
CILF	CIL	1.0000E+00	PCIS LARGE G.F.
CIS1	CIS	6.8636E-04	PCIS SMALL FAILURE, ALL SUPPORT AVAILABLE
CISF	CIS	1.0000E+00	PCIS G.F.
CRD1	CRD	1.3351E-03	NORMAL POST-SCRAM VESSEL INJECTION (ONE PUMP) REQUIRED FOR 24 HOURS - SUPPORTS FOR BOTH PUMPS AVAILABLE
CRD2	CRD	4.4008E-02	NORMAL POST-SCRAM VESSEL INJECTION (ONE PUMP) REQUIRED FOR 24 HOURS - SUPPORTS FOR PUMP 2A AVAILABLE AND SUPPORTS FOR PUMP 1B FAILED
CRD3	CRD	2.0415E-01	ENHANCED CRDHS VESSEL INJECTION (TWO PUMPS) REQUIRED FOR THE FINAL 18 HOURS OF THE 24 HOUR MISSION TIME - ALL SUPPORTS AVAILABLE.
CRD4	CRD	2.0249E-01	ENHANCED CRDHS VESSEL INJECTION (TWO PUMPS) REQUIRED FOR 24 HOURS - ALL SUPPORTS AVAILABLE.
CRDF	CRD	1.0000E+00	CRDHS VESSEL INJECTION (ENHANCED AND NORMAL POST-SCRAM) FAILED DUE TO SUPPORT SYSTEM FAILURE OR DUE TO PLANT CONDITIONS.
CS1	CS	1.9948E-03	CORE SPRAY FAILURE; SUPPORT FOR BOTH LOOPS; LOCA EVENT; TOP EVENT ORP=S
CS10	CS	1.0336E-03	CORE SPRAY FAILURE; SUPPORT TO ONE PUMP UNAVAILABLE; LOCA EVENT; TOP EVENT ORP=F
CS11	CS	7.3443E-03	CORE SPRAY FAILURE; SUPPORT FOR BOTH PUMPS IN ONE LOOP UNAVAILABLE, NON-LOCA EVENT; TOP EVENT ORP=S
CS12	CS	8.3427E-03	CORE SPRAY FAILURE; SUPPORT FOR BOTH PUMPS IN ONE LOOP UNAVAILABLE, LOCA EVENT; TOP EVENT ORP=F

Table 3.3.5-1 (Page 7 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
CS13	CS	1.1226E-03	CORE SPRAY FAILURE; SUPPORT FOR ONE PUMP IN EACH LOOP UNAVAILABLE; NON-LOCA EVENT; TOP EVENT ORP=S
CS14	CS	1.2452E-03	CORE SPRAY FAILURE; SUPPORT FOR ONE PUMP IN EACH LOOP UNAVAILABLE; LOCA EVENT; TOP EVENT ORP=F
CS15	CS	7.6652E-03	CORE SPRAY FAILURE; SUPPORT FOR ALL BUT ONE PUMP IN ONE LOOP UNAVAILABLE; NON-LOCA EVENT; TOP EVENT ORP=S
CS16	CS	8.7562E-03	CORE SPRAY FAILURE; SUPPORT FOR ALL BUT ONE PUMP IN ONE LOOP UNAVAILABLE; LOCA EVENT; TOP EVENT ORP=F
CS2	CS	2.1252E-03	CORE SPRAY FAILURE; SUPPORT FOR BOTH LOOPS; LOCA EVENT; TOP EVENT ORP=F
CS3	CS	3.5519E-02	CORE SPRAY FAILURE; SUPPORT FOR ONE LOOP UNAVAILABLE; LOCA EVENT; TOP EVENT ORP=S
CS4	CS	3.5639E-02	CORE SPRAY FAILURE; SUPPORT FOR ONE LOOP UNAVAILABLE; LOCA EVENT; TOP EVENT ORP=F
CS5	CS	9.0062E-04	CORE SPRAY FAILURE; SUPPORT FOR BOTH LOOPS; NON-LOCA EVENT; TOP EVENT ORP=S
CS6	CS	9.9380E-04	CORE SPRAY FAILURE; SUPPORT FOR BOTH LOOPS; NON-LOCA EVENT; TOP EVENT ORP=F
CS7	CS	2.6615E-02	CORE SPRAY FAILURE; SUPPORT FOR ONE LOOP UNAVAILABLE; NON-LOCA EVENT; TOP EVENT ORP=S
CS8	CS	2.7924E-02	CORE SPRAY FAILURE; SUPPORT FOR ONE LOOP UNAVAILABLE; LOCA EVENT; TOP EVENT ORP=F
CS9	CS	9.9322E-04	CORE SPRAY FAILURE; SUPPORT FOR ONE PUMP UNAVAILABLE; NON-LOCA EVENT; TOP EVENT ORP=S
CSF	CS	1.0000E+00	CORE SPRAY G.F.
CST1	CST	3.8074E-05	UNAVAILABLEABILITY OF CST

Table 3.3.5-1 (Page 8 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
CSTF	CST	1.0000E+00	G.F.
DA1	DA	2.0872E-03	ALL SUPPORT AVAILABLE
DA2	DA	1.5495E-03	AC POWER UNAVAILABLE
DAF	DA	1.0000E+00	G.F.
DB1	DB	2.0492E-03	ALL SUPPORT AVAILABLE
DB2	DB	1.5191E-03	AC POWER UNAVAILABLE
DBF	DB	1.0000E+00	G.F.
DC1	DC	2.0467E-03	ALL SUPPORT AVAILABLE
DC2	DC	1.5072E-03	AC POWER UNAVAILABLE
DCA1	DCA	4.1526E-03	ALL SUPPORT AVAILABLE
DCA2	DCA	2.4318E-02	UNAVAILABLEABILITY OF DCA SYSTEM GIVEN SUPPORT TO ONE COMPRESSOR DIVISION AVAILABLE
DCAF	DCA	1.0000E+00	G.F. GIVEN PCA=F, RBC=F, DO=F, DN=F, RH=F*RI=F
DCF	DC	1.0000E+00	G.F.
DD1	DD	2.0141E-03	ALL SUPPORT AVAILABLE
DD2	DD	1.5425E-03	AC POWER UNAVAILABLE
DDF	DD	1.0000E+00	G.F.
DE1	DE	4.9570E-03	ALL SUPPORT AVAILABLE
DE2	DE	4.6501E-03	AC POWER UNAVAILABLE
DEF	DE	1.0000E+00	G.F.
DF1	DF	3.1963E-03	ALL SUPPORT AVAILABLE
DF2	DF	2.6116E-03	AC POWER UNAVAILABLE
DFF	DF	1.0000E+00	G.F.
DGA	DG	4.9311E-03	ALL SUPPORT AVAILABLE
DGB	DG	4.4975E-03	AC POWER UNAVAILABLE
DGF	DG	1.0000E+00	G.F.
DH1	DH	5.0032E-03	ALL SUPPORT AVAILABLE
DH2	DH	4.4485E-03	AC POWER UNAVAILABLE
DHF	DH	1.0000E+00	G.F.
DI1	DI	5.0570E-04	ONLY ONE DIVISION AVAILABLE
DI2	DI	1.4530E-02	ONE DIVISION AVAILABLE, AA AND DE FAIL FOR DI

Table 3.3.5-1 (Page 9 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
DI3	DI	2.1660E-02	ONE DIVISION AVAILABLE, AB AND DH FAIL FOR DI AND DJ
DIF	DI	1.0000E+00	G.F.
DJ1	DJ	5.0510E-04	ALL SUPPORT AVAILABLE
DJ10	DJ	8.7840E-01	DI FAILED, AA, DE, A3EA AND DG FAILED
DJ11	DJ	1.4530E-02	DI FAILED BY SUPPORT
DJ2	DJ	1.4710E-02	DI SUCCESS, AA AND DE FAIL
DJ3	DJ	1.4780E-02	DI SUCCESS, AB AND DH FAIL
DJ4	DJ	2.1630E-02	DI SUCCESS, A3EA AND DG FAIL
DJ5	DJ	9.0280E-03	DI SUCCESS, AA, DE, A3EA AND DG FAIL
DJ6	DJ	1.6200E-03	DI FAILED
DJ7	DJ	2.2570E-03	DI FAILED, AA AND DE FAIL
DJ8	DJ	2.8690E-03	DI FAILED, AB AND DH FAIL
DJ9	DJ	7.1290E-02	DI FAILED, A3EA AND DG FAIL
DJF	DJ	1.0000E+00	G.F.
DK1	DK	1.3840E-02	SINGLE DIVISION DK AVAILABLE
DKF	DK	1.0000E+00	G.F.
DL1	DL	1.4010E-02	ALL SUPPORT AVAILABLE
DL2	DL	1.9190E-03	SINGLE DIVISION DL AVAILABLE, DK FAILED
DL3	DL	1.3840E-02	SINGLE DIVISION DL AVAILABLE, DK FAILED BY SUPPORT
DLF	DL	1.0000E+00	G.F.
DM1	DM	2.2495E-04	ALL SUPPORT AVAILABLE
DM2	DM	3.3726E-04	A3EC SUPPORT UNAVAILABLE
DM3	DM	1.8957E-03	AC SUPPORT UNAVAILABLE
DMF	DM	1.0000E+00	G.F.
DN1	DN	1.2147E-04	ALL SUPPORT AVAILABLE
DN2	DN	2.2887E-04	A3EA UNAVAILABLE
DN3	DN	1.1079E-03	AB UNAVAILABLE
DNF	DN	1.0000E+00	G.F.
DO1	DO	1.2147E-04	ALL SUPPORT AVAILABLE
DO2	DO	2.2887E-04	AC SUPPORT UNAVAILABLE

Table 3.3.5-1 (Page 10 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
DO3	DO	1.1079E-03	AD SUPPORT UNAVAILABLE
DOF	DO	1.0000E+00	G.F.
DT11	DT1	4.0630E-06	UNAVAILABLEABILITY OF DRYWELL DIVISION I INSTRUMENT TAPS
DT21	DT2	4.0320E-06	UNAVAILABLEABILITY OF DRYWELL DIVISION II INSTRUMENT TAPS
DV11	DV1	4.8650E-03	LOOP B RDVC FAILED - ALL SUPPORT AVAILABLE
DV12	DV1	8.4020E-03	LOOP B RDVC FAILURE - 250V DC RMOV BD 2A OR 2B UNAVAILABLE
DV1B	DV1	0.0000E+00	G.S./BYPASSED
DV1F	DV1	1.0000E+00	G.F.
DV21	DV2	4.5200E-03	DV1 SUCCESS, DC POWER (RB,RC) AND DC POWER (DB,DB) AVAILABLE
DV210	DV2	4.3410E-01	DV1 FAILED, ONE DC POWER (RB OR RC) AND ONE DC POWER (DB OR DD) AVAILABLE
DV211	DV2	5.6850E-03	DV1 BYPASSED, DC POWER (RB,RC) AND ONE DC POWER (DB OR DD) AVAILABLE
DV212	DV2	9.1560E-03	DV1 BYPASSED, ONE DC POWER (RB OR RC) AND ONE DC POWER (DB OR DD) AVAILABLE
DV22	DV2	6.6070E-02	DV1 FAILED, DC POWER (RB,RC) ANF DC POWER (DB,DD) AVAILABLE
DV23	DV2	4.7450E-03	DV1 SUCCESS, ONE DC POWER (RB OR RC) AND DC POWER (DB,DD) AVAILABLE
DV24	DV2	4.3330E-01	DV1 FAILED, ONE DC POWER (RB OR RC) ANF DC POWER (DB,DD) AVAILABLE
DV25	DV2	4.8200E-03	DV1 BYPASSED, DC POWER (RB,RC) AND DC POWER (DB,DD) AVAILABLE
DV26	DV2	8.3450E-03	DV1 BYPASSED, ONE DC POWER (RB OR RC) AND DC POWER (DB,DD) AVAILABLE
DV27	DV2	5.3820E-03	DV1 SUCCESS, DC POWER (RB,RC) AND ONE DC POWER (DB OR DB) AVAILABLE
DV28	DV2	6.7760E-02	DV1 FAILED, DC POWER (RB,RC) AND ONE DC

SF Name...	Top.......	SF Value...	Split Fraction Description*................
			POWER (DB OR DD) AVAILABLE
DV29	DV2	5.5550E-03	DV1 SUCCESS, ONE DC POWER (RB OR RC) AND ONE DC POWER (DB OR DD) AVAILABLE
DV2B	DV2	0.0000E+00	G.S.FULL
DV2F	DV2	1.0000E+00	G.F.
DW1	DW	5.2964E-05	UNAVAILABLEABILITY OF SAI DRYWELL PRESSURE SIGNAL GIVEN ALL SUPPORT AVAILABLE
DW2	DW	4.9566E-03	UNAVAILABLEABILITY OF SAI DRYWELL PRESS SIGNAL GIVEN NO DIVISION I OR II SUPPORT
DWF	DW	1.0000E+00	G.F. OF SAI DW PRESSURE SIGNAL
DWP1	DWP	2.8311E-05	UNAVAILABLEABILITY OF FAIL SAFE DRYWELL PRESS SIGNAL - NO DW INSTR TAP FAILURE
DWP2	DWP	3.2848E-03	UNAVAILABLEABILITY OF FAIL SAFE DRYWELL PRESS SIGNAL - DIV I OR II DW INSTR TAP FAILURE
DWPF	DWP	1.0000E+00	G.F. OF RPS LOW DW PRESSURE SIGNAL
DWS1	DWS	1.8223E-03	DRYWELL SPRAY FAILURE ALL SUPPORT AVAILABLE
DWS2	DWS	2.2119E-02	DRYWELL SPRAY FAILURE, ONE LOOP SUPPORT FAILED
DWSF	DWS	1.0000E+00	DRYWELL SPRAY G.F.
EA1	EA	8.0190E-04	EECW PUMP A3, ALL SUPPORTS AVAILABLE
EA3	EA	3.7380E-03	EECW PUMP A3, OFFSITE POWER UNAVAILABLE
EAF	EA	1.0000E+00	G.F.
EB1	EB	7.9080E-04	EECW PUMP B3, ALL SUPPORTS AVAILABLE, PUMPS A3 AND C3 SUCCESS
EB10	EB	3.6970E-03	EECW PUMP B3, OFFSITE POWER UNAVAILABLE, A3 G.F. AND C3 SUCCESS, OR C3 G.F., AND A3 SUCCESS
EB11	EB	1.4570E-02	EECW PUMP B3, OFFSITE POWER UNAVAILABLE, A3 G.F. AND C3 FAILS, OR A3 FAILS AND C3 G.F.
EB12	EB	3.7380E-03	EECW PUMP B3, LOSS OF OFFSITE POWER, BOTH A3 AND C3 G.F.
EB13	EB	2.1650E-03	EECW PUMP B3, PUMP A3 SUCCESS, PUMP C3 FAILS

Table 3.3.5-1 (Page 12 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
EB14	EB	8.2230E-03	EECW PUMP B3, A3 FAILS, C3 G.F., OTHER SUPPORTS AVAILABLE
EB15	EB	7.9590E-04	EECW PUMP B3, A3 SUCCESS, C3 G.F., OTHER SUPPORTS AVAILABLE
EB2	EB	6.3160E-03	EECW PUMP B3, PUMP C3 SUCCESS, PUMP A3 FAILS
EB3	EB	1.6530E-01	EECW PUMP B3, BOTH PUMPS A3 AND C3 FAIL, OTHER SUPPORTS AVAILABLE
EB4	EB	7.9520E-04	EECW PUMP B3, PUMP A3 G.F., PUMP C3 SUCCESS, OTHER SUPPORTS AVAILABLE
EB5	EB	2.5880E-03	EECW PUMP B3, PUMP A3 G.F., PUMP C3 FAILS, OTHER SUPPORTS AVAILABLE
EB6	EB	8.0190E-04	EECW PUMP B3, BOTH PUMPS A3 AND C3 G.F., OTHER SUPPORTS AVAILABLE
EB7	EB	3.6670E-03	EECW PUMP B3, OFFSITE POWER UNAVAILABLE, BOTH PUMPS A3 AND C3 SUCCESS
EB8	EB	1.1970E-02	EECW PUMP B3, OFFSITE POWER UNAVAILABLE, A3 FAILS AND C3 SUCCESS, OR C3 FAILS AND A3 SUCCESS
EB9	EB	1.9320E-01	EECW PUMP B3, OFFSITE POWER UNAVAILABLE, BOTH PUMP A3 AND C3 FAIL
EBF	EB	1.0000E+00	EECW PUMP B3 GUARANTEED FAILS
EC2	EC	3.7120E-03	EECW PUMP C3, ALL SUPPORTS AVAILABLE
EC3	EC	3.7180E-03	EECW PUMP C3, A3 G.F., ALL SUPPORTS AVAILABLE
EC4	EC	1.2000E-02	EECW PUMP C3, A3 FAILS, ALL SUPPORTS AVAILABLE
ECF	EC	1.0000E+00	EECW PUMP B3 G.F.
ED10	ED	1.0100E-02	EECW PUMP D3, C3 G.F., (A3 SUCCESS B3 FAILS) OR (B3 SUCCESS A3 FAILS), ALL SUPPORTS AVAILABLE
ED11	ED	1.3810E-02	EECW PUMP D3, C3 FAILS, (A3 SUCCESS OR B3 G.F.) OR (A3 G.F. B3 SUCCESS), ALL SUPPORTS

Table 3.3.5-1 (Page 13 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			AVAILABLE
ED12	ED	1.9570E-01	EECW PUMP D3, C3 FAILS, (A3 FAILS B3 G.F.) OR (A3 G.F. B3 FAILS), ALL SUPPORTS AVAILABLE
ED13	ED	2.4120E-01	EECW PUMP D3, C3 G.F., BOTH A3 B3 FAIL, ALL SUPPORTS AVAILABLE
ED14	ED	1.2000E-02	EECW PUMP D3, C3 G.F., (A3 G.F. B3 FAILS) OR (A3 FAILS B3 G.F.), ALL SUPPORTS AVAILABLE
ED15	ED	1.4280E-02	EECW PUMP D3, C3 FAILS, A3 B3 G.F., ALL SUPPORTS AVAILABLE
ED16	ED	3.7180E-03	EECW PUMP D3, ALL A3 B3 C3 G.F., ALL SUPPORTS AVAILABLE
ED17	ED	9.7680E-03	EECW PUMP D3, C3 SUCCESS, (A3 G.F. B3 FAILS) OR (A3 FAILS B3 G.F.), ALL SUPPORTS AVAILABLE
ED2	ED	3.6700E-03	EECW PUMP D3, ALL SUPPORT AVAILABLE
ED25	ED	1.3670E-02	EECW PUMP D3, C3 FAILS A3 AND B3 SUCCESS, ALL SUPPORTS AVAILABLE
ED26	ED	7.7650E-02	EECW PUMP D3, C3 FAILS, (A3 FAILS B3 SUCCESS) OR (B3 FAILS A3 SUCCESS), ALL SUPPORTS AVAILABLE
ED3	ED	3.7070E-03	EECW PUMP D3, C3 G.F., A3 B3 SUCCESS, ALL SUPPORTS AVAILABLE
ED4	ED	9.4090E-03	EECW PUMP D3, A3 FAILS B3 AND C3 SUCCESS, OR B3 FAILS A3 AND C3 SUCCESS, OTHER SUPPORTS AVAILABLE
ED5	ED	3.6740E-03	EECW PUMP D3, C3 SUCCESS, (A3 SUCCESS AND B3 G.F.) OR (A3 G.F AND B3 SUCCESS), ALL SUPPORTS AVAILABLE
ED6	ED	6.6260E-02	EECW PUMP D3, A3 AND B3 FAIL C3 SUCCESS, ALL SUPPORTS AVAILABLE
ED7	ED	3.6790E-03	EECW PUMP D3, C3 SUCCESS, A3 AND B3 G.F., ALL SUPPORTS AVAILABLE

Table 3.3.5-1 (Page 14 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
ED8	ED	7.9160E-01	EECW PUMP D3, A3 B3 C3 ALL FAIL, ALL SUPPORTS AVAILABLE
ED9	ED	3.7120E-03	EECW PUMP D3, C3 G.F., (A3 SUCCESS B3 G.F.) OR (A3 G.F. B3 SUCCESS), ALL SUPPORTS AVAILABLE
EDF	ED	1.0000E+00	EECW PUMP D3 G.F.
EPR301	EPR30	4.7500E-01	OFFSITE GRID RECOVERY, ONE DIESEL FAILS
EPR302	EPR30	4.7300E-01	OFFSITE GRID RECOVERY, TWO DIESELS FAIL
EPR303	EPR30	4.7200E-01	OFFSITE GRID RECOVERY, THREE DIESELS FAIL
EPR304	EPR30	4.7000E-01	OFFSITE GRID RECOVERY, FOUR DIESELS FAIL
EPR30B	EPR30	0.0000E+00	G.S.
EPR61	EPR6	2.7200E-01	OFFSITE GRID RECOVERY, ONE DIESEL FAILS
EPR62	EPR6	2.7300E-01	OFFSITE GRID RECOVERY, TWO DIESELS FAIL
EPR63	EPR6	2.6900E-01	OFFSITE GRID RECOVERY, THREE DIESELS FAIL
EPR64	EPR6	2.6800E-01	OFFSITE GRID RECOVERY, FOUR DIESELS FAIL
EPR6B	EPR6	0.0000E+00	G.S.
FA1	FA	1.5900E-02	ALL SUPPORT AVAILABLE
FAB	FA	0.0000E+00	BYPASS
FAF	FA	1.0000E+00	G.F.
FB1	FB	1.5830E-02	FA SUCCESSFUL
FB2	FB	2.0290E-02	FA FAILS
FBB	FB	0.0000E+00	BYPASS
FBF	FB	1.0000E+00	G.F.
FC1	FC	1.5830E-02	FA, FB SUCCESSFUL
FC2	FC	1.5830E-02	FA OR FB FAIL
FC3	FC	2.3570E-01	FA AND FB FAIL
FCB	FC	0.0000E+00	BYPASS
FCF	FC	1.0000E+00	G.F.
FD1	FD	1.5830E-02	FA, FB, FC SUCCESSFUL
FD2	FD	1.5830E-02	FA OR FB OR FC FAIL
FD3	FD	1.5830E-02	TWO PREVIOUS DIVISIONS FAIL
FD4	FD	9.4870E-01	FA, FB, FC FAIL

Table 3.3.5-1 (Page 15 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
FDB	FD	0.0000E+00	BYPASS
FDF	FD	1.0000E+00	G.F.
FE1	FE	1.5900E-02	ALL SUPPORT AVAILABLE
FEB	FE	0.0000E+00	BYPASS
FEF	FE	1.0000E+00	G.F.
FF1	FF	1.5830E-02	FE SUCCESSFUL
FF2	FF	2.0290E-02	FE FAILS
FFB	FF	0.0000E+00	BYPASS
FFF	FF	1.0000E+00	G.F.
FG1	FG	1.5830E-02	FE, FF SUCCESSFUL
FG2	FG	1.5830E-02	FE OR FF FAIL
FG3	FG	2.3570E-01	FE AND FF FAIL
FGB	FG	0.0000E+00	BYPASS
FGF	FG	1.0000E+00	G.F.
FH1	FH	1.5830E-02	FE, FF, FG SUCCESSFUL
FH2	FH	1.5830E-02	FE OR FF OR FG FAIL
FH3	FH	1.5830E-02	TWO PREVIOUS DIVISIONS FAIL
FH4	FH	9.4870E-01	FE, FF, FG FAIL
FHB	FH	0.0000E+00	BYPASS
FHF	FH	1.0000E+00	G.F.
FIWTRF	FIWTR	1.0000E+00	FIRE WATER NOT AVAILABLE
FIWTRS	FIWTR	0.0000E+00	FIRE WATER AVAILABLE
FWA1	FWA	0.0000E+00	FEEDWATER AVAILABLE
FWAF	FWA	1.0000E+00	FEEDWATER NOT AVAILABLE
FWC1	FWC	8.6480E-05	ALL SUPPORT AVAILABLE
FWC2	FWC	2.4800E-04	OPERATOR FAILS TO TRIP 2/3 FW PUMPS
FWCF	FWC	1.0000E+00	GUARANTEED FAILURE
FWH1	FWH	3.1420E-03	ALL SUPPORT AVAILABLE UNDER ONE OF THREE MFW PUMPS RUNNING CONDITION
FWH2	FWH	2.4606E-02	ALL SUPPORT AVAILABLE UNDER ONE OF ONE MFW PUMP (ASSUMED PUMP A) RUNNING CONDITION
FWHF	FWH	1.0000E+00	GUARANTEED FAIL

Table 3.3.5-1 (Page 16 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
GA1	GA	1.4180E-01	ALL SUPPORT AVAILABLE
GAB	GA	0.0000E+00	BYPASS
GAF	GA	1.0000E+00	G.F.
GB1	GB	1.3910E-01	ALL SUPPORT AVAILABLE
GB2	GB	1.5790E-01	GA FAILS
GB3	GB	1.4180E-01	GA FAILS BY SUPPORT
GBB	GB	0.0000E+00	BYPASS
GBF	GB	1.0000E+00	G.F.
GC1	GC	1.3940E-01	ALL SUPPORT AVAILABLE
GC2	GC	1.3750E-01	ONE PREVIOUS DIVISION FAILS
GC3	GC	1.3910E-01	ONE DIVISION FAILS BY SUPPORT
GC4	GC	2.6680E-01	TWO PREVIOUS DIVISIONS FAIL
GC5	GC	1.5790E-01	ONE DIVISION FAILS BY SUPPORT AND ONE INDEPENDENT
GC6	GC	1.4180E-01	TWO DIVISIONS FAIL BY SUPPORT
GCB	GC	0.0000E+00	BYPASS
GCF	GC	1.0000E+00	G.F.
GD1	GD	1.4150E-01	ALL SUPPORT AVAILABLE
GD10	GD	1.4180E-01	THREE FAIL BY SUPPORT
GD2	GD	1.2650E-01	ONE PREVIOUS DIVISION FAILS
GD3	GD	2.0630E-01	TWO PREVIOUS DIVISIONS FAIL
GD4	GD	4.3290E-01	THREE PREVIOUS DIVISIONS FAIL
GD5	GD	1.3940E-01	ONE DIVISION FAILS BY SUPPORT
GD6	GD	1.3750E-01	ONE DIVISION FAILS BY SUPPORT AND ONE INDEPENDENT
GD7	GD	2.6680E-01	ONE DIVISION FAILS BY SUPPORT AND TWO INDEPENDENTLY
GD8	GD	1.3910E-01	TWO FAIL BY SUPPORT
GD9	GD	1.5790E-01	TWO FAIL BY SUPPORT AND ONE INDEPENDENTLY
GDB	GD	0.0000E+00	BYPASS
GDF	GD	1.0000E+00	G.F.
GE1	GE	1.7420E-01	ALL SUPPORT AVAILABLE

Table 3.3.5-1 (Page 17 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
GEB	GE	0.0000E+00	BYPASS
GEF	GE	1.0000E+00	G.F.
GF1	GF	1.7470E-01	ALL SUPPORT AVAILABLE
GF2	GF	1.7190E-01	GE FAILS
GF3	GF	1.7420E-01	GE FAILS BY SUPPORT
GFB	GF	0.0000E+00	BYPASS
GFF	GF	1.0000E+00	G.F.
GG1	GG	1.7860E-01	ALL SUPPORT AVAILABLE
GG2	GG	1.5630E-01	ONE PREVIOUS DIVISION FAILS
GG3	GG	1.7470E-01	ONE DIVISION FAILS BY SUPPORT
GG4	GG	2.4680E-01	TWO PREVIOUS DIVISIONS FAIL
GG5	GG	1.7190E-01	ONE DIVISION FAILS BY SUPPORT AND ONE INDEPENDENT
GG6	GG	1.7420E-01	TWO DIVISIONS FAIL BY SUPPORT
GGB	GG	0.0000E+00	BYPASS
GGF	GG	1.0000E+00	G.F.
GH1	GH	1.8540E-01	ALL SUPPORT AVAILABLE
GH10	GH	1.7420E-01	THREE FAIL BY SUPPORT
GH2	GH	1.4730E-01	ONE PREVIOUS DIVISION FAILS
GH3	GH	1.7860E-01	ONE DIVISION FAILS BY SUPPORT
GH4	GH	2.0520E-01	TWO PREVIOUS DIVISIONS FAIL
GH5	GH	1.5630E-01	ONE DIVISION FAILS BY SUPPORT AND ONE INDEPENDENT
GH6	GH	1.7470E-01	TWO FAIL BY SUPPORT
GH7	GH	3.7360E-01	THREE PREVIOUS DIVISIONS FAIL
GH8	GH	2.4680E-01	ONE DIVISION FAILS BY SUPPORT AND TWO INDEPENDENTLY
GH9	GH	1.7190E-01	TWO FAIL BY SUPPORT AND ONE INDEPENDENTLY
GHB	GH	0.0000E+00	BYPASS OF HPCI/RCIC (OHC=S)
HPL2	HPL	8.2230E-02	HPCI FAILURE LONG TERM, RCL=S AND OHC=F
HPL3	HPL	8.3410E-02	HPCI FAILURE LONG TERM, RCL=F AND OHC=S
HPL4	HPL	1.3650E-01	HPCI FAILURE LONG TERM, RCL=F AND OHC=F

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SF Name...	Top.......	SF Value...	Split Fraction Description*...............
HPL5	HPL	1.8020E-02	HPCI FAILURE LONG TERM, RCL=B(BYPASSED) AND OHC=S
HPL6	HPL	8.8030E-02	HPCI FAILURE LONG TERM, RCL=B AND OHC=F
HPLF	HPL	1.0000E+00	HPCI GUARANTEED FAILURE LONG TERM
HR60	HR6	0.0000E+00	GUARANTEED SUCCESS WHEN TOP EVENT OHC IS SUCCESSFUL
HR6F	HR6	1.0000E+00	GUARANTEED FAILURE WHEN HPI AND RCI ARE FAILED OR OHC IS FAILED
HRC1	HRC	5.6554E-04	HARDWARE FOR CONTROL OF RCIC & HPCI
HRC2	HRC	8.6574E-03	HARDWARE FOR CONTROL OF RCIC ONLY
HRC3	HRC	3.0573E-04	HARDWARE FOR CONTROL OF HPCI ONLY
HRC4	HRC	8.7362E-03	CONTROL OF HPCI/RCIC
HRC5	HRC	3.0261E-04	CONTROL OF HPCI/RCIC
HRC6	HRC	7.7013E-03	CONTROL OF HPCI/RCIC
HRCF	HRC	1.0000E+00	G.F.
HRF	HR	1.0000E+00	G.F.
HRL0	HRL	0.0000E+00	GUARANTEED SUCCESS WHEN TOP EVENT OHL IS SUCCESSFUL
HRLF	HRL	1.0000E+00	G.F. WHEN HPL AND RCL ARE FAILED OR OHL IS FAILED
HS0	HS	0.0000E+00	FEEDWATER AVAILABLE
HS1	HS	3.2300E-03	OPERATOR RECOVERS MAIN CONDENSER DURING REACTOR BUILDING FLOOD FROM TORUS
HSF	HS	1.0000E+00	FEEDWATER NOT AVAILABLE
HUM1	HUM	7.0813E-04	GIVEN ALL SUPPORT AVAILABLE
HUM2	HUM	4.3520E-04	GIVEN ALL SUPPORT AVAILABLE EXCEPT A3ED (DIVISION C)
HUM3	HUM	5.1983E-04	GIVEN ALL SUPPORT AVAILABLE EXCEPT RN (DIVISION B)
HUMF	HUM	1.0000E+00	G.F.
HXA1	HXA	5.4880E-03	HX A FAILURE ALL SUPPORT AVAILABLE
HXA2	HXA	8.7390E-03	HX A FAILURE ALL SUPPORT AVAILABLE - FOLLOWING

Table 3.3.5-1 (Page 19 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			OFFSITE POWER RECOVERY WITHIN 6 HOURS
HXAF	HXA	1.0000E+00	RHR HX A G.F.
HXB1	HXB	5.2700E-03	RHR HX B FAILURE ALL SUPPORT AVAILABLE, HXA & HXC =S
HXB2	HXB	2.0830E-02	RHR HX B FAILURE GIVEN HXA=F OR HXC=F
HXB3	HXB	5.3540E-03	RHR HX B FAILURE GIVEN HXA=B OR HXC=B
HXB4	HXB	2.9810E-02	RHR HX B FAILURE GIVEN HXA=F & HXC=B OR HXA=B & HXC=F
HXB5	HXB	3.2200E-01	RHR HX B FAILURE GIVEN HXA=F & HXC=F
HXB6	HXB	5.4880E-03	RHR HX B FAILURE GIVEN HXA=B & HXC=B
HXB7	HXB	8.7160E-03	RHR HX B FAILURE ALL SUPPORT AVAILABLE, HXA & HXC =S - FOLLOWING RECOVERY OF OFFSITE POWER WITHIN 6 HOURS
HXBF	HXB	1.0000E+00	RHR HX B G.F.
HXC1	HXC	5.3540E-03	RHR HX C FAILURE ALL SUPPORT AVAILABLE, HXA=S
HXC2	HXC	2.9810E-02	RHR HX C GIVEN HXA=F
HXC3	HXC	5.4880E-03	RHR HX C FAILURE GIVEN HXA=B
HXC4	HXC	8.5850E-03	RHR HX C FAILURE ALL SUPPORT AVAILABLE, HXA=S - FOLLOWING RECOVERY OF OFFSITE POWER WITHIN 6 HOURS
HXCF	HXC	1.0000E+00	RHR HX C G.F.
HXD1	HXD	5.2080E-03	RHR HX D FAILURE ALL SUPPORT AVAILABLE, HXA, HXB & HXC =S
HXD10	HXD	5.4880E-03	RHR HX D FAILURE GIVEN HXA=B & HXC=B & HXB=B
HXD11	HXD	8.4500E-03	RHR HX D FAILURE ALL SUPPORT AVAILABLE, HXA, HXB & HXC =S - FOLLOWING OFFSITE POWER RECOVERY
HXD2	HXD	5.2700E-03	RHR HX D FAILURE GIVEN HXA=B OR HXC=B OR HXB=B
HXD3	HXD	1.7120E-02	RHR HX D FAILURE GIVEN HXA=F OR HXC=F OR HXB=F

Table 3.3.5-1 (Page 20 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
HXD4	HXD	2.0830E-02	RHR HX D FAILURE GIVEN ONE PREVIOUS HX BYPASS AND ONE FAILED
HXD5	HXD	1.9510E-01	RHR HX D FAILURE GIVEN TWO PREVIOUS HX FAILURES
HXD6	HXD	3.2200E-01	RHR HX D FAILURE GIVEN TWO PREVIOUS HX FAILED & ONE BYPASSED
HXD7	HXD	5.8910E-01	RHR HX D FAILURE GIVEN HXA=F & HXC=F & HXB=F
HXD8	HXD	5.3540E-03	RHR HX D FAILURE GIVEN TWO PREVIOUS HX BYPASSED
HXD9	HXD	2.9810E-02	RHR HX D FAILURE GIVEN TWO PREVIOUS HX BYPASSED & ONE FAILED
HXDF	HXD	1.0000E+00	RHR HX D G.F.
INAF	INA	1.0000E+00	G.F.
INAS	INA	0.0000E+00	INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
INBF	INB	1.0000E+00	G.F.
INBS	INB	0.0000E+00	INTACT CONTAINMENT, WTR TO DEBRIS, DWS, NO SPC, VENT
INCF	INC	1.0000E+00	G.F.
INCS	INC	0.0000E+00	INTACT CONTAINMENT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
INDF	IND	1.0000E+00	G.F.
INDS	IND	0.0000E+00	INTACT CONTAINMENT, WTR TO DEBRIS, NO DWS, SPC
INEF	INE	1.0000E+00	G.F.
INES	INE	0.0000E+00	INTACT CONTAINMENT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
INFF	INF	1.0000E+00	G.F.
INFS	INF	0.0000E+00	INTACT CONTAINMENT, WTR TO DEBRIS, NO DWS, NO SPC, NO VENT
INGF	ING	1.0000E+00	G.F.

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SF Name...	Top.......	SF Value...	Split Fraction Description*...............
INGS	ING	0.0000E+00	INTACT CONTAINMENT, NO WTR TO DEBRIS, VENT
INHF	INH	1.0000E+00	G.F.
INHS	INH	0.0000E+00	INTACT CONTAINMENT, NO WTR TO DEBRIS, NO VENT
ISO1	ISO	2.2228E-04	RCIC STEAMLINE ISOLATION FAILURE, ALL SUPPORT AVAILABLE
ISO2	ISO	4.2375E-03	RCIC STEAMLINE ISOLATION GIVEN SUPPORT TO FCV-71-2 OR FCV-71-3 FAILED
ISOF	ISO	1.0000E+00	RCIC STEAMLINE ISOLATION GUARANTEED FAILURE
IVC0	IVC	0.0000E+00	G.S.
IVC1	IVC	7.7839E-05	ALL SUPPORT AVAILABLE
IVC2	IVC	4.9663E-05	LOSS OF PCA OR POWER TO THE OUTBOARD VALVES
IVC3	IVC	5.0102E-05	LOSS OF DCA&PCA OR DCA&PWR TO OUTBD VLVS OR PCA&PWR TO INBD VLVS OR PWR TO INBD&OUTBD VLVS
IVCF	IVC	1.0000E+00	G.F.
IVO1	IVO	1.1620E-15	ALL SUPPORT AVAILABLE
IVOB	IVO	0.0000E+00	BYPASSED
IVOF	IVO	1.0000E+00	G.F.
JAF	JA	1.0000E+00	G.F.
JAS	JA	0.0000E+00	BYPASS CONTAINMENT, WTR TO DEBRIS
JC1	JC	4.4860E-02	BYPASS UNAVAILABLE GIVEN LC HARDWARE FAILURE
JC2	JC	2.6690E-04	BYPASS UNAVAILABLE GIVEN LC SUPPORTS FAILED
JHF	JH	1.0000E+00	G.F.
JHS	JH	0.0000E+00	BYPASS CONTAINMENT, NO WTR TO DEBRIS
KCF	KC	1.0000E+00	G.F.
KCS	KC	0.0000E+00	EARLY CONTAINMENT, WTR TO DEBRIS, DWS
KFF	KF	1.0000E+00	G.F.
KFS	KF	0.0000E+00	EARLY CONTAINMENT, WTR TO DEBRIS, NO DWS
KHF	KH	1.0000E+00	GUARANTEED FAILED
KHS	KH	0.0000E+00	EARLY CONTAINMENT, NO WTR TO DEBRIS, NO DWS

Table 3.3.5-1 (Page 22 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
L8F0	L8F	0.0000E+00	GUARANTEED SUCCESS
L8F1	L8F	6.8261E-03	ALL SUPPORT AVAILABLE
L8F2	L8F	8.5858E-03	LOOP II VESSEL INSTRUMENT TAPS UNAVAILABLE
L8FF	L8F	1.0000E+00	G.F.
L8H1	L8H	2.7872E-02	LEVEL 8 TRIP, ALL SUPPORT AVAILABLE
L8H2	L8H	1.1184E-02	LEVEL 8 TRIP, HPCI ONLY
L8H3	L8H	1.6763E-02	LEVEL 8 TRIP, RCIC ONLY
L8HF	L8H	1.0000E+00	LEVEL 8 TRIP, GUARANTEED FAILURE
L8TR1	L8TR	6.8250E-03	ALL SUPPORT AVAILABLE
L8TR2	L8TR	8.5850E-03	LOOP II VESSEL INSTRUMENT TAPS UNAVAILABLE
L8TRF	L8TR	1.0000E+00	G.F.
LC1	LC	5.8080E-03	STARTUP LEVEL CONTROL FLOWPATH UNAVAILABLE
LCF	LC	1.0000E+00	QUARANTINED FAILS
LECF	LEC	1.0000E+00	G.F.
LECS	LEC	0.0000E+00	LATE CONTAINMENT, WTR TO DEBRIS, DWS
LFF	LF	1.0000E+00	G.F.
LFS	LF	0.0000E+00	LATE CONTAINMENT, WTR TO DEBRIS, NO DWS
LHF	LH	1.0000E+00	G.F.
LHS	LH	0.0000E+00	LATE CONTAINMENT, NO WTR TO DEBRIS, NO DWS
LM11	LM1	2.0690E-03	ALL SUPPORT AVAILABLE
LM1F	LM1	1.0000E+00	G.F.
LM21	LM2	2.0510E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56B) GIVEN LM1 SUCCESS
LM22	LM2	1.0670E-02	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56B) GIVEN LM1 FAILED
LM2F	LM2	1.0000E+00	G.F.
LM31	LM3	2.0350E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56C) - LM1 AND LM2 SUCCESS
LM32	LM3	9.8830E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56C) - LM1(LM2) FAILED AND LM2(LM1) SUCCESS
LM33	LM3	8.3430E-02	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56C) - LM1 AND LM2 FAILED

Table 3.3.5-1 (Page 23 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
LM34	LM3	2.0690E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56C) - LM1 AND LM2 DISABLED/BYPASSED
LM3F	LM3	1.0000E+00	G.F.
LM41	LM4	2.0200E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56D) - LM1, LM2 AND LM3 SUCCESS
LM42	LM4	9.5740E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56D) - LM1, LM2 OR LM3 FAILED
LM43	LM4	4.0840E-02	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56D) - TWO OF LM1, LM2 AND LM3 FAILED
LM44	LM4	5.5140E-01	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56D) - LM1, LM2 AND LM3 FAILED
LM45	LM4	2.0510E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56D) - LM1, LM2 DISABLED AND LM3 SUCCESS
LM46	LM4	1.0670E-02	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56D) - LM1, LM2 DISABLED AND LM3 FAILED
LM4F	LM4	1.0000E+00	G.F.
LPC4	LPC	2.8416E-04	LPCI FAILURE GENERAL TRANSIENT ALL SUPPORT AVAILABLE
LPC5	LPC	6.1766E-03	LPCI FAILURE GENERAL TRANSIENT, ONE RHR LOOP FAILED
LPCF	LPC	1.0000E+00	LPCI G.F.
LPRESF	LPRES	1.0000E+00	HIGH PRESSURE AT VESSEL MELT-THROUGH
LPRESS	LPRES	0.0000E+00	LOW PRESSURE AT VESSEL MELT-THROUGH
LT11	LT1	2.9400E-03	ALL SUPPORT AVAILABLE
LT1F	LT1	1.0000E+00	G.F.
LT21	LT2	2.6530E-03	UNAVAILABLEABILITY OF DIV I, CHANNEL 58B LOW RX LEVEL SIGNAL GIVEN LT1 SUCCESS
LT22	LT2	1.0030E-01	UNAVAILABLEABILITY OF DIV I, CHANNEL 58B LOW RX LEVEL SIGNAL GIVEN LT1 FAILED
LT2F	LT2	1.0000E+00	G.F.
LT31	LT3	2.3830E-03	FAILURE OF DIV II, CHANNEL 58C LOW RX LEVEL SIGNAL - LT1 AND LT2 SUCCESS

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Table 3.3.5-1 (Page 24 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*................
LT32	LT3	1.0410E-01	FAILURE OF DIV II (58C) LOW RX LEVEL SIGNAL - LT1(LT2) FAILED AND LT2(LT1) SUCCESS
LT33	LT3	6.6410E-02	FAILURE OF DIV II, CHANNEL 58C LOW RX LEVEL SIGNAL - LT1 AND LT2 FAILED
LT34	LT3	2.9400E-03	FAILURE OF DIV II, CHANNEL 58C LOW RX LEVEL SIGNAL - LT1 AND LT2 DISABLED/BYPASSED
LT3F	LT3	1.0000E+00	G.F.
LT41	LT4	2.1120E-03	FAILURE OF DIV II (58D) LOW RX LEVEL SIGNAL - LT1, LT2 AND LT3 SUCCESS
LT42	LT4	1.1570E-01	FAILURE OF DIV II (58D) LOW RX LEVEL SIGNAL - LT1, LT2 OR LT3 FAILED
LT43	LT4	4.9890E-03	FAILURE OF DIV II (58D) LOW RX LEVEL SIGNAL - TWO OF LT1, LT2 AND LT3 FAILED
LT44	LT4	9.2990E-01	FAILURE OF DIV II (58D) LOW RX LEVEL SIGNAL - LT1, LT2 AND LT3 FAILED
LT45	LT4	2.6530E-03	FAILURE OF DIV II (58D) LOW RX LEVEL SIGNAL - LT1, LT2 DISABLED AND LT3 SUCCESS
LT46	LT4	1.0030E-01	FAILURE OF DIV II (58D) LOW RX LEVEL SIGNAL - LT1, LT2 DISABLED AND LT3 FAILED
LT4F	LT4	1.0000E+00	G.F.
LVF	LV	1.0000E+00	G.F. OF LOW RX LEVEL TRIP LOGIC
LVP1	LVP	2.9975E-05	UNAVAILABLEABILITY OF FAIL SAFE LOW RX LEVEL SIGNAL GIVEN NO INSTR TAP FAILURE
LVP2	LVP	3.6651E-03	UNAVAILABLEABILITY OF FAIL SAFE LOW RX LEVEL SIGNAL - LOOP I OR II INSTR TAP FAILURE
LVS	LV	0.0000E+00	G.S. OF LOW RX LEVEL TRIP LOGIC
MCD1	MCD	3.1260E-02	ALL SUPPORT AVAILABLE
MCDF	MCD	1.0000E+00	G.F.
MELTF	MELT	1.0000E+00	CORE DAMAGE HAS OCCURRED
MELTS	MELT	0.0000E+00	NO CORE DAMAGE HAS OCCURRED
MSVC1	MSVC	7.7830E-05	ALL SUPPORT AVAILABLE
MSVC2	MSVC	4.9660E-05	LOSS OF SUPPORT EITHER INBOARD OR OUTBOARD

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SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			MSIVs
MSVC3	MSVC	5.0090E-05	LOSS OF SUPPORT TO BOTH INBOARD AND OUTBOARD MSIVs
MSVCF	MSVC	1.0000E+00	G.F.
MT11	MT1	7.5428E-04	ALL SUPPORT AVAILABLE
MT1F	MT1	1.0000E+00	G.F.
MT21	MT2	1.1271E-04	ALL SUPPORT AVAILABLE
MT2F	MT2	1.0000E+00	G.F.
MT31	MT3	7.5428E-04	ALL SUPPORT AVAILABLE
MT3F	MT3	1.0000E+00	G.F.
NA0	NA	0.0000E+00	THE EVENT IS NOT AN ATWS
NAF	NA	1.0000E+00	THE EVENT IS AN ATWS
NBOCB	NBOC	0.0000E+00	THE EVENT IS NOR A BREAK OUTSIDE CONTAINMENT
NBOCF	NBOC	1.0000E+00	THE EVENT IS A BREAK OUTSIDE CONTAINMENT
NCD1	NCD	0.0000E+00	NO CORE DAMAGE HAS OCCURRED
NCDF	NCD	1.0000E+00	CORE DAMAGE HAS OCCURRED
NH11	NH1	3.0330E-03	SAI DIVISION I POWER SUPPLY AVAILABLE
NH1F	NH1	1.0000E+00	G.F.
NH21	NH2	2.9980E-03	SAI DIVISION II POWER AVAILABLE AND NH1 IS SUCCESS
NH22	NH2	1.4630E-02	SAI DIVISION II POWER AVAILABLE AND NH1 IS FAILED
NH23	NH2	3.0330E-03	SAI DIVISION II POWER AVAILABLE AND NH1 IS DISABLED/BYPASSED
NH2F	NH2	1.0000E+00	G.F.
NIEB	NIE	0.0000E+00	INITIATOR IS NOT BOC, FWRU, OR PRFO
NIEF	NIE	1.0000E+00	INITIATOR IS BOC, OR FWRU, OR PRFO
NPI1	NPI	2.7960E-04	SAI DIV I LOW RX PRESSURE PERMISSIVE SIGNAL FAILED GIVEN DIV I SUPPORT AVAILABLE
NPIF	NPI	1.0000E+00	G.F.
NPII1	NPII	2.6200E-04	SAI DIV II LOW RX PRESSURE PERMISSIVE

Table 3.3.5-1 (Page 26 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			SIGNAL FAILED GIVEN DIV I SIGNAL SUCCESS
NPII2	NPII	6.3410E-02	SAI DIV II LOW RX PRESSURE PERMISSIVE SIGNAL FAILED GIVEN DIV I SIGNAL FAILED
NPII3	NPII	2.7960E-04	SAI DIV II LOW RX PRESSURE PERMISSIVE SIGNAL FAILED GIVEN DIV I SIGNAL DISABLED
NPIIF	NPII	1.0000E+00	G.F.
NRUB	NRU	0.0000E+00	INITIATOR IS NOT FWRU
NRUF	NRU	1.0000E+00	INITIATOR IS FWRU
NRV0	NRV	0.0000E+00	NO STUCK OPEN SRVS
NRVF	NRV	1.0000E+00	STUCK OPEN SRVS
OAD1	OAD	1.4910E-03	INHIBIT ADS, ATWS, UNISOLATED VESSEL
OAD2	OAD	1.4700E-03	INHIBIT ADS, ATWS, ISOLATED VESSEL
OAIF	OAI	1.0000E+00	GUARANTEED FAILED
OAL1	OAL	1.6490E-02	LOWER AND CONTROL VESSEL LEVEL, ATWS, UNISOLATED VESSEL
OAL2	OAL	1.8550E-02	LOWER AND CONTROL VESSEL LEVEL, ATWS, ISOLATED VESSEL
OBC1	OBC	7.9338E-04	ALL SUPPORT AVAILABLE
OBCF	OBC	1.0000E+00	G.F.
OBD1	OBD	1.3120E-01	ALL SUPPORT AVAILABLE
OBD2	OBD	8.6016E-04	LONG TERM HPCI OR RCIC AVAILABLE
OBDF	OBD	1.0000E+00	G.F.
ODWS1	ODWS	9.6280E-03	OPERATOR ALIGNS DRYWELL SPRAY, NON-ATWS
ODWS2	ODWS	2.7370E-02	OPERATOR ALIGNS DRYWELL SPRAY DURING ATWS
ODWSF	ODWS	1.0000E+00	G.F.
OEE1	OEE	5.0050E-04	OPERATOR RECOVERS EECW, NON-ATWS
OEE2	OEE	1.6400E-02	OPERATOR RECOVERS EECW, ATWS
OEEB	OEE	0.0000E+00	BYPASS
OEEF	OEE	1.0000E+00	G.F.
OF1	OF	3.8410E-04	CONTROL VESSEL LEVEL WITH FEEDWATER, AUTO-CONTROL = S, 1 FEED PUMP
OF2	OF	2.4910E-03	CONTROL VESSEL LEVEL WITH FEEDWATER,

Table 3.3.5-1 (Page 27 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			AUTO-CONTROL = F, 1 FEED PUMP
OF3	OF	3.3590E-01	CONTROL VESSEL LEVEL WITH FEEDWATER, 3 FEED PUMPS
OF4	OF	7.7770E-03	CONTROL VESSEL LEVEL WITH FEEDWATER, ATWS
OFF	OF	1.0000E+00	G.F.
OFT1	OFT	1.8170E-03	OPERATOR TRIPS TWO FEED PUMPS
OFTF	OFT	1.0000E+00	G.F., OPTR=F
OFTS	OFT	0.0000E+00	GUARANTEED SUCCESS, OPTR=S
OG161	OG16	5.9198E-04	161KV OFFSITE POWER
OG16F	OG16	1.0000E+00	161KV OFFSITE POWER GUARANTEED FAIL.
OG51	OG5	3.9230E-04	500KV OFFSITE GRID UNAVAILABLE
OG5F	OG5	1.0000E+00	G.F.
OHC1	OHC	1.0610E-03	CONTROL OF HPCI AND RCIC
OHC2	OHC	9.1750E-04	CONTROL OF HPCI ONLY
OHC3	OHC	7.3590E-04	CONTROL OF RCIC ONLY
OHC4	OHC	1.0350E-02	CONTROL OF HPCI DURING ATWS
OHL1	OHL	1.4740E-03	LONG TERM CONTROL OF HPCI/RCIC GIVEN OHC=S
OHL2	OHL	4.4930E-03	LONG TERM CONTROL OF HPCI AND/OR RCIC GIVEN OHC=F
OHRF	OHR	1.0000E+00	GUARANTEED FAILURE
OHS1	OHS	8.4290E-03	OPERATOR STARTS OF HPCI - NON-ATWS, 2 SORVS
OHS2	OHS	7.8720E-04	OPERATOR STARTS RCIC/HPCI - NON-ATWS, NO SORV
OHS3	OHS	5.2570E-03	OPERATOR STARTS HPCI DURING ATWS
OHSF	OHS	1.0000E+00	OPERATOR STARTS RCIC/HPCI - G.F.
OIV1	OIV	2.2560E-03	OPERATOR DEFEATS MSIV CLOSURE INTERLOCK, NON-ATWS
OIVF	OIV	1.0000E+00	G.F.
OJC1	OJC	3.2040E-02	OPERATOR CONTROLS VESSEL LEVEL WITH CONDENSATE USING ALTERNATE FLOW PATH
OLA1	OLA	7.7450E-02	OPERATOR MAINTAINS VESSEL LEVEL AT T.A.F.

Table 3.3.5-1 (Page 28 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			WITH RHR/CS
OLC1	OLC	4.7900E-04	OPERATOR CONTROLS VESSEL LEVEL WITH CONDENSATE, FEEDWATER SUCCESSFUL
OLC2	OLC	6.9510E-04	OPERATOR CONTROLS VESSEL LEVEL WITH CONDENSATE, FEEDWATER FAILED
OLCF	OLC	1.0000E+00	G.F.
OLP1	OLP	4.7900E-04	OPERATOR CONTROLS LPCI/CS
OLPF	OLP	1.0000E+00	G.F.
OPTR1	OPTR	1.7960E-03	OPERATOR TRIPS 2 FEEDWATER PUMPS DURING A FEEDWATER RAMPUP
ORF1	ORF	4.1980E-04	OPERATOR RESTARTS FEEDWATER FOLLOWING LEVEL 8 TRIP
ORFF	ORF	1.0000E+00	G.F.
ORP1	ORP	9.5840E-05	OPERATOR FAILS TO START THE RHR AND CS PUMPS
ORP2	ORP	2.5820E-02	OPERATOR STARTS RHR/CS, HIGH PRESSURE INJECTION FAILED
ORP3	ORP	4.3660E-02	OPERATOR RESTORES EECW, STARTS RHR/CS, LOSP WITH POWER RECOVERED
ORPF	ORP	1.0000E+00	G.F.
OSD1	OSD	1.0130E-03	OPERATOR ALIGNS SDC BOTH RHR LOOPS AVAILABLE
OSD2	OSD	1.5380E-03	OPERATOR ALIGNS SDC ONE RHR LOOP AVAILABLE
OSDF	OSD	1.0000E+00	G.F.
OSL1	OSL	5.4420E-03	OPERATOR STARTS SLC, UNISOLATED VESSEL
OSL2	OSL	1.2420E-02	OPERATOR STARTS SLC, ISOLATED VESSEL
OSP1	OSP	7.8170E-05	OPERATOR ALIGNS SPC BOTH RHR LOOPS AVAILABLE, NON-ATWS
OSP2	OSP	5.7740E-03	OPERATOR ALIGNS SPC BOTH RHR LOOPS AVAILABLE - ATWS
OSP3	OSP	7.2130E-05	OPERATOR ALIGNS SPC ONE RHR LOOP AVAILABLE, NON-ATWS
OSPF	OSP	1.0000E+00	G.F.

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SF Name...	Top.......	SF Value...	Split Fraction Description*...............
OSV1	OSV	2.3330E-03	OPERATOR DEFEATS MSIV CLOSURE INTERLOCK DURING ATWS
OSVF	OSV	1.0000E+00	G.F.
OSW1	OSW	7.5160E-04	OPERATOR TRANSFERS MODE SWITCH TO REFUEL/SHUTDOWN
OUB1	OUB	2.8540E-03	OPERATOR TRANSFERS UNIT BOARDS, UNIT 1 OR 2 POWER LOST
OUB2	OUB	4.9230E-03	OPERATOR TRANSFERS UNIT BOARDS, UNIT 1 AND 2 POWER LOST
PCA1	PCA	4.4467E-03	ALL SUPPORT AVAILABLE
PCA2	PCA	4.8760E-03	UNAVAILABLEABILITY OF PCA SYSTEM GIVEN SUPPORT TO COMPRESSOR A OR D UNAVAILABLE
PCA3	PCA	3.2886E-02	UNAVAILABLEABILITY OF PCA SYSTEM GIVEN SUPPORT COMPRESSORS A AND D UNAVAILABLE
PCA4	PCA	5.1329E-02	UNAVAILABLEABILITY OF PCA SYSTEM GIVEN SUPPORT TO COMPRESSORS B AND C UNAVAILABLE
PCAF	PCA	1.0000E+00	G.F.
PX11	PX1	7.9450E-04	POWER AVAILABLE FROM 250 V DC RMOV BOARD 2B
PX1F	PX1	1.0000E+00	G.F.
PX21	PX2	7.9200E-04	POWER AVAILABLE FROM 250V DC RMOV BOARD 2A AND PX1 IS SUCCESS
PX22	PX2	3.8810E-03	POWER AVAILABLE FROM 250V DC RMOV BOARD 2A AND PX1 IS FAILED
PX23	PX2	7.9450E-04	POWER AVAILABLE FROM 250V DC RMOV BOARD 2A AND PX1 IS DISABLED/BYPASSED
PX2F	PX2	1.0000E+00	G.F.
R4801	R480	1.3000E-02	RECOVER 480 V RMOV BD 2A OR 2B
R480B	R480	0.0000E+00	BYPASS
RA1	RA	2.5380E-04	ALL SUPPORT AVAILABLE
RAF	RA	1.0000E+00	G.F.
RB1	RB	1.4420E-04	ALL SUPPORT AVAILABLE
RBC10	RBC	7.1009E-03	LOSP WITH NO ACCIDENT SIGNAL AND EECW

Table 3.3.5-1 (Page 30 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			UNAVAILABLE
RBC11	RBC	1.1418E-02	LOSP WITH AN ACCIDENT SIGNAL AND EECW UNAVAILABLE
RBC17	RBC	7.5184E-03	GIVEN ALL SUPPORT AVAILABLE EXCEPT RCW
RBC19	RBC	1.3106E-02	GIVEN ALL SUPPORT AVAILABLE EXCEPT LOSP & RCW UNAVAILABLE
RBC20	RBC	1.7493E-02	GIVEN ALL SUPPORT AVAILABLE WITH AN ACCIDENT SIGNAL EXCEPT LOSP & RCW
RBC4	RBC	1.7345E-03	GIVEN ALL SUPPORT AVAILABLE EXCEPT EECW
RBCF	RBC	1.0000E+00	G.F.
RBF	RB	1.0000E+00	G.F.
RBI1	RBI	1.1832E-01	ALL SUPPORT AVAILABLE
RBIF	RBI	1.0000E+00	G.F.
RBISOF	RBISO	1.0000E+00	REACTOR BUILDING NOT ISOLATED
RBISOS	RBISO	0.0000E+00	REACTOR BUILDING ISOLATED
RC1	RC	1.4420E-04	ALL SUPPORT AVAILABLEALBE
RCF	RC	1.0000E+00	G.F.
RCI1	RCI	6.6250E-02	RCIC FAILURE; ALL RCIC SUPPORT AVAILABLE
RCI2	RCI	6.6940E-02	RCIC FAILURE; GIVEN MANUAL START OF RCIC/HPCI FAILED(OHS=F)
RCIF	RCI	1.0000E+00	RCIC G.F.
RCL1	RCL	1.8220E-02	RCIC FAILURE; LONG TERM OPERATION; GIVEN EARLY OPERATOR CONTROL OF HPCI/RCIC (OHC=S)
RCL2	RCL	1.0700E-01	RCIC FAILURE; LONG TERM OPERATION; GIVEN OHC=F
RCLF	RCL	1.0000E+00	G.F. OF RCIC LONG TERM OPERATION
RCW1	RCW	2.5213E-05	ALL SUPPORT AVAILABLE
RCW10	RCW	4.2960E-05	POWER TO ONE OPERATING RCW PUMP (1A) AND PUMP 1D UNAVAILABLE
RCW12	RCW	1.1619E-03	POWER TO ALL UNIT 2 RCW PUMPS AND RCW PUMP 1D UNAVAILABLE
RCW13	RCW	8.2220E-04	POWER TO ONE OPERATING UNIT 1 AND ONE UNIT

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			2 PUMP, AND PUMP 1D UNAVAILABLE
RCW15	RCW	5.3649E-01	POWER TO ONE OPERATING UNIT 1 AND ALL UNIT 2 PUMPS, AND PUMP 1D UNAVAILABLE
RCW2	RCW	2.4872E-05	POWER TO ONE RCW PUMP (1A) UNAVAILABLE
RCW4	RCW	4.4808E-04	POWER TO ALL UNIT 2 RCW PUMPS UNAVAILABLE
RCW5	RCW	3.2888E-05	POWER TO ONE UNIT 1 PUMP AND ONE UNIT 2 PUMP UNAVAILABLE
RCW7	RCW	2.0175E-03	POWER TO ONE UNIT 1 PUMP AND ALL UNIT 2 PUMPS UNAVAILABLE
RCW9	RCW	2.5659E-05	POWER TO RCW PUMP 1D UNAVAILABLE
RCWF	RCW	1.0000E+00	G.F.
RD1	RD	1.4420E-04	ALL SUPPORT AVAILABLE
RDF	RD	1.0000E+00	G.F.
RE1	RE	2.7103E-04	ALL SUPPORT AVAILABLE
REF	RE	1.0000E+00	G.F.
RF1	RF	2.7103E-04	ALL SUPPORTS AVAILABLE
RFF	RF	1.0000E+00	G.F.
RG1	RG	5.4206E-04	ALL SUPPORT AVAILABLE
RGF	RG	1.0000E+00	G.F.
RH1	RH	1.6143E-04	ALL SUPPORTS AVAILABLE
RHF	RH	1.0000E+00	G.F.
RI1	RI	1.6143E-04	ALL SUPPORTS AVAILABLE
RIF	RI	1.0000E+00	G.F.
RJ1	RJ	1.6143E-04	ALL SUPPORTS AVAILABLE
RJF	RJ	1.0000E+00	G.F.
RK1	RK	1.3490E-04	ALL SUPPORT AVAILABLE
RK2	RK	1.0160E-03	LOSS OF ALTERNATE SUPPLY
RK3	RK	2.4290E-02	LOSS OF NORMAL SUPPLY
RKF	RK	1.0000E+00	G.F.
RL1	RL	1.3490E-04	ALL SUPPORT, RK SUCCESS
RL2	RL	1.5230E-04	ALL SUPPORT, RK FAILS
RL3	RL	1.3490E-04	RK FAILS BY SUPPORT

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Table 3.3.5-1 (Page 32 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
RL4	RL	1.0170E-03	RK SUCCESS, SHUTDOWN BOARD 2A FAILS
RL5	RL	9.7800E-04	RK FAILS, SHUTDOWN BOARD 2A FAILS
RL6	RL	2.4290E-02	RK SUCCESS, SHUTDOWN BOARD 2B FAILS
RL7	RL	2.3950E-02	RK FAILS, SHUTDOWN BOARD 2B FAILS
RLF	RL	1.0000E+00	G.F.
RM1	RM	3.4305E-04	ALL SUPPORTS AVAILABLE
RMF	RM	1.0000E+00	G.F.
RN1	RN	3.4305E-04	ALL SUPPORTS AVAILABLE
RNF	RN	1.0000E+00	G.F.
RO1	RO	2.7103E-04	ALL SUPPORTS AVAILABLE
ROF	RO	1.0000E+00	G.F.
RP1	RP	2.5662E-04	ALL SUPPORTS AVAILABLE
RPA1	RPA	1.3130E-02	RHR PUMP A FAILS, ALL SUPPORT AVAILABLE
RPAF	RPA	1.0000E+00	RHR PUMP A G.F.
RPB1	RPB	1.2750E-02	RHR PUMP B FAILURE ALL SUPPORT AVAILABLE, RPA=S, RPC=S
RPB2	RPB	1.9040E-02	RHR PUMP B FAILURE GIVEN RPA=F OR RPC=F (WITH OTHER SUCCESS)
RPB3	RPB	3.7290E-02	RHR PUMP B FAILURE GIVEN RPA=F AND RPC=F
RPB4	RPB	1.3130E-02	RHR PUMP B FAILURE GIVEN RPA=B AND RPC=B
RPB5	RPB	1.2890E-02	RHR PUMP B FAILURE GIVEN RPA=B OR RPC=B (WITH OTHER SUCCESS)
RPB6	RPB	3.4260E-01	RHR PUMP B FAILURE GIVEN RPA=F AND RPC=B, OR RPA=B AND RPC=F
RPBF	RPB	1.0000E+00	RHR PUMP B G.F.
RPC1	RPC	8.7460E-03	RHR PUMP C FAILURE, ALL SUPPORT AVAILABLE, RPA=S
RPC2	RPC	3.4260E-01	RHR PUMP C FAILURE GIVEN RPA=F
RPC3	RPC	1.3130E-02	RHR PUMP C FAILURE GIVEN RPA NOT ASKED
RPCF	RPC	1.0000E+00	RHR PUMP C G.F.
RPD1	RPD	8.5010E-03	RHR PUMP D FAILURE ALL SUPPORT AVAILABLE, RP(A,B,C)=S,S,S

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Table 3.3.5-1 (Page 33 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
RPD10	RPD	4.0910E-01	RHR PUMP D FAILURE GIVEN 1 PREVIOUS BYPASS AND 2 FAILURES (MODELED AS RPC & RPD FAILED)
RPD2	RPD	3.4200E-01	RHR PUMP D FAILURE GIVEN RPA,RPC OR RPB=F (MODELED AS RPB=F)
RPD3	RPD	2.5890E-01	RHR PUMP D FAILURE GIVEN 2 PREVIOUS FAILURES (MODELED AS RPA OR RPC FAILED AND RPB FAILED)
RPD4	RPD	6.2610E-01	RHR PUMP D FAILURE GIVEN RPA, RPC AND RPB =F
RPD5	RPD	1.3130E-02	RHR PUMP D FAILURE GIVEN RPA, RPC AND RPB=B
RPD6	RPD	1.2890E-02	RHR PUMP D FAILURE GIVEN RPA OR RPC=B, AND RPB=B
RPD7	RPD	3.4260E-01	RHR PUMP D FAILURE GIVEN 2 PREVIOUS BYPASSES AND A FAILURE (MODELED AS RPB=F)
RPD8	RPD	1.2750E-02	RHR PUMP D FAILURE GIVEN 1 PREVIOUS BYPASS AND 2 SUCCESSES (MODELED AS RPB=B)
RPD9	RPD	3.4040E-01	RHR PUMP D FAILURE GIVEN 1 PREVIOUS SUCCESS, 1 BYPASS, 1 SUCCESS, 1 FAILURE (MODELED AS RPB=F)
RPDF	RPD	1.0000E+00	RHR PUMP D G.F.
RPF	RP	1.0000E+00	G.F.
RPS0	RPS	0.0000E+00	REACTOR SCRAM - G.S.
RPS1	RPS	1.7848E-05	REACTOR SCRAM - ALL SUPP. AVAILABLE
RPS10	RPS	1.3696E-06	REACTOR SCRAM - LOSS OF CONTROL AIR OR (RH AND RI)
RPS11	RPS	1.0257E-03	REACTOR SCRAM - LOFW, LVP FAILED(MANUAL SCRAM ONLY)
RPS2	RPS	1.7848E-05	REACTOR SCRAM - LOSS OF DB OR DD
RPS3	RPS	1.8701E-05	REACTOR SCRAM - LOSS OF DB AND DD
RPS4	RPS	1.7848E-05	REACTOR SCRAM - LOSS OF RB OR RC
RPS5	RPS	1.7848E-05	REACTOR SCRAM - LOSS OF (RB OR RC) AND (DB OR DD)

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Table 3.3.5-1 (Page 34 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
RPS6	RPS	1.8701E-05	REACTOR SCRAM - LOSS OF (RB OR RC) AND DB AND DD
RPS7	RPS	1.7848E-05	REACTOR SCRAM - LOSS OF RB AND RC
RPS8	RPS	1.7848E-05	REACTOR SCRAM - LOSS OF RB AND RC AND (DB OR DD)
RPS9	RPS	1.8701E-05	REACTOR SCRAM - LOSS OF RB AND RC AND DB AND DD
RPT1	RPT	1.0732E-04	RPTS WITH TURBINE TRIPPED - ALL SUPPORTS AVAILABLE
RPT2	RPT	1.1123E-04	RPTS WITH TURBINE TRIPPED - ONE ATWS-RPT DIV DISABLED
RPT3	RPT	1.1308E-04	RPTS WITH TURBINE TRIPPED - ATWS-RPT (BOTH DIVISIONS) DISABLED
RPT4	RPT	1.1536E-04	RPTS WITH TURBINE TRIPPED - ONE RPT-EOC DIV DISABLED
RPT5	RPT	8.2781E-03	RPTS WITH TURBINE TRIPPED - ONE ATWS-RPT AND ONE EOC-RPT DIV TO SAME PAIR OF BREAKERS DISABLED
RPT6	RPT	1.1752E-04	RPTS WITH TURBINE TRIPPED - ONE EOC-RPT DIV AND OPPOSITE ATWS-RPT DIV DISABLED
RPT7	RPT	8.0644E-03	RPTS WITH TURBINE TRIPPED - ONE EOC-RPT AND BOTH ATWS-RPT DIVISIONS DISABLED
RPT8	RPT	1.4739E-04	RPTS WITH NO TURBINE TRIP (EOC-RPT UNAVAILABLE) - ALL SUPPORTS AVAILABLE TO ATWS-RPT
RPT9	RPT	9.2513E-03	RPTS WITH NO TURBINE TRIP - ONE ATWS-RPT DIV DISABLED
RPTF	RPT	1.0000E+00	RPTS WITH NO SUPPORTS AVAILABLE (GUARANTEED FAILED)
RVC0	RVC	9.3210E-01	NON-ATWS, 0 SRV STUCK OPEN
RVC1	RVC	6.1540E-02	NON-ATWS, 1 SRV STUCK OPEN
RVC2	RVC	4.2540E-03	NON-ATWS, 2 SRVs STUCK OPEN
RVC3	RVC	4.4020E-04	NON-ATWS, 3 OR MORE SRVs STUCK OPEN

Table 3.3.5-1 (Page 35 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
RVC4	RVC	8.9920E-01	ATWS, 0 SRV STUCK OPEN
RVC5	RVC	9.2600E-02	ATWS, 1 SRV STUCK OPEN
RVC6	RVC	9.6170E-03	ATWS, 2 SRVs STUCK OPEN
RVC7	RVC	2.3340E-03	ATWS, 3 OR MORE SRVs STUCK OPEN
RVC8	RVC	0.0000E+00	NOT BRANCH OF INTEREST
RVC9	RVC	1.0000E+00	BRANCH OF INTEREST
RVD0	RVD	0.0000E+00	FAILURE BRANCH, ONE OR TWO SRVS NEEDED, HPCI/RCIC FAILURE, 1 OR MORE STUCK OPEN SRVS
RVD1	RVD	9.9310E-01	REMOTE-MANUAL BRANCH, ONE SRV NEEDED, 0, 1 OR MORE STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD10	RVD	9.9310E-01	REMOTE-MANUAL BRANCH, THREE SRVS NEEDED, HPCI/RCIC HARDWARE FAILURE, 0 STUCK OPEN SRVS, 6 SRVS AVAILABLE
RVD11	RVD	9.4460E-01	REMOTE-MANUAL BRANCH, THREE SRVS NEEDED, HPCI/RCIC OPERATOR FAILURE, 0 STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD12	RVD	9.4910E-01	REMOTE-MANUAL BRANCH, THREE SRVS NEEDED, HPCI/RCIC OPERATOR FAILURE, 0 STUCK OPEN SRVS, 6 SRVS AVAILABLE
RVD13	RVD	6.9000E-03	OVERPRESSURE BRANCH, ONE SRV NEEDED, HPCI/RCIC HARDWARE FAILURE, 1 OR MORE STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD14	RVD	5.8000E-03	OVERPRESSURE BRANCH, ONE SRV NEEDED, HPCI/RCIC HARDWARE FAILURE, 1 OR MORE STUCK OPEN SRVS, 6 SRVS AVAILABLE
RVD15	RVD	5.2000E-02	OVERPRESSURE BRANCH, ONE SRV NEEDED, HPCI/RCIC OPERATOR FAILURE, 1 OR MORE STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD16	RVD	5.1700E-02	OVERPRESSURE BRANCH, ONE SRV NEEDED, HPCI/RCIC OPERATOR FAILURE, 1 OR MORE STUCK OPEN SRVS, 6 SRVS AVAILABLE

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Table 3.3.5-1 (Page 36 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
RVD17	RVD	7.3000E-03	OVERPRESSURE BRANCH, TWO SRV NEEDED, HPCI/RCIC HARDWARE FAILURE, 1 STUCK OPEN SRV, 4 SRVS AVAILABLE
RVD18	RVD	5.6000E-03	OVERPRESSURE BRANCH, TWO SRV NEEDED, HPCI/RCIC HARDWARE FAILURE, 1 STUCK OPEN SRV, 6 SRVS AVAILABLE
RVD19	RVD	5.6100E-02	OVERPRESSURE BRANCH, TWO SRV NEEDED, HPCI/RCIC OPERATOR FAILURE, 1 STUCK OPEN SRV, 4 SRVS AVAILABLE
RVD2	RVD	9.9420E-01	REMOTE-MANUAL BRANCH, ONE SRV NEEDED, 0, 1 OR MORE STUCK OPEN SRVS, 6 SRVS AVAILABLE
RVD20	RVD	6.0500E-02	OVERPRESSURE BRANCH, TWO SRV NEEDED, HPCI/RCIC OPERATOR FAILURE, 1 STUCK OPEN SRV, 6 SRVS AVAILABLE
RVD21	RVD	1.0100E-02	OVERPRESSURE BRANCH, THREE SRVS NEEDED, HPCI/RCIC HARDWARE FAILURE, 1 STUCK OPEN SRV, 4 SRVS AVAILABLE
RVD22	RVD	6.9000E-03	OVERPRESSURE BRANCH, THREE SRVS NEEDED, HPCI/RCIC HARDWARE FAILURE, 1 STUCK OPEN SRV, 6 SRVS AVAILABLE
RVD23	RVD	5.5400E-02	OVERPRESSURE BRANCH, THREE SRVS NEEDED, HPCI/RCIC OPERATOR FAILURE, 1 STUCK OPEN SRV, 4 SRVS AVAILABLE
RVD24	RVD	5.0899E-02	OVERPRESSURE BRANCH, THREE SRVS NEEDED, HPCI/RCIC OPERATOR FAILURE, 1 STUCK OPEN SRV, 6 SRVS AVAILABLE
RVD25	RVD	2.0340E-08	FAILURE BRANCH, ONE SRV NEEDED, HPCI/RCIC SUCCESS, NO STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD26	RVD	2.2610E-08	FAILURE BRANCH, ONE SRV NEEDED, HPCI/RCIC SUCCESS, NO STUCK OPEN SRVS, 6 SRVS AVAILABLE

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Table 3.3.5-1 (Page 37 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
RVD29	RVD	9.3310E-08	FAILURE BRANCH, TWO SRV NEEDED, HPCI/RCIC HARDWARE FAILURE, 0 STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD3	RVD	9.4800E-01	REMOTE-MANUAL BRANCH, ONE SRV NEEDED, HPCI/RCIC OPERATOR FAILURE, 1 OR MORE STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD30	RVD	5.7720E-09	FAILURE BRANCH, TWO SRV NEEDED, HPCI/RCIC HARDWARE FAILURE, 0 STUCK OPEN SRVS, 6 SRVS AVAILABLE
RVD31	RVD	7.1950E-07	FAILURE BRANCH, TWO SRV NEEDED, HPCI/RCIC OPERATOR FAILURE, 0 STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD32	RVD	1.2860E-06	FAILURE BRANCH, TWO SRV NEEDED, HPCI/RCIC OPERATOR FAILURE, 0 STUCK OPEN SRVS, 6 SRVS AVAILABLE
RVD33	RVD	1.2940E-07	FAILURE BRANCH, THREE SRVS NEEDED, HPCI/RCIC HARDWARE FAILURE, 1 STUCK OPEN SRV, 4 SRVS AVAILABLE
RVD34	RVD	5.7730E-09	FAILURE BRANCH, THREE SRVS NEEDED, HPCI/RCIC HARDWARE FAILURE, 1 STUCK OPEN SRV, 6 SRVS AVAILABLE
RVD35	RVD	7.1040E-07	FAILURE BRANCH, THREE SRVS NEEDED, HPCI/RCIC OPERATOR FAILURE, 1 STUCK OPEN SRV, 4 SRVS AVAILABLE
RVD36	RVD	1.2860E-06	FAILURE BRANCH, THREE SRVS NEEDED, HPCI/RCIC OPERATOR FAILURE, 1 STUCK OPEN SRV, 6 SRVS AVAILABLE
RVD37	RVD	6.9000E-03	OVERPRESSURE BRANCH, ONE SRV NEEDED, HPCI/RCIC SUCCESS, NO STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD38	RVD	5.8000E-03	OVERPRESSURE BRANCH, ONE SRV NEEDED, HPCI/RCIC SUCCESS, NO STUCK OPEN SRVS,

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			6 SRVS AVAILABLE
RVD39	RVD	7.3000E-03	OVERPRESSURE BRANCH, TWO SRV NEEDED, HPCI/RCIC HARDWARE FAILURE, NO STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD4	RVD	9.4830E-01	REMOTE-MANUAL BRANCH, ONE SRV NEEDED, HPCI/RCIC OPERATOR FAILURE, 1 OR MORE STUCK OPEN SRVS, 6 SRVS AVAILABLE
RVD40	RVD	5.6000E-03	OVERPRESSURE BRANCH, TWO SRV NEEDED, HPCI/RCIC HARDWARE FAILURE, NO STUCK OPEN SRVS, 6 SRVS AVAILABLE
RVD41	RVD	5.6100E-02	OVERPRESSURE BRANCH, TWO SRV NEEDED, HPCI/RCIC OPERATOR FAILURE, NO STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD42	RVD	6.0499E-02	OVERPRESSURE BRANCH, TWO SRV NEEDED, HPCI/RCIC OPERATOR FAILURE, NO STUCK OPEN SRVS, 6 SRVS AVAILABLE
RVD43	RVD	0.0000E+00	NOT BRANCH OF INTEREST
RVD44	RVD	0.0000E+00	NOT BRANCH OF INTEREST
RVD45	RVD	1.0000E+00	BRANCH OF INTEREST
RVD5	RVD	9.9270E-01	REMOTE-MANUAL BRANCH, TWO SRV NEEDED, HPCI/RCIC HARDWARE FAILURE, 0 OR 1 STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD6	RVD	9.9440E-01	REMOTE-MANUAL BRANCH, TWO SRV NEEDED, HPCI/RCIC HARDWARE FAILURE, 0 OR 1 STUCK OPEN SRVS, 6 SRVS AVAILABLE
RVD7	RVD	9.4390E-01	REMOTE-MANUAL BRANCH, TWO SRV NEEDED, HPCI/RCIC OPERATOR FAILURE, 0 OR 1 STUCK OPEN SRVS, 4 SRVS AVAILABLE
RVD8	RVD	9.3950E-01	REMOTE-MANUAL BRANCH, TWO SRV NEEDED, HPCI/RCIC OPERATOR FAILURE, 0 OR 1 STUCK OPEN SRVS, 6 SRVS AVAILABLE
RVD9	RVD	9.8990E-01	REMOTE-MANUAL BRANCH, THREE SRVS NEEDED,

Table 3.3.5-1 (Page 39 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			HPCI/RCIC HARDWARE FAILURE, 1 STUCK OPEN SRV, 4 SRVS AVAILABLE
RVL0	RVL	0.0000E+00	ATWS-EVENT TREE BYPASS
RVL1	RVL	2.0340E-08	RELIEF OR SAFETY MODE - PWR4
RVL2	RVL	2.2610E-08	RELIEF OR SAFETY MODE - PWR6
RVL3	RVL	6.8870E-03	RELIEF MODE - PWR4
RVL4	RVL	5.7910E-03	RELIEF MODE - PWR6
RVO1	RVO	1.3220E-05	NON-ATWS
RVO2	RVO	1.3720E-05	ATWS
RVOB	RVO	0.0000E+00	BYPASS
SDC1	SDC	1.1326E-02	SHUTDOWN COOLING FAILURE ALL SUPPORT AVAILABLE
SDC2	SDC	2.6635E-02	SHUTDOWN COOLING FAILURE, ONE RHR LOOP FAILED
SDCF	SDC	1.0000E+00	SHUTDOWN COOLING G.F.
SGT1	SGT	1.5514E-03	GIVEN ALL SUPPORT
SGT2	SGT	1.1099E-02	GIVEN ALL SUPPORT AVAILABLE EXCEPT DM
SGT4	SGT	1.2845E-02	GIVEN ALL SUPPORT AVAILABLE EXCEPT DN & AA UNAVAILABLE
SGT5	SGT	2.6906E-02	GIVEN ALL SUPPORT AVAILABLE EXCEPT A3ED
SGT6	SGT	2.8724E-02	GIVEN ALL SUPPORT AVAILABLE EXCEPT A3ED AND AA UNAVAILABLE
SGT8	SGT	3.0454E-02	GIVEN ALL SUPPORT AVAILABLE EXCEPT A3ED, DN & AA UNAVAILABLE
SGT9	SGT	3.0668E-02	GIVEN ALL SUPPORT AVAILABLE EXCEPT RM
SGTF	SGT	1.0000E+00	GUARANTEED FAILURE
SGTOPF	SGTOP	1.0000E+00	STANDBY GAS TREATMENT OR HUMIDIFIERS NOT OPERATING
SGTOPS	SGTOP	0.0000E+00	STANDBY GAS TREATMENT AND HUMIDIFIERS OPERATING
SHT21	SHUT2	1.0750E-04	ALL SUPPORT AVAILABLE, SHUT1 AVAILABLE
SHT210	SHUT2	1.9540E-03	SHUT1 AVAILABLE, UB41A AND UB42A FAILED
SHT211	SHUT2	1.5410E-04	SHUT1 AVAILABLE, UB41A AND UB41B FAILED

Table 3.3.5-1 (Page 40 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
SHT212	SHUT2	2.3880E-03	SHUT1 AVAILABLE, UB42A AND UB42B FAILED
SHT213	SHUT2	1.5410E-04	SHUT1 AVAILABLE, UB41B AND UB42B FAILED
SHT214	SHUT2	1.8390E-01	SHUT1 FAILED, UB41A AND UB42A FAILED
SHT215	SHUT2	1.6880E-04	SHUT1 FAILED, UB41A AND UB41B FAILED
SHT216	SHUT2	2.6160E-03	SHUT1 FAILED, UB42A AND UB42B FAILED
SHT217	SHUT2	1.1560E-04	SHUT1 FAILED, UB41B AND UB42B FAILED
SHT22	SHUT2	1.0750E-04	SHUT1 AVAILABLE, UB41A FAILED
SHT23	SHUT2	1.0750E-04	SHUT1 AVAILABLE, UB42B FAILED
SHT24	SHUT2	1.0750E-04	SHUT1 AVAILABLE, UB41A AND UB42B FAILED
SHT25	SHUT2	2.3880E-03	SHUT1 AVAILABLE, UB41A, UB42A AND UB42B FAILED
SHT26	SHUT2	1.5410E-04	SHUT1 AVAILABLE, UB41A, UB41B AND UB42B FAILED
SHT27	SHUT2	2.5490E-05	SHUT1 FAILED
SHT28	SHUT2	1.1730E-04	SHUT1 AND UB41A FAILED
SHT29	SHUT2	5.0810E-05	SHUT1 AND UB42B FAILED
SHT2F	SHUT2	1.0000E+00	G.F.
SHUT11	SHUT1	1.0750E-04	ALL SUPPORT AVAILABLE
SHUT12	SHUT1	2.3880E-03	UB41A FAILED
SHUT13	SHUT1	1.5410E-04	UB42B FAILED
SHUT1F	SHUT1	1.0000E+00	G.F.
SL1	SL	5.7591E-03	ALL SUPPORT AVAILABLE
SL2	SL	2.7449E-02	SUPPORT TO ONE SLC PUMP DIVISION AND TWO RWCU ISOLATION VALVES AVAILABLE
SL3	SL	3.1245E-02	SUPPORT TO ONE SLC PUMP DIVISION AND ONE RWCU ISOLATION VALVE AVAILABLE
SLF	SL	1.0000E+00	G.F.
SP1	SP	7.4123E-04	SUPPRESSION POOL COOLING ALL SUPPORT AVAILABLE
SP2	SP	2.5350E-02	SUPPRESSION POOL COOLING DURING ATWS
SP3	SP	1.3160E-02	SUPPRESSION POOL COOLING, ONE LOOP RHR FAILED
SPF	SP	1.0000E+00	SUPPRESSION POOL COOLING G.F.

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SF Name...	Top.......	SF Value...	Split Fraction Description*................
SPR1	SPR	7.0000E-02	OPERATOR RECOVERS SUPPRESSION POOL COOLING
SPRF	SPR	1.0000E+00	OPERATOR FAILS TO RECOVER SUPPRESSION POOL COOLING
SW1A1	SW1A	1.3430E-02	RHRSW PUMP A1, A2 FAILS, ALL SUPPORTS AVAILABLE
SW1AB	SW1A	0.0000E+00	RHRSW PUMP A1 BYPASS, A2 SUCCESS
SW1AF	SW1A	1.0000E+00	RHRSW PUMP A1 G.F.
SW1B1	SW1B	1.3890E-02	RHRSW PUMP B1, B2 FAILS, ALL SUPPORTS AVAILABLE
SW1B2	SW1B	6.6980E-02	RHRSW PUMP B12, B2 G.F., ALL SUPPORTS AVAILABLE
SW1BB	SW1B	0.0000E+00	RHRSW PUMP B1 BYPASS, B2 SUCCESS
SW1BF	SW1B	1.0000E+00	RHRSW PUMP B1 G.F.
SW1C1	SW1C	1.2520E-02	RHRSW PUMP C1, ALL SUPPORTS AVAILABLE, C2 FAILS, A2 SUCCESS, A1 BYPASS
SW1C2	SW1C	7.9910E-02	RHRSW PUMP C1, ALL SUPPORTS AVAILABLE, A2 FAILS, A1 SUCCESS, C2 FAILS
SW1C3	SW1C	3.1470E-01	RHRSW PUMP C1, ALL SUPPORTS AVAILABLE, A2, A1, C2 ALL FAIL
SW1C4	SW1C	1.3430E-02	RHRSW PUMP C1, ALL SUPPORTS AVAILABLE, C2 FAILS, A2 AND A1 G.F.
SW1CB	SW1C	0.0000E+00	RHRSW PUMP C1 BYPASS, C2 SUCCESS
SW1CF	SW1C	1.0000E+00	RHRSW PUMP C1 G.F.
SW1D1	SW1D	1.3070E-02	RHRSW PUMP D1, ALL SUPPORTS AVAILABLE, D2 FAILS
SW1D10	SW1D	6.6980E-02	RHRSW PUMP D1, ALL SUPPORTS AVAILABLE, B1, B2 AND D2 ALL G.F.
SW1D2	SW1D	6.0900E-02	RHRSW PUMP D1, ALL SUPPORTS AVAILABLE, B2 AND D2 FAIL, B1 SUCCESS
SW1D3	SW1D	3.1100E-01	RHRSW PUMP D1, ALL SUPPORTS AVAILABLE, B2, B1 AND D2 ALL FAIL
SW1D4	SW1D	8.1210E-02	RHRSW PUMP D1, B1 FAILS, (B2 G.F. AND D2

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			FAILS) OR (D2 G.F. AND B2 FAILS), ALL SUPPORTS AVAILABLE
SW1D5	SW1D	1.2880E-02	RHRSW PUMP D1, B1 SUCCESS, B2 G.F., D2 FAILS, ALL SUPPORTS AVAILABLE
SW1D6	SW1D	1.3890E-02	RHRSW PUMP D1, ALL SUPPORTS AVAILABLE, 2/3 OF (B2,B1,D2) G.F. AND THE THIRD ONE FAILS
SW1D7	SW1D	6.8960E-02	RHRSW PUMP D1, ALL SUPPORTS AVAILABLE, B2 SUCCESS, B1 BYPASS, D2 FAILS
SW1D8	SW1D	1.2880E-02	RHRSW PUMP D1, ALL SUPPORTS AVAILABLE, D2 G.F, B1 SUCCESS, B2 FAILS
SW1D9	SW1D	7.0930E-02	RHRSW PUMP D1, ALL SUPPORTS AVAILABLE, B2 AND D2 G.F., B1 SUCCESS
SW1DB	SW1D	0.0000E+00	RHRSW PUMP D1 BYPASS
SW1DF	SW1D	1.0000E+00	RHRSW PUMP D1 G.F.
SW2A1	SW2A	3.5890E-02	RHRSW PUMP A2, ALL SUPPORTS AVAILABLE
SW2AF	SW2A	1.0000E+00	RHRSW PUMP A2 G.F.
SW2B1	SW2B	3.5910E-02	RHRSW PUMP B2, ALL SUPPORTS AVAILABLE
SW2BF	SW2B	1.0000E+00	RHRSW PUMP B2 G.F.
SW2C1	SW2C	3.6860E-02	RHRSW PUMP C2, A2 SUCCESS, A1 BYPASS, ALL SUPPORT AVAILABLE
SW2C2	SW2C	8.8990E-03	RHRSW PUMP C2, A2 FAILS, A1 SUCCESS, ALL SUPPORT AVAILABLE
SW2C3	SW2C	7.6260E-02	RHRSW PUMP C2, A2 AND A1 FAIL, ALL SUPPORTS AVAILABLE
SW2C4	SW2C	3.5890E-02	RHRSW PUMP C2, A2 AND A1 G.F., ALL SUPPORTS AVAILABLE
SW2CF	SW2C	1.0000E+00	RHRSW PUMP C2 G.F.
SW2D1	SW2D	3.6800E-02	RHRSW PUMP D2, ALL SUPPORTS AVAILABLE, 2B SUCCESS, 1B BYPASS
SW2D2	SW2D	1.1170E-02	RHRSW PUMP D2, ALL SUPPORTS AVAILABLE, B2 FAILS, B1 SUCCESS
SW2D3	SW2D	7.0110E-02	RHRSW PUMP D2, ALL SUPPORTS AVAILABLE, B2 AND

Table 3.3.5-1 (Page 43 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
			B1 FAILS
SW2D4	SW2D	1.1990E-02	RHRSW PUMP D2, ALL SUPPORTS AVAILABLE, B2 FAILS, B1 G.F.
SW2D5	SW2D	3.5910E-02	RHRSW PUMP D2, ALL SUPPORTS AVAILABLE, B2 AND B1 G.F.
SW2D6	SW2D	3.7950E-02	RHRSW PUMP D2, ALL SUPPORTS AVAILABLE, B2 G.F., B1 SUCCESS
SW2DF	SW2D	1.0000E+00	RHRSW PUMP D2 G.F.
TB0	TB	0.0000E+00	G.S.
TB1	TB	1.6219E-02	ALL SUPPORT AVAILABLE
TB2	TB	6.0058E-02	UB42B FAILS
TB3	TB	6.0794E-02	UB42A FAILS
TBB	TB	0.0000E+00	G.S.
TBF	TB	1.0000E+00	G.F.
TOR1	TOR	3.6254E-04	GIVEN MEDIUM, LARGE, OR EXCESSIVE LOCA
TOR2	TOR	1.2970E-06	GIVEN GENERAL TRANSIENTS OR SMALL LOCA
TORF	TOR	1.0000E+00	G.F.
U11	U1	5.3057E-02	TOP EVENT U1 WITH ALL SUPPORT SYSTEMS AVAILABLE
U1F	U1	1.0000E+00	TOP EVENT U1 G.F. DUE TO SUPPORT SYSTEM FAILURE
U3F	U3	1.0000E+00	UNIT 3 CROSSTIE G.F.
UB41A1	UB41A	2.3330E-04	ONE DIVISION WITH NO TRANSFER
UB41A2	UB41A	2.2390E-04	ONE DIVISION WITH TRANSFER
UB41AF	UB41A	1.0000E+00	G.F.
UB41B1	UB41B	2.3330E-04	UNIT BOARD 1B FAILS WITH NO TRANSFER
UB41B2	UB41B	2.2400E-04	UNIT BOARD 1B FAILS WITH TRANSFER, UNIT BOARD 1A SUCCESS
UB41B3	UB41B	3.5360E-05	UNIT BOARD 1B FAILS WITH TRANSFER, UNIT BOARD 1A FAILED
UB41BF	UB41B	1.0000E+00	G.F.
UB42A1	UB42A	2.3330E-04	UNIT BOARD 2A FAILS WITH NO TRANSFER

Table 3.3.5-1 (Page 44 of 45). Browns Ferry System Quantification Results

SF Name...	Top.......	SF Value...	Split Fraction Description*...............
UB42A2	UB42A	2.2390E-04	UNIT BOARD 2A FAILS WITH TRANSFER, UNIT BOARD 1A & 1B G.F.
UB42A3	UB42A	2.2400E-04	UNIT BOARD 2A FAILS WITH TRANSFER, UNIT BOARD 1A & 1B SUCCESS
UB42A4	UB42A	3.5360E-05	UNIT BOARD 2A FAILS WITH TRANSFER, UNIT BOARD 1A OR 1B FAILED
UB42A5	UB42A	1.9060E-05	UNIT BOARD 2A FAILS WITH TRANSFER, UNIT BOARD 1A & 1B FAILED
UB42AF	UB42A	1.0000E+00	G.F.
UB42B1	UB42B	2.3330E-04	UNIT BOARD 2B FAILS WITH NO TRANSFER
UB42B2	UB42B	2.2400E-04	UNIT BOARD 2B FAILS WITH TRANSFER, UNIT BOARD 1A & 1B G.F.
UB42B3	UB42B	3.5360E-05	UNIT BOARD 2B FAILS WITH TRANSFER, UNIT BOARD 2A FAILED, UNIT BOARD 1A & 1B GUARANTEED FAILED
UB42B4	UB42B	2.2410E-04	UNIT BOARD 2B FAILS WITH TRANSFER, UNIT BOARD 1A, 1B & 2A SUCCESS
UB42B5	UB42B	3.5370E-05	UNIT BOARD 2B FAILS WITH TRANSFER, UNIT BOARD 1A, 1B OR 2A FAILED
UB42B6	UB42B	1.9060E-05	UNIT BOARD 2B FAILS WITH TRANSFER, 2 OF UNIT BOARDS 1A, 1B AND 2A FAILED
UB42B7	UB42B	5.9330E-05	UNIT BOARD 2B FAILS WITH TRANSFER, UNIT BOARD 1A,1B & 2A FAILED
UB42BF	UB42B	1.0000E+00	G.F.
UB42C1	UB42C	1.2844E-04	ALL SUPPORTS AVAILABLE
UB42C2	UB42C	1.5245E-04	OG16 UNAVAILABLE
UB42CF	UB42C	1.0000E+00	G.F.
UB43A1	UB43A	2.2316E-04	ALL SUPPORTS AVAILABLE
UB43AF	UB43A	1.0000E+00	G.F.
UB43B1	UB43B	2.3311E-04	ALL SUPPORTS AVAILABLE
UB43BF	UB43B	1.0000E+00	G.F.
V1S	V1	0.0000E+00	GUARANTEED SUCCESS

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SF Name...	Top.......	SF Value...	Split Fraction Description*...............
V2S	V2	0.0000E+00	GUARANTEED SUCCESS
V3S	V3	0.0000E+00	GUARANTEED SUCCESS
VNTF	VNT	1.0000E+00	G.F.
VT1F	VT1	1.0000E+00	REACTOR VESSEL LOOP I INSTRUMENT TAPS FAILURE HAS NOT OCCURRED
VT1S	VT1	0.0000E+00	REACTOR VESSEL LOOP I INSTRUMENT TAPS FAILURE OCCURRED
VT2F	VT2	1.0000E+00	REACTOR VESSEL LOOP II INSTRUMENT TAPS FAILURE HAS NOT OCCURRED
VT2S	VT2	0.0000E+00	REACTOR VESSEL LOOP II INSTRUMENT TAPS FAILURE OCCURRED
WETF	WET	1.0000E+00	NO WATER ON DRYWELL FLOOR AT VESSEL MELT-THROUGH
WETS	WET	0.0000E+00	WATER ON DRYWELL FLOOR AT VESSEL MELT-THROUGH

*The terms "lost," "failed," and "unavailable" are used interchangeably in split fraction descriptions to identify the states of previous top events upon which the current top event depends. Occasionally, the mode of failure of a preceding top event (i.e., by a loss of its support or by an intrinsic failure) can influence the evaluation of the current top event. When the mode of failure of previous top events can influence the split fraction failure quantification, and the preceding top event failed due to a support failure, this is noted by the phrase "by support." Otherwise, it is failed due to intrinsic failures.

The term G.F. stands for guaranteed failed. This term is reserved for split fraction conditions that lead to a known failure of the associated top event.

3.3.6 GENERATION OF SUPPORT SYSTEM STATES

The IPE methodology employed by TVA in performance of the Browns Ferry PRA uses the RISKMAN workstation software and linked event trees. This methodology does not develop specific support system states; it completely links the support system calculations with the frontline analysis to ensure that frontline-to-support system dependencies are accurately tracked. A discussion of the PRA methodology employed is provided in Section 2.3.

3.3.7 QUANTIFICATION OF SEQUENCE FREQUENCIES

This section describes the sequence quantification process. The list of initiating events quantified through the plant sequence model is presented in Section 3.1.1. The event tree models that are constructed to describe the plant response to each of these initiator groups are presented in Sections 3.1.2 through 3.1.4. Figure 3.3.7-1 illustrates the linking of the event tree structures, which is performed to delineate the accident sequences from the initiating event categories to the plant damage states. The same support model event trees are used for each of the analyzed initiating event categories. The particular frontline event tree models used vary, depending on the initiating event category. Table 3.3.7-1 identifies the sequence of event trees that is used for each initiating event category.

An illustration of the event tree sequence quantification process is provided in Figure 3.3.7-2. Each sequence through the group of trees is quantified one at a time. The frequency of each sequence is calculated by multiplying the initiating event frequency, expressed in units of expected events per year, by the product of the branch split fraction values along that sequence path. The result is a sequence frequency expressed in units of events per year. Both success and failure branches are considered. To account for intersystem dependencies, the branch split fraction values are quantified dependent of the status of the preceding top events in the sequence path. Therefore, the branch split fraction values for the same top event in different sequence paths in the tree may differ.

The initiating event category frequencies are reported in Section 3.3.1. The system quantification results from Section 3.3.5 are used for the top event branch split fraction values. For event tree quantification, the mean value of each system unavailability is used; i.e., a point estimate quantification is performed. These system results are computed by Monte Carlo simulation and thereby reflect the uncertainties in the component failure rates. Uncertainties are later propagated at the sequence level using the dominant sequence model.

The system models are evaluated once for each unique boundary condition; e.g., with all support available, for loss of offsite power, for station blackout conditions, etc. The resulting system unavailabilities for each boundary condition are called split fractions. In this study, the split fractions are generally given a four-character code name. The first three characters are the same as the associated top event names. The fourth character is a sequential numbering of the different boundary conditions that were evaluated. If more than 10 boundary conditions are evaluated, an additional fifth character is used to continue the sequential numbering of the split fractions. The letter "F" as the fourth character signifies that the split fraction has a numerical value of 1.0; i.e., guaranteed failure.

A key aspect of the event tree quantification process is the assignment of the appropriate system unavailability result (i.e., split fraction) to each of the branch points in the event trees. Table 3.3.7-2 indicates the modeled impacts of each initiating event category on the plant model. The identified impacts are included in the logic rules for assigning the appropriate split fractions. By including the impact of the initiating event categories on the assignment of split fractions via the logic rules, the same event tree may be used for a large number of initiators.

The split fraction assignment logic is prepared for each top event by the user prior to executing the event tree quantification computer software program. The Event Tree

Analysis module of RISKMAN is used to link the event trees for each initiating event and to quantify each sequence. Split fraction assignment logic for each of the top events and for each event tree is provided in Appendix D. Examples of this assignment logic are described below.

The basis for the logic rules, which are used to assign the split fractions, is provided in the dependency tables (Section 3.2.3) and the definition of the system top events (Sections 3.1.2 through 3.1.4). Alternatively, the system models for each top event can be reviewed to identify the dependencies of one system on the other systems.

Table 3.3.7-3 provides the assignment rules for four different top events. The first three top events appear in the support system event trees described in Section 3.1.4. Top Event TB appears in the frontline event trees described in Section 3.1.2.

The split fraction for Top Event OG5 is set equal to the value represented by OG5F (i.e., 1.0) for the case when the initiating event category is loss of offsite power or loss of the 500-kV grid. For other situations, the split fraction for Top Event OG5 is set equal to OG51 (i.e., 3.4×10^{-3}), which is the frequency at which the 500-kV switchyard would be lost during the 24-hour period following an unrelated plant trip. This failure rate is derived from the system analysis quantification associated with the Browns Ferry electric power system model. As there are no top events preceding Top Event OG5 in the event tree models, there are no dependencies on other top events.

The logic for the assignment of split fractions for Top Event OUB is slightly more complex. The model for transfer of the unit boards depends not only on the status of power from the 500-kV switchyard (i.e., Top Event OG5) but also on the failure of the main transformers that provide electrical power feed to the individual units; i.e., MT1 for Unit 1 feed and MT2 for Unit 2 feed. If the 500-kV switchyard fails or if both the Unit 1 and Unit 2 main transformers fail, the value equivalent to split fraction OUB2 (i.e., $X.X \times 10^{-Y}$) is assigned. For the case in which only one unit main transformer is failed, the value assigned is equivalent to split fraction OUB1; i.e., $A.A \times 10^{-B}$. Finally, for other cases in which Top Event OUB is questioned, a value equal to split fraction OUBF (i.e., 1.0) is assigned to the branch point. This split fraction is not to be confused with a split fraction (assigned value of 1.0) representing guaranteed failure. Rather, this "default" split fraction serves as a mechanism to flag conditions that may not be accounted for in the associated logic rules.

The logic for Top Event UB42A is even more complicated. This is because the split fractions for power availability via this unit board are dependent on the status of the previous unit boards (i.e., Top Events UB41A and UB41B) as well as on the status of the unit board transfer (Top Event OUB) and the loss of offsite power initiating event category. This results from the fact that the three unit boards are susceptible to common cause events. For example, if one of the Unit 1 unit boards is failed, it may have been due to a common cause event. Therefore, the conditional probability that the third unit board fails, given that one of the first two have failed (i.e., split fraction UB42A3), is higher. Similarly, the conditional probability that the third fails, given that the first two are both failed (i.e., split fraction UB42A5), is even higher.

A different evaluation of split fractions is demonstrated by split fraction UB42A4. In this case, the two previous unit boards were not questioned (i.e., bypassed) in the event tree models. In other top events, this also results from failure of a top event representing the first division of a system due to the support systems on which the first division is dependent. In these situations, a common cause event was not the reason for the failure of the previous top event. Therefore, the probability for the failure of the current top event is evaluated without any conditions being placed on it. As with the rules for Top Event OG5, the appropriate split fraction for Top Event UB42A depends on the status of the loss of offsite power initiator. When quantifying each sequence in the trees, beginning with the first logic rule at the top of the list (of split fraction rules) and progressing downward, the first logic condition that is satisfied defines the split fraction that is to be used at each specific branch point.

The reader may be tempted to conclude that the assignment of logic rules becomes more and more complicated the later the top event appears in the trees. In practice, this is not the case. The later top events often depend on just a few of the preceding top events. This is illustrated by the rules for Top Event TB, which is the high pressure general transient tree; i.e., HPGTET. Top Event TB models the closure of the turbine stop or control valves and the closure of five of the nine turbine bypass valves. A "guaranteed failure" value of 1.0, represented by split fraction TBF, is assigned if the power is not available from 480V shutdown board 2A (i.e., Top Event AB), the Unit 2 4-kV unit boards 2A and 2B; i.e., Top Events UB42A and UB42B. In addition, a special condition that also represents the unavailability of power from 480V shutdown board 2A is presented by the intermediate variable NOGB.

Intermediate variable NOGB is defined by successful operation of diesel generator B (i.e., GB=S) but a failure to provide sufficient cooling to the diesel from the EECW system; i.e., OEE=F. Under normal operating conditions, 480V shutdown board 2A receives power from the unit board 2A via shutdown bus 2 and 4-kV shutdown board B. When power is lost to unit board 2A, diesel generator B is required to start and supply power to 480V shutdown board 2A. Since EECW is questioned in the tree after the diesel, a "feedback loop" is needed to represent the loss of the diesel and the loss of power to the 480V shutdown board, when sufficient EECW cooling is not available. This "feedback loop" is represented by the intermediate variable NOGB.

The remainder of the split fractions for Top Event TB are assigned in a manner similar to that described previously. However, unlike Top Event UB42A, which is the ninth top event questioned and is dependent on three of the previous eight top events questioned, Top Event TB is the 125th top event questioned and is dependent on only 6 of the previous top events.

One symbol used in the assignment of split fraction rules is the "-" symbol. This symbol is used to represent the complement logic. For example, the assignment rule for split fraction TBF could be rewritten as follows:

TBF if AB=F + -(UB42A=S + UB42B=S) + NOGB

As for the previous top events, the first assignment logic rule that is found to apply for a particular sequence specifies the appropriate split fraction.

Once the sequence frequencies have been quantified, they must be grouped according to end states. The frequency of each end state can then be computed by summing of the sequence frequencies assigned to that group. Similar to the split fraction logic assignment rules, end state logic assignment rules, called "binning" rules, are used to assign each sequence to a specific end state. The basis for these rules is discussed in Section 4.3. A complete set of split fraction logic assignment rules and end state logic assignment rules is documented in Appendix D.

To optimize computing time, RISKMAN allows the analyst to specify a calculation truncation frequency for each initiator. In calculating the frequency of a particular scenario, the computer code keeps track of the intermediate result as the initiator frequency is multiplied, in turn, by the split fraction values encountered as the computation proceeds left to right through the event trees. If the intermediate result for a particular scenario falls below the user-specified calculation truncation frequency, then that sequence (actually, a family of sequences branching from that point) is not defined further, and the frequency at the time of truncation is added to a bin called "unaccounted for." A more descriptive term would be "unresolved frequency." The event tree methodology permits this explicit accounting of "truncated scenarios"; explicitly determining the impact of truncation or pruning using large linked fault trees is much more difficult.

Results of the sequence quantification process include a list of the key sequences, their frequency of occurrence, and the frequency of each plant damage state, summed over the initiating event categories or for a single event category at a time. The sequences are described in terms of the initiating event category, the status of each top event along the sequence path (i.e., top event successes and failures), the split fractions used at each branch and their values, and the overall sequence frequency. The list of key sequences is stored in a database for subsequent review and interpretation. The frequency above which sequence information is stored in the database varies for each initiating event category. The quantification cutoff and the storage cutoff frequencies are listed in Table 3.3.7-4. The total of the "unaccounted frequency," most of which is success (i.e., all of which had a frequency less than the quantification cutoff frequency for the initiating event category to which they belong), is 2.47×10^{-3} per year.

Table 3.3.7-5 identifies the initiator frequency and the calculation truncation frequency for each of the initiating events considered in this analysis. As can be seen, the largest truncation value was 1×10^{-9}, and the smallest truncation value was 1×10^{-13}. No sequences with frequency greater than 1×10^{-9} were truncated from the analysis. Table 3.3.7-5 also identifies the total "unaccounted for" frequency for each initiator as well as the percentage of each initiator that remains unresolved.

Less than 0.04% of the total initiating event frequency remains unresolved. The percentage unresolved for any individual initiator exceeds 1% for two initiators.

If lower calculation truncation values were chosen, most of the unresolved frequency would wind up being assigned to the "success" state. This statement is based on a series of trending analyses that were performed (Reference 3.3.7-1). These trending analyses also permit a bound to be specified for the portion of the unresolved frequency that may be associated with scenarios resulting in core damage.

As can be seen in Table 3.3.7-5, each initiator is assigned to one of six groups. Group 1 is made up of the two loss of station power initiators. Group 2 includes those transients in which vessel isolation is anticipated. Group 3 includes those transients in which vessel isolation is not necessarily anticipated. Group 4 is made up of the small LOCA and inadvertent SRV opening initiators. The break outside containment and pressure regulator failure (open) initiators comprise Group 5. Group 6 is made up of medium and large LOCAs. The groups were defined according to what portions of the linked event trees are exercised by individual initiators. A representative initiator was chosen from Groups 1 through 5 and was requantified using smaller calculation truncation values. The fraction of the initially unresolved frequency ultimately assigned to a nonsuccess plant damage state was determined. These fractions for Groups 1 through 5 are as follows:

Group 1:	0.014
Group 2:	0.0017
Group 3:	0.0019
Group 4:	0.0067
Group 5:	0.0013

In other words, 0.17% of the unresolved frequency from Group 2 initiators made up of sequences individually less than 1×10^{-9} would be reclassified as core damage if lower calculational truncation values were used. This estimate is considered to be conservative since those low frequency scenarios have not been reviewed for additional success paths. The logic rules governing the event tree quantification process assure a scenario is assigned to the core damage category unless a rule explicitly identifies a successful outcome. The bound on the potential core damage frequency contribution from sequences whose individual frequencies are below the current cutoffs is therefore 1.2×10^{-5}. This assessment conservatively assumes 100% of the unresolved large and medium LOCA frequency (Group 6) result in core damage.

References

3.3.7-1. Letter from D. H. Johnson, PLG, to R. J. McMahon, TVA, "Browns Ferry PRA Unaccounted Frequency Trending Analysis," September 1, 1992.

Table 3.3.7-1 (Page 1 of 3). Event Trees Used for Quantification of Initiators

Initiating Event Category	ELECT12	ELECT3	SIOL	MESUPT	PRETREE	HPOTET	LPOTET	CNTMT	GTPDS	MLOCA2	LLOCA1	MLOCA-CNTMT	LOCA-CNTMT	LOCAPDS	VSEQ
Transients with the Condenser Not Available															
1. Feedwater Rampup (FWRU)	1	2	3	4	5	6	7	8	9						
2. Inadvertent (other) Scram (ISCRAM)	1	2	3	4	5	6	7	8	9						
3. Loss of the 500-kV Grid (L500)	1	2	3	4	5	6	7	8	9						
4. Division I Loop A Lower Instrument Tap Failure (LIA)	1	2	3	4	5	6	7	8	9						
5. Division I Loop B Lower Instrument Tap Failure (LIB)	1	2	3	4	5	6	7	8	9						
6. Division II Loop A Lower Instrument Tap Failure (LIIA)	1	2	3	4	5	6	7	8	9						
7. Division II Loop B Lower Instrument Tap Failure (LIIB)	1	2	3	4	5	6	7	8	9						
8. Total Loss of Feedwater (LOFW)	1	2	3	4	5	6	7	8	9						
9. Loss of Raw Cooling Water (LRCW)	1	2	3	4	5	6	7	8	9						
10. *Partial Loss of Feedwater* (PLFW)	1	2	3	4	5	6	7	8	9						
11. *Scram Required* (SCRAMR)	1	2	3	4	5	6	7	8	9						
12. *Turbine Trip — Bypass Available* (TT)	1	2	3	4	5	6	7	8	9						
13. Division I Upper Instrument Tap Failure (UI)	1	2	3	4	5	6	7	8	9						
14. Division II Upper Instrument Tap Failure (UII)	1	2	3	4	5	6	7	8	9						
15. Very Small Loss of Coolant Accident (VLOCA)	1	2	3	4	5	6	7	8	9						
Transients with the Condenser Not Available															
16. Closure of All MSIVs (CIV)	1	2	3	4	5	6	7	8	9						
17. Loss of I&C Board A (LICA)	1	2	3	4	5	6	7	8	9						
18. Loss of I&C Board B (LICB)	1	2	3	4	5	6	7	8	9						
19. Loss of All Condensate (LOAC)	1	2	3	4	5	6	7	8	9						

*See Page 3 for event tree identifiers.

Note: Numbers in the matrix indicate the order that the trees are linked during quantification.

Table 3.3.7-1 (Page 2 of 3). Event Trees Used for Quantification of Initiators

Initiating Event Category	ELECT12	ELECT3	SICL	MESUPT	PRETREE	HPCTET	LPCTET	CNTMT	CTPDS	MLOCA2	LLOCA1	MLOCA-CNTMT	LOCA-CNTMT	LOCAPDS	VSEQ
Transients with the Condenser Available (continued)															
20. Loss of Condenser Vacuum (LOCV)	1	2	3	4	5	6	7	8	9						
21. Loss of Plant Air (LOPA)	1	2	3	4	5	6	7	8	9						
22. Loss of Offsite Power (500-kV and 161-kV grid loss) (LOSP)	1	2	3	4	5	6	7	8	9						
23. Loss of Unit 2 120V Preferred Power (LUPS)	1	2	3	4	5	6	7	8	9						
24. Partial Loss of Condensate (PLOC)	1	2	3	4	5	6	7	8	9						
25. Pressure Regulator Failure — Open (PRFO)	1	2	3	4	5	6	7	8	9						
26. Turbine Trip — Bypass Not Available (TTWB)	1	2	3	4	5	6	7	8	9						
Stuck-Open Relief Valves and Small LOCA															
27. Inadvertent Opening of One Safety Relief Valve (IOOV)	1	2	3	4	5	6	7	8	9						
28. Inadvertent Opening of Three or More Safety Relief Valves (IOTM)	1	2	3	4	5	6	7	8	9						
29. Inadvertent Opening of Two Safety Relief Valves (IOTV)	1	2	3	4	5	6	7	8	9						
30. Small Loss of Coolant Accident (SLOCA)	1	2	3	4	5	6	7	8	9						
Breaks outside Containment															
31. Break outside Containment (BOC)	1	2	3	4	5	6	7	8	9						
Medium and Large LOCAs															
32. Excessive Loss of Coolant Accident (reactor vessel failure) (ELOCA)	1	2	3	4							5		6	7	
33. Core Spray Line Break inside Containment (LLC)	1	2	3	4							5		6	7	
34. Recirculation Discharge Line Break (LLD)	1	2	3	4							5		6	7	
35. Other Large LOCA (LLO)	1	2	3	4							5		6	7	
36. Recirculation Suction Line Break (LLS)	1	2	3	4							5		6	7	
37. Medium Loss of Coolant Accident (MLOCA)	1	2	3	4						5		6		7	

*See Page 3 for event tree identifiers.

Note: Numbers in the matrix indicate the order that the trees are linked during quantification.

Table 3.3.7-1 (Page 3 of 3). Event Trees Used for Quantification of Initiators

Initiating Event Category	ELECT12	ELECT3	SIGL	MESUPT	PRETREE	HPGTET	LPGTET	CNTMT	GTPDS	MLOCA2	LLOCA1	MLOCA-CNTMT	LOCA-CNTMT	LOCAPDS	VSEQ
Floods and Other Events															
38. EECW/RHRSW Pumping Station Flood (FLPH1)	1	2	3	4	5	6	7	8	9						
39. EECW Flood in the Reactor Building on a Shutdown Unit (FLRB1)	1	2	3	4	5	6	7	8	9						
40. EECW Flood in the Reactor Building on the Operating Unit (FLRB2)	1	2	3	4	5	6	7	8	9						
41. Flood from the Condensate Storage Tank (FLRB3C)	1	2	3	4	5	6	7	8	9						
42. Flood from the Torus (FLRB3S)	1	2	3	4	5	6	7	8	9						
43. Turbine Building Flood (FLTB)	1	2	3	4	5	6	7	8	9						
44. Interfacing Systems Loss of Coolant Accident (ISLOCA)															1

Event Tree Identifiers (from Section 3.1)

ELECT12	Unit 1 and 2 Electric Power Support
ELECT3	Unit 3 Electric Power Support
SIGL	Actuation Signal Support
MESUPT	Mechanical Support Systems
PRETREE	General Transient Sorting Pretree
HPGTET	High Pressure General Transient
LPGTET	Low Pressure General Transient
CNTMT	General Transient Containment Interface
GTPDS	General Transient Plant Damage Sorting
MLOCA2	Medium LOCA
LLOCA1	Large LOCA
MLOCACNTMT	Medium LOCA Containment Interface
LOCACNTMT	Large LOCA Containment Interface
LOCAPDS	Large and Medium LOCA Plant Damage Sorting
VSEQ	V-Sequence

Note: Numbers in the matrix indicate the order that the trees are linked during quantification.

Table 3.3.7-2 (Page 1 of 5). Sequence Modeling Impacts for Each Initiating Event Category Summary	
Initiating Event Category	***Impacts of Initiators on* Plant System Top Events**
Transients with the Condenser Available	
1. Feedwater Ramp-Up (FWRU)	Top Events NIE, NRU, and FWH are guaranteed failed.
2. Inadvertent (other) Scram (ISCRAM)	Top Event RPS is a guaranteed success.
3. Loss of the 500-kV Grid (L500)	Top Event OG5 is guaranteed failed.
4. Division I Loop A Lower Instrument Tap Failure (LIA)	Top Event VT1 is forced to the L1A branch.
5. Division I Loop B Lower Instrument Tap Failure (LIB)	Top Event VT1 is forced to the L1B branch .
6. Division II Loop A Lower Instrument Tap Failure (LIIA)	Top Event VT2 is forced to the L2A branch.
7. Division II Loop B Lower Instrument Tap Failure (LIIB)	Top Event VT2 is forced to the L2B branch.
8. Total Loss of Feedwater (LOFW)	Top Event FWH is guaranteed failed.
9. Loss of Raw Cooling Water (LRCW)	Top Event RCW is guaranteed failed.
10. Partial Loss of Feedwater (PLFW)	Top Event FWH is always FWHZ.
11. Scram Required (SCRAMR)	No specific impacts are modeled.
12. Turbine Trip - Bypass Available (TT)	Top Event TB is a guaranteed success.
13. Division I Upper Instrument Tap Failure (UI)	Top Event VT1 is forced to the U1 branch, and Top Events LM1, LM2, NH1, LT1, and LT2 are guaranteed failed.
14. Division II Upper Instrument Tap Failure (UII)	Top Event VT2 is forced to the U2 branch, and Top Events LM3, LM4, NH2, LT3, and LT4 are guaranteed failed.

Table 3.3.7-2 (Page 2 of 5). Sequence Modeling Impacts for Each Initiating Event Category Summary

Initiating Event Category	Impacts of Initiators on Plant System Top Events
Transients with the Condenser Available (continued)	
15. Very Small Loss of Coolant Accident (VLOCA)	No specific impacts are modeled.
Transients with the Condenser Not Available	
16. Closure of All MSIVs (CIV)	Top Event TB is bypassed, Top Event IVC is guaranteed success, and Top Events OBC, OBD, IVO, OSV, and FWH are guaranteed failed.
17. Loss of I&C Board A (LICA)	Top Events DN, BVR, MCD, and CD are guaranteed failed.
18. Loss of I&C Board B (LICB)	Top Events DO and DCA are guaranteed failed.
19. Loss of All Condensate (LOAC)	Top Events BVR, MCD, and CD are guaranteed failed.
20. Loss of Condenser Vacuum (LOCV)	Top Events BVR, MCD, and FWH are guaranteed failed.
21. Loss of Plant Air (LOPA)	Top Event PCA is guaranteed failed.
22. Loss of Offsite Power (500-kV and 161-kV grid loss) (LOSP)	Top Event TB is bypassed, and Top Events OG5, OG16, UB41A, UB41B, UB42A, UB42B, IVO, and CD are guaranteed failed.
23. Loss of Unit 2 120V Preferred Power (LUPS)	Top Events DJ, BVR, MCD, and FWH are guaranteed failed.
24. Partial Loss of Condensate (PLOC)	Top Event BVR is guaranteed failed; Top Event CD is always CD3.

Table 3.3.7-2 (Page 3 of 5). Sequence Modeling Impacts for Each Initiating Event Category Summary

Initiating Event Category	Impacts of Initiators on Plant System Top Events
Transients with the Condenser Not Available (continued)	
25. Pressure Regulator Failure - Open (PRFO)	Top Event NIE is guaranteed failed.
26. Turbine Trip - Bypass Not Available (TTWB)	Top Event TB is guaranteed success, and Top Events BVR and OSV are guaranteed failed.
Stuck-Open Relief Valves and Small LOCA	
27. Inadvertent Opening of One Safety Relief Valve (IOOV)	Top Event RVC is forced to the SORV1 branch.
28. Inadvertent Opening of Three or More Safety Relief Valves (IOTM)	Top Event RVC is forced to the SORV3 branch.
29. Inadvertent Opening of Two Safety Relief Valves (IOTV)	Top Event RVC is forced to the SORV2 branch.
30. Small Loss of Coolant Accident (SLOCA)	Top Event RVC is forced to the SORV1 branch.
Breaks Outside Primary Containment	
31. Break Outside Primary Containment (BOC)	Top Event IVC is guaranteed success, and Top Events NIE, NBOC, IVO, and OSV are guaranteed failed.
Medium and Large LOCAs	
32. Excessive Loss of Coolant Accident (reactor vessel failure) (ELOCA)	Uses a special event tree (LLOCA1). Top Events DV1 and DV2 are bypassed; Top Event NCD is guaranteed failed.
33. Core Spray Line Break Inside Primary Containment (LLC)	Uses a special event tree (LLOCA1). Top Events DV1 and DV2 are bypassed; Top Event CS is always CS2.

Table 3.3.7-2 (Page 4 of 5). Sequence Modeling Impacts for Each Initiating Event Category Summary

Initiating Event Category	Impacts of Initiators on Plant System Top Events
Medium and Large LOCAs (continued)	
34. Recirculation Discharge Line Break (LLD)	Uses a special event tree (LLOCA1). Top Event DV1 is bypassed; RHR top events vary based on this initiator.
35. Other Large LOCA (LLO)	Uses a special event tree (LLOCA1). Top Events DV1 and DV2 are bypassed.
36. Recirculation Suction Line Break (LLS)	Uses a special event tree (LLOCA1). RHR top events vary based on this initiator.
37. Medium Loss of Coolant Accident (MLOCA)	Uses a special event tree (MLOCA2). No specific impacts are modeled.
Floods and Other Events	
38. EECW/RHRSW Pumping Station Flood (FLPH1)*	Top Events EA, SW2A, and SW1A are guaranteed failed.
39. EECW Flood in the Reactor Building on a Shutdown Unit (FLRB1)*	Top Events EA and EC are guaranteed failed.
40. EECW Flood in the Reactor Building on the Operating Unit (FLRB2)*	Top Events EA, EC, HPI, RCI, HPL, RCL, RPA, RPB, RPC, RPD, and CS are guaranteed failed.
41. Flood from the Condensate Storage Tank (FLRB3C)*	Top Event CST is guaranteed failed.
42. Flood from the Torus (FLRB3S)*	Top Events TOR, HPI, RCI, HPL, RCL, RPA, RPB, RPC, RPD, and CS are guaranteed failed.
43. Turbine Building Flood (FLTB)*	Top Events RCW, PCA, MCD, and CD are guaranteed failed.

*Because the flood initiators involve a period of time (i.e., 20 minutes up to several hours) before the flooding renders the impacted equipment unavailable, it is assumed that the plant operators will perform a controlled shutdown of the plant. For this reason, the safety relief valves are assumed not to be challenged and therefore cannot fail to reseat; i.e., the branch used for Top Event RVC during floods is always SORVO.

Table 3.3.7-2 (Page 5 of 5). Sequence Modeling Impacts for Each Initiating Event Category Summary	
Initiating Event Category	**Impacts of Initiators on Plant System Top Events**
Floods and Other Events (continued)	
44. Interfacing Systems Loss of Coolant Accident (ISLOCA)	A special model, documented in Appendix E, Section E.2, is used for this initiator.

Table 3.3.7-3. Example Failure Branch Split Fraction Assignment Rules

```
Top Event OG5      500-kV Switchyard
   OG5F(1.0)          if INIT=LOSP + INIT=L500
   OG51(3.4-3)        otherwise


Top Event OUB      Operator Transfers Unit Boards to 161-kV Grid
                   on Failure of the 500-kV Grid

   OUB2(1.0-2)        if OG5=F + MT1=F * MT2=F
   OUB1(1.0-1)        if MT1=F + MT2=F
   OUBF(1.0)          otherwise


Top Event UB42A    4-kV Unit Board 2A

   UB42AF(1.0)        if OUB=F + INIT=LOSP
   UB42A5(1.5-1)      if OUB=S * UB41A=F * UB41B=F
   UB42A4(2.5-3)      if OUB=S * UB41A=B * UB41B=B
   UB42A3(2.3-3)      if OUB=S * (UB41A=F + UB41B=F)
   UB42A2(2.4-3)      if OUB=S * UB41A=S *UB41B=S
   UB42A1(4.0-4)      if OUB=B


Top Event TB       Turbine Trip and Turbine Bypass Valve Control

   NOGB:= GB=S * OEE=F
   TBB(0.0)           if INIT=CIV + INIT=LOSP
   TBO(0.0)           if INIT=TT + INIT=TTWB
   TBF(1.0)           if AB=F + UB42A=F * UB42B=F + NOGB
   TB3(6.1-2)         if AB=S * UB42A=F * UB42B=S
   TB2(5.8-2)         if AB=S * UB42A=S * UB42B=F
   TB1(1.6-2)         if AB=S * UB42A=S * UB42B=S
```

<u>KEY:</u>

```
*  and
+  or
LOSP       Loss of Offsite Power Initiator
L500       Loss of 500-kV Grid Initiator
CIV        Closure of All MSIVs Initiator
TT         Turbine Trip Initiator
TTWB       Turbine Trip with Turbine Bypass Valve Failure
           Initiator
```

Table 3.3.7-4 (Page 1 of 2). Browns Ferry Quantification and Storage Cutoff Frequencies				
Initiator	Frequency	Description	Quantification Truncation Cutoff	Storage Cutoff
BOC	6.6900-04	Break Outside Primary Containment	1.0000-12	1.0000-10
CIV	5.6000-01	Closure of All MSIVs	1.0000-09	1.0000-09
ELOCA	9.3900-09	Excessive LOCA	1.0000-13	2.0000-11
FLPH1	2.5000-02	EECW/RHRSW Pumping Station Flood	1.0000-10	1.0000-09
FLRB1	1.2000-02	EECW Flood in Reactor Building — Shutdown Unit	1.0000-10	1.0000-09
FLRB2	1.7000-06	EECS/RHRSW Flood in Reactor Building — Operating Unit	1.0000-11	1.0000-09
FLRB3C	9.8000-05	Flood from the Condensate Storage Tank	1.0000-12	1.0000-12
FLRB3S	9.6000-05	Flood from the Torus	1.0000-10	1.0000-09
FLTB	4.5000-02	Turbine Building Flood	1.0000-09	1.0000-09
FWRU	1.6000-01	Feedwater Rampup	1.0000-09	1.0000-09
IOOV	4.1500-02	Inadvertent Opening of One SRV	5.0000-10	1.0000-09
IOTM	8.7900-04	Inadvertent Opening of Three or More SRVs	1.0000-12	1.0000-10
IOTV	5.8700-03	Inadvertent Opening of Two SRVs	1.0000-10	1.0000-09
ISCRAM	1.5800+00	Inadvertent (other) SCRAM	1.0000-09	1.0000-09
ISLOCA	4.6400-08	Interfacing Systems LOCA	1.0000-10	1.0000-09
L500	7.6500-02	Loss of 500-kV Grid	1.0000-10	1.0000-10
LIA	5.9000-03	Division I Lower A Instrument Tap Failure	1.0000-10	1.0000-09
LIB	5.9000-03	Division I Lower B Instrument Tap Failure	1.0000-10	1.0000-09
LICA	3.5300-03	Loss of I&C Board A	1.0000-10	1.0000-09
LICB	3.5400-03	Loss of I&C Board B	1.0000-10	1.0000-09
LIIA	5.9000-03	Division II Lower A Instrument Tap Failure	1.0000-10	1.0000-09
Note: Exponential notation is indicated in abbreviated form; e.g., 6.6900-04 = 6.6900×10^{-04}.				

Initiator	Frequency	Description	Quantification Truncation Cutoff	Storage Cutoff
LIIB	5.9000-03	Division II Lower B Instrument Tap Failure	1.0000-10	1.000-09
LLC	8.2800-05	Core Spray Line Break	1.0000-13	1.0000-10
LLD	3.1300-04	Recirculation Discharge Line Break	1.0000-13	1.0000-09
LLO	1.0600-04	Other Large LOCA	1.0000-13	1.0000-10
LLS	9.1900-05	Recirculation Suction Line Break	1.0000-13	1.0000-10
LOAC	3.9900-02	Loss of All Condensate	1.0000-10	1.0000-10
LOCV	3.2800-01	Loss of Condenser Vacuum	1.0000-09	1.0000-09
LOSP	3.5200-02	Total Loss of Offsite Power	1.0000-09	1.0000-09
LRCW	3.5300-03	Loss of Raw Cooling Water	1.0000-09	1.0000-08
LUPS	1.4300-02	Loss of Unit 2 120V Preferred Power	1.0000-09	1.0000-08
MLOCA	3.3300-04	Medium LOCA	1.0000-10	1.0000-09
PLFW	2.8600-01	Partial Loss of Feedwater	1.0000-09	1.0000-09
PLOC	5.4600-02	Partial Loss of Condensate	1.0000-10	1.0000-09
PRFO	4.6100-02	Pressure Regulator Fails Open	1.0000-10	1.0000-09
SCRAMR	3.8600-01	Scram Required (manual Scrams)	5.0000-10	1.0000-09
SLOCA	4.1500-03	Small Loss of Coolant Accident	1.0000-11	1.0000-10
TT	1.5900+00	Turbine Trip	1.0000-09	1.0000-09
TTWB	3.1300-01	Turbine Trip without Bypass	1.0000-09	1.0000-09
UI	6.6000-04	Division I Upper Instrument Tap Failure	1.0000-12	1.0000-10
UII	6.6000-04	Division II Upper Instrument Tap Failure	1.0000-12	1.0000-10
VLOCA	2.3400-02	Very Small LOCA (recirculation pump seal LOCA)	1.0000-10	1.0000-09

Table 3.3.7-4 (Page 2 of 2). Browns Ferry Quantification and Storage Cutoff Frequencies

Note: Exponential notation is indicated in abbreviated form; e.g., 6.6900-04 = 6.6900 × 10^{-04}.

Table 3.3.7-5 (Page 1 of 3). Impact of Calculation Truncation Frequency on Sequence Quantification

Initiator	Initiator Frequency	Calculation Truncation Frequency	Total Unaccounted For Frequency	Percentage of Initiator Unresolved
Group 1: Loss of AC Power				
Loss of Offsite Power (LOSP)	3.52×10^{-2}	1×10^{-9}	5.88×10^{-4}	1.67
Loss of 500-kV (L500)	7.65×10^{-2}	1×10^{-10}	3.94×10^{-5}	0.05
Group 2: Isolation Events				
Turbine Building Flood (FLTB)	4.50×10^{-2}	1×10^{-9}	3.95×10^{-5}	0.09
MSIV Closure (CIV)	5.60×10^{-1}	1×10^{-9}	1.87×10^{-4}	0.03
Loss of Condenser Vacuum (LOCV)	3.28×10^{-1}	1×10^{-9}	1.58×10^{-4}	0.05
Turbine Trip without Bypass (TTWB)	3.13×10^{-1}	1×10^{-9}	1.56×10^{-4}	0.05
Loss of Raw Cooling Water (LRCW)	3.53×10^{-3}	1×10^{-9}	1.54×10^{-5}	0.44
Loss of Plant Air (LOPA)	7.87×10^{-2}	1×10^{-9}	6.73×10^{-5}	0.09
Loss of I&C A (LICA)	3.53×10^{-3}	1×10^{-10}	4.46×10^{-6}	0.13
Loss of VPS (LVPS)	1.43×10^{-2}	1×10^{-9}	2.51×10^{-5}	0.18
Group 3: Nonisolation Events				
Loss of Feedwater (LOFW)	5.06×10^{-1}	1×10^{-9}	1.83×10^{-4}	0.04
Turbine Trip (TT)	1.59	1×10^{-9}	2.52×10^{-4}	0.02
Loss of All Condensate (LOAC)	3.99×10^{-2}	1×10^{-10}	1.68×10^{-5}	0.04
Inadvertent Scram (ISCRAM)	1.58	1×10^{-9}	2.86×10^{-4}	0.02
Feedwater Ramp Up (FWRU)	1.60×10^{-1}	1×10^{-9}	1.03×10^{-4}	0.06
Scram Required (SCRAMR)	3.86×10^{-1}	5×10^{-10}	9.93×10^{-5}	0.03
Partial Loss of Feedwater (PLFW)	2.86×10^{-1}	1×10^{-9}	1.24×10^{-4}	0.04
Partial Loss of Condensate (PLOC)	5.46×10^{-2}	1×10^{-10}	1.66×10^{-5}	0.03
Flood in Reactor Building (FLRB3S)	9.60×10^{-5}	1×10^{-10}	3.63×10^{-7}	0.38
Flood in Pump House (FLPH1)	2.50×10^{-2}	1×10^{-10}	9.76×10^{-6}	0.04
Instrument Tap Failure (LIIB)	5.90×10^{-3}	1×10^{-10}	5.07×10^{-6}	0.09
Instrument Tap Failure (LIB)	5.90×10^{-3}	1×10^{-10}	5.07×10^{-6}	0.09

Table 3.3.7-5 (Page 2 of 3). Impact of Calculation Truncation Frequency on Sequence Quantification

Initiator	Initiator Frequency	Calculation Truncation Frequency	Total Unaccounted For Frequency	Percentage of Initiator Unresolved
Group 3: Nonisolation Events (continued)				
Instrument Tap Failure (LIIA)	5.90×10^{-3}	1×10^{-10}	5.07×10^{-6}	0.09
Instrument Tap Failure (LIA)	5.90×10^{-3}	1×10^{-10}	5.07×10^{-6}	0.09
Instrument Tap Failure (UI)	6.60×10^{-4}	1×10^{-12}	1.78×10^{-7}	0.03
Instrument Tap Failure (UII)	6.60×10^{-4}	1×10^{-12}	1.46×10^{-7}	0.02
Flood in Reactor Building (FLRB1)	1.20×10^{-2}	1×10^{-10}	6.51×10^{-6}	0.05
Flood in Reactor Building (FLRB3C)	9.80×10^{-5}	1×10^{-12}	4.45×10^{-8}	0.05
Flood in Reactor Building (FLRB2)	1.70×10^{-6}	1×10^{-11}	1.61×10^{-8}	0.95
Very Small LOCA (VLOCA)	2.34×10^{-2}	1×10^{-10}	1.06×10^{-5}	0.05
Loss of I&CB (LICB)	3.54×10^{-3}	1×10^{-10}	4.62×10^{-6}	0.13
Group 4: Small LOCA and Open SRVs				
Small LOCA (SLOCA)	4.15×10^{-3}	1×10^{-11}	1.31×10^{-6}	0.03
Inadvertent Opening of One SRV (IOOV)	4.15×10^{-2}	5×10^{-10}	2.80×10^{-5}	0.07
Inadvertent Opening of Two SRVs (IOTV)	5.87×10^{-3}	1×10^{-10}	4.48×10^{-6}	0.08
Inadvertent Opening of Three or More SRVs (IOTM)	8.79×10^{-4}	1×10^{-12}	1.47×10^{-7}	0.02
Group 5: Isolation Events/Pretree				
Break Outside Containment (BOC)	6.69×10^{-4}	1×10^{-12}	2.06×10^{-7}	0.03
Pressure Regulator Failure Open (PRFO)	4.10×10^{-2}	1×10^{-10}	1.79×10^{-5}	0.04
Group 6: LOCA				
Recirculation Discharge Line Break (LLD)	3.13×10^{-4}	1×10^{-13}	1.95×10^{-8}	0.01
Recirculation Section Line Break (LLS)	9.19×10^{-5}	1×10^{-13}	1.07×10^{-8}	0.01
Core Spray Line Break (LLC)	8.28×10^{-5}	1×10^{-13}	1.01×10^{-8}	0.01
Other Large LOCA (LLO)	1.06×10^{-4}	1×10^{-13}	1.14×10^{-8}	0.01
Excessive LOCA (ELOCA)	9.39×10^{-9}	1×10^{-13}	1.19×10^{-10}	1.27

Table 3.3.7-5 (Page 3 of 3). Impact of Calculation Truncation Frequency on Sequence Quantification

Initiator	Initiator Frequency	Calculation Truncation Frequency	Total Unaccounted For Frequency	Percentage of Initiator Unresolved
Group 6: LOCA (continued)				
Interfacing Systems LOCA (ISLOCA)	4.64×10^{-4}	1×10^{-10}	6.48×10^{-11}	0.14
Medium LOCA (MLOCA)	3.33×10^{-4}	1×10^{-10}	7.50×10^{-7}	0.22
Total	6.25		2.47×10^{-3}	

3.3.7-19

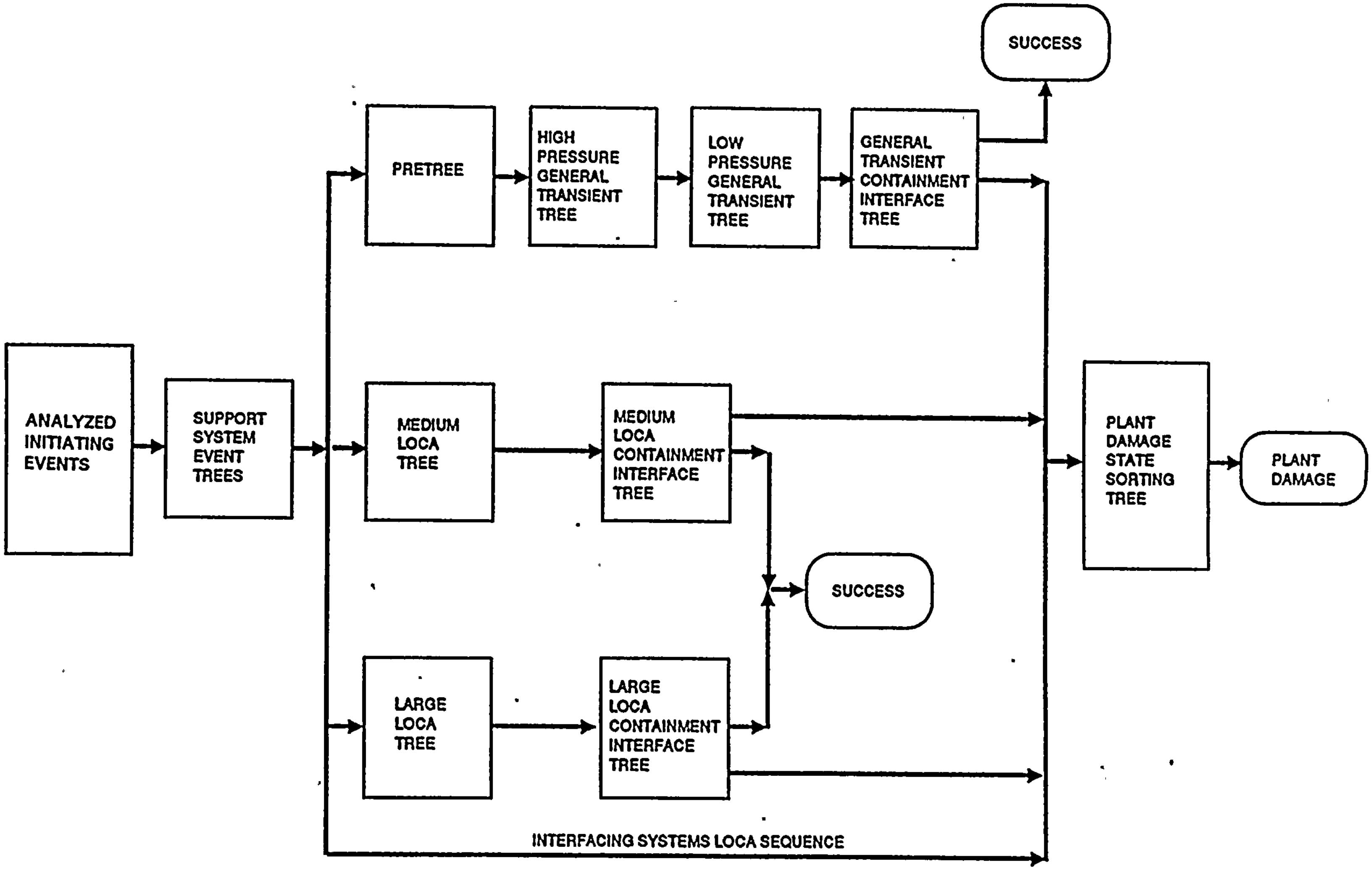
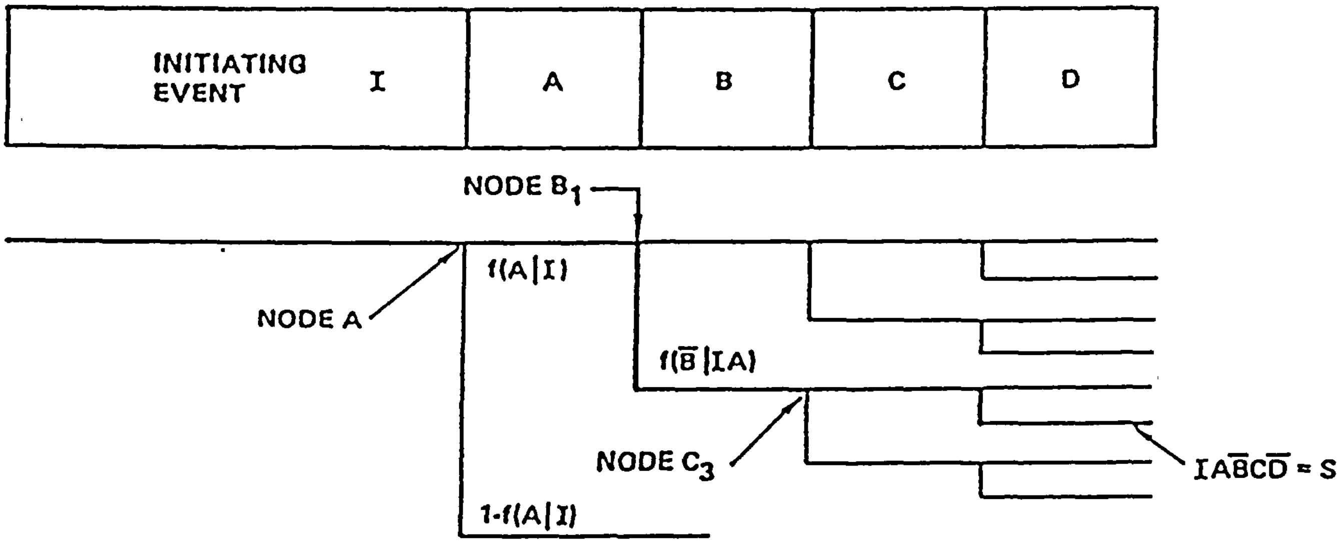


Figure 3.3.7-1. Linking of Event Tree Models for Accident Sequence Quantification



$S = I\,A\,\overline{B}\,C\,\overline{D}$

$\phi(S) = \phi(I) f(A|I) f(\overline{B}|IA) f(C|IA\overline{B}) f(\overline{D}|IA\overline{B}C)$

Figure 3.3.7-2. Illustration of Accident Sequence Quantification

3.3.8 INTERNAL FLOODING ANALYSIS

3.3.8.1 Introduction

An analysis has been completed to identify accident sequences involving internal floods at Browns Ferry Units 1, 2, and 3. Since Unit 2 was operating, the primary focus of the analysis was on Unit 2; however, the results and conclusions are applicable to any of the operating units.

Probabilistic risk assessments (PRA) have shown that spatial hazards such as floods can contribute to core damage frequency since more than one component or system can be affected by the same common cause event. Floods that cause an initiating event and a common mode failure of critical systems (usually support systems that cause additional intersystem-dependent failures) are important. This section summarizes a more detailed section of this report that documents this analysis (Appendix E.1). The analysis identified internal flooding initiating events and their associated frequencies and impacts on plant equipment. The flood scenarios were treated as initiating events to the transient response model as identified in Sections 3.1.1 and 3.1.2. The quantitative results and contributions to risk from internal floods were summarized in Section 3.4.

3.3.8.2 Methodology and Approach

The basic approach was a screening analysis that first establishes potential major flood sources and PRA equipment locations. Flood scenarios were postulated in terms of the flooding source, the extent of propagation to adjacent locations, and the equipment impacted. The frequencies of these scenarios were then quantified as initiating events to the transient event tree model with impacts on event tree top events defined based on the flood impact to equipment. A more detailed analysis of the flood initiator was then performed when the risk results were important. The methodology was summarized further below:

- **Plant Familiarization.** Key plant design information that provides details of the plant systems and layout was reviewed. The PRA models were reviewed and considered to ensure familiarity with important intersystem dependencies, success criteria, and plant response models.

- **Flood Experience Review.** Flood data reported in the PLG database (Reference 3.3.8-1) were reviewed to ensure familiarity with actual flood events, their locations within the plant, and causes. These data were used in the quantification of internal flood scenario initiating event frequencies. Plant-specific screening of flood events in Reference 3.3.8-1 was performed and used in the analysis.

- **Evaluation of Flood Sources.** Using the plant design information and a general knowledge of plant layout, major flood sources and their locations were identified. For example, Wheeler Reservoir supplies the emergency equipment cooling water (EECW) system, which supplies cooling to several plant locations. EECW was identified as a flood source, and its locations within buildings were identified from the flow diagram.

- **Evaluation of Plant Locations.** Using plant design information such as arrangement drawings, internal flood studies, and information from the evaluation of flood sources, buildings where floods can have an impact on the systems were identified. Then, each building was evaluated further with regard to equipment housed at each elevation/room, flood sources, propagation paths, and means of flood detection and isolation. Flood scenarios were identified for further evaluation when a potential flood that can impact more than one PRA evaluated system was identified.

- **Plant Walk-Through.** A walk-through was conducted to collect additional information and to confirm previous documentation and judgments on flood sources, and their potential impact, propagation paths, and detection.

- **Scenario Quantification.** Based on the above, scenarios were postulated, evaluated, and quantified as initiating events, with their impact on other plant systems defined. To support quantification, the flood events from Reference 3.3.8-1 were partitioned and screened based on the plant-specific design and arrangement.

- **Risk Model.** The flood scenarios were included as initiating events to the transient event tree model, as described in Section 3.3.7.

3.3.8.3 Conclusions

No scenarios that lead directly to core damage were identified. Those scenarios postulated were summarized in Table 3.3.8-1. Figure 3.3.8-1 summarizes the plant-specific screening and partitioning of industry events and the applicable flood scenarios in Table 3.3.8-1. As shown, the scenarios postulated were based on potentially large floods from significant flood sources. Smaller flood sources and leaks were judged to be insignificant due to plant design features. For example, the reactor building was large with open grating and stairs, the bottom elevation can be flooded with the contents of a condensate storage tank (CST) (375,000-gallon) without failing the PRA-evaluated pumps located here, and the location of PRA-evaluated electrical equipment was at higher elevations. The scenarios that were postulated were from the following significant flood sources:

- Emergency Equipment Cooling Water (EECW), Residual Heat Removal Service Water (RHRSW), and Raw Cooling Water (RCW) from Wheeler Reservoir

- Condensate Storage Tank (CST)

- Condenser Circulating Water (CCW)

- Suppression Pool (Torus)

The following conclusions provide additional insights gained from the analysis:

- Turbine building floods have a relatively high frequency based on industry experience. In addition, significant flood sources such as condenser circulation water, fire water, and raw water were in the turbine building. At Browns Ferry, normal offsite AC power supplies to emergency power were not affected by turbine building floods. Doors from the control bay and reactor building open into the turbine building, and they were pressure doors, designed to prevent floods from entering. A large flood scenario in the turbine building that fails plant air, feedwater, the main condenser, raw service water, and raw cooling water systems was postulated. This scenario was not expected to contribute significantly to risk.

- The reactor building at Browns Ferry, which houses most of the PRA-evaluated electrical equipment, was open with floor grating and open stairs so that floods propagate to the bottom, Elevation 519'. This bottom elevation houses the RHR, core spray, high pressure coolant injection (HPCI), and reactor core isolation cooling (RCIC) pumps in corner rooms. The corner rooms communicate directly through the torus room such that Elevation 519' was a large area. Even if the CST was emptied into the building (375,000 gallons), the single pumps located here would still function. Thus, there was time to identify and isolate floods. Scenarios (e.g., EECW header failure without isolation) that flood this elevation and fail these pumps, although unlikely, were postulated to occur but were not important contributors to risk. This is because reactor feedwater, the condenser, and crossties to the other units were not affected. The vital electrical equipment was located at higher elevations where severe floods were unlikely to reach, and flood sources in these areas were limited.

- The control bay contains process racks, relays, and controls for the plant. There were fire water sprinklers in rooms and a stand pipe supply to hose reels in the stairwells. In addition, EECW and raw cooling water (RCW) supply air conditioning. However, the frequency and size of floods in these areas were relatively low, and personnel were always present. The likelihood of operators not maintaining functions was judged to be unlikely. Therefore, no scenarios were postulated in this building.

- EECW-related floods have occurred in the industry, and its failure impacts many other systems due to functional dependencies. Even the successful isolation of a major flood can result in the loss of a pump division or supply header. EECW flood scenarios were postulated in the pumping station and reactor building, as these locations contain most of the EECW system.

- The suppression pool and CST were major flood sources, and they could empty into the reactor building. Loss of this water also results in a common mode failure of other systems that depend on these sources. Two reactor building flood scenarios were postulated (one associated with each source).

- Although the condenser circulating water was a very large flood source, such floods were limited to the turbine building and pumping station. Floods associated with the turbine building and circulating water were included in the scenario described for the turbine building.

- Fire water floods were evaluated, but no specific scenarios were postulated. The frequency and impact of fire water floods were evaluated to be contained in or enveloped by the turbine building and reactor building scenarios. The preaction fire water system used throughout vital areas was reliable with regard to the frequency of initiators and alarms, and the flow capacity was low.

3.3.8.4 References

3.3.8-1. PLG, Inc., "Database for Probabilistic Risk Assessment of Light Water Nuclear Power Plants: Flood Data," Volume 9, Revision 0, PLG-0500, March 1990.

Table 3.3.8-1. Internal Flood Results

Flood	Annual Frequency	Description	Cause of Plant Trip	Plant Model Impact
FLTB	4.5-2	Turbine Building	Loss of Condenser, Feedwater or Plant Control Air	Loss of Feedwater, Condenser, RCW, RSW, and Station Air
FLPH1	2.5-2	EECW Pump Room	Manual Reactor Trip Loss of EECW Header	Loss of One EECW and Two RHRSW Pumps
FLRB1	1.2-2	EECW in Reactor Building - Shutdown Units	Manual Reactor Trip Loss of EECW Header	Loss of One Pump Supply to One EECW Header
FLRB2	1.7-6	EECW in Reactor Building - Operation	Manual Reactor Trip Loss of an EECW Header	Loss of EECW Header RHR, HPCI, RCIC, and Core Spray Unavailable
FLRB3C	9.8-5	CST Drained to Reactor Building	Manual Reactor Trip	CST, CRD Unavailable; Water Source for HPCI, and RCIC, Impacted
FLRB3S	9.6-5	Suppression Pool Drained to Reactor Building	Manual Reactor Trip	Suppression Pool, RHR, HPCI, RCIC, and Core Spray Unavailable

Note: Exponential notation is indicated in abbreviated form; e.g., 3.6-2 = 3.6×10^{-2}.

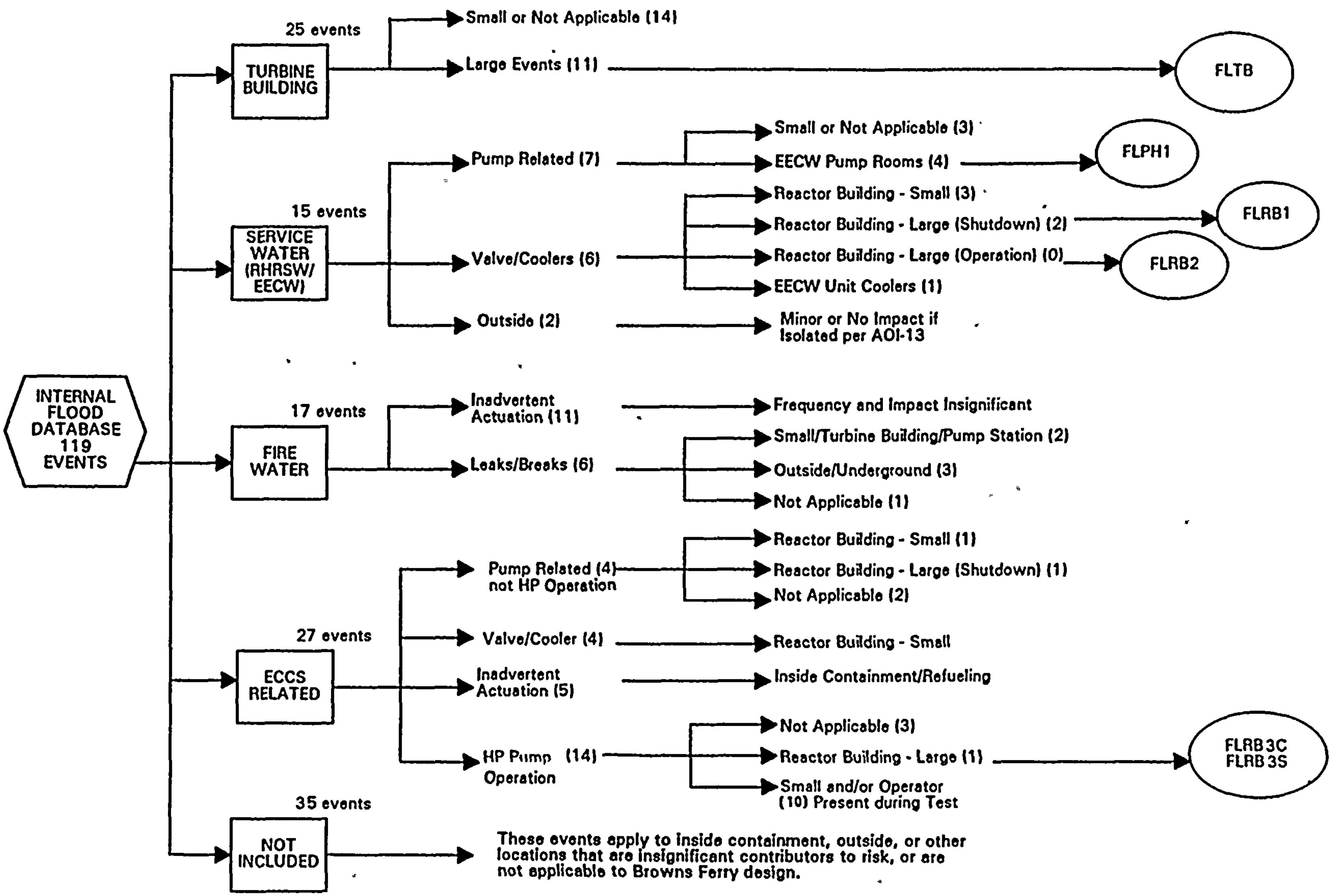


Figure 3.3.8-1. Screening and Partitioning of Flood Events at Browns Ferry

3.3.9 INTERFACING SYSTEMS LOSS OF COOLANT ACCIDENT EVALUATION

An interfacing systems loss of coolant accident (LOCA) outside primary containment is initiated by failures of valves that isolate the reactor vessel from low pressure systems. These interfaces between the reactor coolant system (RCS) and low pressure systems can be important to risk because the low pressure system can rupture, leading to a LOCA outside primary containment and to unavailability of systems that are used to mitigate the LOCA. In addition, reactor coolant escapes outside primary containment, and if core damage occurs, release of radioactive material bypass the primary containment. This section summarizes a more detailed section of this report that documents this evaluation (Appendix E).

The evaluation includes the identification and quantification of interfacing system LOCA initiating events, an assessment of low pressure system failure modes and their probabilities, and an accident sequence analysis that considers operator and equipment response to these failures. The following sections further summarize results, methodology, approach, and evaluation.

3.3.9.1 Summary and Conclusions

The core spray and residual heat removal (RHR) systems were identified as the most important systems outside primary containment that interface with the RCS. If the core spray or RHR system is overpressurized and either ruptures or leaks significantly, it is important that the operators diagnose the event and isolate the LOCA per alarm response procedures and/or Emergency Instructions before the condensate storage tank and suppression pool are emptied into the reactor building. Failure is assumed to result in core damage with primary containment bypass due to flooding of RHR, core spray, high pressure coolant injection (HPCI), and reactor core isolation cooling (RCIC) pumps.

The following summarizes the initiating events with their calculated mean annual frequency:

Initiating Event	Path Description	Leakage (gpm)	Annual Frequency (mean)
VI	Core Spray Injection	> 93	4.9×10^{-6}
VITM	Core Spray Injection T&M	> 93	8.3×10^{-6}
VR	RHR Injection	> 267	1.3×10^{-6}
VRTM	RHR Injection T&M	> 267	5.3×10^{-6}
VS	RHR Suction	> 52	6.3×10^{-6}

As shown above, the frequency of an interfacing LOCA initiating event is relatively low even though there have been precursor events associated with test and maintenance (T&M) errors. One such precursor event occurred at Browns Ferry. Credit is taken for improved practices and procedures that were implemented after this event occurred. Air is removed from the testable check valves inside primary containment during power operation, the check valves are not tested during operation, and they are leak tested during cold shutdown prior to power operation. Thus, the frequency of a check valve being held open by air or stuck open is significantly reduced, relative to precursor data.

The mean annual frequency of accident sequence end states from quantification of the event sequence model is summarized in the following table:

Initiating Event	End States Annual Frequency (mean)						
	S	SLRHR	RH1	RH2	CS1	CDBS	CDBL
VI	4.9×10^{-6}	N/A	N/A	N/A	5.4×10^{-9}	2.2×10^{-11}	2.3×10^{-13}
VR	0	N/A	1.3×10^{-6}	N/A	N/A	5.5×10^{-9}	2.2×10^{-12}
VITM	8.3×10^{-6}	N/A	N/A	N/A	9.1×10^{-9}	1.4×10^{-11}	6.4×10^{-13}
VRTM	0	N/A	5.3×10^{-6}	N/A	N/A	8.5×10^{-9}	6.4×10^{-12}
VS	6.0×10^{-6}	1.3×10^{-8}	N/A	2.8×10^{-7}	N/A	3.1×10^{-8}	7.7×10^{-10}
Total	1.9×10^{-5}	1.3×10^{-8}	6.6×10^{-6}	2.8×10^{-7}	1.5×10^{-8}	4.6×10^{-8}	7.8×10^{-10}

The first five end states are success (S), a small LOCA to suppression pool (SLRHR), and successful isolation of the LOCA with one division of RHR unavailable or with core spray unavailable (RH1 or CS1), or with both RHR divisions unavailable (RH2). The remaining two end states result from failure to isolate a LOCA outside primary containment, which leads to core damage with primary containment bypass either small (CDBS) or large (CDBL). The end state definitions are summarized in Section 3.3.9.5. As shown in the above tables, the core damage results (CDBS and CDBL) are relatively low. One reason for this is that core spray and RHR discharge paths are designed to 500 and 450 psig, respectively, and the materials and schedule of piping provide significant margins over design. Even the RHR suction path that is designed to 150 psig has a low conditional probability of rupture (less than 1×10^{-4}). The probability of RHR discharge rupture at normal reactor operating pressure is approximately 1×10^{-3}, and is dominated by heat exchanger shell failure at high temperatures. Thus, the probability of a large LOCA outside primary containment is assessed to be unlikely. In addition, response procedures adequately address these initiators, and there is time to isolate a LOCA outside primary containment because it takes more than 400,000 gallons of water to accumulate at Elevation 519' to fail the RHR, core spray, RCIC, and HPCI pumps. Appendix E.2 also reports the results of a sensitivity study in which no credit is taken for operator actions. The core damage result for this sensitivity case (CDBS + CDBL) is 6.9×10^{-6} per reactor-year.

3.3.9.2 Interfacing System LOCA Paths

Primary containment penetrations that connect to the RCS were screened to identify the important interfaces with systems outside primary containment. The screening criteria considered design pressure, pipe diameter, number of isolation valves, and the potential consequences of a LOCA outside primary containment. Table 3.3.9-1 documents the screening. The screening explicitly considered LOCAs involving the scram discharge header. The core spray and RHR systems were identified as the most important systems outside primary containment that interfaces with the RCS. Two core spray injection paths and two RHR injection paths (each path has a normally closed check valve and MOV in series) and the RHR shutdown cooling suction path (two normally closed MOVs in series) were identified as the interfacing systems LOCA paths to be evaluated further. Figures 3.3.9-1 through 3.3.9-3 provide simplified drawings of these paths.

3.3.9.3 Initiating Event Model

Failure models were developed for the core spray and RHR injection paths for both equipment failure contributions (initiating events VI and VR) and T&M contributions (initiating events VITM and VRTM). In addition, a failure model was developed for the RHR shutdown cooling suction path (initiating event VS). The final expressions for failure of two valves in series are as follows:

$$VI = VR = 2*\lambda(V1)[\lambda(V1)*T_e/2 + 2*\lambda_d + \lambda_s*T_e + \lambda_g]$$

$$VITM = VRTM = \lambda_{T\&M}*[\lambda(V1) + \lambda_d + \lambda_r]$$

$$VS = \lambda(V1)[\lambda(V1)*T_e/2 + 2*\lambda_d + \lambda_s*T_e + 2*\lambda_g]$$

where

$\lambda(V1)$ = the valve failure frequency of exceeding leakage greater than the relief valve capacity. This frequency is derived from Figure 3.3.9-4, which was developed from events in Reference 3.3.9-1 and approximately 1×10^8 check valve hours in Reference 3.3.9-2. Leaks less than the relief capacity are assumed to be insignificant to risk and so are neglected.

T_e = time between tests (18 months).

λ_d = the rupture on demand frequency.

λ_s = the frequency of MOV spuriously opening.

λ_g = the frequency of MOV open indicating closed.

λ_r = the frequency of check valve failure to reseat

3.3.9.4 RHR Overpressure Analysis

An overpressure analysis of the RHR system was performed (Reference 3.3.9-3). The pressure capacity (fragility) of core spray and RHR piping, flanged connections, valve bonnets, heat exchangers, and pumps was analyzed. Both gross rupture failure modes and leakage failure modes were evaluated, with results presented as median capacities and their uncertainties, which included both modeling and material uncertainties.

The core spray and RHR injection paths are designed to 500 and 450 psig, respectively. Piping is Schedule 30 or higher, SA 106 Grade B carbon steel. The median rupture capacity of piping depends on pipe diameter and Schedule (thickness), temperature, and corrosion allowance. The conditional probability of pipe rupture is unlikely (1×10^{-4}), even using a conservative case of room temperature and a high corrosion allowance.

The RHR heat exchanger shell conditional failure dominates the rupture failure mode at high temperatures (1 $\times$ 10^{-3}).

The overpressure analysis provided detailed information on leakage at gasketed flange connections, including valve bonnets and heat exchanger head flanges. Since bolt yield stresses are very high, complete failure of the bolts leading to a large leak is unlikely and neglected. However, there is a high likelihood of leakage when the RHR system is overpressurized due to heat exchanger head flanges. Exceeding gross leakage pressure (GLP) is unlikely for valves in the core spray and RHR discharge paths (1 $\times$ 10^{-3}). The probability of exceeding GLP in the RHR suction path is 0.05. The probability of exceeding GLP in the RHR discharge path is 1.0 due to the heat exchangers. GLP is used to define the onset of gross leakage, or gross leakage pressure, as the point at which the gasket stress is equal to the pressure being retained. Leakage at this point is very small, and as the pressure increases above GLP, the leakage area increases. The RHR heat exchangers have the largest leakage, approaching a small LOCA (on the order of a few hundred gallons per minute) at 1.5 GLP.

The probability and impact of leakage were treated in a simple way. If GLP is not exceeded, the leakage is considered to be insignificant, and the model assumes successful termination of the event; that is, the operators are assumed to identify and correct the event. If GLP is exceeded, a small LOCA is assumed outside primary containment, which requires operator response for success. In addition, the system that leaked is assumed to be unavailable. The model neglects the probability of larger LOCAs due to leakage. This assumption is insignificant except for the RHR discharge paths where the frequency of exceeding GLP is 1.0 and the frequency of rupture is 1 $\times$ 10^{-3}. The probability of exceeding a small LOCA due to heat exchanger leakage at normal operating pressure was estimated as approximately 0.1. However, as the heat exchanger leakage increases in size, the probability decreases, the conditional probability that the initiating leak was greater than a small LOCA must be included, and the RCS will be depressurizing, which tends to reduce leakage. Thus, this potential nonconservatism is judged to be a reasonable assumption, given other conservatisms.

3.3.9.5 Accident Sequence Analysis

An event sequence diagram (ESD) was developed to document the accident sequence analysis. The ESD was converted to an event tree to quantify accident sequences. The event tree is presented in Appendix E.2 as Figure E.2-6. The following provides a brief summary of the event tree model:

- **System Pumps Isolated.** This event tree top event models whether the next set of isolation valves is closed. This determines whether the initiating leak relieves to the suppression pool, which is normally aligned to the suction side of the pumps or pressurizes the interfacing system. Failure means the leak is to the suppression pool, and success means the system is overpressurized.

- **Initiating Leak Small.** Given that the leak is to the suppression pool or that overpressurization causes a rupture failure mode to occur, this top event questions whether the initiating leak is a small LOCA or less. Success means that the leak is small and that the operators have more time than for the failure case, which is assumed to be a large LOCA. If the leak is to the suppression pool and this top event fails, it is assumed to be a large LOCA to the suppression pool, which is unanalyzed and binned to core damage with primary containment bypass.

- **System Remains Intact.** This top event models the probability that the system does not rupture outside primary containment. Failure means there is a large failure outside primary containment. Whether the LOCA outside primary containment is large or small depends on the previous top event. In either case, failure of this top event requires operator response below.

- **Leak Less Than GLP.** Given that the system outside primary containment did not rupture in the previous top event, this top event questions whether the system leakage exceeds a small LOCA. Success means that the leakage is <GLP, which is insignificant leakage, and that the sequence is binned to success. Failure means that GLP is reached, and that a small LOCA outside primary containment that requires operator response in the next top event is assumed.

- **Operators Isolate before Pumps Flooded.** Given a LOCA outside primary containment (small or large), the operators must diagnose the event and isolate the LOCA, as described in alarm response procedures before the CST and suppression pool flood of the core spray, RHR, HPCI, and RCIC pumps in the reactor building basement. It takes more than 400,000 gallons (the CST is approximately 375,000 gallons) to fail these pumps; therefore, there is ample time for operator action.

Environmental impacts other than flooding were judged to be minor due to the reactor building design. It is assumed that the operator response to LOCA outside primary containment is the dominant mitigative action.

The following summarizes the accident sequence end states:

End State	Description
SUCCESS	There is no LOCA to the suppression pool, the overpressurization did not cause rupture, and GLP is not exceeded (operator success assumed).
SLRHR	Small LOCA to suppression pool, with both RHR divisions unavailable.
RH1	Operators successfully isolated LOCA outside in RHR discharge, and the RHR division is unavailable.
RH2	Operators successfully isolated LOCA outside in RHR suction, and both RHR divisions are unavailable.
CS1	Operators successfully isolated LOCA outside in core spray discharge, and the core spray division is unavailable.
CDBS	Core damage with no small primary containment bypass. The LOCA outside is small, and the operators fail to isolate the LOCA before pumps are flooded.
CDBL	Core damage with no large primary containment bypass. The LOCA outside is large, and the operators fail to isolate the LOCA before pumps are flooded.

For the core damage end states (CDBS and CDBL), it is assumed that the core spray, RHR, HPCI, and RCIC systems, located at the lowest elevation of the reactor building, are unavailable.

3.3.9.6 References

3.3.9-1 S. M. Stoller Corporation, *Nuclear Power Experience,* updated monthly.

3.3.9-2 EG&G Idaho, Inc., "Data Summaries of Licensee Event Reports of Valves at U.S. Commercial Nuclear Power Plants," prepared for U.S. Nuclear Regulatory Commission, NUREG/CR-1363, Vol. 1, June 1980.

3.3.9-3 Wesley, D. A., H. Hadidi-Tamjed, "Pressure-Dependent Fragilities for the Browns Ferry Nuclear Plant Core Spray and RHR Systems," EQE Engineering Consultants, April 1992.

Table 3.3.9-1 (Page 1 of 2). Primary containment Penetrations that Connect to Reactor Vessel - Screening			
Penetration Number	Description	Line Diameter (inches)	Screening
X-7A	Main Steam	26	Two normally open MSIVs (FCV 1-14 and 1-15) with high pressure piping.
X-7B	Main Steam	26	Two normally open MSIVs (FCV 1-26 and 1-27) with high pressure piping.
X-7C	Main Steam	26	Two normally open MSIVs (FCV 1-37 and 1-38) with high pressure piping.
X-7D	Main Steam	26	Two normally open MSIVs (FCV 1-51 and 1-52) with high pressure piping.
X-8	Main Steam Drain	3	Two normally closed MOVs (FCV 1-55 and 1-56). Third normally closed valve (1-58) in parallel with 1" line and orifice.
X-9A	Feedwater	24	Two check valves, one inside primary containment and one outside, high pressure design outside primary containment, and normally open manual valve inside. The HPCI connection has two valves in series, normally closed in addition to being a high pressure design.
X-9B	Feedwater	24	Two check valves, one inside primary containment and one outside, high pressure design outside primary containment, and normally open manual valve inside. The RCIC connections and drains have two valves in series, normally closed in addition to being a high pressure design.
X-10	RCIC Steam	3	Two normally open primary containment isolation valves (FCV 71-2 and 71-3), FCV 71-8, 71-9 (turbine stop) are normally closed, 71-10 (governor valve) normally open, and system is high pressure design up to turbine.
X-11	HPCI Steam	10	Two normally open primary containment isolation MOVs (FCV-73-2 and 73-3). FCV 73-16 and 73-18 (governor valve) are normally closed, 73-17 (turbine stop) is normally open, and system is high pressure design up to turbine.
X-12	RHR Shutdown Cooling Suction Line	20	Two normally closed primary containment isolation valves. Piping and additional closed valves outside are designed to 150 psig. Retain as interfacing LOCA path.
X-13A	RHR Injection (LPCI)	24	Check valve inside primary containment and normally closed MOV outside. An additional open MOV outside and design pressure is 450 psig upstream of the MOV. Retain as interfacing LOCA path.
X-13B	RHR INJECTION (LPCI)	24	Check valve inside primary containment and normally closed MOV outside. An additional open MOV outside and design pressure is 450 psig upstream of the MOV. Retain as interfacing LOCA path.

Table 3.3.9-1 (Page 2 of 2). Primary containment Penetrations that Connect to Reactor Vessel - Screening			
Penetration Number	Description	Line Diameter (in)	Screening
X-16B	Core Spray Injection	12	Check valve inside, normally closed MOV outside, and lower pressure design (500 psig) outside. Retain as interfacing LOCA path.
X-35A-E	TIP	1 1/2	Actual line size is 3/8 inch, with a ball valve outside and a manual explosive shear valve outside.
X-36	CRD Hydraulic System Return	4	Check valve inside primary containment (85-576) and check valve outside (85-573). Normally closed valve (FCV 85-50) outside and high pressure design.
X-37	CRD Inlets (185)	1	Small lines and high pressure design outside including the scram discharge volume and isolation valves. If scram discharge instrument volume drains or vents fail to close after a scram, reactor vessel leakage through the CRD seals would discharge to the instrument volume and drain to the reactor building equipment drain sump. There are redundant, fail-closed, air-operated valves in each drain and vent line. There are two scram instrument discharge volumes in the reactor building.
X-38	CRD Outlets (185)	3/4	Small lines and high pressure design outside including the scram discharge volume and isolation valves. If scram discharge instrument volume drains or vents fail to close after a scram, reactor vessel leakage through the CRD seals would discharge to the instrument volume and drain to the reactor building equipment drain sump. There are redundant, fail-closed, air-operated valves in each drain and vent line. There are two scram instrument discharge volumes in the reactor building.
X-42	SLC	1 1/2	Check valve inside primary containment (63-526) and check valve outside (63-525). Normally closed explosive valves (63 8A and B) and high pressure design up to pump discharge check valves (63-514 and 63-516).

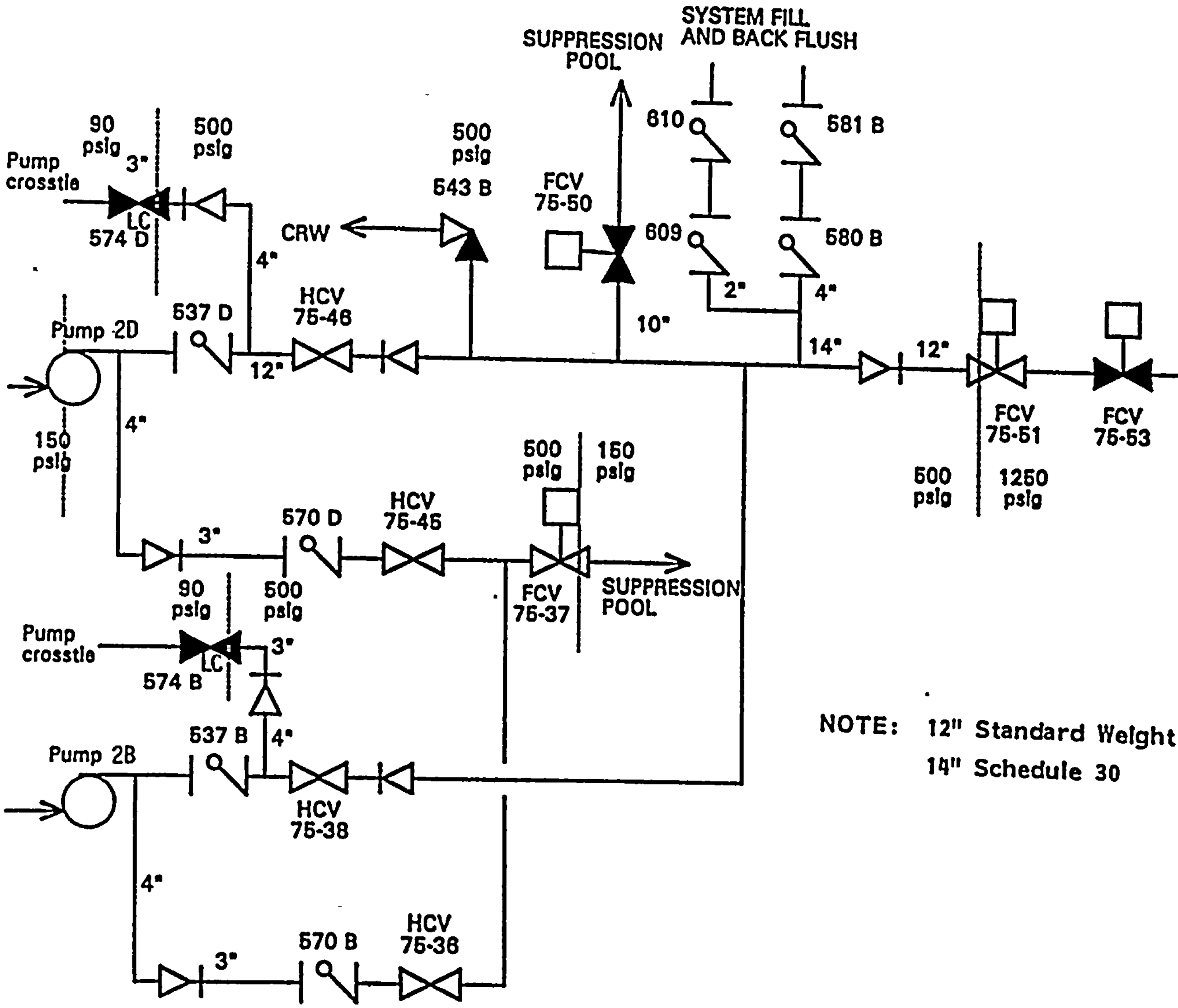


Figure 3.3.9-1. Core Spray Injection Division B

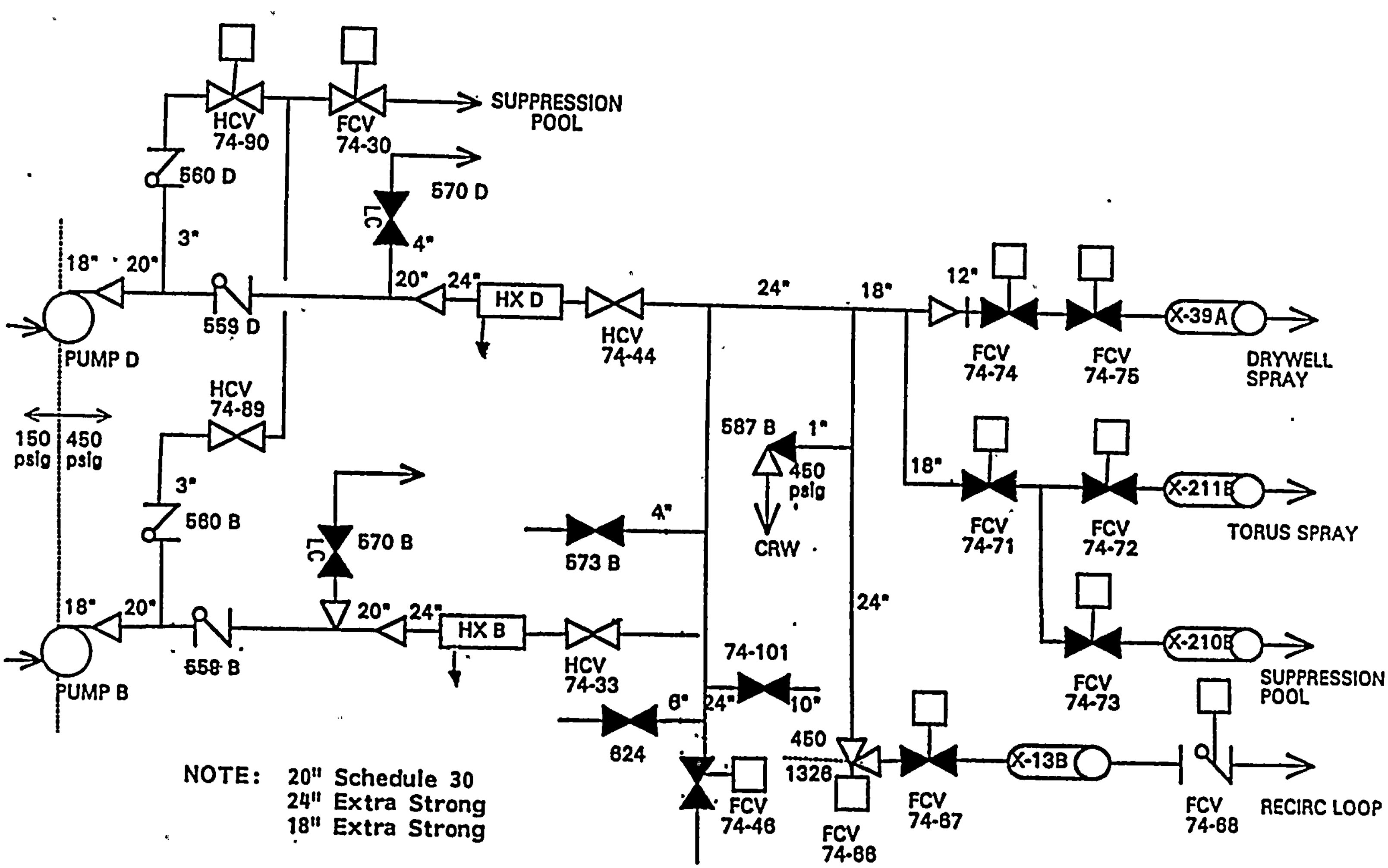
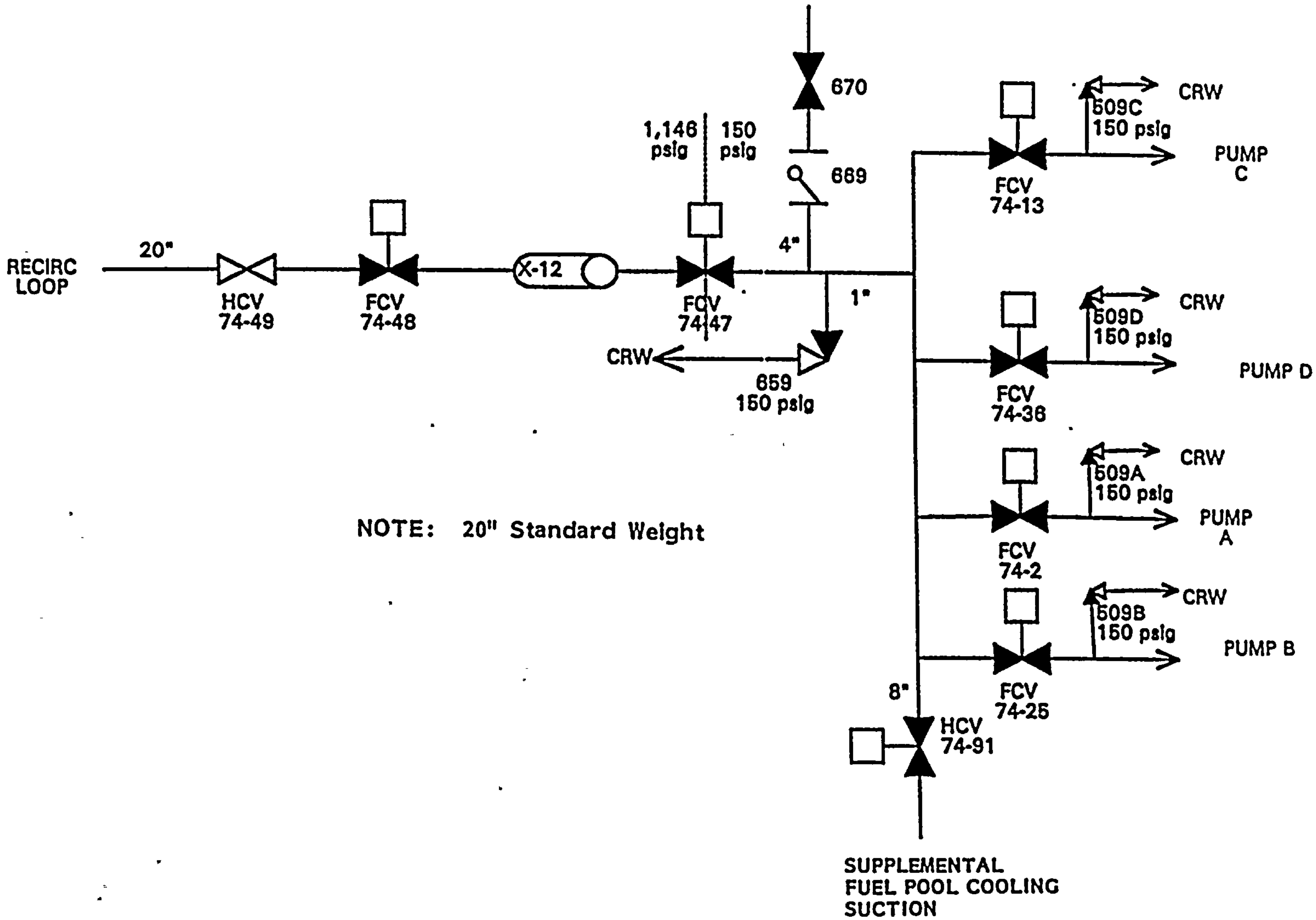


Figure 3.3.9-2. RHR Injection Division B



NOTE: 20" Standard Weight

Figure 3.3.9-3. RHR Suction Line

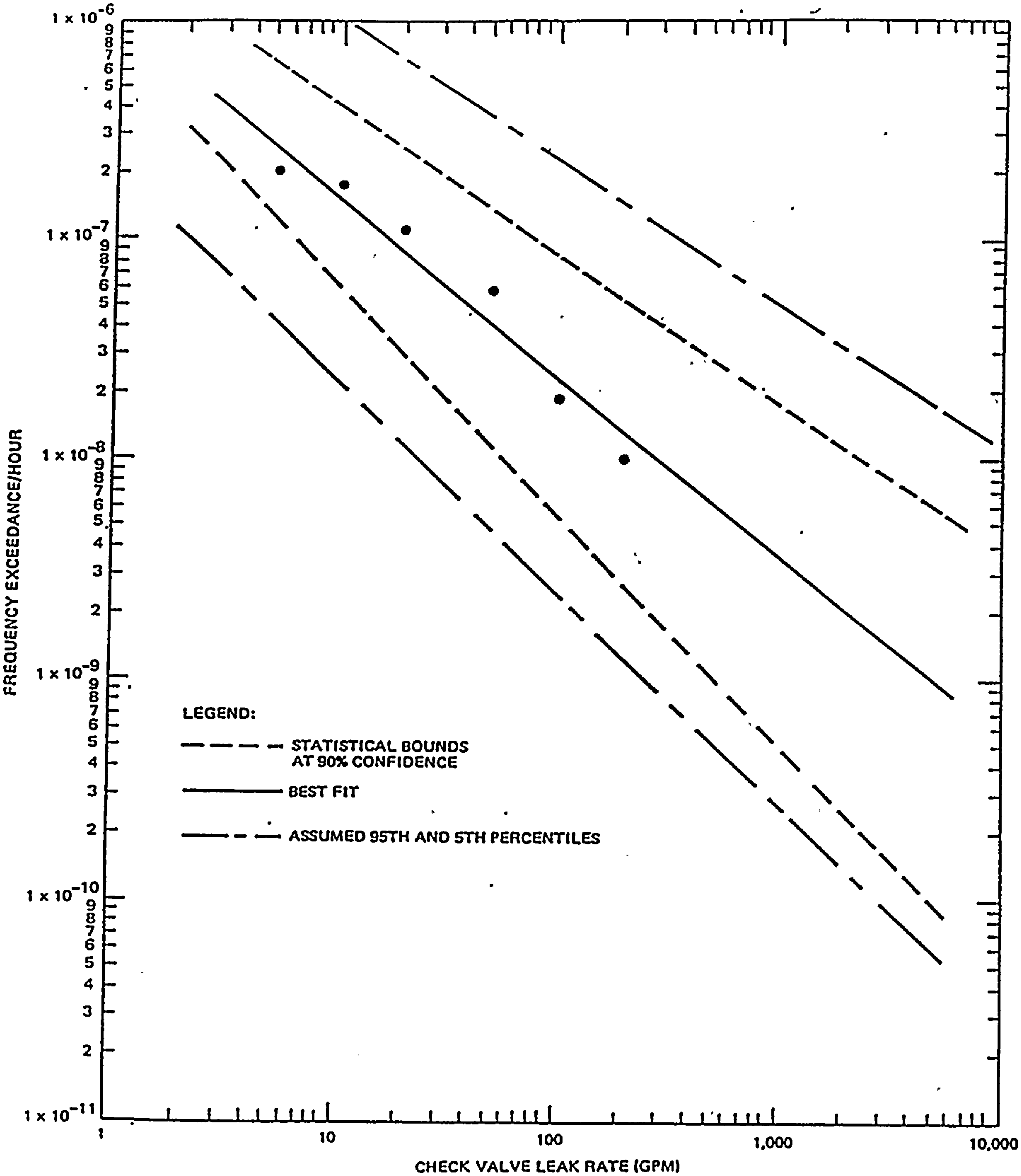


Figure 3.3.9-4. Frequency of Check Valve Leakage Events

3.4 RESULTS AND SCREENING PROCESS

3.4.1 OVERVIEW OF RESULTS AND CONTRIBUTORS

This section presents the results of the Browns Ferry Nuclear Plant Unit 2 probabilistic risk assessment (PRA). The Level 1 plant sequence model includes the responses of support and frontline systems that are important for determining the core damage frequency (CDF) and the frequency of plant damage states (PDS), as defined in Section 4.3. The Level 2 analysis determines the primary containment response to core damage sequences and is reported in Section 4.4. The plant model results include contributions from internal initiating events and internal floods.

The total CDF computed for Browns Ferry is 4.8×10^{-5} per reactor-year.* This value is the mean of the uncertainty distribution for Browns Ferry, which is presented in Figure 3.4-1.

The results from the current plant model quantification were examined in numerous ways. One way is to examine the results at the PDS level. Table 3.4-1 presents the frequency of PDSs that define different categories of core damage scenarios. Thirty PDSs make up the total CDF, of which only nine have at least 0.1% of the CDF. The definitions of the PDSs are provided in Section 4.3. The logic that is used to assign each sequence to a particular PDS is discussed in Section 3.1.3.1.

The plant model quantification results were reviewed by initiating event category. Figure 3.4-2 shows the frequency of core damage that is attributable to sequences grouped by initiating events. The most important initiator is the loss of offsite power (LOSP). This single group accounts for 69% of the core damage frequency. This group includes both station blackout (SBO) and non-SBO sequences. Accident sequences that are initiated by a flood in the turbine building are the second largest group, with 10% of the core damage frequency. The top five initiators comprise 86% of the total core damage frequency. The results of the plant model quantification are interpreted in Section 3.4.3, which describes the vulnerability screening.

The most informative way to look at the results is to examine the individual sequences that lead to core damage. The highest frequency core damage sequences are discussed in detail in Section 3.4.2.

3.4.2 APPLICATION OF GENERIC LETTER SCREENING CRITERIA

The U.S. Nuclear Regulatory Commission (NRC) sequence-reporting requirements for the purpose of fulfilling the individual plant examination (IPE) requirements are discussed in Reference 3.4-1. The Browns Ferry PRA plant model provides the results in systemic

*The unit for the core damage frequency is events per nuclear-powered electric generating unit per calendar year. This definition is abbreviated to "per reactor-year" in this presentation.

sequences as opposed to functional sequences. The reporting guidelines for systemic sequences are as follows:

- Any systemic sequence that contributes 1×10^{-7} or more per reactor-year to core damage.
  - There are 52 sequences listed in Table 3.4-2 with frequency greater than 1×10^{-7} per reactor-year.
- Systemic sequences within the upper 95% of the total CDF (see Table 3.4-1).
  - 3,006 sequences make up the upper 95% of the total CDF. The top 100 sequences are listed in Table 3.4-2.
- Systemic sequences within the upper 95% of the total primary containment failure frequency (see Table 3.4-1).
  - Information relating to this reporting criterion is provided in Section 4.6.
- Systemic sequences that contribute to a primary containment bypass frequency in excess of 1×10^{-8} per reactor-year.
  - There are four sequences involving containment bypass that have frequency greater than 1×10^{-8} per reactor-year. None of these sequences appear in the top 100 sequences.
- Any other systemic sequences that the utility determines to be important to CDF or to poor primary containment performance.
  - No such sequences were identified.

The NRC sequence-reporting guidance states that the total number of most significant sequences to be reported should not exceed 100. The accident analysis is also limited to sequences initiated from power operation and from hot standby; events that are initiated from cold shutdown or during refueling are specifically excluded. Events that are initiated from both power operation and hot standby are included in the model, and therefore are considered for inclusion in the list of key sequences reported. The NRC reporting guidelines specify that the mean frequency be reported for each sequence. Use of both the mean initiating event category frequencies and the mean values from the system unavailabilities when quantifying each sequence provides a very close approximation to the mean sequence frequencies. In fact, for most of the sequences, these approximate sequence frequencies are equal to the mean. These frequencies are reported here. Monte Carlo uncertainty propagation was used to report the complete uncertainty distribution for the total core melt frequency.

The approach used to quantify sequences, as described in Section 3.3.7, enabled the PRA team to examine the highest frequency sequences.

Table 3.4-2 presents the 100 highest frequency sequences contributing to the total core damage frequency. This list accounts for sequences whose individual frequency was greater than about 5.0×10^{-8} per reactor-year. The sequences presented in Table 3.4-2 include the initiating event categories, the event failures that occur with frequency less than 1.0, the guaranteed event failures that occur with frequency 1.0 because they are dependent on other events that have failed, and the Level 1 end state or PDS to which the sequence belongs. The events listed provide a brief description of the accident progression, and the applicable human recovery actions. Both the support and frontline system failures that contribute to the accident progression are noted. The containment response is described in Section 4 for each Level 1 key plant damage state. Specific assumptions that are key to the accident progressions are presented in Section 3, as part of the accident sequence model descriptions. The individual sequence frequency and its percentage contribution to the total CDF are also provided. The top 100 sequences account for 55% of the total CDF. The sum of the other core damage sequences contributes to less than 46% of the total CDF.

A detailed discussion of the top ten sequences is provided below.

The highest frequency core damage sequence begins with the complete loss of offsite power. The incoming 500-kV and 161-kV are lost. The reactor successfully scrams and high pressure coolant injection (HPCI) and reactor core isolation cooling (RCIC) initiate successfully and provide vessel level and pressure control. The onsite emergency diesel generators fail; this is a station blackout scenario. Successful load shedding allows the battery lifetime to be extended to 4 hours. At 4 hours, HPCI and RCIC are lost due to loss of DC power. The MAAP code was used to determine vessel level as a function of time, given loss of level control at 4 hours. The results of that analysis indicate that if level control can be reestablished within 6 hours, then successful termination of the scenario is possible. In this scenario, however, AC power is not restored within 6 hours and core damage is anticipated. Because AC power is unavailable, suppression pool cooling is not possible. The primary and secondary containments did, however, isolate successfully.

Sequences 5, 7, 9, and 10 are also station blackout scenarios and are closely related to the first scenario. Scenario 5 is, in fact, identical to scenario 1 with the added failure of the secondary containment to isolate.

Sequences 7 and 9 are identical to scenario 1 with the added failure to start of HPCI and RCIC, respectively. In scenario 7, RCIC operates successfully until the batteries are depleted, and, in scenario 9, HPCI operates successfully for the first 4 hours.

Operation of HPCI and RCIC for several hours would allow the operator to at least partially depressurize the reactor vessel. Manual actuation of a safety relief valve could assist in depressurization. Following loss of DC power, the vessel would likely repressurize prior to vessel breach. The tenth highest frequency scenario is similar, but not identical, to scenario 1. Sequence 10 is a station blackout scenario with offsite power unrecovered within 6 hours. Once again, HPCI and RCIC are successfully operated for vessel level and pressure control until their respective DC power sources are depleted. The key difference in scenario 10 is the presence of a stuck-open safety relief valve. Vessel repressurization prior to vessel breach is less likely in scenario 10 as compared to scenario 1.

Scenario 2 is initiated by a flood in the turbine building. The electrical power system is unaffected in this scenario. PRA equipment in the turbine building is lost due to the initiator. This equipment includes the raw cooling water pumps, the plant air compressors, and the condensate pumps. Drywell control air is lost due to closure of its isolation valves, which are pneumatically served by plant control air. The main steam isolation valves (MSIV) eventually close due to loss of control air; the condenser is lost as the primary heat sink. In scenario 2, the reactor successfully scrams, and both RCIC and HPCI fail early in the post-scram plant response. The reactor vessel remains at high pressure. High pressure level control using enhanced flow from the control rod drive hydraulic system is not possible due to the loss of raw cooling water, which supports operation of the control rod drive pumps. Low pressure systems are available but cannot provide vessel injection since the vessel has remained pressurized. Suppression pool cooling is successful; however, core damage is anticipated due to loss of vessel level control.

Sequences 3 and 4 are similar and can be thought of as "partial" station blackout scenarios. Again, the initiator is loss of offsite power. The reactor successfully scrams, and HPCI and RCIC successfully provide vessel level and pressure control. In sequence 3, diesels A, B, and C fail. In sequence 4, diesels A, B, and D fail. Offsite power recovery is not accomplished within 6 hours, and HPCI and RCIC are lost due to battery depletion. Manual operation of the safety relief valves assumes vessel depressurization; however, the remaining RHR pump (pump 2D in sequence 3 and pump 2B in sequence 4) that is capable of providing both vessel level control and heat removal fails. Core damage is anticipated due to loss of level control.

Sequences 6 and 8 are initiated by different events but are similar is the manner in which the plant responds. Sequence 6 is initiated by a flood in the turbine building. The direct and consequential failure due to this initiator is the same as described above for sequence 2. In sequence 6, however, two important 250V DC power sources fail: battery boards 2 and 3. The power supply to both divisions of the shared actuation logic, which supplies initiation signals to HPCI, RCIC, core spray, and residual heat removal (RHR), and permissive signals to core spray and RHR are lost. Manual actuation of the low pressure systems is possible, but vessel injection using these systems is not, due to the lack of an in-vessel pressure permissive signal. The DC power failures render HPCI and RCIC unavailable. Core damage is anticipated due to the loss of level control. Sequence 8 is initiated by closure of all MSIVs. The additional failure involving a stuck-open relief valve complicates the establishment of enhanced flow from the control rod drive hydraulic system promptly to prevent extensive core damage; otherwise, sequence 8 is quite similar to sequence 6.

The front-end analysis for Browns Ferry includes consideration of primary containment bypass events from line breaks outside primary containment, reactor building flood from the torus, interfacing systems loss of coolant accident (LOCA) initiators, and from transient initiators in which the main turbine fails to trip and the MSIVs fail to close. The highest frequency core damage sequences from these scenarios are listed in Table 3.4-2. These sequences are identified by a "J" in the second position of the PDS identifier. The front-end analysis also considers the failure of the primary containment to isolate. These sequences are also listed in Table 3.4-2. These sequences are identified by a "K" in the second position of the PDS identifier along with containment isolation failure (Top Event CIS or CIL).

Reporting guideline 3, above, requests that key sequences contributing to the total primary containment failure frequency be presented. The back-end analysis is documented in Section 4, with the back-end results provided in Section 4.10.

3.4.3 VULNERABILITY SCREENING

Section 3.4.2 provided a look at the plant model results by examining the key sequences to the core damage frequency. This section interprets the results by examining the contributors that are found in many sequences from several vantage points.

TVA has adopted two sets of criteria for identifying vulnerabilities; one set is based on the results of core damage frequency that are used to evaluate potential vulnerabilities in the systems that protect the reactor core integrity. The second set is based on the results for large, early release frequency that are used to evaluate vulnerabilities from the point of view of containment integrity. Each set includes criteria for the numerical results, how the results are distributed across the underlying contributors, and the availability of cost-effective ways to reduce core damage or large, early release frequency.

A vulnerability may exist if the mean core damage frequency exceeds 5×10^{-4} per reactor-year or if the mean large, early release frequency exceeds 5×10^{-5} per reactor-year. Several plants evaluated using similar PRA data and methods have been reported to the NRC total core damage frequencies in the range of 5×10^{-5} to 5×10^{-4} per reactor-year. These results seem to be typical for modern nuclear power plants in the United States. For the large, early release criteria, some additional margin below total core damage frequency is believed to be appropriate. TVA has chosen a factor of 10 benefit for the containment as a suitable basis for identifying a vulnerability. Therefore, the criterion for large, early release is a factor of 10 below the core damage criterion, or 5×10^{-5} per reactor-year.

Given an exceedance of either of these criteria, a vulnerability is identified, only if a common function, system, operator action, or other common element can be identified that contributes substantially to the total frequency. More than one vulnerability may then be identified. Alternatively, none may be identified if the frequency is well balanced and made up of many different and individually small contributions. Identified vulnerabilities are then to be evaluated for availability of cost-effective enhancements.

The occurrence of a vulnerability is therefore based on the total core damage frequency or the early release frequency. If a vulnerability exists, then the specific plant design or operating feature defined as the vulnerability is that which contributes in a substantial way to the frequency criteria being exceeded. To be unique to Browns Ferry, the vulnerability must be either a contributor not seen in PRAs for other plants or one that makes a disproportionately high frequency contribution. No vulnerabilities were identified.

3.4.3.1 Event or System Importance

A perspective of the underlying contributors to risk was gained by evaluating various importance measures of the individual event tree branch point probabilities, or split fractions, that are evaluated in this study. One importance measure often used is computed by determining the percentage contribution to the total CDF made by sequences grouped by common failed split fractions. This is in contrast to the look at individual sequences in the previous section.

The accident sequence model contains two types of split fractions: guaranteed failure (GF) split fractions, whose failure frequency is set to equal 1.0 because of functional dependencies on other equipment or on operator actions that has already failed in the same accident sequence, and nonguaranteed failure (NGF) split fractions; i.e., those whose split fraction values are less than 1.0.

The split fractions for a particular top event can be grouped into one of these two categories. A list of the split fraction definitions is provided in Section 3.3.5 and Appendix D. The importance rankings for these groups of split fractions are evaluated separately because the evaluation of each group has different risk management implications. The importance of the highest ranked top events for each group of split fractions is described below.

- **Guaranteed Failed Split Fraction Importance.** The risk contribution from guaranteed failed split fractions results from the dependencies between systems and between multiple operator actions. The risk contribution of guaranteed failed split fractions is not associated with the reliability characteristics of the associated system. To reduce or eliminate the importance of these split fractions, it is necessary to attack the dependencies of the important system on the other systems whose failure triggered the guaranteed value. The most important guaranteed failed split fractions are summarized in Table 3.4-3.

  The highest ranked guaranteed failed split fraction is NCDF, no core damage guaranteed failure. It is a switch that will be in the failed state for all scenarios in which core damage has occurred. All core damage sequences, except those associated with interfacing systems LOCA, include this split fraction.

  The second highest ranked guaranteed failed split fraction is associated with Top Event DW, which tracks the availability of a high drywell pressure actuation signal. This signal, with the low reactor pressure signal, provides automatic actuation of the emergency core cooling system (ECCS) equipment. The high drywell pressure signal fails if the power for the electronic circuits from 250V DC RMOV boards 2A and 2B is unavailable. To actuate the high drywell pressure signal, the scenario must involve raising the pressure in the drywell. This pressure increase occurs during LOCA initiating events. Therefore, for transient initiators (e.g., turbine trip and loss of feedwater), Top Event DW was guaranteed failed.

- **Nonguaranteed Split Fraction Failure.** The importance evaluation of the nonguaranteed failure split fractions is summarized in Table 3.4-4. For these split fractions, it is possible to change the CDF by changing the reliability characteristics of the associated system. For this group of split fractions, four different importance measures are used: the percentage contribution of the sequences with that split fraction failed, the factor increase in the CDF when the split fraction is arbitrarily reassigned a value of 1.0, the factor decrease in the CDF when the split fraction is arbitrarily reassigned to a value of 0.0, and the change in CDF per unit change of the split fraction value. These four importance measures are termed importance, risk achievement worth, risk reduction worth, and the CDF derivative in the rest of this section. Each of the measures is presented in Table 3.4-4 for each nonguaranteed failed split fraction, along with the split fraction value used in the event tree quantification and the frequency of core damage sequences that involve failure of the split fraction.

- Split Fractions 1 and 8 — Conditions Relating to Stuck-Open SRV State (O stuck open, RVCO; 1 stuck open, RVCI). The highest ranked nonguaranteed failed split fraction in importance (i.e., percentage contribution to total CDF) is RVCO at 66%. This split fraction models the failure of the safety relief valves (SRV) to reclose, given that they opened. Specifically, split fraction RVCO, which is used at a multibranch point (i.e., a point at which there are more than two possible outcomes) in the event tree, represents the successful reclosure of all SRVs; i.e., no SRVs fail to reclose. Similarly, the eighth-ranked nonguaranteed failed split fraction is RVC1, which represents the failure of one SRV to reclose. Its importance is 14%.

- Split Fraction 2 — Conditions Relating to Reactor Depressurization State — Plant Depressurized. The second-ranked nonguaranteed failed split fraction is RVD2, depressurization of the reactor vessel using the SRVs. This split fraction is also used at a multibranch point in which there are three possible outcomes: (1) plant depressurizes, (2) plant does not depressurize but SRVs operate in overpressure mode; or (3) SRVs are stuck shut. Specifically, split fraction RVD2 represents outcome 1, plant depressurizes, and has an importance of 54%.

- Split Fractions 3 through 6 — Diesel Generators A through D Unavailability. The third, fourth, fifth, and sixth highest ranked nonguaranteed failed split fractions represent failure of a Unit 1 or Unit 2 emergency diesel generator (split fractions GA1, GB2, GC4, and GD4, respectively). The diesel generators are normally kept in a standby configuration and are available for rapid starting and loading. Diesel failures can occur during startup, the early stages of running operation, or during extended operation such as during an extended loss of offsite power condition. The importance of these split fractions is as follows:

    - GA1 = 53%
    - GB2 = 47%
    - GC4 = 40%
    - GD4 = 23%

- Split Fractions 7 and 10 — RHR Pump 2D Unavailability. The seventh highest ranked nonguaranteed failed split fraction is RPD10, which represents the RHR pump division 2D. RPD10 has 18% importance to the CDF. Like the diesel generators discussed above, the RHR pumps are maintained in a standby status until demanded. The significant ways in which failures can occur include both independent and common cause failure of the pump to start, test, and maintain alignments, which render the pump division unavailable, and failure of check valves to open on demand. In a similar manner, the tenth highest ranked nonguaranteed failed split fraction is RPB6, which represents the RHR pump division 2B. The importance of RPB6 is 13%.

- Split Fraction 9 — 250V DC Battery Board 3 Unavailability. The ninth-ranked nonguaranteed failed split fraction is DGA at 14%. DGA represents the unavailability of power from 250V DC battery board 3. The significant failures that make battery board 3 unavailable include unscheduled maintenance on the battery charger or the battery, failure of the battery when demanded, or failure of the charger.

— **Top Event Importance.** Table 3.4-5 provides an importance ranking of key event tree top events in the Level 1 plant model event trees. The information provided in Table 3.4-5 includes:

- TOP — Top event designator, including branch name for multibranch top events.
- PROBABILISTIC — The fraction of sequence frequency for which the top event was not guaranteed to occur but occurred independently.
- GUARANTEED EVENT — The fraction of sequence frequency for which the top event was guaranteed to occur due to preceding events in the plant.
- TOTAL — The total fraction of sequence frequency in which the top event was failed.
- FREQUENCY — The frequency of occurrence of top event failure.

The top events with an importance of 1% or greater are included in the table. Because each top event contains a number of different split fractions, this approach is a more general way to examine groups of sequences. The top events are ranked according to their percentage to the CDF involving sequences that include failures of these top events. The highest ranked top events are related to the highest ranked nonguaranteed failed split fractions presented earlier in Table 3.4-4. The key split fractions presented in Table 3.4-4 account for large proportions of the total top event importance.

— **Operator Action Importance.** In addition to the system and event importance just discussed, an importance ranking of individual operator action events is provided in Table 3.4-6. The highest ranked operator action is RVO22, which represents the manual depressurization of the reactor vessel using the SRVs. The next highest ranked action is OLP1, which represents control of reactor vessel level at low pressure using either the RHR low pressure injection path or the core spray system.

3.4.3.2 Sensitivity Cases

Another way of evaluating the contributors to risk is by examining the sensitivity of results to general classes of events. For the Level 1 models, the sensitivity or importance of various groups of events can be determined by reviewing individually the sequences that contribute the most to core damage in a manner that is similar to the calculation used to compute the importance measures for individual events and systems as presented in the previous section. Alternatively, the sensitivity of various changes to the base models may be computed directly by requantifying all of the plant model event trees and comparing the results to the base case results. For this application, the contribution of various event or system groups was reviewed.

- **Initiating Event Group.** Table 3.4-7 presents the dominant contributors to the total CDF. Nonstation blackout loss of offsite power scenarios account for the largest group shown in Table 3.4-7. The second largest group involves station blackout scenarios. The station blackout scenarios involve a total loss of offsite power accompanied by a failure of the Unit 1 and Unit 2 emergency diesel generators to start and run. The Unit 3 diesel generators are questioned in the model; however, if the four Unit 1/Unit 2 diesel generators are unavailable, the Unit 3 diesel generators are assumed to be unavailable as a result of common cause failure. One or two electric power recovery factors are included in the scenarios, depending on the status of high pressure injection via HPCI or RCIC. The scenarios contain an electric power recovery factor that represents the failure to recover offsite power within the first 30 minutes following the loss of AC power. If HPCI or RCIC operate successfully, a second recovery factor represents the failure to recover offsite power between 30 minutes and 6 hours following the loss of AC power.

  Other group contributors in Table 3.4-7 include a loss of vital DC power (i.e., failure of battery boards 2 and 3), scenarios in which the reactor vessel remains at high pressure, and anticipated transients without scram (ATWS).

- **End States.** Another way of looking at the Level 1 results is to break down the CDF by a similar end state, as shown in Table 3.4-8. These results are based on the events in the Level 1 plant model. Primary containment phenomena after core damage may result in failure of primary containment due to increased pressures, but these failure modes are not addressed.

  Ninety-seven percent of the CDF involves sequences in which the primary containment isolation system has succeeded, and there is no bypass of the primary containment and the primary containment is intact at the time of core damage. A small fraction of the CDF, about 2%, is associated with a late primary containment failure. These scenarios typically occur as a result of a loss of suppression pool. Less than 1% of the total CDF involves sequences in which the primary containment fails early or the containment is bypassed. The sources of early primary containment failure include unmitigated ATWS and failure of the primary containment to isolate. The sources of primary containment bypass were discussed in Section 3.4.2.

- **Operator Action Sensitivity.** A sensitivity case was performed that requantified the base case event trees. Sequences that drop below the CDF criteria because of a reduction by more than 1 order of magnitude by credit taken for operator actions are discussed.

  The failure rate database was modified by raising the dynamic operator action error rates to at least 0.1. For actions whose error rates were already greater than 0.1, they were not changed. Electric power recovery factors, which depend more on the types of failures involved than on the response of the control room crew, were also left unchanged. Then, the split fractions were requantified using the revised database. The resulting split fractions were then used to requantify the Level 1 plant model event trees.

The highest CDF sequences were then identified. Some sequences already had frequencies greater than 1×10^{-7} per reactor-year. They are evaluated with higher human error rates; their frequencies are even higher.

Table 3.4-9 provides a summary and comparison of the operator action sensitivity with the IPE results.

A brief discussion of the new sequences that appeared above 1×10^{-7} in the sensitivity case is provided below.

Sequences initiated by a turbine building flood contribute the highest frequency to core damage for this sensitivity case. The top sequences involve failure of two separate operator actions; e.g., failure to align for suppression pool cooling, and failure to align for shutdown cooling in the highest ranked sequences. Other double operator action failures include failure to control level using HPCI/RCIC, coupled with a failure to align for suppression pool cooling or a failure to control level using RHR or core spray.

Another category of sequences is low frequency initiating events (e.g, three or more stuck-open relief valves and large and medium break LOCA events), with a single operator action failure. In these cases, the single operator action failure that occurs is 1 of the 10 highest actions reported previously in Table 3.4-6.

A third group of scenarios is associated with the highest frequency initiating events such as turbine trip or inadvertent scram at power. In this group, multiple hardware failures have occurred in addition to an operator action failure.

The key lesson learned from this sensitivity case is that the new sequences that result primarily involve the failure of two or more operator actions. Those that involve the failure of only one action are already visible in the base case; e.g., failure to align for suppression pool cooling.

3.4.4 DECAY HEAT REMOVAL EVALUATION

Resolution of Unresolved Safety Issue (USI) A-45 has been incorporated into the IPE requirements that allow plant-specific evaluation of the safety adequacy of decay heat removal systems. According to NUREG-1335, the evaluation is restricted to events initiated from power operation. A discussion of the decay heat removal capability at Browns Ferry for preventing severe accident situations is provided below.

The results for Browns Ferry provide indications of the importance of systems that directly perform the decay heat removal function. Table 3.4-10 indicates the importance measures for systems that perform the decay heat removal function at Browns Ferry. Three were considered: the main condenser, the RHR system in the suppression pool cooling mode, and the RHR system in the shutdown cooling mode. Importance is measured by the percentage of CDF attributable to sequences that involve failure of the indicated top event.

These measures are not strictly additive because more than one of the ranked top events may, and often do, fail in the same sequence.

The removal of decay heat from a boiling water reactor can be accomplished by a variety of means. For example, the use of HPCI or RCIC for inventory control uses reactor steam to operate the pump turbine. However, this steam is exhausted to the suppression pool, and the heat transmitted to the pool must ultimately be removed. The suppression pool cooling mode of the RHR system is used for removing this heat to outside the plant; i.e., to an ultimate heat sink.

The decay heat removal alternative to be used for rejecting heat to the ultimate heat sink is dependent on the means by which the heat is actually removed from the reactor. Two paths are available for accomplishing this heat removal: the turbine bypass valves to the main condenser, and the SRVs to the suppression pool. Once the reactor pressure has been reduced below the SDC interlock, the shutdown cooling mode of RHR operation can be used. This function of the RHR system acts to remove the decay heat from the reactor directly and transfers it to the ultimate heat sink. The means of removing heat to the ultimate heat sink therefore is dependent on the path used to extract heat from the reactor vessel. A third possible path to ultimate heat sink is RWCU and RBCCW, which can remove heat from the reactor via the nonregenerative heat exchangers. This path was not modeled.

To examine each of these functions, groups of sequences containing the systems and operator actions related to these functions were collected and reviewed. Table 3.4-10 lists the results of that review. The groups of sequences were collected in two broad categories: one in which one or more SRVs are stuck open, and one in which they are not. These two categories were further separated by the functions that could satisfactorily remove the decay heat.

The plant model conservatively takes credit for suppression pool cooling as the only means of removing the decay heat when the SRVs are stuck open. In other words, the event model requires suppression pool cooling if one or more SRVs are stuck open regardless of the availability of the main condenser. This group accounts for 4% of the CDF and 6% of the decay heat removal failures examined.

This group can be further separated into causes of the failure of the suppression pool cooling function; i.e., hardware failure, or failure of the operator to align for suppression pool cooling. These two subcategories account for 2% and 98% of the sequences in the category, respectively.

The second category of decay heat failures is those in which the relief valves are not stuck open. To fail to remove decay heat in this category, the heat removal alternatives involving the main condenser and the RHR system must be unavailable. This category accounts for 61% of the CDF.

The "No Stuck-Open SRV" category was segregated into subcategories based on hardware failures or operator action failures. This segregation, however, is more complicated than for the stuck-open SRV case. The failures in this group include hardware failures (i.e., the main condenser) and hardware failure of suppression pool cooling and shutdown cooling, operator failures to align the RHR system, or some combination of both RHR hardware failure and operator action failure. As a result, three subcategories were developed, based on the type of failure of the RHR system. These subcategories are hardware-only failures of the RHR system, operator action-only failures, and combinations of hardware and operator failures. These subcategories have the following importance to the CDF total:

- Hardware-only failures (2%).
- Operator action-only failures (58%).
- Combinations of hardware and operator failures (0.3%).

The main condenser does not require any specific operator action to remain available to remove decay heat. As long as the MSIVs remain open, and the condenser and condensate system remain in operation, decay heat can be removed to the main condenser.

As long as the MSLs remain open and the condenser and condensate system remain in operation, decay heat can be removed to the main condenser. The condensate system is modeled to return condensate to the reactor via the startup feedwater bypass, LCV. No credit has been taken for parallel pump path, which could be used to reflood the vessel.

The suppression pool cooling and shutdown cooling modes of RHR system operation share common hardware in the RHR pumps and heat exchangers but have separate flow paths for accomplishing decay heat removal. The suppression pool cooling mode requires an SRV to be opened and the suction from and return to the suppression pool to be available. The shutdown cooling mode requires that the RHR pump suction be transferred to the reactor vessel recirculation line, and that the return path, via the low pressure injection path, be available.

In summary, the failure to remove decay heat accounts for 64% of the total CDF. One caveat must be made with regard to these values. The failure to remove decay heat includes scenarios in which a loss of offsite power develops into a station blackout. If this large group of sequences is excluded from the examination, the failure to remove decay heat contributes only 38% to the total core damage.

In conclusion, no vulnerabilities of the Browns Ferry decay heat removal systems have been identified. The majority of the CDF comes from station blackout scenarios that cause a loss of power to the decay heat removal systems, rather than from failure of the systems themselves.

3.4.5 USI AND GSI SCREENING

The technical basis for resolving USI A-45, the evaluation of the decay heat removal function, is provided in Section 3.4.4. No vulnerabilities of the systems that are used to perform decay heat removal have been identified.

No other USIs or GSIs are resolved by this submittal.

3.4.6 REFERENCES

3.4-1. U.S. Nuclear Regulatory Commission, "Individual Plant Examination: Submittal Guidance," NUREG 1335, August 1989.

Table 3.4-1. Browns Ferry Plant Damage State Categories

Rank	PDS Category[1]	Reactor Vessel Pressure	Water on Drywell Floor	Primary Containment Heat Removal Available	Primary Containment Status	Frequency per Reactor-Year	Percentage of CDF
1	PIH	Low[2]	No	No	Isolated	2.87-5[3]	59
2	OIA	Low	Yes[4]	Yes	Isolated	4.89-6	10
3	MIA	High	Yes	Yes	Isolated	4.71-6	10
4	PID	Low	Yes[5]	Yes	Isolated	4.31-6	9
5	NIH	High	No	No	Isolated	3.77-6	8
6	NLF[6]	High	Yes	--	Late Failure	9.71-7	2
7	MKC[7]	High	Yes	--	Early Failure	3.97-7	1
8	OJA	Low	Yes	--	Bypassed	1.39-7	<1
9	NJA	High	Yes	--	Bypassed	4.68-8	<1

Notes:

1. The PDS categories are defined in Section 4.3. The first character signifies the reactor pressure at the time of vessel breach. The second character identifies the containment status at the onset of core damage. The third character indicates the status of active plant systems affecting primary containment performance.
2. Vessel will repressurize before vessel breach.
3. Exponential notation is indicated in abbreviated form; e.g., 2.87-5 = 2.87×10^{-5}.
4. Water for debris cooling may fail.
5. Limited water supply from the CRD system.
6. Combines all late failure PDS frequencies (NLF + PLF + OLF + OLC +MLC).
7. Combines MKC and OKC PDS frequencies.
8. Refer to Section 4.6 for a description of the selection criteria.

Table 3.4-2 (Page 1 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
1	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	6.53E-06	13.65
2	TURBINE BUILDING FLOOD - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAV	1.38E-06	2.88
3	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM	PIHV	1.28E-06	2.67

Table 3.4-2 (Page 2 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE			
4	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	1.18E-06	2.47
5	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - REACTOR BUILDING ISOLATION FAILURE	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	PIHZ	8.76E-07	1.83

Table 3.4-2 (Page 3 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Sequence Description	Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
6	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIHV	6.67E-07	1.40
7	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP)	PIHX	6.07E-07	1.27

Table 3.4-2 (Page 4 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	STATE - 0 RELIEF VALVES STUCK OPEN - HPCI UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
8	CLOSURE OF ALL MSIVS - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	5.43E-07	1.14
9	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP)	PIHX	4.51E-07	.94

Table 3.4-2 (Page 5 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Sequence Description	Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	STATE - 0 RELIEF VALVES STUCK OPEN	- MSIVS FAIL TO REMAIN OPEN			
	- RCIC UNAVAILABLE (6 HOURS)	- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL			
	- FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS	- HPCI UNAVAILABLE LONG TERM			
	- CONDITIONS RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-	- CONDENSER UNAVAILABLE AS HEAT SINK			
	STATE - PLANT DEPRESSURIZED	- VESSEL INJECTION WITH CRDHS UNAVAILABLE			
		- OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY			
		- RHR PUMP A UNAVAILABLE			
		- RHR PUMP C UNAVAILABLE			
		- RHR PUMP B UNAVAILABLE			
		- RHR PUMP D UNAVAILABLE			
		- U2 TO U1 RHR CROSS CONNECT UNAVAILABLE			
		- OPERATOR FAILS TO ESTABLISH TORUS COOLING			
		- RHR LOW PRESSURE INJECTION PATH UNAVAILABLE			
		- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT			
		- DRYWELL SPRAY UNAVAILABLE			
		- STANDBY GAS TREATMENT SYSTEM UNAVAILABLE			
		- SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
10	TOTAL LOSS OF OFFSITE POWER	- DG 3A UNAVAILABILITY	PIHX	4.33E-07	.91
	- DG A UNAVAILABLE	- DG 3B UNAVAILABLE			
	- DG B UNAVAILABLE	- DG 3C UNAVAILABLE			
	- DG C UNAVAILABLE	- DG 3D UNAVAILABLE			
	- DG D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE			
	- FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES	- PLANT CONTROL AIR SYSTEM UNAVAILABLE			
	- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)	- OPERATOR FAILS TO RECOVER EECW (START SWING PUMP)			
	STATE - 1 RELIEF VALVE STUCK OPEN	- MSIVS FAIL TO REMAIN OPEN			
	- FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS	- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL			
		- CONDENSER UNAVAILABLE AS HEAT SINK			
		- VESSEL INJECTION WITH CRDHS UNAVAILABLE			
		- OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY			
		- RHR PUMP A UNAVAILABLE			
		- RHR PUMP C UNAVAILABLE			
		- RHR PUMP B UNAVAILABLE			
		- RHR PUMP D UNAVAILABLE			
		- U2 TO U1 RHR CROSS CONNECT UNAVAILABLE			
		- OPERATOR FAILS TO ESTABLISH TORUS COOLING			
		- RHR LOW PRESSURE INJECTION PATH UNAVAILABLE			
		- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT			
		- DRYWELL SPRAY UNAVAILABLE			
		- STANDBY GAS TREATMENT SYSTEM UNAVAILABLE			
		- SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
11	TOTAL LOSS OF OFFSITE POWER	- DG B UNAVAILABLE	PIHX	4.10E-07	.86

Table 3.4-2 (Page 6 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- DG A UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
12	TOTAL LOSS OF OFFSITE POWER - FUEL OIL SYSTEM FOR DIESEL A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG A UNAVAILABLE - DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE	PIHX	4.10E-07	.86

Table 3.4-2 (Page 7 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
13	TOTAL LOSS OF FEEDWATER - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	3.85E-07	.81
14	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3C UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHX	3.22E-07	.67

Table 3.4-2 (Page 8 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- STANDBY GAS TREATMENT SYSTEM UNAVAILABLE			
15	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3D UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	3.00E-07	.63
16	LOSS OF CONDENSER VACUUM - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MAIN CONDENSER UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO DEPRESSURIZE USING TBV'S - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	2.98E-07	.62
17	TURBINE TRIP WITHOUT BYPASS - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA-	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE	PIDV	2.94E-07	.61

Table 3.4-2 (Page 9 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - TBVS FAIL TO RELIEVE\MAINTAIN RX PRESSURE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO DEPRESSURIZE USING TBV'S - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
18	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3A UNAVAILABILITY - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	2.91E-07	.61
19	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3D UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE RHR PUMP C UNAVAILABLE	PIHX	2.89E-07	.60

Table 3.4-7. Browns Ferry Contributors to Core Damage		
Case	Frequency per Reactor-Year	Percent of Total CDF
Nonstation Blackout LOSP	2.0×10^{-5}	42
Station Blackout	1.3×10^{-5}	27
Loss of Vital DC Power	5.3×10^{-6}	11
Sequence in which the Reactor Remains at High Pressure	4.4×10^{-6}	9
Anticipated Transient without Scram	1.3×10^{-6}	3
Total Core Damage Frequency: 4.85×10^{-5} per Reactor-Year		

Table 3.4-8. Browns Ferry Level 1 Primary Containment States with Core Damage		
Primary Containment State	Frequency per Reactor-Year	Percent of Total CDF
Intact	4.64×10^{-5}	97
Late Failure	8.65×10^{-7}	2
Early Failure	3.94×10^{-7}	<1
Bypass	1.96×10^{-7}	<1
Total Core Damage Frequency: 4.85×10^{-5} per Reactor-Year		

Table 3.4-9. Comparison of Operator Action Sensitivity Results with the Browns Ferry Nuclear Power Plant IPE Results		
Initiating Event	Percentage of CDF in Operator Action Model	Percent of CDF in Browns Ferry IPE
1. Flood in Turbine Building	55	10
2. Loss of Offsite Power	10	69
3. Turbine Trip	8	2
5. Inadvertent Scram at Power	7	1
6. Inadvertent Opening of Three or More SRVs	3	1
7. Other Events	17	17

Table 3.4-2 (Page 12 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
25	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG C UNAVAILABLE - DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	2.42E-07	.51
26	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL D UNAVAILABE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG D UNAVAILABLE - DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY	PIHX	2.42E-07	.51

Table 3.4-2 (Page 13 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
27	LOSS OF ALL CONDENSATE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MAIN CONDENSER UNAVAILABLE - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK	MIAV	2.30E-07	.48
28	TOTAL LOSS OF OFFSITE POWER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAV	2.18E-07	.46
29	TOTAL LOSS OF OFFSITE POWER - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - FAILURE TO RECOVER TORUS COOLING	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - TORUS COOLING HARDWARE UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	MIHV	2.12E-07	.44

Table 3.4-2 (Page 14 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Sequence Description	Guaranteed Events/Comments	End State	Frequency (per year)	Percent
30	TOTAL LOSS OF OFFSITE POWER - FUEL OIL SYSTEM FOR DIESEL A UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL B UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL C UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL D UNAVAILABE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL 3A UNAVAILABLE - DG 3A UNAVAILABILITY - FUEL OIL SYSTEM FOR DIESEL 3B UNAVAILABLE - DG 3B UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL 3C UNAVAILABLE - DG 3C UNAVAILABLE - FUEL OIL FOR DIESEL 3D UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	2.07E-07	.43
31	TURBINE TRIP - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 3 OR MORE VALVES STUCK OPEN - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE	OIAV	1.98E-07	.41
32	INADVERTENT (OTHER) SCRAM - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 3 OR MORE VALVES STUCK OPEN	- DRYWELL PRESSURE SIGNAL UNAVAILABLE	OIAV	1.93E-07	.40

Table 3.4-2 (Page 15 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT				
33	TURBINE BUILDING FLOOD - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK - REACTOR BUILDING ISOLATION FAILURE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAZ	1.85E-07	.39
34	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE - REACTOR BUILDING ISOLATION FAILURE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHZ	1.71E-07	.36
35	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DG B UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE	PIHV	1.68E-07	.35

Table 3.4-2 (Page 16 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE			
36	TOTAL LOSS OF OFFSITE POWER - FUEL OIL SYSTEM FOR DIESEL A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DG A UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	1.68E-07	.35
37	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE - REACTOR BUILDING ISOLATION FAILURE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHZ	1.59E-07	.33

Table 3.4-2 (Page 17 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
38	TOTAL LOSS OF OFFSITE POWER - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	NIHV	1.39E-07	.29
39	TURBINE BUILDING FLOOD - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	NIHV	1.34E-07	.28
40	FEEDWATER RAMPUP - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	1.22E-07	.25

Table 3.4-2 (Page 18 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
41	TOTAL LOSS OF OFFSITE POWER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	OIAV	1.20E-07	.25
42	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - HPCI UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	1.19E-07	.25
43	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 2 RELIEF VALVES STUCK OPEN	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHX	1.16E-07	.24

Table 3.4-2 (Page 19 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
44	LOSS OF ALL CONDENSATE - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - VESSEL INJECTION WITH CRDHS UNAVAILABLE	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MAIN CONDENSER UNAVAILABLE - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIHV	1.11E-07	.23
45	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - POWER SUPPLY DIVISION II UNAVAILABLE - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIHV	1.11E-07	.23
46	TOTAL LOSS OF OFFSITE POWER	- 250 RMOV BD 2A UNAVAILABLE	PIHV	1.11E-07	.23

Table 3.4-2 (Page 20 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
47	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - HPCI UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	1.10E-07	.23
48	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - FUEL OIL SYSTEM FOR DIESEL 3B UNAVAILABLE	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP)	PIHX	1.05E-07	.22

Table 3.4-2 (Page 21 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
49	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - FUEL OIL SYSTEM FOR DIESEL 3C UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE	PIHX	1.05E-07	.22

Table 3.4-2 (Page 22 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Sequence Description	Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
50	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - FUEL OIL FOR DIESEL 3D UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	1.05E-07	.22
51	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - FUEL OIL SYSTEM FOR DIESEL 3A UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE	PIHX	1.05E-07	.22

Table 3.4-2 (Page 23 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Sequence Description	Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
52	MEDIUM LOCA - HIGH PRESSURE COOLANT INJECTION SYSTEM UNAVAILABLE - FAILURE TO DEPRESSURIZE VIA THE SRVS		OIAV	1.03E-07	.22
53	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DG C UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	9.94E-08	.21
54	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DIV II HI RX PRESS SIGNAL UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL	PIHX	9.69E-08	.20

Table 3.4-2 (Page 24 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Sequence Description	Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
55	LOSS OF RAW COOLING WATER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAV	9.53E-08	.20
56	TURBINE BUILDING FLOOD - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	OIAV	9.49E-08	.20
57	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - RHRSW PUMP B1 (SWING PUMP) UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK	PIHV	9.40E-08	.20

Table 3.4-2 (Page 25 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE			
58	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	9.33E-08	.20
59	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL D UNAVAILABE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DG D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHX	9.21E-08	.19

Table 3.4-2 (Page 26 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
60	INADVERTENT (OTHER) SCRAM - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - TURBINE TRIP FAILURE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO DEPRESSURIZE USING TBV'S - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	9.18E-08	.19
61	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - REACTOR BUILDING ISOLATION FAILURE	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE POWER SUPPLY DIVISION I UNAVAILABLE POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIHZ	8.96E-08	.19

Table 3.4-2 (Page 27 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
62	TURBINE BUILDING FLOOD - HPCI/RCIC CONTROL HARDWARE UNAVAILABLE - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAV	8.88E-08	.19
63	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	8.81E-08	.18
64	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - RHRSW PUMP D1 (SWING PUMP) UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHX	8.75E-08	.18

Table 3.4-2 (Page 28 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
65	CLOSURE OF ALL MSIVS - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - POWER SUPPLY DIVISION II UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 V RMOV BD 2B UNAVAILABLE POWER SUPPLY DIVISION I UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	8.60E-08	.18
66	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	8.47E-08	.18
67	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3EA AND 480 SD BD 3EA UNAVAILAB- - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- 250 V RMOV 1A UNAVAILABLE 250 V RMOV 2C UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	MIAV	8.16E-08	.17

Table 3.4-2 (Page 29 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Sequence Description	Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE			
68	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	8.16E-08	.17
69	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - HPCI UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - REACTOR BUILDING ISOLATION FAILURE	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE	PIHZ	8.14E-08	.17

Table 3.4-2 (Page 30 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
70	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAV	8.07E-08	.17
71	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DG B UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	8.02E-08	.17
72	TOTAL LOSS OF OFFSITE POWER - FUEL OIL SYSTEM FOR DIESEL A UNAVAILABLE - DG B UNAVAILABLE	- DG A UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE	PIHX	8.02E-08	.17

Table 3.4-2 (Page 31 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
73	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	7.85E-08	.16
74	TURBINE TRIP - AUTOMATIC/MANUAL REACTOR SCRAM FAILURE - STANDBY LIQUID CONTROL SYSTEM UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	- DRYWELL PRESSURE SIGNAL UNAVAILABLE	MIAV	7.68E-08	.16
75	CLOSURE OF ALL MSIVS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE	OIAV	7.37E-08	.15

Table 3.4-2 (Page 32 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL			
76	CLOSURE OF ALL MSIVS - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - REACTOR BUILDING ISOLATION FAILURE	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDZ	7.29E-08	.15
77	CLOSURE OF ALL MSIVS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 3 OR MORE VALVES STUCK OPEN - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN	OIAV	7.29E-08	.15
78	LOSS OF PLANT AIR - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS)	PIDV	7.23E-08	.15

Table 3.4-2 (Page 33 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
79	TOTAL LOSS OF OFFSITE POWER - 4KV SD BD A AND 480V SD BD 1A POWER UNAVAILABLE - 4KV SD BD B AND 480V SD BD 2A UNAVAILABLE - 4KV SD BD C AND 480V SD BD 1B UNAVAILABLE - 4KV SD BD D AND 480V SD BD 2B UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	NIHX	6.91E-08	.14
80	LOSS OF 500KV GRID - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MAIN CONDENSER UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO DEPRESSURIZE USING TBV'S - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	6.83E-08	.14

Table 3.4-2 (Page 34 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
81	LOSS OF 500KV GRID - OPERATOR FAILS TO RESTORE POWER TO UNIT BOARDS - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - TURBINE TRIP FAILURE - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	NIHX	6.76E-08	.14
82	TURBINE TRIP - AUTOMATIC/MANUAL REACTOR SCRAM FAILURE - OPERATOR FAILS TO START SLC	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, STATE - PLANT DEPRESSURIZED	MKCV	6.74E-08	.14
83	TURBINE TRIP - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - AUTOMATIC/MANUAL REACTOR SCRAM FAILURE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	- 250 V RMOV BD 2B UNAVAILABLE POWER SUPPLY DIVISION I UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - STANDBY LIQUID CONTROL SYSTEM UNAVAILABLE	MIAV	6.63E-08	.14
84	TOTAL LOSS OF OFFSITE POWER - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - FAILURE TO RECOVER 480V RMOV BDS 2A OR 2B	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	NIHV	6.42E-08	.13

Table 3.4-2 (Page 35 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- RHR PUMP D UNAVAILABLE	- RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE			
85	TOTAL LOSS OF OFFSITE POWER - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE	OIAV	6.40E-08	.13
86	TOTAL LOSS OF OFFSITE POWER - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - RHR PUMP A UNAVAILABLE - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	NIHV	6.40E-08	.13
87	TOTAL LOSS OF FEEDWATER - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - POWER SUPPLY DIVISION II UNAVAILABLE	- 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE	PIDV	6.37E-08	.13

Table 3.4-2 (Page 36 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Sequence Description	Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN	- DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
88	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO INITIATE DW SPRAY	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	6.34E-08	.13
89	TOTAL LOSS OF FEEDWATER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 3 OR MORE VALVES STUCK OPEN - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE	OIAV	6.19E-08	.13
90	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE	PIHZ	6.05E-08	.13

Table 3.4-2 (Page 37 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - REACTOR BUILDING ISOLATION FAILURE	- DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
91	CLOSURE OF ALL MSIVS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 2 RELIEF VALVES STUCK OPEN - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL	OIAV	6.02E-08	.13
92	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- 250 RMOV BD 2A UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE (6 HOURS)	MIAV	5.98E-08	.13

Table 3.4-2 (Page 38 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
		- CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE			
93	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	5.91E-08	.12
94	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - REACTOR BUILDING ISOLATION FAILURE	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHZ	5.82E-08	.12

Table 3.4-2 (Page 39 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Sequence Description	Guaranteed Events/Comments	End State	Frequency (per year)	Percent
95	TOTAL LOSS OF OFFSITE POWER - 4KV SD BD A AND 480V SD BD 1A POWER UNAVAILABLE - 4KV SD BD B AND 480V SD BD 2A UNAVAILABLE - 4KV SD BD C AND 480V SD BD 1B UNAVAILABLE - 4KV SD BD D AND 480V SD BD 2B UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	NIHX	5.78E-08	.12
96	TOTAL LOSS OF FEEDWATER - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - OPERATOR FAILS TO DEPRESSURIZE USING TBV'S - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	5.77E-08	.12
97	CLOSURE OF ALL MSIVS - AUTOMATIC/MANUAL REACTOR SCRAM FAILURE - OPERATOR FAILS TO START SLC	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, STATE - PLANT DEPRESSURIZED - CONDENSER UNAVAILABLE AS HEAT SINK	MXCV	5.67E-08	.12
98	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE	PIHX	5.58E-08	.12

Table 3.4-2 (Page 40 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	- DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
99	TOTAL LOSS OF OFFSITE POWER - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - RHR PUMP A UNAVAILABLE - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	NIHV	5.57E-08	.12
100	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3A UNAVAILABILITY - DG 3C UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE	PIHX	5.57E-08	.12

Table 3.4-2 (Page 41 of 41). Browns Ferry Top 100 Sequences Contributing to Core Damage

Rank No.	Sequence Description	Guaranteed Events/Comments	End State	Frequency (per year)	Percent
	STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE			

Table 3.4-3 (Page 1 of 2). Browns Ferry Most Important Guaranteed Failed Split Fractions

Split Fraction Importance
Sorted by Importance

....	SF Name...	Importance...	Achievement..	Reduction..	Derivative..	SF Value....	Frequency......
1.	NCDF	9.9903E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.7767E-05
2.	DWF	9.7979E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.6847E-05
3.	IVOF	8.2754E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.9568E-05
4.	HSF	8.2320E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.9360E-05
5.	CDF	8.1990E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.9202E-05
6.	CRDF	7.9940E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.8222E-05
7.	LPCF	7.8761E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.7658E-05
8.	DWSF	7.7852E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.7224E-05
9.	RCWF	7.4517E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.5629E-05
10.	PCAF	7.2319E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.4578E-05
11.	OG5F	7.0437E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3679E-05
12.	UB43BF	7.0025E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
13.	UB43AF	7.0025E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
14.	UB41AF	7.0024E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
15.	UB42BF	7.0024E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
16.	UB42AF	7.0024E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
17.	UB41BF	7.0024E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
18.	SHUT1F	7.0024E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
19.	SHT2F	7.0024E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
20.	UB42CF	6.9927E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3435E-05
21.	OG16F	6.9380E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3173E-05
22.	OLPF	6.5352E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.1247E-05
23.	U1F	6.3994E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.0598E-05
24.	OSPF	6.3079E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.0160E-05
25.	U3F	6.3055E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.0149E-05
26.	SW2CF	6.1295E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.9307E-05
27.	SW1CF	6.1295E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.9307E-05
28.	DKF	6.1237E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.9280E-05
29.	RHF	6.1214E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.9268E-05
30.	ABF	6.0156E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.8763E-05
31.	RPAF	5.8237E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7845E-05
32.	RPCF	5.8132E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7795E-05
33.	SW1AF	5.7519E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7502E-05
34.	SW2AF	5.7519E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7502E-05
35.	RMF	5.7420E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7455E-05
36.	REF	5.7420E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7455E-05

Table 3.4-3 (Page 2 of 2). Browns Ferry Most Important Guaranteed Failed Split Fractions

Split Fraction Importance
Sorted by Importance

....	SF Name..	Importance...	Achievement..	Reduction..	Derivative..	SF Value.....	Frequency......
37.	AAF	5.6478E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7004E-05
38.	HPLF	5.1398E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4575E-05
39.	SW2BF	5.0996E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4383E-05
40.	EBF	5.0979E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4375E-05
42.	RGF	5.0972E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4371E-05
43.	RFF	5.0972E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4371E-05
44.	RPBF	5.0614E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4200E-05
45.	ACF	5.0090E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.3950E-05
46.	SW1BF	4.9788E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.3805E-05
47.	RCLF	4.8874E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.3368E-05
48.	SW1DF	4.7399E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.2663E-05
49.	SGTF	4.7393E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.2660E-05
50.	RBCF	4.6500E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.2233E-05

Table 3.4-4 (Page 1 of 2). Browns Ferry Most Important Nonguaranteed Failed Split Fractions

Split Fraction Importance
Sorted by Importance

....	SF Name...	Importance....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
1.	RVC0*	6.6076E-01	3.8737E-01*	9.4099E+00*	-4.3140E-04	9.3210E-01	3.1593E-05
2.	RVD2*	5.3752E-01	4.6562E-01*	9.2600E+01*	-4.4053E-03	9.9420E-01	2.5700E-05
3.	GA1	5.2501E-01	4.0447E+00	4.9693E-01	1.6963E-04	1.4180E-01	2.5103E-05
4.	GB2	4.7181E-01	3.4967E+00	5.3186E-01	1.4176E-04	1.5790E-01	2.2559E-05
5.	GC4	3.9897E-01	1.9736E+00	6.4574E-01	6.3487E-05	2.6680E-01	1.9076E-05
6.	GD4	2.2700E-01	1.1861E+00	8.5791E-01	1.5694E-05	4.3290E-01	1.0854E-05
7.	RPD10	1.7750E-01	1.2549E+00	8.2355E-01	2.0622E-05	4.0910E-01	8.4871E-06
8.	RVC1*	1.4395E-01	3.0512E+00*	8.6549E-01*	1.0451E-04	6.1540E-02	6.8826E-06
9.	DGA	1.4299E-01	2.9353E+01	8.5949E-01	1.3624E-03	4.9311E-03	6.8369E-06
10.	RPB6	1.2991E-01	1.2460E+00	8.7181E-01	1.7890E-05	3.4260E-01	6.2114E-06
11.	RCI1	1.2981E-01	2.1933E+00	9.1533E-01	6.1105E-05	6.6250E-02	6.2066E-06
12.	GD3	1.2167E-01	1.4432E+00	8.8479E-01	2.6701E-05	2.0630E-01	5.8176E-06
13.	DH1	1.1943E-01	2.4485E+01	8.8191E-01	1.1285E-03	5.0032E-03	5.7106E-06
14.	RBI1	9.8421E-02	8.3279E-01**	1.0224E+00**	-9.0677E-06	1.1832E-01	4.7059E-06
15.	RVD22*	9.2484E-02	1.4218E+01*	9.0816E-01*	6.3641E-04	6.9000E-03	4.4220E-06
16.	HPI4	9.2093E-02	1.7127E+00	9.1200E-01	3.8286E-05	1.0990E-01	4.4033E-06
17.	GE1	6.2402E-02	9.4017E-01	1.0126E+00	-3.4640E-06	1.7420E-01	2.9836E-06
18.	RVD5*	5.6744E-02	9.4367E-01*	8.6597E+00*	-3.6893E-04	9.9270E-01	2.7131E-06
19.	GB1	5.2018E-02	1.2439E+00	9.6059E-01	1.3547E-05	1.3910E-01	2.4872E-06
20.	GF1	5.1806E-02	9.4368E-01**	1.0119E+00**	-3.2632E-06	1.7470E-01	2.4770E-06
21.	GG1	4.7785E-02	9.6921E-01**	1.0067E+00**	-1.7922E-06	1.7860E-01	2.2848E-06
22.	RPA1	4.5973E-02	4.0847E+00	9.5896E-01	1.4945E-04	1.3130E-02	2.1981E-06
23.	HPI2	4.5116E-02	8.9798E-01	1.0095E+00**	-5.3312E-06	8.5020E-02	2.1572E-06
24.	GC2	4.3492E-02	1.2470E+00	9.6063E-01	1.3692E-05	1.3750E-01	2.0795E-06
25.	FA1	4.2450E-02	2.9695E+00	9.6818E-01	9.5692E-05	1.5900E-02	2.0297E-06
26.	GH1	4.1779E-02	9.7725E-01**	1.0052E+00**	-1.3351E-06	1.8540E-01	1.9976E-06
27.	RVD9*	3.7315E-02	9.6307E-01*	4.6199E+00*	-1.7485E-04	9.8990E-01	1.7842E-06
28.	FB1	3.6378E-02	2.6402E+00	9.7362E-01	7.9686E-05	1.5830E-02	1.7393E-06
29.	GD7	3.4622E-02	1.0634E+00	9.7692E-01	4.1356E-06	2.6680E-01	1.6554E-06
30.	GB3	3.3632E-02	1.2027E+00	9.6651E-01	1.1292E-05	1.4180E-01	1.6081E-06
31.	RPC2	3.1436E-02	1.0586E+00	9.6944E-01	4.2653E-06	3.4260E-01	1.5031E-06

* These split fractions are associated with multiple branch top events. The importance listed for the split fraction is correct; however, the values for achievement and reduction factors have no meaning.
**The number of sequences saved to the model database is insufficient to obtain an accurate measure of achievement and reduction factors.

Table 3.4-4 (Page 2 of 2). Browns Ferry Most Important Nonguaranteed Failed Split Fractions

Split Fraction Importance
Sorted by Importance

.....	SF Name..	Importance....	Achievement..	Reduction..	Derivative..	SF Value.....	Frequency......
32.	GC1	2.7642E-02	1.1219E+00	9.8026E-01	6.7713E-06	1.3940E-01	1.3217E-06
33.	RVC3*	2.4380E-02	5.6335E+01*	9.7563E-01*	2.6469E-03	4.4020E-04	1.1657E-06
34.	SPR1	2.4216E-02	1.3206E+00	9.7587E-01	1.6481E-05	7.0000E-02	1.1578E-06
35.	RVC2*	2.2366E-02	6.2129E+00*	9.7773E-01*	2.5031E-04	4.2540E-03	1.0694E-06
36.	RPS1	2.1771E-02	0.0000E+00	9.7823E-01	0.0000E+00	1.7848E-05	1.0410E-06
37.	GD2	1.9920E-02	1.1053E+00	9.8475E-01	5.7650E-06	1.2650E-01	9.5247E-07
38.	CRD4	1.9237E-02	1.0669E+00	9.8301E-01	4.0108E-06	2.0249E-01	9.1980E-07
39.	FC1	1.9177E-02	1.5900E+00	9.9051E-01	2.8664E-05	1.5830E-02	9.1691E-07
40.	RVD6*	1.7007E-02	9.8309E-01*	4.0030E+00*	-1.4439E-04	9.9440E-01	8.1318E-07
41.	RVD10*	1.6728E-02	9.8339E-01*	3.3909E+00*	-1.1511E-04	9.9310E-01	7.9984E-07
42.	FD1	1.6721E-02	1.4541E+00	9.9270E-01	2.2060E-05	1.5830E-02	7.9951E-07
43.	HPI6	1.6306E-02	1.1499E+00	9.8578E-01	7.8454E-06	8.6670E-02	7.7962E-07
44.	U11	1.5933E-02	1.2808E+00	9.8427E-01	1.4177E-05	5.3057E-02	7.6180E-07
45.	GH2	1.5645E-02	9.6777E-01**	1.0056E+00**	-1.8072E-06	1.4730E-01	7.4806E-07
46.	RVC4*	1.5572E-02	9.8617E-01*	1.1233E+00*	-6.5583E-06	8.9920E-01	7.4454E-07
47.	PX23	1.4919E-02	1.9746E+01	9.8509E-01	8.9700E-04	7.9450E-04	7.1333E-07
48.	RPB3	1.3109E-02	1.3357E+00	9.8700E-01	1.6672E-05	3.7290E-02	6.2679E-07
49.	GD6	1.2919E-02	1.0778E+00	9.8759E-01	4.3150E-06	1.3750E-01	6.1771E-07
50.	RPD4	1.2899E-02	1.0077E+00	9.8710E-01	9.8504E-07	6.2610E-01	6.1673E-07

*These split fractions are associated with multiple branch top events. The importance listed for the split fraction is correct; however, the values for achievement and reduction factors have no meaning.

**The number of sequences saved to the model database is insufficient to obtain an accurate measure of achievement and reduction factors.

Table 3.4-5 (Page 1 of 2). Browns Ferry Top Event Importance

Sorted by Probabilistic Importance

.....	Top..............	Probabilistic..	Guar. Event..	Total.......	Frequency......
1.	RVC(SORV0)	6.7131E-01	9.6923E-02	7.6824E-01	3.6732E-05
2.	EPR30	6.4287E-01	0.0000E+00	6.4287E-01	3.0738E-05
3.	RVD(DEP)	6.3062E-01	5.2607E-03	6.3588E-01	3.0404E-05
4.	EPR6	6.2469E-01	0.0000E+00	6.2469E-01	2.9868E-05
5.	GB	5.5743E-01	4.4322E-02	6.0175E-01	2.8772E-05
6.	GA	5.2489E-01	4.2537E-02	5.6743E-01	2.7131E-05
7.	GC	4.7321E-01	2.7664E-02	5.0087E-01	2.3948E-05
8.	GD	4.2446E-01	2.6021E-02	4.5048E-01	2.1539E-05
9.	RPD	2.0422E-01	4.4919E-01	6.5341E-01	3.1242E-05
10.	HPI	1.4996E-01	1.0407E-01	2.5402E-01	1.2146E-05
11.	RPB	1.4622E-01	5.0544E-01	6.5166E-01	3.1158E-05
12.	RCI	1.2585E-01	1.1104E-01	2.3688E-01	1.1326E-05
13.	DG	1.0995E-01	0.0000E+00	1.0995E-01	5.2572E-06
14.	RVC(SORV1)	1.0863E-01	1.5272E-03	1.1015E-01	5.2668E-06
15.	RBI	9.2661E-02	6.4072E-03	9.9068E-02	4.7368E-06
16.	RVD(NODEP)	9.2445E-02	0.0000E+00	9.2445E-02	4.4201E-06
17.	DH	8.9743E-02	8.7092E-05	8.9830E-02	4.2951E-06
18.	GG	6.3817E-02	2.8223E-01	3.4604E-01	1.6545E-05
19.	GH	6.3367E-02	2.8236E-01	3.4573E-01	1.6530E-05
20.	GE	6.2402E-02	2.8208E-01	3.4448E-01	1.6471E-05
21.	GF	6.1527E-02	2.8198E-01	3.4351E-01	1.6424E-05
22.	OLP	5.2914E-02	6.5138E-01	7.0430E-01	3.3675E-05
23.	RPA	4.4741E-02	5.8163E-01	6.2637E-01	2.9949E-05
24.	FB	4.4322E-02	0.0000E+00	4.4322E-02	2.1192E-06
25.	RPC	4.3278E-02	5.8062E-01	6.2390E-01	2.9831E-05
26.	FA	4.2450E-02	8.7092E-05	4.2537E-02	2.0338E-06
27.	FC	2.7577E-02	0.0000E+00	2.7577E-02	1.3186E-06
28.	FD	2.5934E-02	0.0000E+00	2.5934E-02	1.2400E-06
29.	SPR	2.4216E-02	3.3530E-04	2.4551E-02	1.1739E-06
30.	RPS	1.9761E-02	0.0000E+00	1.9761E-02	9.4486E-07
31.	CRD	1.7996E-02	8.1227E-01	8.3027E-01	3.9698E-05
32.	RVC(SORV2)	1.7908E-02	0.0000E+00	1.7908E-02	8.5626E-07
33.	U1	1.5861E-02	6.3839E-01	6.5425E-01	3.1282E-05
34.	RVC(SORV3)	1.4020E-02	9.4195E-03	2.3439E-02	1.1207E-06
35.	FF	1.2549E-02	6.3861E-03	1.8935E-02	9.0533E-07
36.	PX2	1.2349E-02	9.1303E-02	1.0365E-01	4.9559E-06
37.	SW2D	1.1126E-02	4.5778E-01	4.6891E-01	2.2420E-05
38.	AB	1.0573E-02	6.0145E-01	6.1202E-01	2.9263E-05
39.	SW2B	1.0406E-02	5.0990E-01	5.2031E-01	2.4878E-05
40.	AD	9.8749E-03	4.4764E-01	4.5751E-01	2.1875E-05

Table 3.4-5 (Page 2 of 2). Browns Ferry Top Event Importance

Sorted by Probabilistic Importance

.....	Top..............	Probabilistic..	Guar. Event...	Total.........	Frequency......
41.	AA	9.4178E-03	5.6475E-01	5.7417E-01	2.7453E-05
42.	AC	8.8172E-03	5.0078E-01	5.0960E-01	2.4366E-05
43.	SW1B	8.7009E-03	4.6193E-01	4.7063E-01	2.2503E-05
44.	CS	8.3393E-03	1.0874E-01	1.1708E-01	5.5979E-06
45.	CIL	7.4854E-03	1.3605E-04	7.6214E-03	3.6441E-07
46.	SW1D	7.0982E-03	4.4211E-01	4.4921E-01	2.1478E-05
47.	FG	7.0781E-03	1.2182E-02	1.9260E-02	9.2089E-07
48.	SW2A	7.0759E-03	5.7513E-01	5.8221E-01	2.7838E-05
49.	FH	7.0430E-03	6.3861E-03	1.3429E-02	6.4209E-07
50.	FE	6.9346E-03	6.4732E-03	1.3408E-02	6.4107E-07

Table 3.4-6. Browns Ferry Operator Action Importance to Core Damage			
Operator Action Designator	Description	Operator Action Failure Rate Mean Value	Importance to CDF
RVD22	Manual Depressurization of the Reactor Vessel Using the Safety Relief Valves	6.90×10^{-3}	.092
OLP1	Control Reactor Vessel Level at Low Pressure Using RHR or Core Spray	4.79×10^{-4}	.070
SPR1	Recover Suppression Pool Cooling by Closing Alternate LPCI Valves or Local-Manual Suppression Pool Valve Operation	7.00×10^{-2}	.024
U11	Align Alternate Injection to Reactor Vessel via the Unit 1 to Unit 2 RHR Crosstie	5.31×10^{-2}	.016
ORP2	Start RHR or Core Spray Pumps Given That High Pressure Injection (HPCI, RCIC) has Failed	2.58×10^{-2}	.007
R4801	Restore Power to 480V RMOV Board 2A or 2B	1.30×10^{-2}	.007
OUB2	Transfer Unit 1 and Unit 2 Unit Boards to 161-kV Power, Given Loss of 500-kV Power	4.92×10^{-3}	.006
OSL1	Start Standby Liquid Control System, Given ATWS with the Reactor Vessel Isolated	5.44×10^{-3}	.005
ODWS1	Align RHR for Drywell Spray during non-ATWS Scenarios	9.63×10^{-3}	.005
OSP1	Align RHR for Suppression Pool Cooling during Non-ATWS Scenarios, Given Both Loops of RHR are Available	7.82×10^{-5}	.004
OSL2	Start Standby Liquid Control System, Given That ATWS and the Reactor Vessel is Not Isolated.	1.24×10^{-2}	.003

Table 3.4-7. Browns Ferry Contributors to Core Damage		
Case	Frequency per Reactor-Year	Percent of Total CDF
Nonstation Blackout LOSP	2.02×10^{-5}	42
Station Blackout	1.30×10^{-5}	27
Loss of Vital DC Power	5.28×10^{-6}	11
Sequence in which the Reactor Remains at High Pressure	4.42×10^{-6}	9
Anticipated Transient without Scram	9.45×10^{-7}	2
Total Core Damage Frequency: 4.85×10^{-5} per Reactor-Year		

Table 3.4-8. Browns Ferry Level 1 Primary Containment States with Core Damage		
Primary Containment State	Frequency per Reactor-Year	Percent of Total CDF
Intact	4.64×10^{-5}	96
Late Failure	8.65×10^{-7}	2
Early Failure	3.94×10^{-7}	<1
Bypass	1.96×10^{-7}	<1
Total Core Damage Frequency: 4.85×10^{-5} per Reactor-Year		

Table 3.4-9. Comparison of Operator Action Sensitivity Results with the Browns Ferry Nuclear Power Plant IPE Results

Initiating Event	Percentage of CDF in Operator Action Model	Percent of CDF in Browns Ferry IPE
1. Flood in Turbine Building	55	10
2. Loss of Offsite Power	10	69
3. Turbine Trip	8	2
5. Inadvertent Scram at Power	7	1
6. Inadvertent Opening of Three or More SRVs	3	1
7. Other Events	17	17

Table 3.4-10. Importance Evaluation for the Decay Heat Removal Function

Scenario Description	Top Events Examined	Comments	Percentage of CDF
Sequences involving one or more stuck-open SRVs.	NRV	This top event is failed to track the SRVs being stuck open.	< 0.1
	SP, SPR	Hardware top events for suppression pool cooling. Includes failure from all causes.	
	NRV	This top event is failed to track the SRVs being stuck open.	4
	OSP	Operator unsuccessful in aligning for suppression pool cooling. Includes operator failures under all conditions.	
Sequences in which SRVs are not stuck open.	NRV	This top event is successful to track that no stuck-open SRVs exist.	2
	HS	This top event tracks the status of the main condenser and its associated systems.	
	SP, SPR, SDC	Hardware top events for suppression pool cooling and shutdown cooling. Includes failures from all causes.	
	NRV	This top event is successful to track that no stuck-open SRVs exist.	58
	HS	This top event tracks the status of the main condenser and its associated systems.	
	OSP	Operator unsuccessful in aligning suppression pool cooling	
	OSD	Operator unsuccessful in aligning shutdown cooling and cannot be used.	
	NRV	This top event is successful to track that no stuck-open SRVs exist.	1
	HS	This top event tracks the status of the main condenser and its associated systems.	
	OSP, SDC	Operator unsuccessful in aligning suppression pool cooling and shutdown cooling hardware fails.	
	or SP, SPR, OSD	or Suppression pool cooling hardware fails and operator unsuccessful in aligning for shutdown cooling.	

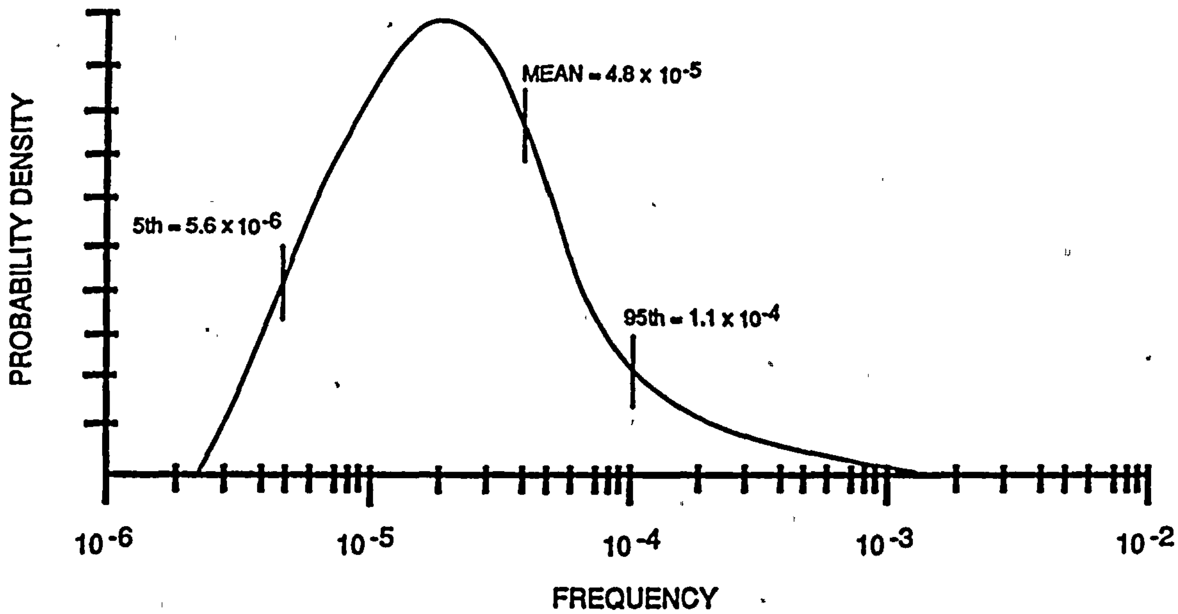


Figure 3.4-1. Browns Ferry Core Damage Frequency

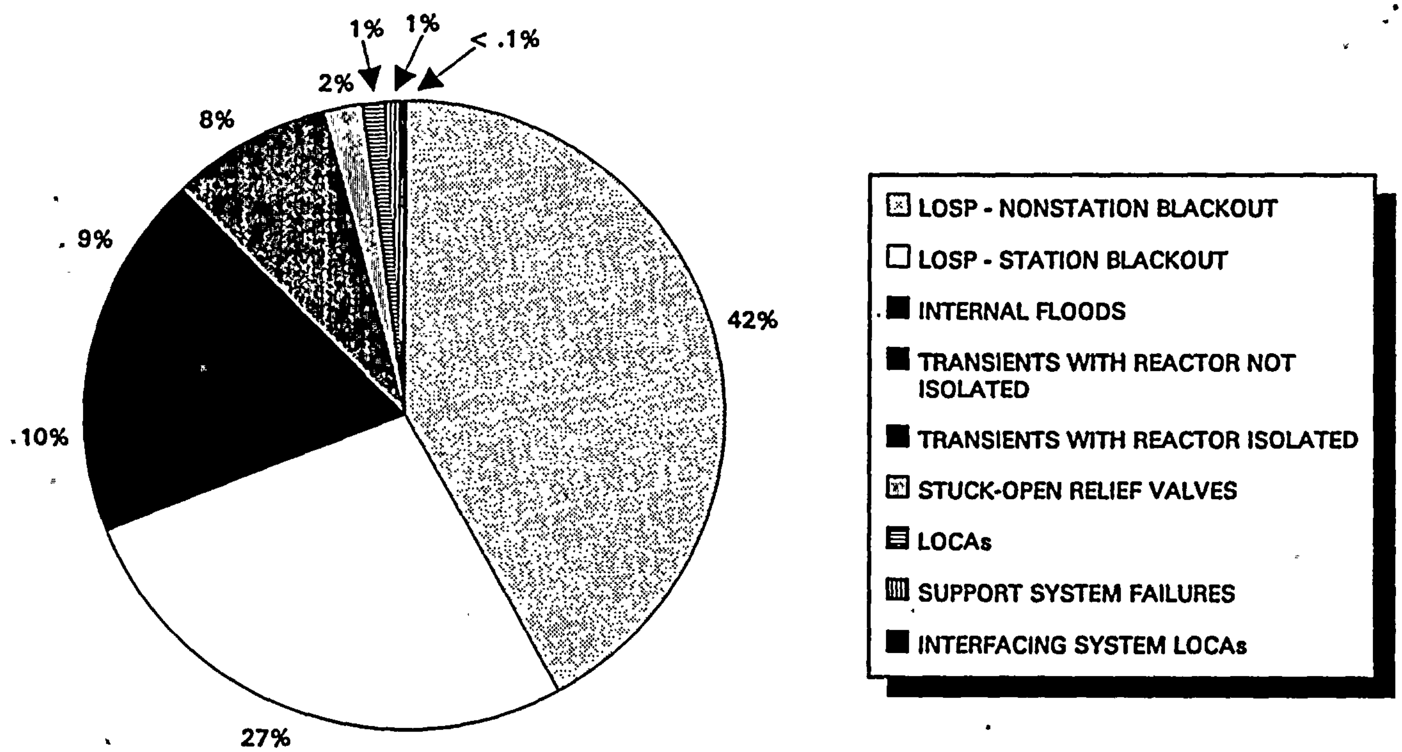


Figure 3.4-2. Browns Ferry Core Damage Frequency by Initiating Event Category

4. BACK-END ANALYSIS

The back-end or degraded core and containment response analysis described in this section addresses the physical progression of severe accident sequences. The degraded core and containment response analysis begins with the onset of sustained core damage when reactor vessel water level recedes below the top of active fuel and determines if the damaged core can be recovered in the reactor vessel. If in-vessel level or coolant recovery is not possible, extensive fuel melting and eventual vessel lower head melt-through will occur. The containment response analysis evaluated the performance of containment systems and the probability that the core debris is successfully contained within the intact primary containment. Should primary containment failure (loss of containment integrity) occur, the assessment then evaluated the performance of the secondary containment, the secondary containment isolation, and the standby gas treatment system (SBGTS). In this document, the terms "back-end," "containment response," "containment performance," and "Level 2 PRA" are used interchangeably.

The back-end analysis interfaces with the front-end (or plant) analysis through the appropriate definition of a set of plant damage states (PDS). These states are the endpoints of the sequences in the Level 1 portion of the event trees and the initiating events for the Level 2 or containment event trees (CET). The end products of the back-end analysis include a set of release categories, which define the radionuclide releases into the environment, and a quantification of the frequency of each release category. The release categories constitute the endpoints of this Level 2 probabilistic risk assessment (PRA) and a measure of the potential consequences of severe accidents. The release categories provide the interface to the site consequence analysis task in which numerical estimates of public health effects and property damage could be made. Another important product of the back-end analysis is the identification of any individual accident sequences whose frequencies exceed the screening frequency prescribed in NUREG-1335 (Reference 4-1).

The overall relationship between the Level 1 and Level 2 portions of the accident sequence model is shown in Figure 4-1.

The scope of the back-end analysis includes:

- The definition of the PDSs applicable to Browns Ferry Unit 2. These have already been reflected in the Level 1 results described in Section 3.
- The selection of key plant damage states (KPDS) from the quantitative Level 1 results using selection guidance provided in NUREG-1335, and defining representative severe accidents sequence(s) for each KPDS.
- The development and quantification of the Browns Ferry CET and the determination of the core and containment response for each KPDS.
- A Browns Ferry-specific containment structural analysis to determine failure modes for a range of temperature criteria and pressure-dependent containment failure probabilities.

- The development of a Browns Ferry-specific model of the reactor coolant system (RCS), the primary containment, the secondary containment (and the adjoining refueling bay and turbine building), and numerous systems for the Modular Accident Analysis Program [(MAAP) Reference 4-2].

- Best estimate MAAP analyses of the representative KPDS sequences to determine the thermal-hydraulic response of the plant, the time available for recovery actions, the determination of if and when containment failure would occur, and, if containment failure occurs, the timing and release fractions of selected radionuclide groups. Selected sensitivity MAAP analyses were also performed.

- The definition of radionuclide release categories as a function of the degree of core damage, and the mode and timing of containment failure.

- The quantification of the probability that each Level 1 accident sequence characterized by its KPDS will result in each release category when combined with the Level 1 results. This permits the quantification of the frequency of each release category and a definition of the important contributing sequences.

- Selection of key release categories and their associated source terms.

The end product of this task is a characterization (in terms of fission product source terms) of the impact of each severe accident sequence on the mode, timing, and magnitude of radionuclides released from the plant. This characterization is accomplished through a range of deterministic engineering analyses of the physical processes that determine the core melt progression, the containment response, the containment failure condition, and the release and transport of radionuclides. These analyses determine such physical parameters as the containment pressure and temperature as a function of time, the pressure at which the containment may fail, the rate at which the molten debris may penetrate the concrete pedestal/drywell floor, and the rate and quantity of hydrogen that would be produced and released into the containment. A unique CET quantification is defined for each group of severe accident sequences having the same plant damage state. Different split fractions for the CET nodes characterize the different plant damage states.

The Browns Ferry back-end analysis supplements plant-specific analyses with relevant published information. The Level 2 team has used the information provided in the NRC-sponsored NUREG-1150 study for Peach Bottom Unit 2 (Reference 4-3). This information is described in NUREG/CR-4551 (Reference 4-4) and supplementary NUREG reports referenced in subsequent subsections.

<u>References</u>

4-1. U.S. Nuclear Regulatory Commission, "Individual Plant Examination: Submittal Guidance," NUREG-1335, August 1989.

4-2. Henry, R. E., and M. G. Plys, "MAAP-3.0B — Modular Accident Analysis Program for LWR Power Plants," Electric Power Research Institute, EPRI NP-7071-CCML, November 1990.

4-3. U.S. Nuclear Regulatory Commission, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," NUREG-1150, December 1990.

4-4. Sandia National Laboratories, "Evaluation of Severe Accident Risks: Peach Bottom, Unit 2," prepared for U.S. Nuclear Regulatory Commission, NUREG/CR-4551, SAND86-1309, Volume 4, Revision 1, Parts 1 and 2, December 1990.

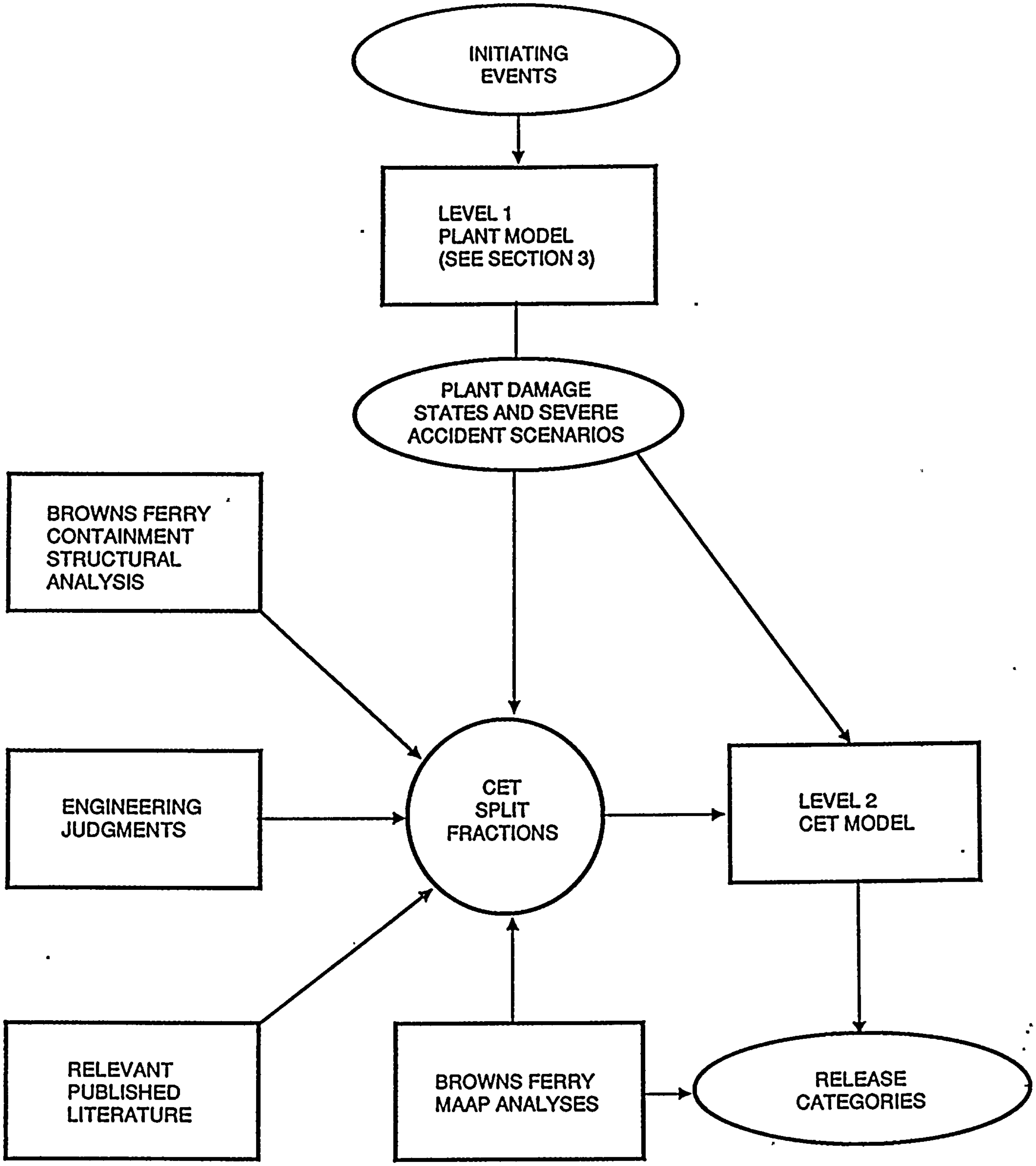


Figure 4-1. Overview of Level 1 and Level 2 Assessments

4.1 PLANT DATA AND DESCRIPTION

4.1.1 COMPARISON OF BROWNS FERRY AND PEACH BOTTOM

Both the Browns Ferry Nuclear Plant and the Peach Bottom plant contain General Electric boiling water reactors (BWR) located in Mark I containments. Given this general characterization of similarity and the significant severe accident database that has been generated for Peach Bottom,* it is appropriate to compare Browns Ferry and Peach Bottom features in some detail. This comparison made use of published Peach Bottom results, and, reviewed any differences in the results for each plant to determine whether they are traceable to differences in plant features reflected in the analyses.

The containment configuration and major dimensions are very similar. Table 4.1-1 provides a limited comparison of RCS and containment design features for the two plants. As can be seen, Browns Ferry is very similar to Peach Bottom.

The Browns Ferry plant is very similar to Peach Bottom Unit 2 except that both the Browns Ferry refueling bay and the turbine building are common for the three units and have substantially larger volumes than their Peach Bottom counterparts. These larger volumes will, to some extent, result in longer fission product residence times and reduced releases to the environment.

Figure 4.1-1 shows an isometric cutaway of the Browns Ferry reactor vessel and internals, which are very similar to other BWR4 3,293 MWt NSSS plants; e.g., Browns Ferry Units 1, 2 and 3, Peach Bottom Units 2 and 3, Fermi Unit 2, and Hope Creek are BWR4 units with Mark I containments, and Limerick Units 1 and 2 and Susquehanna Units 1 and 2 are BWR4 units with Mark II containments.

Figure 4.1-2 shows an elevation of the Browns Ferry primary containment, reactor building and refuel bay. The torus room floor elevation is at 519', and the refueling floor elevation is at 664'. The reactor building exterior walls are of poured in-place reinforced concrete construction but are not designed for any significant internal pressure. The refueling bay is of a steel frame construction with sealed and insulated steel siding; the refueling bay roof elevation is at approximately 715'. Steam and feedwater piping penetrate primary containment at the drywell spherical shell equator, and pass through a steam tunnel before passing into the turbine building. The turbine building is of steel frame, steel siding construction.

Figure 4.1-3 shows the Browns Ferry reactor building volume and the volumes of the adjoining refueling bay and turbine building. Blowout panels are located between the reactor building and both the refueling bay and turbine building and in the refueling bay exterior walls. The blowout panel design pressure differential, flow area, and elevations are noted in Figure 4.1-3. The refueling bay and turbine building volumes for Browns Ferry are substantially larger than those for Peach Bottom.

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*Peach Bottom was one of the five plants analyzed in NUREG-1150 (Reference 4.1-1).

4.1.2 PRIMARY CONTAINMENT AND SECONDARY CONTAINMENT BUILDING WALK-THROUGH

A photographic walk-through of the Browns Ferry Nuclear Plant was accomplished as part of the overall Browns Ferry PRA effort. This task familiarized members of the Level 2 IPE team with the structures and components in the drywell, torus, reactor building, and refueling bay that directly influence the phenomena that govern the response to severe accidents.

Extensive investigation of the primary and secondary containment building was performed by Oak Ridge National Laboratory (ORNL) as part of the NRC's Severe Accident Sequence Analysis (SASA) Program. To supplement the ORNL investigation, the Level 2 team identified several items of interest and a photographic tour was conducted by BFN plant personnel during which pictures were taken of specific structures and components in the drywell, torus, reactor building, and refueling bay. A list of structures and components in those areas was furnished to plant personnel who provided the photographs to the Level 2 team for review.

4.1.2.1 Primary Containment Walk-Through

The investigation of the primary containment included the drywell and torus regions and concentrated on the following features:

- Drywell Shell/Vent Pipe Geometry. The vent system connects the drywell and suppression pool and conducts flow from the drywell to the suppression pool. It is designated to distribute this flow uniformly in the pool following a postulated pipe rupture in the drywell. Large vent pipes form the connection between the drywell and the pressure suppression chamber. A total of eight circular vent pipes are provided, each having a diameter of 6.75 feet. The opening of the vent pipes is approximately 18 inches off the drywell floor. Jet deflectors are provided at the entrance of each vent pipe to prevent possible damage to the vent pipes from the jet forces that might accompany a pipe break in the drywell.

- Drywell Shell/Drywell Floor Interface. Investigation of the intersection of the drywell shell and the drywell floor revealed a smooth transition and the fact that no curbs exist at the interface of the drywell floor and drywell shell. The steel drywell shell penetrates the concrete floor of the drywell at this intersection point. This flat intersection configuration extends circumferentially around the floor of the drywell.

- Pedestal/Drywell Interface. The opening from the drywell to the reactor support pedestal is approximately 3 feet wide and 7 feet high. The doorway is an open portal with no door. The floor area between the drywell and the pedestal region is a flat surface with no ledges, steps, or curbs that would enhance or retard fluid flow between the pedestal and the drywell. The pedestal floor is flat with no significant obstructions.

- Pedestal Region. An equipment drain sump is located in the pedestal floor. The sump is covered by a steel grating with approximately 2 inches by 7 inches rectangular openings. The sump opening is approximately 6 feet by 12 feet and is approximately 4 feet deep. Looking upward from the pedestal region towards the bottom of the reactor vessel reveals a myriad of structures consisting of primarily control rod drive (CRD) lateral housing restraints, mechanisms and CRD hydraulic lines.

- **SRV Vacuum Breakers.** The safety relief valves (SRV) relieve to tailpipes that discharge beneath the water level in the suppression pool through a ramshead and T-quencher arrangement. The SRV tailpipes are grouped in banks of either two or three, with the banks of tailpipes penetrating the jet deflectors attached to the main vent pipes. Each tailpipe is equipped with both a 2.5-inch diameter and a 10-inch-diameter vacuum breaker. The 10-inch vacuum breakers are located approximately 2 to 3 feet above the floor and are faced in opposite directions of the adjacent vacuum breakers on the adjacent tailpipes. The 2.5-inch vacuum breakers are located approximately 2 feet above each 10-inch vacuum breaker. There are no structures or equipment close to the SRV vacuum breakers that could obstruct flow or cause interference when the vacuum breaker cycles.

- **Torus-To-Drywell Vacuum Breakers.** Automatic vacuum relief devices are used to maintain the design pressure difference between the suppression pool and the drywell. The suppression pool-to-drywell vacuum breakers are located on the ends of the main vent pipes within the gas space above the suppression pool. These vacuum breakers allow flow of gases from the torus region to the drywell region to equalize the differential pressure between the regions. There are no structures or pieces of equipment close to the vacuum breakers that could obstruct flow or cause interference when the vacuum breaker cycles.

4.1.2.2 Secondary Containment Building Walk-Through

The investigation of the secondary containment included both the reactor building and refueling bay and concentrated on the following features:

- **Reactor Building-To-Torus Vacuum Breakers.** The reactor building-to-torus vacuum breakers (RBTVB) are used to limit the external pressure on the torus from exceeding the external design pressure. The RBTVBs draw air from the reactor building into the torus when the torus pressure is below that of the reactor building. The RBTVBs are located in the reactor building on the west side of the drywell. The RBTVBs are positioned on a large diameter steel pipe that protrudes vertically through the floor. The RBTVBs are mounted on the ends of horizontal tees fitted to the vertical pipe. There are two sets of two RBTVBs in series. There are no structures or equipment close to the RBTVBs that could obstruct flow or cause interference when the vacuum breaker cycles.

- **Corner Rooms.** The basement of the reactor building houses the torus. There are four corner rooms that are located adjacent to the torus structure. These corner rooms house the core spray, RHR, and RCIC turbine/pump. These pumps are mounted on pedestals above the floor slab of the corner rooms. These corner rooms do not have doors and communicate freely with the torus room. Each corner room is accessible from the upper regions of the reactor building via open stairwells.

- **HPCI Room.** The Unit 2 HPCI room is a separate room located adjacent to the southeast corner room. The Unit 2 HPCI room is accessible from the southeast corner room via an open doorway.

- **Refueling Floor.** The refueling floor is common to the three reactor zones. The refueling floor is an open region that spans the length of the three reactor zones. The height of the refueling floor ceiling is approximately 50 feet. The superstructure of the refueling floor is a structural steel frame that supports roof decking and overhead crane tracks. The refueling floor walls are made of insulated metal siding panels. There are three equipment hatches, two stairwells, and two elevator shafts that connect the three reactor zones to the refueling floor.

- **Reactor Building-To-Refueling Floor Blowout Panels.** The reactor building-to-refueling floor (RBRF) blowout panels for Unit 2 are located on top of the transfer shaft. This equipment transfer shaft has an opening between the refueling floor and Unit 2 reactor zone approximately 17 feet by 17 feet. This opening is closed off by a panel made up of approximately 3-inch angle iron (welded back to back to form a "tee") grid on a grid spacing of approximately 30 inches. In each cell, sheet metal panels, approximately 30 inches by 30 inches, are bolted to the angle iron grid. The RBRF blowout panels are approximately 300 square feet of relieving area. These blowout panels are designed to relieve when the pressure difference across the panels exceeds 0.25 psid.

- **Refueling Floor-To-Environment Blowout Panels.** The refueling floor-to-environment (RFE) blowout panels are mounted on the north and south walls of the refueling floor. These panels are designed to relieve excess pressure that may occur in the refueling floor region. These blowout panels relieve directly into the environment. The blowout panels are composed of steel panels attached to the steel building framing. Cables are attached to the blowout panels to prevent a missile hazard should they come loose following an overpressure event in the refueling floor. The RFE blowout panels are approximately 3,000 square feet of relieving area. These blowout panels are designed to relieve when the pressure difference across the panels exceeds 0.35 psid.

- **Reactor Building-To-Turbine Building Blowout Panels.** The reactor building-to-turbine building (RBTB) blowout panels are located in the steam tunnel at the reactor building/turbine building. The RBTB blowout panels are made up of angle iron and sheet metal. The RBTB blowout panels are approximately 270 square feet of relieving area. These blowout panels are designed to relieve when the pressure difference across the panels exceeds 0.625 psid.

- **Turbine Building.** The turbine building is contiguous to all three units. The large door into the turbine building is not left open during operation (SOS must approve opening of the door by security personnel). There are no blowout panels in the turbine building siding or roof. Normal turbine building ventilation exhaust is not automatically isolated in the event of an accident.

4.1.3 CONTAINMENT AND REACTOR BUILDING SYSTEMS ANALYSIS

The active containment and reactor building systems (e.g., isolation, drywell spray and standby gas treatment) that are important in Level 2 analysis are included in the front-end event trees described in the Level 1 analysis. These systems are included in the front-end trees to ensure proper treatment of system dependencies between the front-end systems that are needed for preventing core damage, the containment and reactor building systems that can mitigate the offsite consequences of the core damage scenarios, and the support systems that tie together both types of systems. Considering these support systems in the Level 1 event trees simplifies the implementation of dependencies.

The active containment systems are included in the Level 1 model so that the resulting CETs examine primarily phenomenological issues and their associated uncertainties. This is important because the probabilities assigned to the CET have a meaning that is entirely different from the probabilities assigned to random variables, such as whether a system will work in the plant event trees.

Even though the containment systems are included in the Level 1 model, information on the status of these systems is passed into the Level 2 model in the definitions of the plant damage states. This is explained more fully in Section 4.3.

4.1.4 EQUIPMENT SURVIVABILITY IN A SEVERE ACCIDENT ENVIRONMENT

Selected equipment and instrumentation are designed to operate in environmental conditions associated with design basis accidents, such as a loss of coolant accident (LOCA) or a main steam line break. In a severe accident involving core melt and vessel breach, the conditions inside containment can be more demanding than the design basis to the extent that equipment operability may be in question.

An evaluation of the available means to monitor an accident and to arrest or mitigate its progression should include a review of equipment survivability; that is, the capability of equipment exposed to severe accident conditions to remain functional. The following qualitative analysis is intended to assess the survivability of equipment for Browns Ferry under severe accident conditions. It is therefore limited to the evaluation of possible mitigation of the accident once core damage and vessel breach has occurred, as well as monitoring containment conditions (e.g., pressure, temperature, water levels, etc.) as a severe accident progresses so as to affect possible accident management actions. The potential for arresting the accident before core damage is addressed in the Level 1 analysis.

4.1.4.1 Containment Conditions

The IDCOR Technical Report 17 (Reference 4.1-2) addressed the issue of equipment survivability in a severe accident environment. Peach Bottom was one of the reference plants analyzed there. Typical values for degraded core environments to which various pieces of equipment may be exposed during degraded core scenarios are presented. Table 4.1-2 provides a listing of important pieces of equipment, location, and functions that are important to the mitigation of degraded core accidents.

4.1.4.2 Monitoring and Actuation Equipment

The monitoring capabilities required to enable operators to take the correct emergency response actions have been identified in Regulatory Guide 1.97. The hardware that provides the parameter readings has been designed at Browns Ferry to the environmental requirements appropriate for their purpose and location. The required systems that provide long-term mitigation functions operate from controls outside the containment.

For the situation in which the accident progresses to severe core damage or melt, and possibly beyond reactor vessel bottom head failure, the useful parameters are reduced to those that are associated with understanding the condition of the containment and the performance and control of the remaining systems for core debris and containment cooling.

The systems that could provide the last level of defense against containment breach are the drywell spray mode of RHR and injection using the condensate system.

The parameters that provide important information to the operators in the aftermath of core damage and that rely on hardware located in the containment are as follows:

- Reactor Vessel Pressure
- Reactor Vessel Water Level
- Containment Pressure
- Containment Area Radiation
- Drywell Temperature
- Suppression Pool Temperature

Table 4.1-2 provides a qualitative description of the various pieces of equipment, location, function, and the vulnerability of the hardware to survive the severe accident environment. The survivability is based on the information reported in Reference 4.1-2.

4.1.4.3 Safety Relief Valves

The SRVs are only modeled for overpressure protection or manual operation. By manually opening one or more of these SRVs, the reactor pressure will be reduced such that low pressure coolant injection (LPCI), core spray, and condensate (CND) systems can deliver water to the reactor vessel. The LPCI, core spray, and CND systems provide cooling to the core and prevent excessive fuel-clad temperatures. The SRVs relieve the high pressure steam from the reactor vessel to the suppression pool. In the manual depressurization mode, the SRVs can be operated from a control room switch.

The most limiting environment to which the SRVs, solenoids (which are qualified for high temperature and steam environments), and power cables will be exposed directly is a degraded core environment since they are located in the drywell.

4.1.4.4 Electrical Penetrations

The function of the electrical penetrations is to supply electrical power to various pieces of equipment and control signals for protective and control functions. In addition, the electrical penetrations provide containment integrity. The electrical penetration functions in the degraded core environment are to remain operational and to maintain containment integrity prior to containment failure. Since the electrical penetrations constitute a portion of the primary containment pressure boundary, their performance in severe accident conditions has been included in the Browns Ferry pressure capacity analysis reported in Section 4.4.

The most limiting environment to which the electrical penetrations will be exposed directly is a degraded core environment since they are located in the drywell.

4.1.4.5 Equipment and Personnel Access Hatches

The function of the equipment and personnel access hatches is to provide access to the drywell. These hatches are part of the primary containment boundary. The function of the hatches in the degraded core environment is to maintain containment integrity prior to containment failure. Since the hatches constitute a portion of the primary containment pressure boundary, their performance in severe accident conditions has been included in the Browns Ferry pressure capacity analysis reported in Section 4.4.

The most limiting environment to which the hatches will be exposed directly is a degraded core environment since they are located in the drywell.

4.1.4.6 Torus-to-Drywell Vacuum Breakers

The torus/drywell vacuum breakers are installed at the ends of the vent headers within the torus. The functions of the vacuum breakers are to relieve gases from the torus to the drywell to prevent a significant pressure differential between the drywell and the torus and to prevent excessive negative pressures in the drywell. This pressure difference is postulated to occur following a loss of coolant accident during the time period in which the drywell atmosphere is cooled and the pressure is decreasing. Rapid depressurization of the drywell could occur during the operation of drywell sprays following a LOCA. If the vacuum breakers were to stick open after reactor vessel failure but prior to containment failure, the adverse effects would include bypass of the suppression pool for pressure suppression as well as for scrubbing fission products. A critical function of the vacuum breakers is to reclose after opening. The vacuum breaker operation is affected by the pressure difference between the drywell and the torus. Following review of this component, it is determined that there are no environmentally sensitive parts associated with the vacuum breakers that could impact their operation.

The most limiting environment to which the vacuum breakers will be exposed directly is a degraded core environment since they are located in the torus.

4.1.4.7 Core Spray System

The core spray system is used for injecting water into the reactor vessel during the progression of a severe accident scenario. The primary function of the core spray system prior to vessel breach is to provide core injection for scenarios in which the reactor pressure is below the shutoff head of the core spray pumps. The primary function of the core spray system following vessel breach is to provide core injection to the depressurized reactor vessel. The water injected by the core spray system is sprayed into the vessel and exits through the bottom of the breached reactor vessel and into the drywell. Therefore, the core spray system can provide water to quench core debris both in vessel and on the drywell floor. The only valves inside the primary containment whose failure would result in the failure of core spray are FCV-75-26 and FCV-75-54. These valves are check valves and are assumed to remain operational in the extreme drywell environment.

Additional components of core spray system include the spray ring headers and associated nozzles. Since these components are physically located above the core inside the reactor vessel, they will be exposed to high temperatures during core heatup, degradation, and vessel failure. The primary function evaluated for the core spray is to inject water into the vessel following vessel failure. It is assumed that the ring headers will remain functional and maintaining the spray pattern is not required following vessel failure.

The most limiting environment to which the core spray valves will be exposed directly is a degraded core environment since they are located in the drywell. The pumps are assumed to fail due to the exposure to the degraded core environment following containment failure. or containment venting. Due to the openness of the torus room and the absence of doors on the corner rooms, the core spray system is assumed to fail following containment failure.

4.1.4.8 Residual Heat Removal System

The residual heat removal (RHR) system is used for several functions during the progression of a severe accident scenario. The RHR pumps are used to provide LPCI into the reactor vessel for cases in which the reactor pressure is below the shutoff head of the RHR pumps. The RHR pumps are also used to provide decay heat removal from the containment through suppression pool cooling (SPC). The RHR pumps can also be aligned to provide drywell spray (DWS) and torus spray (TS) to limit the containment pressurization.

The primary function of the RHR system prior to vessel breach is to provide LPCI for scenarios in which the reactor pressure is below the shutoff head of the RHR pumps. For high reactor pressure scenarios, the RHR system is unable to provide LPCI but may be used to control containment pressurization through either the SPC, DWS, or TS function. For cases in which the SPC mode is available, the RHR pumps will be used to remove decay heat from the suppression pool.

The primary function of the RHR system following vessel breach is to provide LPCI to the reactor vessel. The DWS function of the RHR may be used to provide removal of steam from the containment atmosphere as well as providing water to quench core debris on the drywell floor. For cases in which the SPC mode is available, the RHR pumps will be used to remove decay heat from the suppression pool. The only valves inside the primary containment whose failure would result in the failure of LPCI mode are FCV-74-54 and FCV-74-68. These valves are check valves and are assumed to remain operational in the extreme environment. There are no valves inside containment associated with the SPC mode.

The most limiting environment to which the RHR check valves will be exposed directly is a degraded core environment since they are located in the drywell. The pumps are assumed to fail due to the exposure to the degraded core environment following containment failure or containment venting. Due to the openness of the torus room and the absence of doors on the corner rooms, the RHR pumps are assumed to no longer be available following containment failure or containment venting.

4.1.4.9 Standby Gas Treatment System

The function of the standby gas treatment system is to provide a means for minimizing the release of radioactive material from the containment into the environment. This is accomplished by filtering and exhausting the air from any of the zones of the reactor building and by maintaining the building at a negative pressure during containment isolation conditions.

The primary function of the SBGTS for degraded core scenarios is to minimize the release of radioactive materials released from the containment to the environment. This release of radioactive materials may occur from interfacing systems LOCA, drywell shell melt-through, or drywell overpressurization scenarios. The breach of primary containment will result in the pressurization of the reactor building, leading to probable failure of blowout panels located in the reactor building, turbine building, or refueling floor. Following the release of mass and energy into the reactor building, the operability of the SBGTS would be of major importance in maintaining a negative pressure on the reactor building and refueling zone to limit the ground level radioactive release of radioactive materials into the environment through the failed refueling zone blowout panels.

The SBGTS fans are located in a separate building outside the reactor building and would not be directly exposed to the environment in the reactor building following containment breach. There are several dampers in the reactor building and refueling zone that are air operated and have solenoids that are qualified for high temperature and steam environments.

Following review of these components, it is determined that there are no environmentally sensitive parts associated with the SBGTS fans and dampers that could impact operability.

4.1.4.10 Condensate System

The condensate system pumps are capable of injecting water into the reactor vessel during the progression of a severe accident scenario. The primary function of the CND system prior to vessel breach is to provide core injection for low pressure scenarios. The primary function of the CND system following vessel breach is to provide core injection to the reactor vessel. The water injected by the CND system would be injected into the vessel and would exit through the bottom of the breached reactor vessel into the drywell. The CND system therefore provides water to quench core debris on the drywell floor. The only valves inside the primary containment whose failure would result in the failure of CND are CHK-3-558 and CHK-3-572. These check valves are assumed to remain operational in the extreme environment.

The environment following containment failure will not result in an extreme turbine building environment as long as the reactor building-to-turbine building blowout panels do not fail. Therefore, the CND system function is not expected to be lost at the time of containment failure.

4.1.4.11 Summary

The equipment survivability assessment was based on review of the IDCOR Technical Report 17 (Reference 4.1-2). As long as the drywell and torus are intact, it is assumed that the environment in the reactor and turbine buildings will not prevent the use of equipment in those buildings. However, at the time of drywell failure, it is assumed in the Level 2 assessment that any active equipment in the torus room, adjacent corner rooms, and anywhere else in the reactor building will not be available due to elevated temperature, humidity, and radiation environments. Qualitatively, this equipment survivability assessment does not take any undue credit for the operation of equipment that is exposed to an extreme environment resulting from core damage and subsequent containment breach.

4.1.5 REFERENCES

4.1-1. U.S. Nuclear Regulatory Commission, "Severe Accident Risks: An Assessment of Five U.S. Nuclear Power Plants," NUREG-1150, December 1990.

4.1-2. NUS Corporation, "Equipment Survivability in a Degraded Core Environment," IDCOR Technical Report 17, August 1984.

Table 4.1-1 (Page 1 of 3). Basic RCS and Containment Comparison		
Plant Name **Type of Reactor** **Type of Containment**	**Peach Bottom** **BWR/4** **Mark I**	**Browns Ferry** **BWR/4** **Mark I**
<u>Reactor Core</u>		
Thermal Power (Mwt)	3,293	3,293
Number of Fuel Assemblies	764	764
Number of Control Rods	185	185
<u>Reactor Vessel</u>		
Inside Diameter (inches)	251	251
Inside Height (feet)	72.92	72.92
Design Pressure (psig)	1,250	1,250
Number of Safety Valves	2	0
Lowest Safety Valve Setpoint (psig)	1,230	N/A
Safety Valve Capacity (klb/hr)	925	N/A
Safety Valves Vent To	Drywell	N/A
Number of Relief Valves	11	13
Lowest Relief Valve Setpoint (psig)	1,105	1,105
Relief Valves Capacity (klb/hr)	889	851
Relief Valves Vent To	Suppression Pool	Suppression Pool
<u>RHR System</u>		
Number of Loops	2	2
Number of Pumps	4	4
Flow Rate per Pump (gpm at psid reactor vessel to drywell)	10,000 at 20	10,000 at 0
Number of Heat Exchangers	4	4
Maximum Capacity of Heat Exchanger (Btu/hr)	70,000,000	70,000,000
<u>RHR Service Water System</u>		
Number of Pumps	3	8
Flow Rate per Pump (gpm)	4,666	4,500
<u>Core Cooling Systems</u>		
RCIC		
Number of Pumps	1	1
Capacity (gpm at psid)	616 at 1,120	616 at 1,120
HPCI		
Number of Pumps	1	1
Flow Rate per Pump (gpm at psid)	5,000 at 1,120	5,000 at 1,120

Table 4.1-1 (Page 2 of 3). Basic RCS and Containment Comparison Table		
Plant Name Type of Reactor Type of Containment	Peach Bottom BWR/4 Mark I	Browns Ferry BWR/4 Mark I
LPCI (RHR)		
Number of Divisions	2	2
Number of Pumps per Division	2	2
Flow Rate per Pump (gpm at psid reactor to dry vessel)	10,000 at 20	10,000 at 0
Core Spray		
Number of Divisions	2	2
Number of Pumps per Division	2	2
Flow Rate per Pump (gpm at psid)	3,125 at 122	3,125 at 105
Shutoff Head (psid)	N/A	~ 400
Containment		
Constructor	CBI	PDM
Drywell Material and Construction	Steel	Steel
Drywell Free Volume (ft^3)	175,800	159,800
Drywell Design Temperature (°F)	281	281
Torus Material and Construction	Steel	Steel
Torus Minimum Free Volume (ft^3)	123,000	126,200
Torus Maximum Water Volume (ft^3)	N/A	127,800
Torus Design Temperature (°F)	281	281
Containment Design Pressure (psig)	56	56
Drywell to Torus Vent Configuration	Diagonal large-diameter vertical piping venting below the water level of the pool.	Diagonal large-diameter vertical piping venting below the water level of the pool.
Drywell Spray (RHR)		
Number of Trains	2	2
Flow Rate per Pump (gpm at psid reactor to dry vessel) (Amendment 8, FSAR)	10,000 at 20	10,000 at 0

Table 4.1-1 (Page 3 of 3). Basic RCS and Containment Comparison Table

Plant Name Type of Reactor Type of Containment	Peach Bottom BWR/4 Mark I	Browns Ferry BWR/4 Mark I
Secondary Containment		
Reactor Zone Free Volume below Refueling Floor (ft^3)	1,122,000	1,360,000
Blowout Panel Design Pressure		
Hatch Cover (psid)	N/A	0.25
Refueling Floor (psid)	0.25	0.25
Steam Tunnel (psid)	0.30	0.625
Standby Gas Treatment System		
Design Flow (Unit 2, CFM)	N/A	4,660
Refueling Floor Area (three units)		
Free Volume (ft^3)	1,314,000	2,601,000
Blowout Panel Design Pressure (psid)	N/A	0.35
Turbine Building		
Volume (ft^3)	2,100,000	5,700,000

Table 4.1-2. Equipment Evaluated for Severe Accident Survivability

Equipment	Location	Function	Vulnerability
Safety Relief Valves	Drywell	Provide overpressure protection or manual reactor vessel depressurization.	Exposed to degraded core environment prior to vessel breach; unimportant after vessel breach.
Electrical Penetrations	Drywell	Allow for both containment integrity and power cable operability.	Exposed to degraded core environment after vessel breach.
Equipment and Personnel Access Hatches	Drywell	Provide containment integrity.	Exposed to degraded core environment after vessel breach.
Drywell/Torus Vacuum Breakers	Torus	Control of torus-to-drywell differential pressure.	Exposed to degraded core environment.
Core Spray System	Drywell/Torus	Provide makeup and flow path from the suppression pool to the reactor vessel.	Check valves and piping exposed to degraded core environment after vessel breach; pumps exposed after containment failure.
Residual Heat Removal System	Drywell/Torus	Provide makeup and flow path from the suppression pool to the reactor vessel.	Check valves exposed to degraded core environment; pumps exposed after containment failure.
Standby Gas Treatment System	Reactor Building and Outside Reactor Building	Minimize release of radioactive materials following containment breach.	Dampers located in Reactor Building exposed to extreme environment; SBGTS fans not exposed to extreme environment.
Condensate System	Drywell/Turbine Building	Provide makeup from the CST or condenser hotwell to the reactor vessel.	Check valves exposed to degraded core environment.

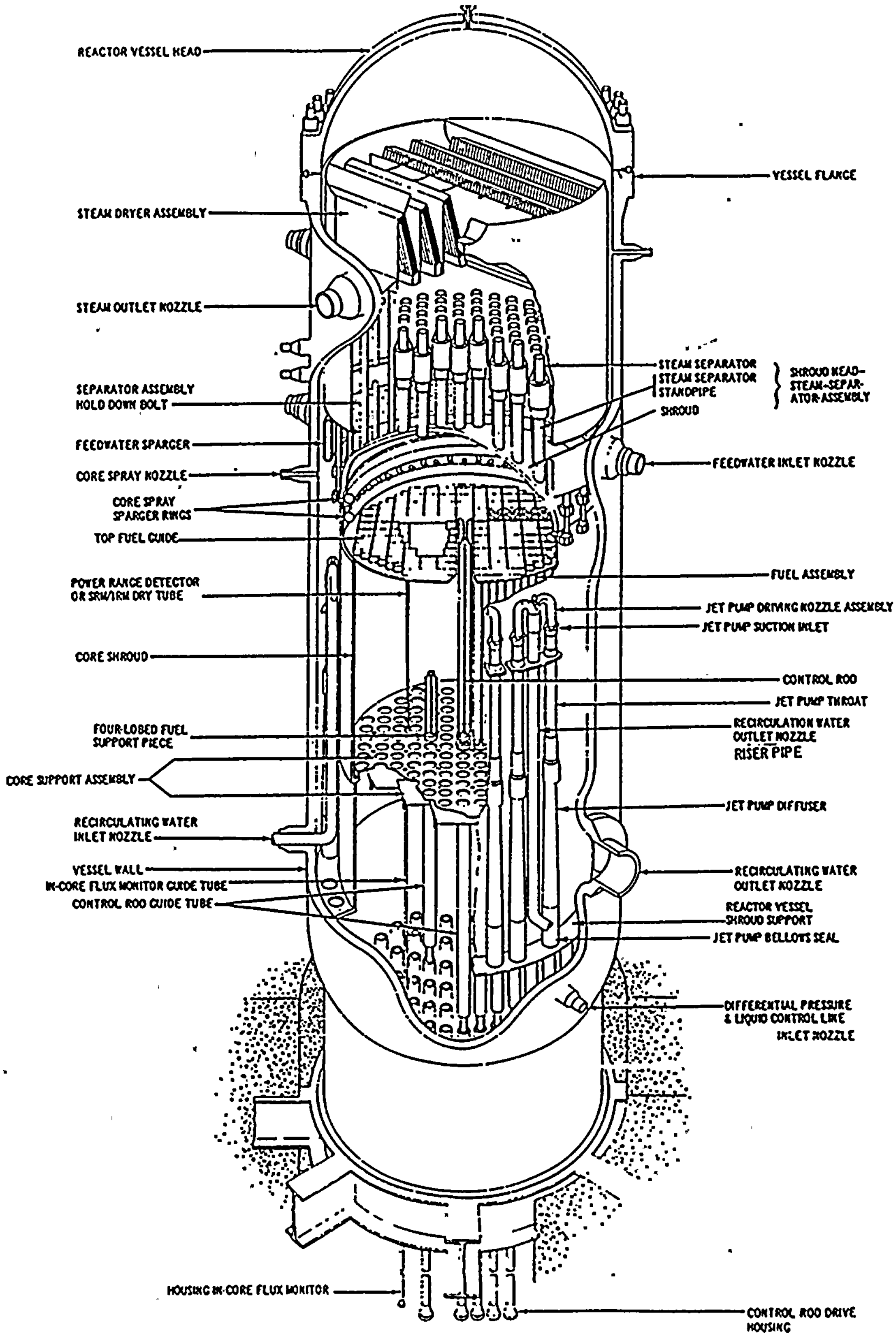

Figure 4.1-1. Reactor Vessel and Internals

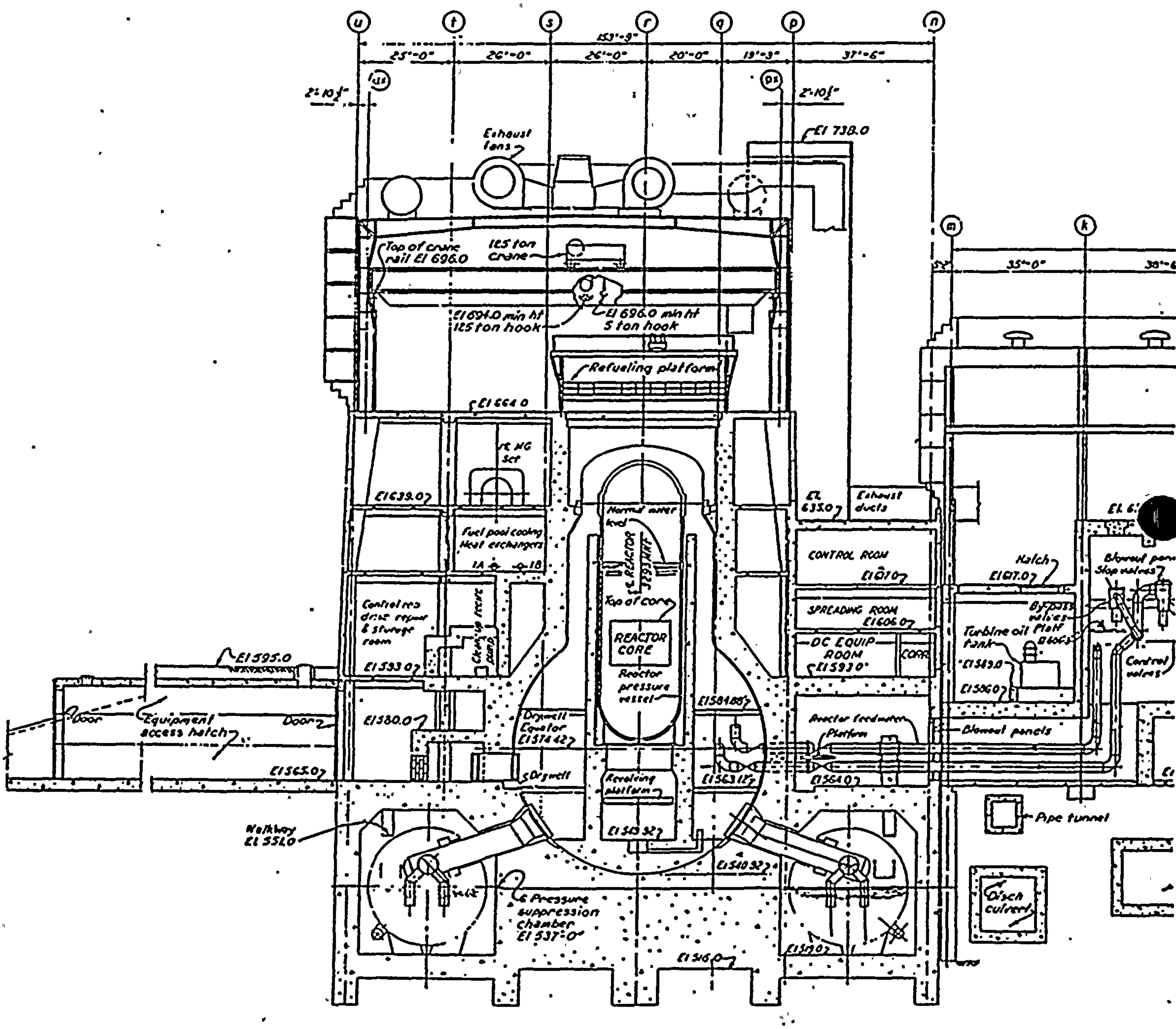

Figure 4.1-2. Containment, Reactor Building, Refuel Bay Elevation

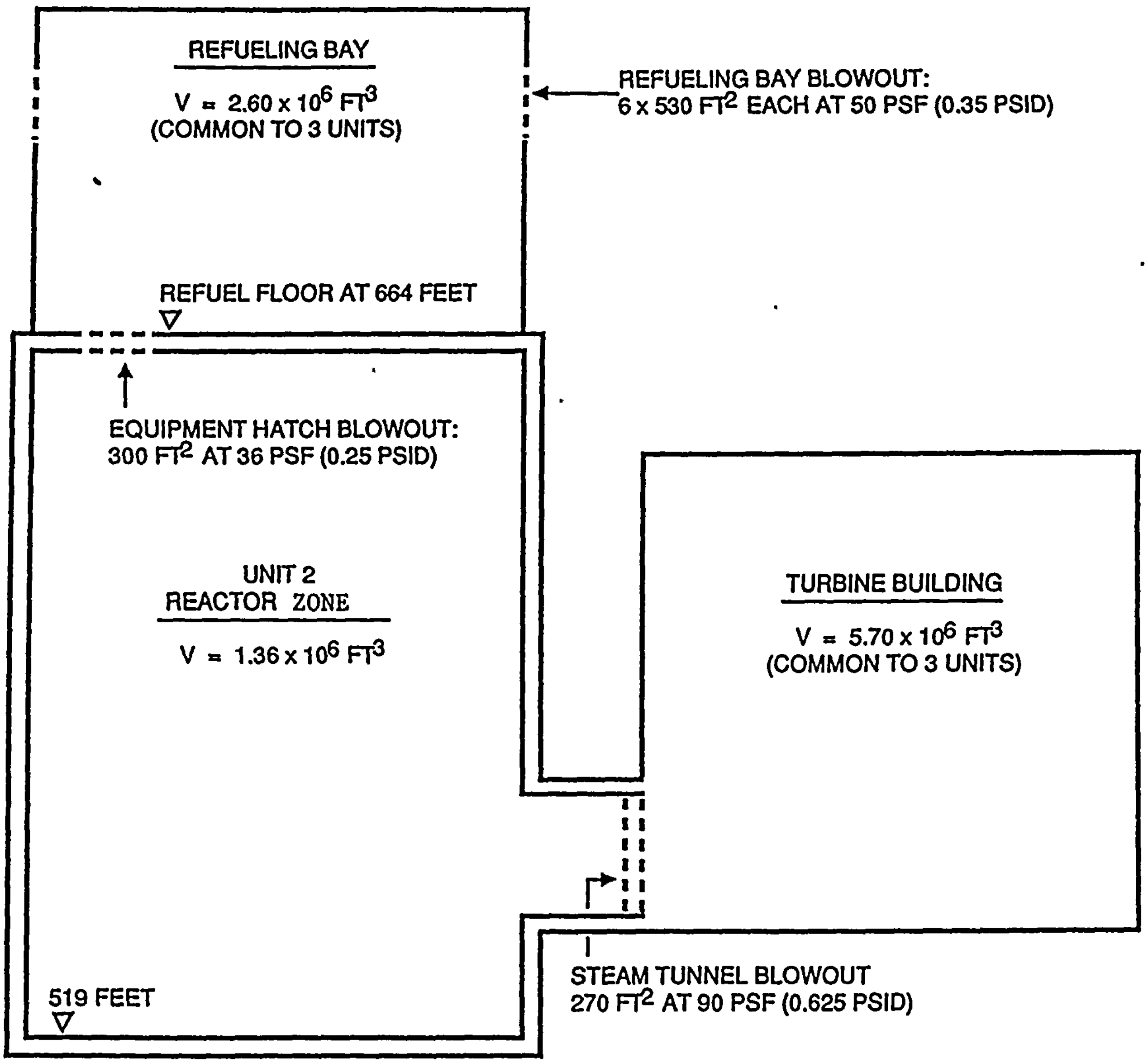

Figure 4.1-3. Browns Ferry Unit 2 Reactor Zone, Refueling Bay, and Turbine Building Volumes and Blowout Panel Specifications

4.2 PLANT MODELS AND METHODS FOR PHENOMENOLOGICAL EVALUATIONS

It was decided by TVA early on in the Browns Ferry project to use the MAAP code as the basis of the severe accident analysis methodology rather than using comparative analysis with the Peach Bottom results reported in NUREG/CR-4551, Volume 4. The basis for this decision is TVA's commitment to have state-of-the-art severe accident analysis capability in-house, to be able to analyze a wide variety of severe accident scenarios and related sensitivity cases, and to address Browns Ferry-specific design and operational features. Where warranted, focused engineering analyses have been done (by hand calculations) to address specific issues. These evaluations are described in Section 4.8 and are included in Reference 4.2-1 (PLG-0883).

4.2.1 ANALOGY TO NUREG-1150 REFERENCE PLANT (PEACH BOTTOM)

As summarized in Section 4.1, the NSSS and containment geometry parameters for Browns Ferry and Peach Bottom are nearly identical. Both are General Electric BWR-4 plants of 3,293-MWt rating, employing a Mark I containment. The containment constructor for Browns Ferry was Pittsburgh-Des Moines Steel (PDM), whereas the contractor for Peach Bottom was Chicago Bridge and Iron Company (CB&I). There are some construction detail differences noted below (and as reflected in the structural evaluations presented in Section 4.4):

- Drywell Head Closure Flange. The PDM design is much stiffer than that for the CB&I design, resulting in a higher unseating pressure for Browns Ferry than for Peach Bottom.
- Drywell-To-Torus Ventline Bellows. Browns Ferry bellows are located inside of vent and are pressurized externally, whereas the Peach Bottom bellows are located outside of vent and are internally pressurized.
- Some Differences in Plate Thickness. For example, the Browns Ferry torus thickness is about 25% greater than that for Peach Bottom.

Other differences include the layout of the reactor building, the refueling floor volume, and the standby gas treatment system design. In particular, the Browns Ferry refueling floor volume is shared by the three units and is very large. Should the Browns Ferry blowout panels between the reactor building on the refueling floor fail, the larger volume is expected to provide longer holdup (even if the refueling volume blowout panels fail) with reduced releases into the environment.

4.2.2 BROWNS FERRY UNIQUE PHENOMENOLOGICAL ISSUES AND ANALYSES

No Browns Ferry-unique issues were identified.

4.2.3 REFERENCES

4.2-1. PLG, Inc., "Assortment of Selected Engineering Analyses in Support of the Browns Ferry Level 2 IPE," PLG-0883, August 1992.

4.3 PLANT DAMAGE STATES

4.3.1 SELECTION OF PLANT DAMAGE STATE PARAMETERS

To define the plant damage states, a containment event tree was developed (see Section 4.5), and the information from the Level 1 model that was needed to evaluate the split fraction values for the CET top events was identified for inclusion in the PDS coding. The relevant phenomenological issues addressed in the Peach Bottom Unit 2 severe accident risk evaluation [as described in NUREG/CR-4551 (Reference 4.3-1)] were included in the CET.

The CET considers the influence of physical and chemical processes on challenging the pressure boundary integrity of the containment and, should containment failure or bypass occur, on affecting the release of fission products into the environment. The considerations include those that influence the in-vessel core melt progression, the potential for in-vessel recovery, the characterization of dynamic pressure and thermal loads occurring during or shortly after vessel breach, the characterization of long-term loads, the availability of containment venting, the timing and mode of containment failure, and, should containment failure or bypass occur, the potential mitigating effects of the reactor building, and the standby gas treatment system (SBGTS) on the release of fission products into the environment. To capture these conditions, the pertinent PDS information falls into three general categories:

- The physical conditions in the reactor coolant system and the primary containment at the time of sustained core uncovery.
- The integrity of the primary containment and the status of its associated active systems.
- The integrity of the secondary containment (i.e., the reactor building and refuel bay) and the status of its associated active systems.

The Level 1 analysis considered secondary containment isolation as success when the normal ventilation connections to the Unit 2 reactor zone and the refuel bay were successfully isolated. However, (1) there are communication paths between the Unit 2 reactor zone and the adjacent Unit 1 and Unit 3 reactor zones, and (2) that secondary containment comprises the reactor zones and the common refuel bay. The significance of this modeling oversight can have an effect on the source terms evaluated in Section 4.9, Radionuclide Release Categories and Source Terms. The significance of this effect depends upon the electric power status and whether normal ventilation and/or SBGTSs are operating.

The most dominant contributor to risk is the extended station blackout scenario. In such a case, any dampers between the Unit 2 reactor zones and the adjacent Units 1 and 3 reactor buildings will close; i.e., they are failsafe. If they were to fail to close, the net effect would be to increase the volume of the Unit 2 reactor zone, which would provide somewhat greater decontamination. For cases wherein electric power is available, there is the possibility for out-leakage to the adjacent reactor zones and direct exhaust to the atmosphere through the Unit 1 and Unit 3 ventilation systems. However, plant experience has shown that when the Level 1 SBGTS and secondary containment acceptance criteria are met, the Unit 2 reactor zone is at a lower pressure than the adjacent reactor zones (i.e., there would be modest in-leakage), so this Level 1 modeling oversight is judged to have an insignificant impact on the Level 2 results.

4.3.2 PLANT DAMAGE STATE DEFINITION

The physical conditions of the RCS and the primary and secondary containment that define the PDS are described below. The Level 1 analysis ends at the onset of significant core damage (e.g., sustained core uncovery), and the Level 2 analysis evaluated possible recovery actions that will arrest core damage within the vessel and thereby prevent vessel breach (similar to the Three Mile Island Unit 2 accident).

The physical conditions in the RCS and the primary containment important to PDS definition are as follows:

- **Pressure Inside the Reactor Pressure Vessel at the Onset of Core Damage.** This is an important parameter because high pressure can more forcefully eject molten debris through penetrations in the vessel bottom head, and the blowdown jet can more forcefully remove debris from the reactor pedestal region. High pressure can also result in more vigorous zirconium oxidation as the in-vessel steam passes through the debris during blowdown. A pressure of approximately 200 psia has been identified as the breakpoint below which high pressure effects are no longer a concern.

- **Presence of Water on the Drywell Floor.** The accumulation of a substantial amount of water on the drywell floor and in the in-pedestal sump is important to containment response because the interaction with hot core debris when vessel breach occurs can have the following effects:

  - Providing a mechanism to initially quench the molten debris and to prevent (or reduce the likelihood of) direct thermal attack of the drywell shell or the concrete drywell floor by core debris.

  - Fragmenting and dispersing the core debris from the pedestal region into the drywell.

  - Causing the containment pressure to increase by formation of steam and heatup of the containment atmosphere.

  Water will be present on the drywell floor for most loss of coolant accident LOCA initiators and, for non-LOCA initiators, water will be present by containment spray actuation prior to vessel breach (discharging through the drywell spray spargers).

The primary containment conditions that are considered in the PDS matrix are as follows:

- **Containment Pressure Boundary Integrity Status.** Containment pressure boundary integrity at the onset of core damage not only includes addressing concerns related to containment isolation failures and potential containment bypasses but also considers the possibility of early or late containment failures occurring prior to core damage. A potential cause for early containment failure could be an unmitigated anticipated transient without scram (ATWS) event with the vessel isolated. Late containment failures can occur in isolation events with successful core cooling (with core decay heat being transferred to the suppression pool) but with no suppression pool cooling or venting (the WASH-1400 "TW" scenario).

- **Availability of Water To Cool the Core Debris.** Water can be provided to cool core debris (which has melted through the vessel lower head and is located on the drywell floor or sumps) either by the containment spray system injecting through the drywell spray spargers or by water being injected into the vessel and (after vessel breach and depressurization) flowing through the failed portion of the lower vessel head onto the drywell floor. If water is available for debris bed cooling, a distinction is made about whether that water is provided before or after vessel breach since this affects the likelihood of liner failure due to corium thermal attack.

- **Suppression Pool Cooling.** If water is available for cooling of the debris bed on the drywell floor, the decay heat and chemical energy generated in the core debris will be transferred to the suppression pool in the form of steam and/or water passing through the vent system. In such a case, the availability of suppression pool cooling is an important PDS parameter. If no water is available for debris bed cooling, considerable noncondensible gases are generated from drywell floor concrete decomposition and suppression pool cooling is not questioned.

- **Containment Venting.** In core damage scenarios that do not have water available for debris bed cooling and/or do not have suppression pool cooling, drywell temperature and pressure will increase, and the emergency response team is directed to actuate the containment vent system to prevent containment failure. The human actions to implement this venting (often referred to as "dirty venting") are addressed in the Level 2 analysis, as the availability of any power supplies (either electrical or pneumatic) required to open the vent valves has been determined from the Level 1 analysis.

The secondary containment conditions that are considered in the PDS matrix are as follows:

- **Secondary Containment Isolation and Integrity.** For core damage scenarios that eventually result in primary containment failure, the secondary containment can be effective in reducing the offsite consequences if it is properly isolated and intact. Secondary containment isolation signals are generated from high drywell pressure, low-low reactor water level, or high secondary containment ventilation radiation. Thus, the Level 1 analysis must evaluate secondary containment isolation as a PDS parameter. The reactor building is a reinforced concrete building; building pressures greater than 0.25 psig are relieved by blowout panels located above the refueling floor.

- **Standby Gas Treatment System.** The SBGTS is designed to maintain a slightly negative pressure in a properly isolated reactor building by a filter/fan system taking suction from the building and exhausting up the plant stack. The availability of SBGTS is evaluated in the Level 1 model and is a PDS parameter. If the secondary containment is not isolated, the SBGTS is judged to be ineffective and its status is not questioned.

The CET addressed the possibility of containment failure due to the dynamic loads occurring at vessel breach; e.g., direct containment heating or drywell shell melt-through. If containment failure does occur, these secondary containment systems may provide a mitigation function.

Another example is why reactor building fire spray status is tracked. The effectiveness of fire sprays on source term mitigation will be dependent on the predicted location of containment failure (or release location for containment bypass events) and the expected release path through the reactor building; e.g., the blowout panels. If the release path does not pass through a sprayed zone (or if the release is not expected to actuate spray), then fire sprays may be unimportant.

4.3.3 COMPREHENSIVE PDS MATRIX FOR BROWNS FERRY

Based on the preceding considerations, a four-character PDS coding system has been developed for the Browns Ferry PRA. The PDS matrix is presented in Figure 4.3-1.

The first character of the code is a letter from M to P that signifies:

1. The pressure in the reactor pressure vessel at the time of vessel breach. (M and N denote high pressure, and O and P denote low pressure.)

2. Whether water is on the drywell floor at the time of vessel failure. (M and O have abundant water on the drywell floor, whereas N and P have an essentially dry drywell floor.)

The second character of the code is one of four letters relating to the status of the containment at the onset of core damage:

1. Containment is isolated and intact at the time of vessel breach (I).

2. Containment is bypassed (J).

3. Containment is not isolated or fails prior to core damage within a few hours of event initiation (K).

4. Late failure, typically from conditions wherein the reactor water level is being maintained, the vessel is isolated, and steam is being relieved to the suppression pool, but suppression pool cooling failures cause containment failures and consequential core damage; i.e., "TW" events (L).

The third character of the code is a letter (A through H), indicating the status of active plant systems affecting primary containment performance. This characterization identifies if debris cooling, suppression pool cooling, and/or torus venting are available.

The fourth character of the code is also a letter (V, X and Z), indicating the condition of the reactor building and its systems at the onset of core damage.

Plant damage states are assigned to each core damage scenario in the Level 1 quantification using RISKMAN end state binning rules. These binning rules are based on the status of preceding top events (e.g., whether they succeed or fail) and, in some cases, on the initiating event. The total number of possible PDSs, as noted in Figure 4.3-1, is large. After Level 1 quantification was performed, a process known as "conservative condensation" was used to combine the frequencies of lower frequency and consequence states with those having higher frequency and consequence. This allowed a more manageable number of key plant damage states, as described in Section 4.6.1, to be developed. Detailed accident progression analyses were conducted using the Modular Accident Analysis Program code (Reference 4.3-2) for the representative sequences in the key plant damage states to determine the timing of core degradation and vessel breach; the loads imposed on the containment; an evaluation of the timing, probability, and mode of containment failure; as well as the consequence mitigation provided by the reactor building if containment failure occurs.

4.3.4 REFERENCES

4.3-1. Sandia National Laboratories, "Evaluation of Severe Accident Risks: Peach Bottom, Unit 2," prepared for U.S. Nuclear Regulatory Commission, NUREG/CR-4551, SAND86-1309, Vol. 4, Rev. 1, Part 1, December 1990.

4.3-2. Henry, R. E., and M. G. Plys, "MAAP-3.0B — Modular Accident Analysis Program for LWR Power Plants," Electric Power Research Institute, EPRI NP-7071-CCML, November 1990.

CONTAINMENT STATUS			CONTAINMENT CONDITIONS AT TIME OF CORE UNCOVERY															
		2ND CHA →	INTACT (I)								BYPASSED (J)		NOT ISOLATED OR FAILED EARLY (K)			FAILED LATE (L)		
WATER TO CORE DEBRIS ?			YES	YES	YES	YES	YES	YES	NO	NO	YES	NO	YES	YES	NO	YES	YES	NO
DRYWELL SPRAYS ?			YES	YES	YES	NO	NO	NO	NO	NO	-	-	YES	NO	NO	YES	NO	NO
SUPP POOL COOLING ?			YES	NO	NO	YES	NO	NO	N/A	N/A	-	-	-	-		-		
TORUS VENT AVAILABLE ?			N/N	YES	NO	N/N	YES	NO	YES	NO	-	-	-		-	-	-	-
CONDITIONS AT CORE UNCOVERY		3RD CHAR →	A	B	C	D	E	F	G	H	A	H	C	F	H	C	F	H
VESSEL PRESSURE	WATER ON DW FLOOR	1ST CHAR ↓																
HIGH	WET	M																
	DRY	N																
LOW	WET	O																
	DRY	P																

REACTOR BLDG STATUS AT TIME OF CORE UNCOVERY			
RX BLDG ISOLATED	YES	YES	NO
SBGTS OPERATING	YES	NO	-
RX BLDG STATUS 4TH CHAR →	V	X	Z

Figure 4.3-1. Browns Ferry Plant Damage State Matrix

4.4 CONTAINMENT STRUCTURAL EVALUATION AND CONTAINMENT FAILURE CHARACTERIZATION

A focused evaluation of the Browns Ferry Unit 2 containment structural capacities at elevated pressures and temperature was conducted, and is provided in Reference 4.4-1. The purposes of this section are to: (1) describe the probabilistic framework used to assess the uncertainties in containment failure pressures, (2) summarize the results of that assessment, and (3) develop composite containment failure probability distributions that have been used in the containment response analysis and in the CET quantification.

The Browns Ferry Mark I containment configuration and overall dimensions are shown in Figure 4.4-1. As noted in Section 4.2.1, Pittsburgh-Des Moines Steel Company was the Browns Ferry containment fabricator. The drywell head shell is joined to the top of the drywell cylinder section by a flange connection. The spherical and cylindrical portions of the drywell are surrounded by a thick, reinforced concrete biological shield wall that is separated from the drywell metal shell by a 2.19-inch gap. The suppression pool is fabricated of 16 mitered, cylindrical shell segments to form a circular torus with a centerline (major) radius of 55.75 feet and a torus ring (minor) radius of 15.5 feet, respectively, and a shell thickness of 0.75 inches. Eight vent lines interconnect the lower part of the drywell sphere with the suppression chamber; expansion bellows are provided on each vent to accommodate differential movement. The plate material used in the drywell and suppression chamber shells is ASME SA-516 Grade 70 carbon steel with code-specified minimum room temperature yield and ultimate stresses of 38 and 70 KSI, respectively. The drywell head flange has 208 2.5-inch-diameter bolts. Sealing is provided by two silicone rubber O-rings located in grooves in the lower flange face. The bolts are preloaded so that an internal pressure of 165 psig is required to begin flange separation, although separation does not necessarily infer leakage because of the resiliency of the O-rings.

The containment fragility analysis investigated a large number of potential failure modes including the following:

1. Drywell Sphere-To-Cylinder Knuckle
2. Drywell Cylinder
3. Drywell Closure Flange
4. Torus
5. Drywell-To-Torus Vent Line Bellows
6. Numerous Hatches
7. Personnel Air Lock
8. Electrical Penetrations

The failure criterion to determine the median shell failure pressure was based on limit state analyses using a 3.5% median strain limit. Ultimate tensile tests indicate failure strains well above 10% or more. The lower failure strain criteria was used to account for biaxial strain effects, strain concentrations, bending effects, and gauge length effects. Because of the relative dimensions, the drywell cylinder, the drywell knuckle and the sphere failure modes involve contact with the biological shield at the strain failure criterion; therefore, "load sharing" between the steel shell and the reinforced concrete was accounted for.

For severe accident scenarios, containment temperature response will vary depending on whether the core or core debris is covered with water. For "wet" cases, near saturation conditions result in both the torus and drywell, and moderate temperatures (i.e., in the order of 350°F) are expected when pressure reaches 150 psig. For "dry" cases, wherein corium is spread onto the drywell floor and there is no overlying water, little mass or energy transfer from the drywell to the torus occurs since only concrete decomposition products are being generated. For such dry cases, high drywell temperatures result from natural convection and radiation heating effects, but the torus and torus vent temperatures should be substantially cooler than the drywell. Accordingly, pressure capacities for the drywell modes (knuckle, cylinder, sphere, and closure flange) were evaluated at temperatures ranging from 200° F to 800°F. High temperature creep effects were not addressed. Subsequent evaluations indicate that non-time dependent failures are likely before creep rupture effects come into play. Pressure capacities for the torus modes (torus and vent line bellows) were evaluated at temperatures ranging from room temperature to 400°F.

Section 4.4.1 will describe the probabilistic framework used to characterize containment pressure capacity, and Section 4.4.2 will describe the results of the Browns Ferry evaluation.

4.4.1 PROBABILISTIC CHARACTERIZATION OF PRESSURE CAPACITY

The pressure capacity analysis characterized each containment failure mode by a predicted median pressure capacity, $\hat{P}$, and two random variables for uncertainties in modeling the failure mode (m) and in the material strength properties (s). The two random variables are taken as lognormally distributed, having unit median and logarithmic standard deviations defined as β_m and β_s, for material and strength uncertainties, respectively. The overall uncertainty is evaluated by a composite logarithmic standard deviation, β_c, evaluated as

$$\beta_c = \sqrt{\beta_m^2 + \beta_s^2}$$

The cumulative probability that failure occurs at a pressure less than or equal to an applied pressure, x, is evaluated as

$$P_f = \text{Prob}\ (P \leq x) = \phi \left[\frac{\ln(x/\hat{P})}{\beta_c} \right]$$

where

P_f = cumulative probability that the true failure pressure (P) is below the applied pressure (x).

P = random pressure capacity (a lognormal distribution).

x = applied pressure (psid).

β_c = composite logarithmic standard deviation of P.

$\hat{P}$ = median pressure capacity (psid).

$\phi(.)$ = cumulative distribution function for a standard normal random variable.

4.4.2 BROWNS FERRY PRESSURE CAPACITY ANALYSIS

Using the above probabilistic framework, the evaluation determined both the median pressure capacity ($\hat{P}$) and the composite logarithmic standard deviation (β) for each of the failure modes over a range of temperatures. In general, the modeling and strength uncertainties associated with the shell and the hatch failure modes were judged to be highly correlated within each category. Therefore, the limiting (i.e., lowest pressure capacity) shell and hatch modes were used in the probabilistic pressure capacity analysis. These two limiting modes are the drywell knuckle and the drywell closure flange. These results are summarized in Table 4.4-1; note that a "bimodel lognormal" distribution is used for the knuckle failure mode to account for the bioshield reinforced cocrete load sharing. Such a distribution uses a different logarithmic standard deviation for applied pressures below and above the median value. Also shown in the table is the 95% confidence failure pressure (i.e., the analyst is 95% confident that the true failure pressure is not below the noted value), which is indicative of the lower tail of the pressure capacity distribution, P. The drywell closure flange incipient leakage pressure is noted in Table 4.4-2. Three important aspects of this failure mode are noted below.

First of all, the drywell closure flange failure mode is judged to result in controlled leakage that results in a relatively small leakage area. (The other modes involve shell membrane failures that involve crack running and are judged to be large.) This is because the flange and bolt stress levels when flange separation commences are well below the material yield strength, so the structural system behaves elastically. For slow pressure rise cases, it is desirable that small, controlled leakage modes occur before large, sudden failures since the blowdown rates are much slower and the corresponding refueling bay residence time (and the source term decontamination factor) is larger. The drywell closure flange pressure capacity values noted in Table 4.4-2 are the pressure levels when leakage begins, which leads to the second aspect noted below.

The drywell closure flange seal is actually made with the two large-diameter elastomeric O-rings located within grooves in the lower flange face. The O-rings are compressed by the upper flange when the head is installed. For O-ring temperatures below about 450°F, it is expected that there will be enough resiliency in the elastomeric material that considerable "springback" of the O-ring is likely. For temperatures greater than about 450°F, the O-rings are expected to experience severe degradation and to extrude out any gap between the flange faces. Thus, for high temperature scenarios, leakage is likely to occur at the time that flange separation commences if other failure modes have not already occurred. This is not the case at lower temperatures, however. When incipient leakage begins it is expected that localized seal "cutting" will occur. For "wet" debris cases, about 10 in^2 of leakage is required to prevent further pressure rise. This corresponds to about 8% of the flange circumference. For dry cases, significantly smaller leak areas are required to prevent further pressure rise.

The third insight into flange leakage addresses the effects of any temperature lag between the bolts and the inner flange temperature. Because the inner flange surface is directly exposed to the hot gases and vapors that would naturally convect to the upper part of the drywell in a severe accident, it would be expected that the inner part of the flange is at a higher temperature than the bolts, which are located about 5 inches further out in enlarged holes in the flange. The "thermal prestress" associated with the bolt thermal lag is quite substantial, being equivalent to an increase in separation pressure of 155 psi/100°F bolt thermal lag.

An evaluation of the bolt-to-flange thermal lag was made for the extended blackout accident scenario (key PDS PIH; see Reference 4.4-2). Assuming a linear increase in flange temperature with time, the bolt temperature lags that of the flange by about 0.6 hours. Therefore, if the drywell gas temperature is increasing at a rate of 50°F/hour, the corresponding bolt thermal lag would be 30°F, resulting in a 46 psi increase in the incipient leakage pressure.

To put these probabilistic pressure capacity results in perspective, evaluations have been made of the failure probabilities for the knuckle and drywell closure flange as a function of pressure for temperatures of 200°F, 300°F, 400°F, 600°F, and 800°F. The results of these analyses are shown in Figures 4.4-2 through 4.4-6. Each of the failure modes is considered to be independent, and the methods are described in Reference 4.4-3. Figure 4.4-7 shows the change in total failure probability as temperature is increased from 200°F to 800°F.

The pressure levels (in psig) corresponding to the 5th, 10th, and 50th percentile failure probabilities are as noted below.

Percentile Failure Probabilities	Temperature (°F)				
	200	300	400	600	800
5th	132	127	123	120	126
10th	145	140	135	130	134
50th	192	187	178	161	161

The reason that the 5% and 10% probability failure values at 800°F are higher than the corresponding values at 600°F is because of the decreased beta value.

These results will be used to evaluate CET split fractions I2, L2, I3, and L3, as described in Section 4.8, and will be used to establish containment failure timing in the MAAP analyses discussed in Section 4.7.

4.4.3 REFERENCES

4.4-1. EQE Engineering, Inc., "Containment Overpressure Capacity for the Browns Ferry Nuclear Plant," August 1992.

4.4-2. PLG, Inc., "Assortment of Selected Engineering Analyses in Support of the Browns Ferry Level 2 IPE," PLG-0883, August 1992.

4.4-3. Fleming, K. N., D. R. Buttemer, and R. K. Deremer, "Methods for Estimating Containment Failure Probability," PLG, Inc., PLG-0844, November 1991.

$\hat{P}$ = median pressure capacity (psid).

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4.4.2 BROWNS FERRY PRESSURE CAPACITY ANALYSIS

Using the above probabilistic framework, the EQE evaluation determined both the median pressure capacity ($\hat{P}$) and the composite logarithmic standard deviation (β_c) for each of the failure modes over a range of temperatures. In general, the modeling and strength uncertainties associated with the shell and the hatch failure modes were judged to be highly correlated within each category. Therefore, the limiting (i.e., lowest pressure capacity) shell and hatch modes were used in the probabilistic pressure capacity analysis. These two limiting modes are the drywell knuckle and the drywell closure flange. These results are summarized in Table 4.4-1; note that a "bimodel lognormal" distribution is used for the knuckle failure mode to account for the bioshield reinforced cocrete load sharing. Such a distribution uses a different logarithmic standard deviation for applied pressures below and above the median value. The interested reader is encouraged to read the EQE report included as Appendix 4A. Also shown in the table is the 95% confidence failure pressure (i.e., the analyst is 95% confident that the true failure pressure is not below the noted value), which is indicative of the lower tail of the pressure capacity distribution, P. The drywell closure flange incipient leakage pressure is noted in Table 4.4-2. Three important aspects of this failure mode are noted below.

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These results will be used to evaluate CET split fractions I2, L2, I3, and L3, as described in Section 4.8, and will be used to establish containment failure timing in the MAAP analyses discussed in Section 4.7.

4.4.3 REFERENCES

4.4-1. PLG, Inc., "Assortment of Selected Engineering Analyses in Support of the Browns Ferry Level 2 IPE," PLG-0883, August 1992.

4.4-2. Fleming, K. N., D. R. Buttemer, and R. K. Deremer, "Methods for Estimating Containment Failure Probability," PLG, Inc., PLG-0844, November 1991.

Table 4.4-1. Summary of Primary Containment Pressure Capacity Evaluation

Temperature (°F)	200	300	400	600	800
Drywell Knuckle Failure Mode					
Median Pressure Capacity (psig)	274	276	278	271	229
Beta (for $P < P_{median}$)	0.39	0.42	0.44	0.47	0.30
Beta (for $P > P_{median}$)	0.27	0.31	0.34	0.37	0.30
95% Confidence Capacity (psig)	144	138	135	125	140
Drywell Closure Flange Leakage					
Median Incipient Leakage (psig)	202	197	186	165	165
Beta Composite	0.21	0.21	0.20	0.14	0.14
95% Confidence Capacity (psig)	143	140	134	131	131

Table 4.4-2. Drywell Closure Flange Incipient Leakage Pressure

Temperature (°F)	Median Leak Pressure (psig)	Logarithmic Standard Deviation
200	202	0.21
300	197	0.21
400	186	0.21
600	165	0.14
800	165	0.14

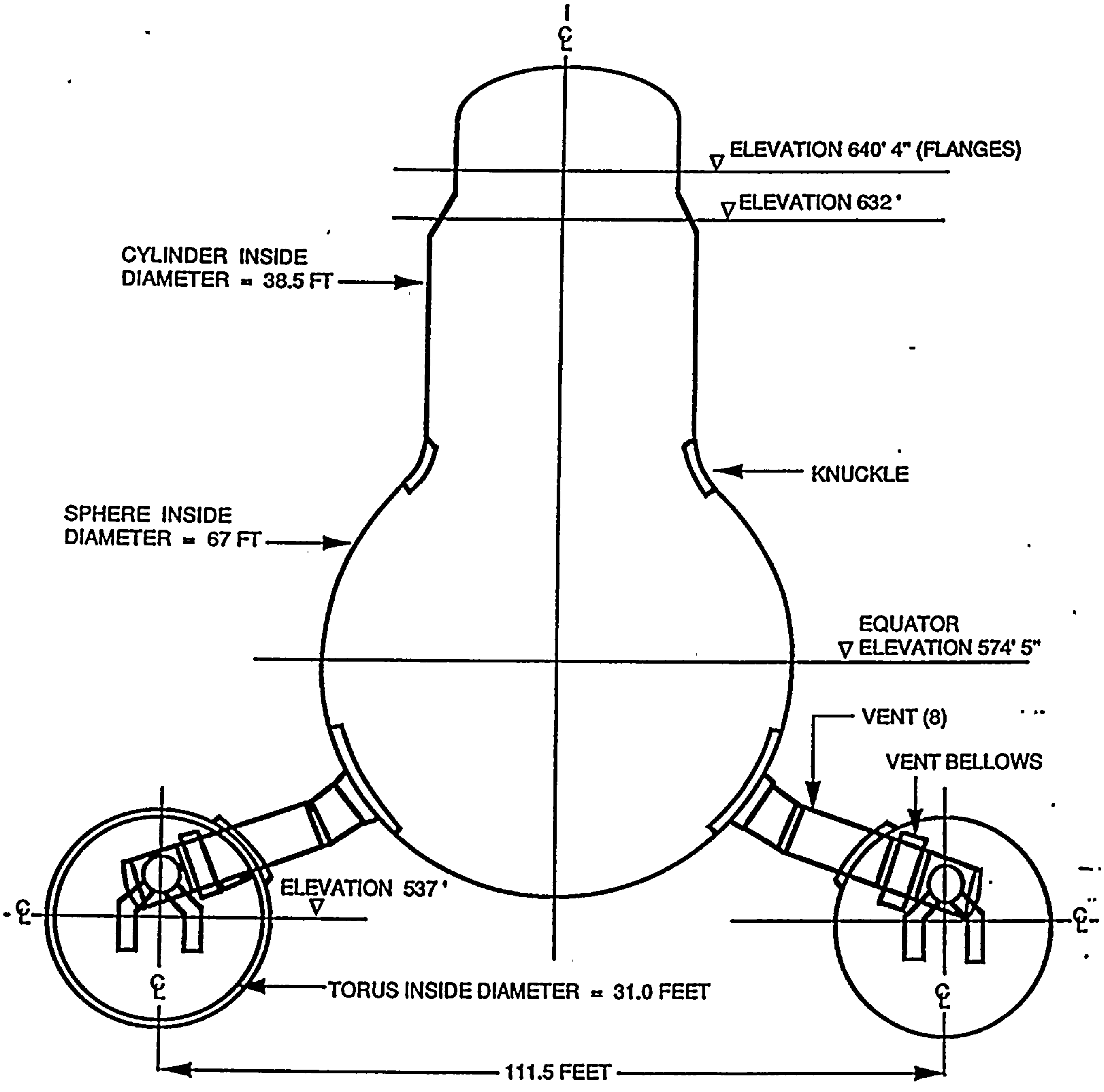

Figure 4.4-1. Browns Ferry Containment

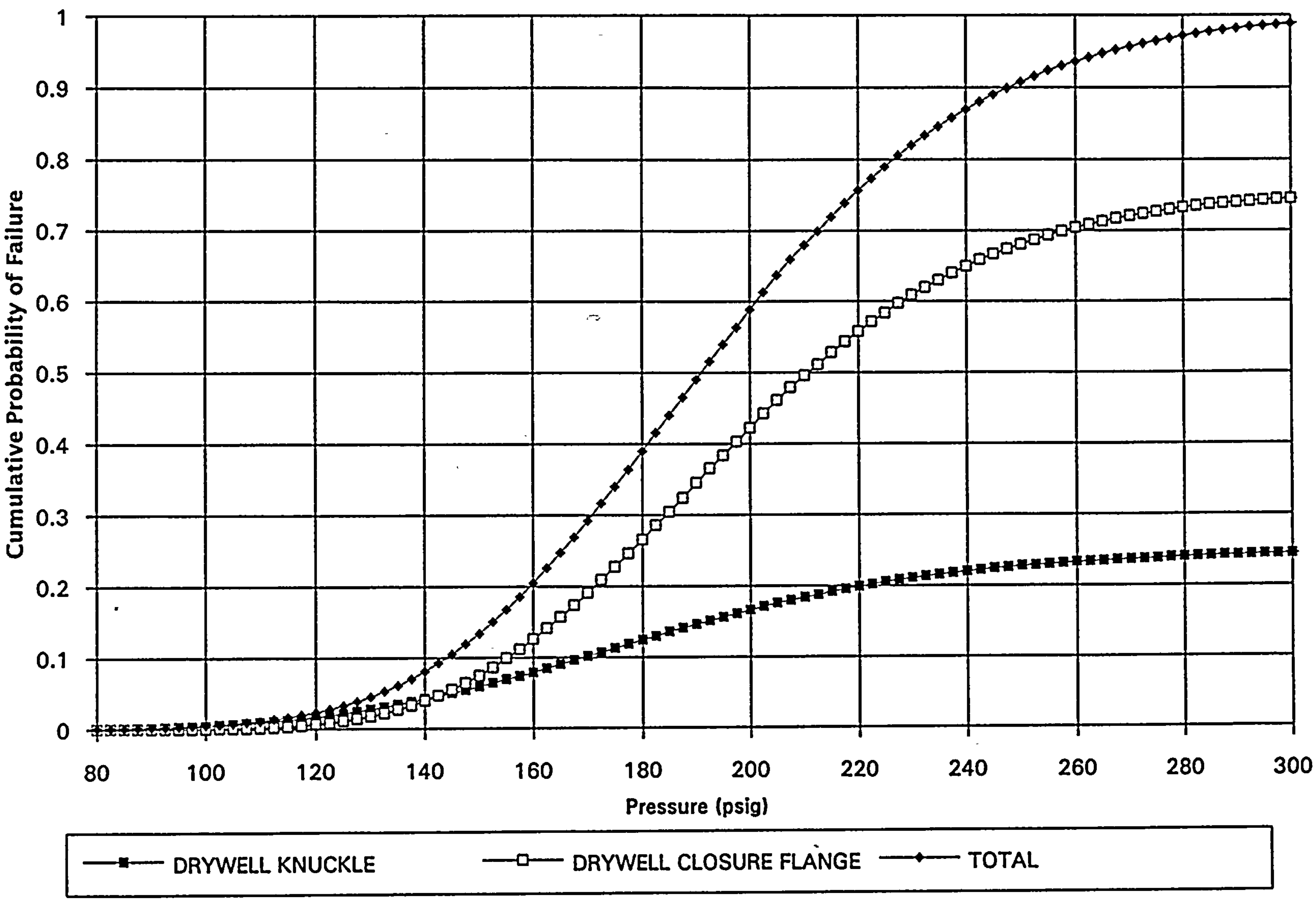

Figure 4.4-2. Cumulative Failure Probability of Browns Ferry Containment at 200°F

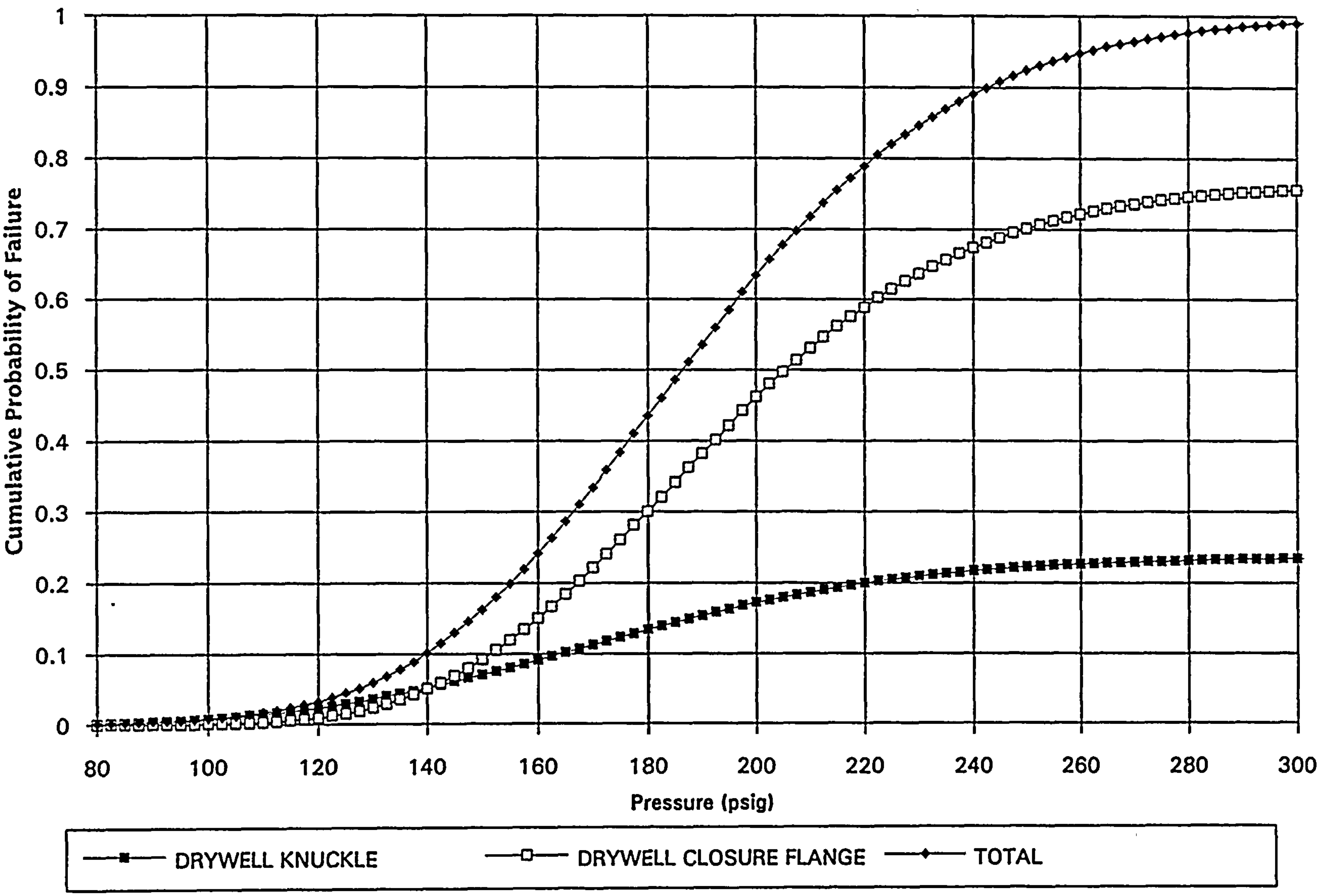

Figure 4.4-3. Cumulative Failure Probability of Browns Ferry Containment at 300°F

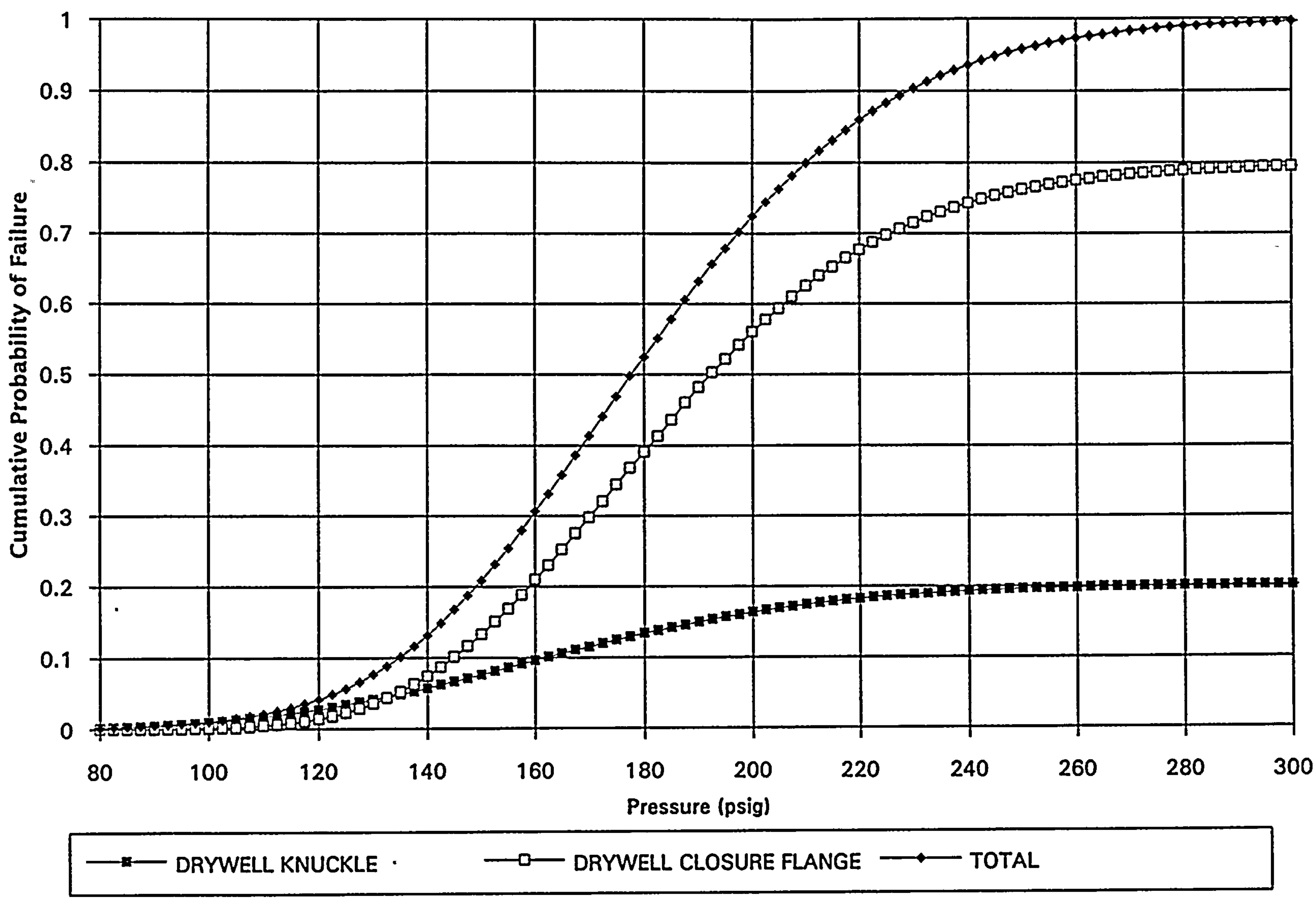

Figure 4.4-4. Cumulative Failure Probability of Browns Ferry Containment at 400°F

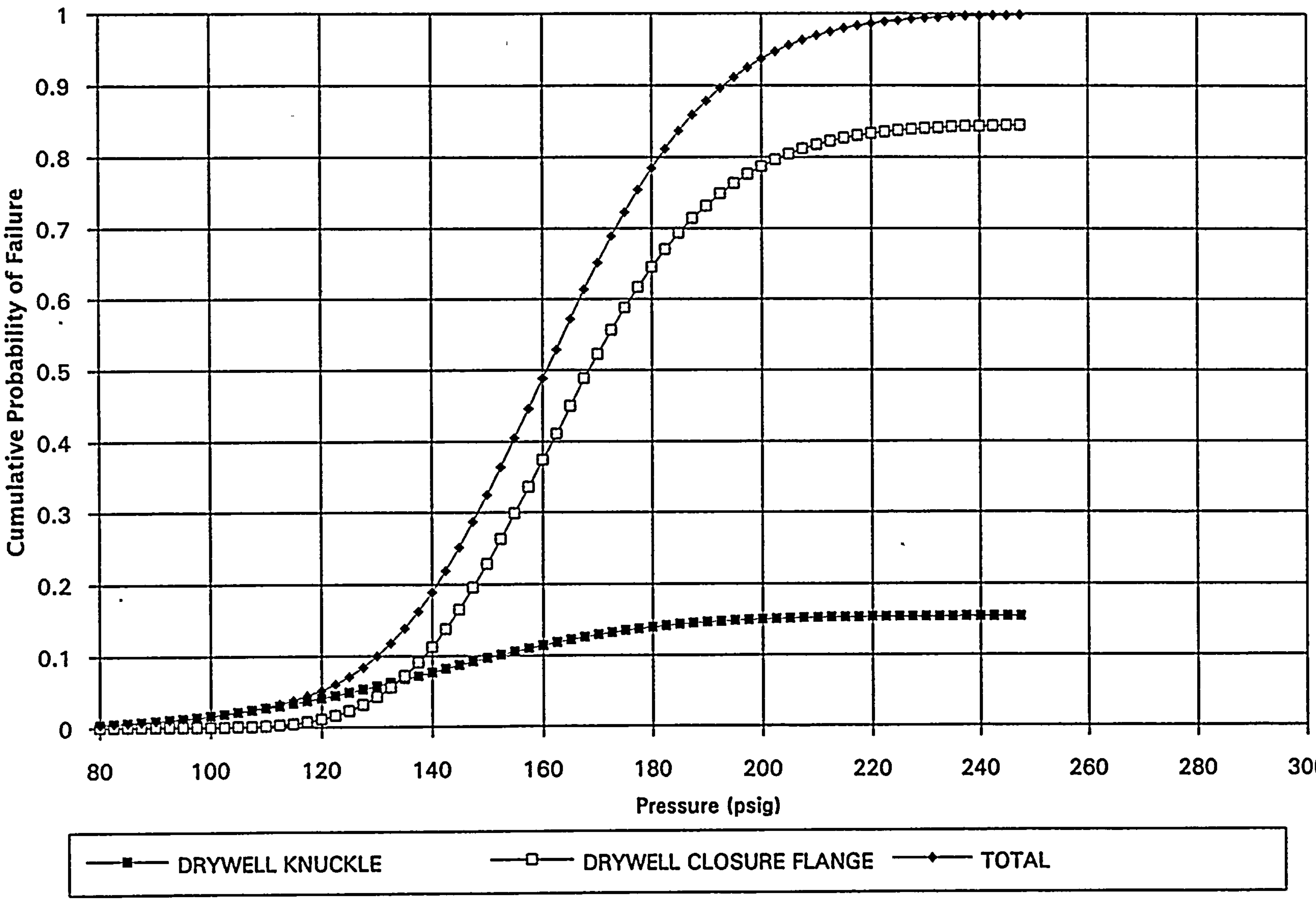

Figure 4.4-5. Cumulative Failure Probability of Browns Ferry Containment at 600°F

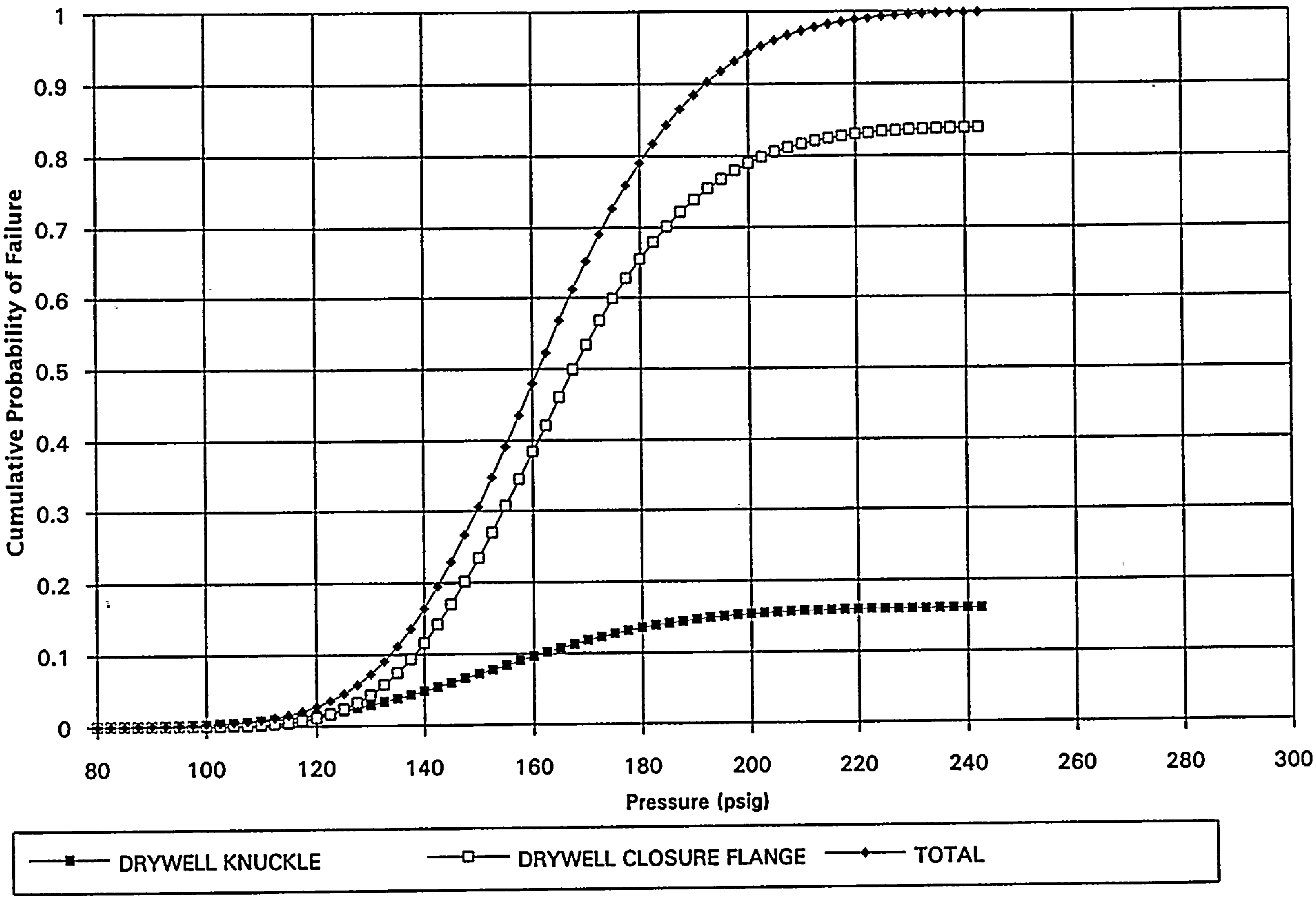

Figure 4.4-6. Cumulative Failure Probability of Browns Ferry Containment at 800°F

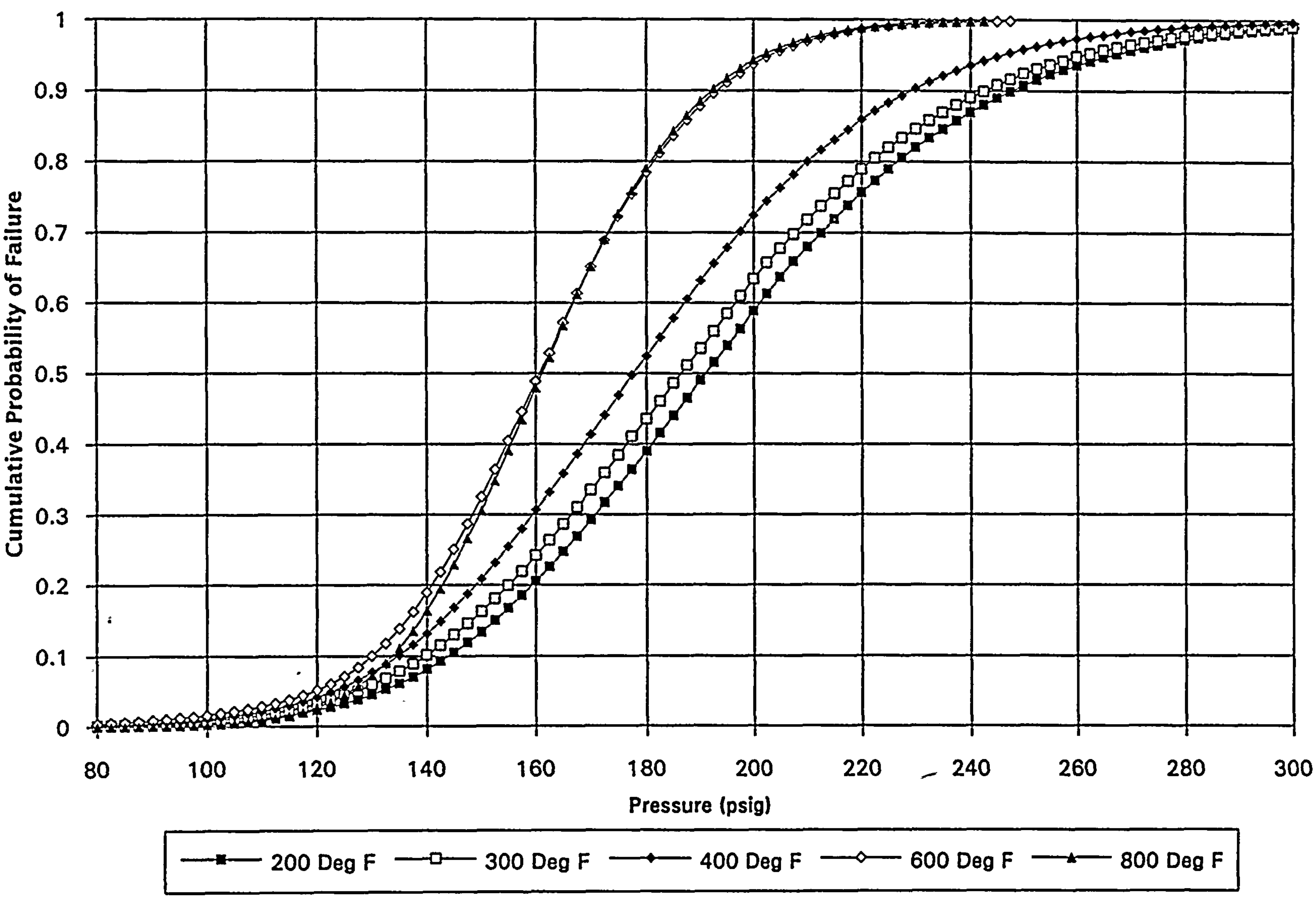

Figure 4.4-7. Cumulative Failure Probability of Browns Ferry Containment for Range of Temperatures

4.5 CONTAINMENT EVENT TREE

Given that the onset of core damage has occurred as evaluated in the Level 1 Browns Ferry PRA, the Level 2 analysis evaluates the progression of the accident sequence from a particular plant damage state to a specific release category through the use of a Browns Ferry-specific CET. The PDS matrix adopted in the Level 1 analysis is described in Section 4.3 and is shown in Figure 4.3-1. The CET addresses the in-vessel core degradation, the potential for in-vessel recovery of the damaged core, the phenomena associated with the ex-vessel progression of the accident, containment integrity challenges and the potential for containment failure, and, if containment failure occurs, the timing and type of failure, and the effectiveness of the reactor building* and its associated safeguards (e.g., standby gas treatment system) on the mitigation of the offsite release. For practical reasons, the CET end states are binned into a limited number of release categories in a manner that is similar to that for the binning of plant event tree end states into PDSs; Section 4.7 describes the release category assignment process. The CET was quantified for the dominant scenario(s) associated with each key plant damage state (KPDS).** Although unique CETs are not required for each KPDS, the CET branching probabilities will, in most cases, vary for each.

The CET is used to evaluate accident scenarios wherein the containment is not bypassed. Thus, PDSs with the second letter I, K, or L are evaluated with the CET. For PDSs that involve containment bypass (i.e., the second PDS letter is J), containment performance is of secondary importance, and the issue is to assess the radiological source term for a selected few bypass scenarios. These evaluations are described in Section 4.9.3.

4.5.1 CONTAINMENT EVENT TREE LOGIC

NUREG-1150 (Reference 4.5-1) [and its supporting Level 2 document NUREG/CR-4551 (Reference 4.5-2)] identified 145 questions for the Peach Bottom Unit 2 accident progression event tree (APET). These include questions that relate to the type of initiating event, the status of the reactor coolant system, the availability of various safety systems, the status of containment isolation or bypass, status of the suppression pool, direct containment heating (DCH), location and size of the containment breach, hydrogen discharge and burning, and conditions in the reactor building. Some questions are repeated for various accident phases. The Browns Ferry CET, was quantified for each significant PDS (see Section 4.6.3). As each of the 145 questions in the Peach Bottom APET has two or more outcomes (dependent on the PDS being evaluated and on answers to previous questions), the number of possible paths through the fully developed APET is large. The development of the Browns Ferry CET has used (and the forthcoming quantification will use) the NUREG-1150 document, the results of a Browns Ferry-specific containment pressure capacity analysis (Section 4.4), and the results of core degradation, containment response and source term accident progression analyses described in Sections 4.7 and 4.9. The Browns Ferry Level 2 analysis team has developed a more manageable, moderate-sized CET that captures the important attributes of the more

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*The term "reactor building" includes the reactor building itself as well as the connecting refueling bay.

**The KPDSs are described in Section 4.6.1.

complex Peach Bottom APET. Any design differences between Browns Ferry and Peach Bottom that would affect the insights noted in Reference 4.5-2 are noted in Section 4.1.

One of the earlier top events in the Browns Ferry CET questions whether core damage progression is arrested in-vessel; this category of evaluation is sometimes referred to as Level "1-and-a-half" as it evaluates the time frame from the onset of core damage, to vessel breach. To address this question requires sequence-specific, detailed thermal-hydraulic analyses, and there is significant uncertainty in the outcome. The ability to arrest core damage is strongly influenced by the in-vessel core degradation process, the time interval between the onset of core damage (defined as the beginning of sustained core uncovery in the Level 1 analysis), and the time when either the in-vessel core debris is no longer coolable or vessel melt-through occurs. Depending on the scenario, it may also be influenced by operator actions and the availability of plant hardware. Most recovery actions that would prevent the onset of core damage have been addressed in Level 1 but have failed, thus leading to core damage. For many core damage sequences, the time interval between the beginning of core damage and vessel breach is sufficiently short in comparison with the time of core damage initiation, such that the contribution of these arrested sequences to total core damage frequency may be relatively small. Experience has shown that certain accident sequences conservatively mapped to core damage in the Level 1 analyses are often found to be recoverable when detailed thermal-hydraulic analyses are done in Level 2. Such "analytical recovery" is included and documented in the Level 2 process.

To ensure a proper characterization of risk, the event headings in a CET must provide adequate characterization of the magnitude, timing, and location of the release of radioactivity into the environment. Thus, the development and definition of CET headings and the definition of fission product release categories must be performed integratedly and somewhat chronologically. Of major importance to boiling water reactors (BWR) are such concerns as drywell shell failure due to corium thermal attack, containment bypass, suppression pool bypass, ability to provide water to the drywell for debris quenching and fission product scrubbing, containment venting, direct heating, containment failure timing and location, size of breach, hydrogen burns in the reactor building, and the ability of the reactor building to retain fission products released into the building from the containment.

The Browns Ferry CET is shown in Figure 4.5-1. The tree chronologically models the core degradation, vessel failure (if in-vessel recovery does not occur), containment behavior, and finally, the reactor building behavior if containment failure occurs.

Top Events 1 through 6 (IQ through IR) address questions relevant to the time period, starting at the initiation of core damage, to the point in time when vessel breach is imminent if in-vessel arrest of core degradation has not occurred. Top Event 7 (DS) questions whether drywell spray has been initiated before vessel breach so as to flood the drywell floor and thereby reduce the likelihood of drywell shell failure as corium is dispersed from the reactor vessel. Top Events 8 through 11 (I2 through WD) question phenomena that can occur in the time period during and shortly after vessel breach, and address issues related to the potential for short-term, highly transient loading conditions that could cause early containment failure. Early containment failure in this study includes the 4-hour time interval following vessel breach since natural processes (e.g., aerosol agglomeration and settling, or fission product plateout) will significantly reduce the potential source term if containment failure were to occur at a later time. The potentially rapid loads that could fail containment following vessel breach include phenomena associated with blowdown, DCH effects, ex-vessel fuel coolant interactions, or drywell shell failure due to corium thermal attack. These rapid loading functions, as a result of sudden mass and energy releases into the containment atmosphere, are oftentimes characterized by a pressure "spike," as opposed to the slower, longer term loading function such as a monotonically increasing pressure level, if debris cooling or torus cooling are unavailable. Top Events 12 through 16 (S3 through L3) address the longer term containment response (i.e., for the time period beginning 4 hours after vessel breach and extending to approximately 36 hours) and, the possibility that containment failure is prevented altogether by: (1) adequate debris bed cooling, and (2) either containment heat removal or venting. The last three top events question phenomena that affect the reactor building integrity and its ability to reduce the offsite source term when containment failure occurs.

4.5.2 DESCRIPTION OF CET TOP EVENTS

The following subsections describe the CET structure and specific conditions or phenomena that are addressed in the CET top events. Section 4.9 describes how the status of these events, as well as the PDS characteristics, is used to define the CET end states into radionuclide release categories.

4.5.2.1 CET Entry State

- **Top Event 0 — Representative Key Plant Damage State (IE).** The representative KPDS is the entry event to the CET and represents a "bin" or "group" of accident sequences from the Level 1 analysis, which are expected to behave phenomenologically in a similar manner. The phenomenological behavior of the PDS is defined by the dominant accident sequence(s) with the highest frequency within that bin (see Section 4.6). The CET applies to every PDSs except those that involve containment bypass. However, the CET is quantified separately for each KPDS scenario because the top event split fractions are usually dependent on the state of the plant as defined by the PDS.

  For example, only sequences in which reactor coolant pressure is high at the time of vessel breach have the potential for significant energy transfer from the debris to the containment atmosphere, which can lead to "direct containment heating" phenomena. Most of the information related to the availability of relevant active containment and reactor building safeguard systems is passed into the tree via the definition of the PDS and the contributing dominant sequences. This requires that, in addition to representing the systems and functions important to maintaining core cooling, the plant (i.e., "Level 1") event tree(s) must also address those active systems and functions that are important to containment and reactor building isolation, suppression pool heat removal, the presence of water on the drywell floor at the time of vessel breach, the availability of continued water sources for debris bed cooling, and reactor building functions.

  Because of the dependence of vessel injection and core and drywell spray systems on the state of the containment (e.g., the suppression pool is a source of water for emergency core cooling pumps), there is a significant coupling between events in the plant event tree(s) and those in the CET. In general, the PDS addresses the availability of the systems to perform their function. Implicit in the PDS definition are a number of factors that influence the course of events that occur in the containment following vessel breach and the resulting source term. For example, a water source for quenching and cooling the core debris is important because it affects the potential for core-concrete interactions and for liner failure, provides a means for removing heat from the drywell atmosphere, and can influence the radiological source term.

4.5.2.2 Events Prior to Vessel Breach

- **Top Event 1 — In-Vessel Quenching of Core Debris (IQ).** Top Event 1 (IQ) addresses uncertainties about whether molten core debris relocating through the core support structure will be quenched by the water inside the reactor vessel lower head so that the impact on subsequent events can be modeled. Two basic modes of debris behavior in the vessel, which are addressed by this top event, are envisioned.

  Quenching of the debris bed in the lower vessel implies that the core debris, which has relocated from its normal position (above the core support structure) into the reactor vessel lower plenum, is "fluidized" and adequately cooled by the water in the lower plenum (approximately 4,000 ft^3 of water is located below the bottom of active fuel) and that thermal attack of the vessel lower head does not begin until core debris dryout occurs. This quenching action delays vessel breach and provides an extended time for recovery of injection systems for in-vessel recovery or drywell spray initiation. If vessel injection can be recovered before vessel dryout occurs, it is possible to recover a molten core inside the vessel without vessel breach. This is what happened at Three Mile Island (TMI) and is subsequently addressed in Top Event 6 (IR). Furthermore, even without vessel injection recovery, the water initially in the vessel bottom could quench the debris, followed after vessel dryout by a slow reheating of the debris and vessel lower head. This would cause a delayed failure of the vessel lower head. For example, the latent heat of vaporization of the lower plenum water represents about 1 core full power minute of energy. If the core decay heat were 1% (corresponding to about 2 hours after scram), this energy represents almost a 2-hour delay.

  In the no-quenching relocation mode, it is postulated that the molten core debris accumulates above a crust near the bottom of the active core and is suddenly released into the vessel bottom without appreciable quenching, leading to a localized attack of the vessel bottom head at the penetrations with a shorter vessel breach delay. Because the quenching interaction with water in the vessel bottom is absent, this debris behavior mode is likely to result in an earlier vessel breach, less in-vessel hydrogen generation and in the ejection of a large amount of water at the time of vessel breach. Assuming that about 30% of this water flashes to steam, the unflashed water depth on the drywell floor is about 1 foot.

  The evidence supporting either the quenching or the no-quench relocation mode is limited, particularly in the case of a BWR with fuel assembly wrappers. The TMI accident was a pressurized water reactor injection recovery case with subsequent quenching. The in-vessel quenching model employed in the BWRSAR code (described in Section 4.7.1) models in-vessel quenching. The models typically adopted with MAAP analyses have very limited in-vessel quenching and result in prompt vessel failure when the corium falls into the lower head water. The Browns Ferry Level 2 team has opted to use MAAP in this individual plant examination project. It is recognized that, relative to MAAP, the BWRSAR model predicts delays in vessel breach in the order of a few hours, somewhat greater in-vessel hydrogen production, and significantly less water being released from the vessel at the time of vessel breach. In light of these inconsistencies and observations, the success path for this top event is representative of the MAAP model, the failure path is representative of the BWRSAR model, and only the success path will be evaluated in these IPE analyses. If further research within the nuclear industry shows major differences, future analyses can invoke this top event. Some credit for in-vessel quenching will be taken for electric power recovery in station blackout scenarios (see Top Event IR for key PDS PIH in Section 4.8).

- **Top Event 2 — Safety Relief Valve(s) (SRV) Do Not Stick Open prior to Vessel Breach in High Pressure Melt Scenarios (VS).** Detailed analyses of the in-vessel accident progression for high pressure core damage scenarios indicate that high temperature gases pass through the SRVs in the time period between core uncovery to vessel breach. The SRVs experience numerous open-close cycles during this period. Because of the high temperature of gases flowing through the open SRVs, as well as possible vapors and aerosols, it is possible that an SRV could fail to reseat.

  Top Event 2 (VS) addresses the possibility for high pressure damage states. Success of this top event implies that the SRVs properly reseat. For low pressure PDSs, the SRVs do not cycle when elevated vessel temperature occur; Top Event 2 (VS) is set to guaranteed failure for these PDS quantifications.

- **Top Event 3 — Containment Intact before Vessel Breach (I1).** This top event questions whether the containment is intact prior to vessel breach. It addresses preexisting containment leak paths due to isolation failures, or the possibility that containment failure can occur prior to core damage (as defined by the plant damage state) or any induced containment failures that could occur prior to vessel breach.

- **Top Event 4 — Small Leak Area if I1 Fails (L1).** This top event questions the containment leak area if Top Event 3 (I1) fails. For small, controlled leak areas, the potential for rapid containment pressurization at the time of vessel breach [as will be addressed in later Top Event 8 (I2)] could further increase the effective leak area. For example, if Top Event 3 (I1) failure is caused by a failure to isolate a relatively small line [i.e., Top Event 3 (I1) fails, and Top Event 4 (L1) succeeds], it is possible that the rapid containment pressurization at the time of vessel breach can cause a large leak to develop in Top Event 9 (L2).

- **Top Event 5 — Suppression Pool Not Bypassed before Vessel Breach (S1).** This top event questions whether the suppression pool is bypassed prior to vessel breach; success implies that any releases into the drywell will be scrubbed in the torus. Potential failure modes include a stuck-open torus-to-drywell vacuum breaker. There are 12 torus-to-drywell vacuum breakers, each with an equivalent flow area of about 1.3 ft^2. This event will influence the degree of fission product scrubbing of the ex-vessel release. For non-loss of coolant accident (LOCA) events, a stuck-open torus-to-drywell vacuum breaker itself will not affect the scrubbing potential for the in-vessel release, unless a tail pipe vacuum breaker also sticks open on the lower setpoint pressure SRV(s).

- **Top Event 6 — Degraded Core Recovered In-Vessel (IR).** This top event questions whether core damage progression can be arrested in the time period from the beginning of core damage to the time of vessel breach; e.g., similar to the course of events that occurred in the TMI Unit 2 accident in 1979. Recovery actions prior to the onset of core uncovery are treated in the Level 1 analysis. The likelihood of in-vessel recovery is dependent on the characterization of core degradation as well as on the time available for in-vessel recovery. The time window is dependent on the specific core damage scenario. This top event is also used to account for any conservative core melt prevention success criteria used in Level 1, which more refined Level 2 thermal-hydraulic analyses show do not result in core damage. As will be noted in Section 4.8, these evaluations assume that coolable core geometry is lost when water level recedes below 2/3 core uncovery. It is recognized that this may be somewhat conservative.

- **Top Event 7 — Drywell Spray Initiated prior to Vessel Breach (DS).** This top event questions whether drywell spray has been initiated before vessel breach. Drywell spray availability is one of the PDS variables, but spray is initiated manually as directed in the Emergency Operating Instructions (EOI). If drywell spray is operable and manually initiated, the drywell floor will be flooded up to the vent lines (about 20 inches above the drywell floor), thereby decreasing the likelihood of drywell shell failure due to thermal attack by the core debris [addressed later in Top Event 10 (LF)].

4.5.2.3 Events during or Shortly after Vessel Breach

The following four top events question phenomena occurring during or within about 4 hours after vessel breach:

- **Top Event 8 — Containment Intact after Vessel Breach (I2).** This top event addresses the probability of containment structural failure at the time of vessel breach and in the subsequent 4-hour time interval [not drywell shell failure due to corium thermal attack, which is questioned in Top Event 10 (LF)]. This failure is dependent on conditions in the containment just prior to the vessel breach and the additional dynamic loading (e.g., a pressure spike and perhaps a temperature spike in the drywell atmosphere but not necessarily a significant temperature increase in the drywell shell) on the containment, resulting from the phenomenon that accompanies vessel breach; e.g., blowdown loads, DCH, or XVFCI.

- **Top Event 9 — Small Leak Area if Containment Fails in Top Event 8 (I2) (L2).** This top event is somewhat similar to Top Event 4 (L1), except that it addresses the equivalent containment leak area if failure occurs in Top Event 8 (I2) at or within 4 hours after vessel breach. A large leak at Top Event 9 (L2) is defined as one that can cause a rapid blowdown into the reactor building, such as to cause reactor building blowout panels to fail. For example, a scenario in which Top Event 8 (I2) fails and Top Event 9 (L2) succeeds implies that the blowdown forces associated with the Top Event 8 (I2) failure mode are insufficient (in themselves) to cause consequential failure of the reactor building. Conversely, scenarios with Top Events 8 (I2) and 9 (L2) failed imply that the containment failure blowdown forces will, in turn, impose rapid dynamic loads on the reactor building panels.

- **Top Event 10 — No Fission Products Released into Reactor Building due to Drywell Shell Failure (LF).** This top event questions whether corium thermal attack can fail the drywell shell and, in turn, result in fission product release. Top Event 10 (LF) evaluates the likelihood of liner melt-through and subsequent fission product release. It will be affected by both the reactor pressure at the time of vessel breach and the presence of a significant amount of water on the drywell floor either before or shortly after. The failure mode envisioned by this top event is corium being swept out of the pedestal region below the reactor vessel and thermally attacking the drywell shell at the drywell floor elevation adjacent to the pedestal opening. The liner is backed by sand in this area, and direct leakage into the reactor building around the vent lines is envisioned. Success of Top Event 10 (LF) implies no (or an insignificant) liner melt-through release path. Failure of Top Event 10 (LF) implies liner melt-through, resulting in a leak directly from the drywell into the reactor building torus room. The leak size is taken to be sufficiently large to preclude long-term overpressure failures.

- **Top Event 11 — Continued Water Supply to the Core Debris on the Drywell Floor after Vessel Breach (WD).** Previous Top Event 7 (DS) questioned whether drywell spray was initiated prior to vessel breach. Top Event 11 (WD) addresses the availability of other water sources to the core debris following vessel breach. This water can be provided by low pressure vessel injection sources (e.g., condensate, core spray, or low pressure coolant injection) flowing through the vessel breach, or by delayed manual initiation of drywell spray. Control rod drive flow is another way to provide water, but its capacity is not nearly as large. Top Event 11 (WD) is also used to address possible failure of pumps in the reactor building if either liner failure [Top Event 10 (LF)] or containment structural failure [Top Event 8 (I2)] occurs, creating a severe steam and high temperature environment. As described in Section 4.1.4, containment or liner failure is assumed to fail pumps in the reactor building; i.e., core spray, residual heat removal and CRD would not be available if Top Event 10 (LF) or 8 (I2) fail, leaving only condensate flow. Note in the CET structure that Top Event 11 (WD) is not asked if Top Events 7 (DS), 8 (I2), and 10 (LF) are success since drywell spray will continue operating. Also note that Top Event 11 (WD) is asked even if Top Event 7 (DS) was successful but either Top Event 8 (I2) or 10 (LF) fail since the RHR pumps are assumed to fail due to the adverse environment.

4.5.2.4 Long-Term Containment Events

- **Top Event 12 — Suppression Pool Not Bypassed Late (S3).** This top event is similar to Top Event 5 (S1), except that it addresses longer term suppression pool bypass failure modes that occur after vessel breach; success implies torus scrubbing. The two principal failure modes considered are either: (1) the possibility that a torus-to-drywell vacuum breaker sticks open even though the containment remains intact, or (2) core debris being swept into the drywell-to-torus vents and subsequently melting through at the capped vent line ends where debris could collect. Note in the CET structure that Top Event 12 (S3) is not questioned if water is being provided to the drywell floor [Top Event 11 (WD) or Top Event 7 (DS) are successful] since core debris will be well covered by the 20-inch-deep water pool and corium heat will be transferred to the torus as sensible heat in the overflowing water. Also note in the CET structure that Top Event 12 (S3) is not questioned if liner failure occurs, given that the drywell pressure is insufficient to cause downcomer vent clearing.

- **Top Event 13 — Corium Debris on Drywell Floor is Coolable, Resulting in Little Core-Concrete Interaction (CC).** This event questions the degree of cooling of the corium on the drywell floor and in the drywell sump. The presence of water on the drywell floor prior to vessel breach and/or water availability to the debris after vessel breach are important considerations as are the amount and dispersive nature of corium ejected at vessel breach. Success implies limited core-concrete interactions.

- **Top Event 14 — Emergency Crew Vents Containment in Core Damage Scenarios (DV).** This event questions whether the emergency response crew follows procedures and intentionally vents the suppression pool air space in a core damage scenario. This is sometimes referred to as "dirty venting." Success of Top Event 14 (DV) implies that adequate venting has occurred and that the vent flow capacity is sufficient to preclude long-term containment failure. The vent system is assumed to have insufficient capacity to accommodate an unmitigated ATWS event.

- **Top Event 15 — Containment Intact Late (I3).** This event questions whether long-term containment integrity is maintained. Success requires that no previous failures have occurred (i.e., Top Events 3 (I1) and 8 (I2) succeed), that fission product release due to liner failure does not occur, and that long-term containment heat removal is available, as denoted by the PDS. Note, in the event tree structure, that Top Event 15 (I3) is not questioned if "dirty venting" [by success of Top Event 14 (DV)] occurs. If a continued water supply is not providing debris bed cooling, corium thermal attack of the drywell floor and sumps is likely, providing large amounts of noncondensible gases, and the containment failure would likely be in the drywell area at high temperature and moderate pressure. Suppression pool cooling would have limited benefit for these scenarios because of the limited energy transfer from the dry debris to the torus. If debris bed cooling is available (i.e., a continued water supply to the debris) but suppression pool cooling is not available, a relatively slow containment pressurization would occur, and the failure mode would likely be at high pressure and moderate temperature; i.e., the containment would be at near saturation conditions. Success of Top Event 15 (I3) implies no appreciable release of fission products into the environment.

- **Top Event 16 — Small Leak Area if Containment Fails in Top Event 15 (I3) (L3).** This top event is similar to Top Events 4 (L1) and 10 (LF) but differs in two aspects. First, it applies to the longer term failure mode (well past the time of vessel breach) addressed in Top Event 15 (I3), wherein the slow pressure rise can be arrested by controlled leakage; i.e., "leak-before-break" considerations. Second, it addresses the rapidity of the containment blowdown loads, which influences the decontamination effectiveness of the reactor building as well as the rate of release of fission products into the environment.

4.5.2.5 Events Pertaining to Reactor Building Effectiveness

A description of the Browns Ferry reactor building and the adjoining refueling bay and turbine building and the associated blowout panels is provided in Section 4.1.

For accident scenarios that result in primary containment failure, the reactor building can mitigate the offsite release. As described earlier, blowout panels are located at the refueling floor and in the refueling bay exterior walls. If the containment failure mode results in a slow, controlled leak (as contrasted to a large, uncontrolled break) and the standby gas treatment system is operating and does not subsequently fail due to a extreme environment or excessive filter aerosol plugging, it is possible that reactor building integrity will be maintained, and a slow, filtered release through the plant stack occurs. (The plant stack exhausts 1,168 feet above grade.) In such a scenario, the possibility that hydrogen burns in the (uninerted) reactor building could cause building or SBGTS failure is a concern. If the SBGTS is not operating, reactor building failure (through the blowout panels) is considered to be likely, regardless of the containment failure mode (although building exfiltration could keep pressure below 0.35 psig for slow containment leak cases). If SBGTS is inoperable and the containment failure mode is a controlled leak with a moderately tortuous path from the containment leak location to the blowout panels, considerable fission product holdup and depletion through settling and plateout are possible (and washout by reactor building fire sprays is also possible, if spray is actuated and the release path flows through the sprayed area), in addition to the slow and elevated release. If the containment failure mode is a large, uncontrolled break, reactor building failure is likely, and the SBGTS will have little or no effect.

From the above discussion, it is apparent that the effectiveness of the reactor building in mitigating offsite releases following core damage scenarios with containment failure can range from a filtered, elevated release through the plant stack with no building exfiltration, at the one extreme, to a low, direct ground-level release with no reactor building holdup, at the other extreme.

- Top Event 17 — No Hydrogen Burn in Reactor Building (HB). Top Event 17 (HB) questions whether hydrogen released from the containment burns within the reactor building. Factors that will influence Top Event 17 (HB) include the amount of hydrogen produced, the composition (nitrogen, air, steam, hydrogen, CO, CO_2, etc.) and the rate of gas release from the failed containment, the possibility of reactor building fire sprays deinerting steam, the possibility of localized burning at the release jet or of hydrogen accumulation, whether the SBGTS is operating, whether an active ignition source is available, and the possibility of a delayed nonactive ignition. Any significant hydrogen burn would be expected to exceed the design pressure of the blowout panels.

- Top Event 18 — Reactor Building Effectiveness In Reducing Offsite Radiological Releases (BE). This top event questions how effective the reactor building and the adjoining refueling bay and turbine building are in reducing the releases from the failed containment. The evaluation of this effectiveness is derived from scenario-specific MAAP analyses. The figure of merit judgmentally selected for this analysis is the reactor building decontamination factor for cesium iodine (CsI). The reactor building decontamination factor is evaluated by dividing the CsI release fraction from containment by the fraction of CsI released into the environment. If the reactor building decontamination factor is greater than 10, Top Event 18 (BE) is considered a success.

- **Top Event 19 — No High Temperature-Induced Long-Term Drywell Failure (IL).** This top event is only questioned if containment failure has occurred and Top Event 18 (BE) is successful. This is questioned because delayed heating of the drywell could cause thermal expansion-induced penetration failures near the top of the drywell; this can only occur if Top Event 11 (WD) has failed. Such drywell failures would release fission products into the drywell closure head region, which would be released indirectly into the refueling bay (below the shield plug) with little hold-up in the reactor building.

The Browns Ferry CET is shown in Figure 4.5-1. It has 19 top events, 36 condensed sequences, and 5,128 total sequences. Quantification of the CET, including the evaluation of the conditional split fraction values, is discussed in Section 4.8.

4.5.3 DESCRIPTION OF CONDENSED SEQUENCES

Each of the 36 condensed sequences shown in Figure 4.5-1 will be briefly described to explain the rationale behind the CET structure. As noted before, the CET will be quantified for a large number of representative accident scenarios from the nonbypass key plant damage states. As such, initiator and sequence-specific split fraction values are used in the CET quantification as described in Section 4.8.

The first 35 condensed sequences (or 2,564 actual sequences) are based on the MAAP in-vessel quenching model; i.e., limited corium debris quenching in the lower vessel head water and prompt vessel breach. Condensed Sequence 36 is for the quantification based on the BWRSAR quench model, which currently is not being addressed in this IPE.

Condensed sequence (CS) 1 has MAAP in-vessel quenching (IQ = S), no SRV sticks open (VS = S), successful containment isolation and no containment failure prior to core damage (I1 = S), the suppression pool is not bypassed (SI = S), and in-vessel recovery of the damaged core occurs (IR = S). No vessel breach occurs, and a modest source term is likely.

CS 2 is similar to CS 1, except that no in-vessel recovery occurs, and core damage and vessel breach ensue (IR = F), drywell sprays are initiated before vessel breach (DS = S), no containment failure at or within 4 hours after vessel breach occurs (I2 = S), drywell shell failure due to corium thermal attack does not occur (LF = S), there is no appreciable core-concrete interaction occurring on the drywell floor or in the drywell sumps (CC = S), and the operators vent the torus air space as directed in steps PC/P-16 and PC/P-18 of EOI-2 (DV = S). The operators will not be directed to "dirty vent" unless the containment pressure exceeds 55 psig. It is not likely that containment pressure will rise above 55 psig in this scenario with little or no CCI (it is very unlikely that the hydrogen pressure alone could cause 55 psig) unless torus cooling is unavailable (as denoted by the PDS attributes). If Top Event DV is through the torus, there should be considerable decontamination, and the source term will be dictated by the noble gases.

CS 3 is similar to CS 2, except that Top Event DV fails (or, more likely, the operators do not vent because torus cooling was available and pressure remains below 55 psig), and no long-term containment failure occurred (I3 = S). A modest source term is likely for this scenario.

CS 4 is similar to CS 3, except that small, late containment failure occurs (I3 = F and L3 = S). This implies that containment pressure exceeded 55 psig (probably because torus cooling was unavailable), but the operators either failed to "dirty vent" or were unable to because of vent dependency (i.e., vent valve actuation dependencies on air and/or electric power) or hardware failures. No appreciable hydrogen burn occurs in the reactor building (HB = S), the reactor building is effective in reducing the offsite releases (BE = S; i.e., the reactor building decontamination factor is greater than 10), and no later thermally induced drywell penetration failures (which could release directly into the refueling bay and bypass the reactor building; IL = S) occur. A moderate source term (primarily noble gases) would occur with CS 4.

CS 5 is similar to CS 4, except that a late, high temperature-induced drywell penetration failure occurs due to vertical thermal explosion (IL = F), bypassing the reactor building some time after containment failure occurs and resulting in a somewhat higher source term than for CS 4.

CS 6 is similar to CS 4, except that the reactor building decontamination factor is small (less than 10), implying that multiple reactor building blowout panels have failed. Since HB = S in CS 6 (i.e., no significant hydrogen burn occurs in the reactor building), the blowout panel failures are likely due to the containment blowdown associated with the small, late containment failure.

CS 7 is similar to CS 6, except for two reasons. CS 7 addresses sequences 4 through 6 as noted by the transfer to subtree X3 (as denoted by X3 in the next to last column in Figure 4.5-1). Subtree X3 is composed of sequences 4, 5, and 6 as denoted in the tree structure. Because CS 7 has a substantial hydrogen burn in the reactor building, blowout panel failures that cause the building to be ineffective (BE = F) are likely due to the hydrogen burn-induced pressure increase.

CS 8 is similar to CS 4 through CS 7, except that the late containment failure is large. For such cases, reactor building blowout panel failures or reactor building bypass are more likely than if a small failure occurs.

CS 9 is similar to CS 2 through CS 8, except that considerable CCI occurs (CC = F). Thus, one would expect more noncondensible gas generation from drywell floor concrete thermal decomposition (CO_2 and CO) and possibly more hydrogen generation from oxidation of any remaining metallic zirconium within the corium melt by the steam liberated from the CCI process.

CS 10 is similar to the earlier sequences, except that liner failure occurs shortly after vessel breach due to corium thermal attack at the drywell floor elevation. Note that for CS 10, drywell spray had been initiated before vessel breach (DS = S). However, as described in Section 4.1.4, drywell shell failure is expected to release considerable steam and/or high temperature gases into the torus room. Because of the close proximity of the corner rooms to the torus room, the severe reactor building environment after liner failure is assumed to fail the core spray pumps, the RHR pumps (that provide drywell spray), and the CRD pumps that are located in the reactor building. Thus, when DS = S and

LF = F, the CET questions whether water from sources other than that supplied by reactor building components is available for debris cooling. There are only two such water sources: condensate flow or fire water locally intertied to the core spray piping prior to liner failure. Since fire water interties require spool pieces to be connected inside the reactor building and since the reactor building temperature and radiation levels make the building uninhabitable following liner failure, no postdrywell shell failure credit is taken for fire water. In CS 10, alternate water supplies are available (WD = S), suppression pool bypass (S3) is not questioned because of vent water flow, little CCI occurs (CC = S), and reactor building hydrogen burn and source term mitigation are questioned in transfer 4.

CS 11 is the same as CS 10, except that significant CCI occurs (CC = F).

CS 12 is also similar, except that no water is available to the drywell floor (WD = F), which will, of course, affect the likelihood of CCI.

CS 13 is identical to the preceding scenarios up to the point of vessel breach, except that a small containment failure occurs within 4 hours after vessel breach (I2 = F and L2 = S). Liner failure does not occur (LF = S), a continued water supply to the core debris on the drywell floor is available (WD = S; the containment failure mode could have failed drywell spray, which had been available), little CCI occurs, and the operators initiate dirty venting.

CS 14 has no dirty venting and questions the reactor building source term mitigation.

CS 15 is similar to CS 13 and 14, except that CCI occurs.

CS 16 is similar to CS 13 through 15, except that no water is available for debris cooling. Suppression pool bypass (Top Event S3) is questioned because there is no water spillover into the vents and is successful (S3 = S; note that this is influenced by the location of the small containment failure), and further questions are addressed in subtree X8.

CS 17 is similar to CS 16, except that the suppression pool is bypassed.

CS 18 is similar to CS 13 through CS 17, except that liner failure occurs (LF = F). Even though a small structural failure has also occurred (I2 = F and L2 = S), the liner failure is assumed to be substantially larger than the small structural failure, and subtree X10 questions the reactor building behavior, as did CS 10 through CS 12.

CS 19 has a large containment failure at or within 4 hours of vessel breach (L2 = F). As noted in Section 4.4, this large failure is likely to be in the upper part of the drywell (i.e., in the knuckle or cylinder areas), which are judged to be quite large and will release directly into the refueling bay. Liner failure is not questioned, but water is available for debris cooling, and suppression pool bypass does not occur. (This is probably unimportant for large drywell breaks, however.)

CS 20 through CS 22 address further variations on debris cooling and suppression pool bypass.

CS 23 to CS 29 are similar to previous unrecovered sequences except that drywell spray is not initiated before vessel breach. For these cases, water to core debris after vessel breach is asked even if containment and liner failure are successful. For high pressure accident scenarios, this water can be provided by low pressure vessel injection, which would flow onto the drywell floor through the vessel breach area.

CS 30 addresses the case wherein suppression pool bypass (by a stuck-open torus-to-drywell vacuum breaker) occurs prior to vessel breach (SI = F). The Level 1 analysis does not address this issue because the vacuum breakers are passive components, so the assessment will evaluate its likelihood, both before and after core damage. Suppression pool bypass will have an impact on both the timing of core damage and the corresponding source term.

CS 31 to CS 34 address scenarios wherein the containment pressure boundary is failed prior to vessel breach. Browns Ferry-specific MAAP analyses for severe accidents indicate that containment pressure levels prior to vessel breach are well below the threshold containment failure pressure for __I___ PDSs; this nomenclature indicates the second PDS character to be an "I." Unmitigated ATWS conditions that can rapidly pressurize and fail containment and containment isolation failure are assigned to __K___ PDSs. Accident scenarios wherein late containment failure precedes core damage (e.g., the Reactor Safety Study "TW" class of scenarios) are assigned to __L___ PDSs. Therefore, I1 = S for __I___ PDS scenarios, and I1 = F for __K___ and __L____ PDSs. CS 31 is for the case wherein a small containment isolation or structural failure occurs before core damage (L1 = S), suppression pool scrubbing (S1 = S) and drywell spray occurs (DS = S), and the transfer to subtree 12 addresses the relevant release category assignment issues.

CS 32 through CS 34 address variations of CS 31.

CS 35 has an SRV failing to reseat prior to vessel breach (VS = F). This issue is only addressed for high pressure accident scenarios, wherein SRV cycling would occur, converting otherwise high pressure scenarios into lower pressure scenarios. It should be pointed out that an SRV sticking open may result in an earlier core uncovery time, on the one hand, but on the other hand, lower vessel pressure at the time of vessel breach does result in a reduced challenge to containment. The transfer to subtree 15 addresses the issues addressed earlier.

CS 36 is for the cases wherein the BWRSAR in-vessel quenching of core debris in the water contained in the lower vessel head is adopted. This is a phenomenological issue that is not being addressed in the current Browns Ferry IPE.

4.5.4 REFERENCES

4.5-1. U.S. Nuclear Regulatory Commission, "Severe Accident Risks: An Assessment of Five U.S. Nuclear Power Plants," NUREG-1150, December 1990.

4.5-2. U.S. Nuclear Regulatory Commission, "Evaluation of Severe Accident Risks: Peach Bottom Unit 2," NUREG/CR-4551, Vol. 4, Rev. 1, Part 1, March 1990.

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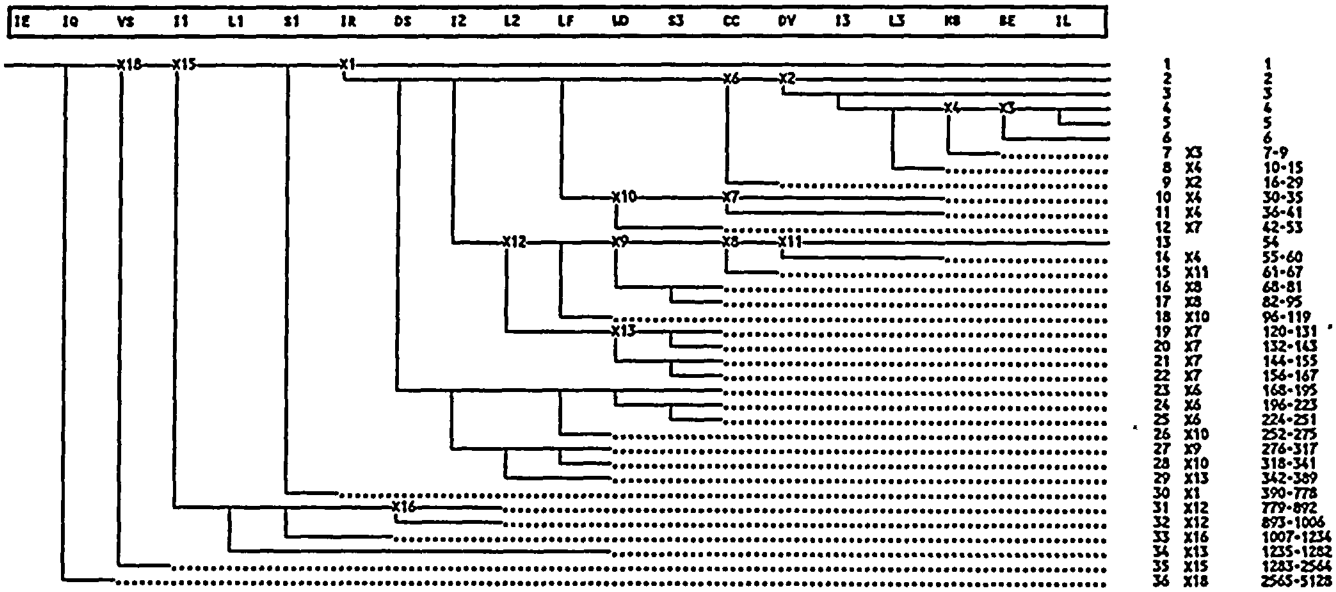
MODEL Name: BFNSRM
Event Tree: BFNLEV2

12:28:21 01 AUG 1992



Top Event Designator.....	Top Event Description........................
IE	Initiating Event
IQ	IN-VESSEL QUENCHING OF CORE DEBRIS
VS	SRV(S) DOES NOT STICK OPEN BEFORE VESSEL BREACH
I1	CONTAINMENT INTACT BEFORE VESSEL BREACH
L1	"SMALL" LEAK IF I1 FAILS
S1	SUPPRESSION POOL NOT BYPASSED BEFORE VB
IR	DEGRADED CORE RECOVERED IN-VESSEL
DS	DRYWELL SPRAY INITIATED BEFORE VESSEL BREACH (INCLUDES OPERATOR ACTION)
I2	CONTAINMENT INTACT AFTER VESSEL BREACH
L2	"SMALL" LEAK IF I2 FAILS
LF	NO SIGNIFICANT RELEASE BY DRYWELL LINER FAILURE
WO	CONTINUED WATER SUPPLY TO DEBRIS AFTER LINER MELT-THROUGH OR I2 FAILURE
S3	SUPPRESSION POOL NOT BYPASSED LATE
CC	NO APPRECIABLE CCI ON DRYWELL FLOOR OR SUMP
DV	"DIRTY" VENTING AFTER VESSEL BREACH DRYWELL AND/OR TORUS
I3	CONTAINMENT INTACT LATE
L3	"SMALL" LEAK IF I3 FAILS (FOR RB LOADS)
HB	NO H2 BURN IN REACTOR BUILDING
BE	REACTOR BUILDING EFFECTIVE (DF > 10)
IL	NO TEMPERATURE INDUCED LONG-TERM FAILURE

Figure 4.5-1. Browns Ferry Containment Event Tree

4.6 KEY PLANT DAMAGE STATES AND REPRESENTATIVE SEQUENCES

4.6.1 SELECTION OF KEY PLANT DAMAGE STATES FROM LEVEL 1 RESULTS

The results of the Level 1 point estimate quantification for internal initiators (including internal floods) are shown in Table 4.6-1. The first three columns list the plant damage states in descending order of frequency, showing the three-character PDS designator, the total frequency (per year) for each PDS, and the cumulative percentage contribution to the total core damage frequency (CDF). (The CDF is 4.84×10^{-5} per reactor-year.) As described in Section 4.3, the Level 1 quantification assigns each core damage scenario to a four-character PDS, in which the fourth character describes the status of the reactor building and its associated equipment. Thus, the status of the reactor building is known for each of the three-character PDSs and will be included in the containment event tree quantification but is not shown in Table 4.6-1 for clarity purposes. Columns four and higher list the initiating events in descending order of contribution to core damage frequency. The bottom two rows show for each initiating event the core damage frequency and the cumulative percentage contribution to the total core damage frequency. Note that: (1) the first 5 PDSs have successful (primary) containment isolation (e.g., the second character is "I") and collectively account for about 96% of the total core damage frequency, and (2) 20 PDSs have frequencies greater than 1×10^{-8} per reactor-year. The loss of offsite power initiating event category contributes about 68% of the total core damage frequency and that the first eight initiating event categories collectively account for over 91% of the total core damage frequency.

For Level 2 analyses in support of the Browns Ferry individual plant examination, a representative set of key plant damage states is selected based on both frequency and potential consequence considerations. The front-end screening criteria described in Section 2.1.6 of NUREG-1335 (Reference 4.6-1) provide the following guidelines for systemic sequences:

- Any systemic sequence contributing greater than 1×10^{-7} per reactor-year to core damage.
- All systemic sequences in the upper 95% of the total core damage frequency.
- All systemic sequences in the upper 95% of the total containment failure frequency.
- Any systemic sequence contributing greater than 1×10^{-8} per reactor-year to the containment bypass.
- Any systemic sequence judged to be an important contributor to core damage or poor containment performance.

Systemic sequences are those core damage scenarios as typically determined by a detailed system-level event tree analysis. The U. S. Nuclear Regulatory Commission (NRC) also provides guidance in Appendix 2 of Generic Letter No. 88-20 (Reference 4.6-2) on functional sequence selection criteria that are similar to those noted above for systemic sequences, except that the frequency values are a factor of 10 higher. Functional sequences are typically function-level faults, for which, in most cases, a given function can be satisfied by several system events.

Furthermore, in Section 2.2.25 of NUREG-1335, it is stated that "all accident sequences (represented now by plant damage states or bins) that meet the screening criteria (*sic*, taken as the functional sequence screening criteria) should be represented by CETs according to standard practice." Thus, at the PDS level, we must be assured that the key PDSs selected for CET quantification account for 95% of the total CDF, 95% of the total containment failure frequency (we interpret this to include all PDSs except those with second character "I"), all PDSs with frequencies greater than 10^{-6} per year, and all containment bypass PDSs with frequencies greater than 10^{-7} per year.

Based on the above criteria, nine KPDSs have been identified as requiring consideration in the Level 2 analysis as noted in Table 4.6-2, which also identifies certain PDS attributes and their containment status. The selected KPDSs superimposed onto the PDS matrix are shown in Figure 4.6-1.

The first five KPDSs (PIH, OIA, MIA, PID, and NIH) have successful containment isolation and collectively account for 95.9% of the total CDF; these collectively satisfy the 95% of CDF criteria. Furthermore, no PDS with successful containment isolation has the frequency above 10^{-6} per year, satisfying another of the above criteria.

The next KPDS is NLF, which involves late containment failure. As will be described in the next section, the NLF scenarios (as well as the other PDSs with a second-character "L," which are subsumed into this KPDS) involve reactor vessel isolation, adequate vessel level control, but no suppression pool cooling [(similar to the "TW" category in the Reactor Safety Study) Reference 4.6-3]. These events can lead to containment venting and/or eventual containment failure.

The next KPDS is MKC, which involves early containment failure (due to an unmitigated anticipated transient without scram scenario, or, for the subsumed PDS OKC, primarily containment isolation failure).

The next two KPDSs involve containment bypass from either main steam line isolation failures or interfacing systems loss of coolant accidents (ISLOCA).

Note that the nine KPDSs selected collectively account for 99.1% of the total core damage frequency. Also note that the key PDSs with containment failure or bypass collectively represent more than 95% of the total frequency in this category and include all such "containment failure" PDSs with frequencies greater than 10^{-7} per year. Therefore, all Level 2 selection criteria are satisfied. Based on this, the selected key PDSs provide representation of potential offsite consequences for the Browns Ferry Level 2 evaluation. Figure 4.6-2 shows the relative KPDS contributions for isolated and nonisolated cases. Table 4.6-3 shows the relative fraction of the reactor building status conditions for each KPDS.

4.6.2 SELECTION OF REPRESENTATIVE ACCIDENT SEQUENCES FOR SEVERE ACCIDENT ANALYSIS

Each KPDS noted in Table 4.6-2 is made up of a large number of individual core damage scenarios that can have different initiating events. However, as noted in Section 4.3, the PDS attributes have been selected to group the core damage scenarios with regard to their challenge to containment integrity or, should containment failure occur, their offsite consequence potential. Whereas each core damage scenario is unique in its initiator and/or Level 1 top event successes and failures, it is expected that there is a great deal of similarity in the overall thermal-hydraulic response of the plant. Therefore, as part of the Level 2 analysis approach, representative accident scenarios have been selected for each KPDS for deterministic analysis, using the Browns Ferry-specific Modular Accident Analysis Program (MAAP) model (see Section 4.7).

The representative scenarios for each KPDS are described in Table 4.6-4.

4.6.3 REFERENCES

4.6-1. U.S. Nuclear Regulatory Commission, "Individual Plant Examination: Submittal Guidance," NUREG-1335, August 1989.

4.6-2. U.S. Nuclear Regulatory Commission, "Individual Plant Examination for Severe Accident Vulnerabilities," 10CFR50.4(§), Generic Letter No. 88-20, November 23, 1988.

4.6-3. U.S. Nuclear Regulatory Commission, "Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," WASH-1400, NUREG-75014, October 1975.

Volume 3

TVA

BROWNS FERRY NUCLEAR PLANT UNIT 2 PROBABILISTIC RISK ASSESSMENT INDIVIDUAL PLANT EXAMINATION

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PLG

A. BROWNS FERRY INDIVIDUAL PLANT EXAMINATION (IPE) SUCCESS CRITERIA

This appendix summarizes the system and top event success criteria used in the Browns Ferry individual plant examination (IPE) for systems analysis and plant response to the initiating events identified in Section 3.1.1.

Success criteria for IPE event trees are partially based on the success criteria defined for the safety systems used in the analyses of the design basis accidents presented in Chapter 15 of the facility Safety Analysis Reports (SAR). The safety analyses are based on not exceeding certain core parameters [e.g., 2,200°F maximum clad temperature for a design basis loss of coolant accident (LOCA)] with conservative values of reactor power, trip delays, etc. In addition, the safety analyses usually assume a single, active failure coincident with a loss of offsite power at the time of the initiator. Using just the SAR system, success criteria are sometimes too conservative for IPE purposes. In these cases, other methods of determining realistic success criteria are used. These methods include a review of previously published and reviewed IPEs for other similar plants, or a plant-specific analysis for a particular type of scenario.

For the Browns Ferry IPE, SAR success criteria, previously published probabilistic risk assessment (PRA) criteria, and plant-specific analyses have been used to develop the success criteria used in the system analysis process.

Table A-1 identifies the general success criteria that are used to develop the more specialized criteria that are necessary for systems analysis. Table A-2 presents a summary of the functional success criteria used in the Browns Ferry IPE. These functional criteria are based on NUREG/CR-4550, Vol. 4, Peach Bottom plant analysis to support NUREG-1150. The criteria in NUREG/CR-4550 are based on previously published and reviewed PRAs. In addition, the functional criteria to be satisfied are based, in part, on the BFN Emergency Procedures and are as follows:

- Reactivity Control
- Reactor Pressure Control
- Inventory Makeup
- Containment Pressure Control

Tables A-3 through A-6 present the system success criteria in terms of the top events modeled in the IPE. Most of these criteria are based on the safety analysis presented in the Browns Ferry SAR. Specific differences are described in the following paragraphs.

- **IPE Time Criteria.** The IPE generally requires that systems perform their function for 24 hours after any initiating event. Within this 24-hour period, repair of failed components is not modeled for most systems. Selected, scenario-specific repair actions (e.g., restart diesel generators) are included as recovery actions, where appropriate. After 24 hours, IPEs implicitly assume that there is sufficient time to complete any necessary repairs prior to core damage due to the low decay heat values after 24 hours. In addition, the Updated Final Safety Analysis Report (USAR) analyses, in the context of a single failure criterion, do not allow additional failures after the imposed single limiting failure.

- **Diesel Generator Operating Times.** The diesel generator operating times are based on simulation studies of the loss of offsite power and the site-specific data on time to restore offsite power.

- **DC Power Availability.** The USAR discusses that batteries supply DC power loads for 2 hours after a loss of offsite power. The IPE uses 4 hours based on unit-specific station blackout study requirements.

- **Heating, Ventilating, and Air Conditioning (HVAC) System Success Criteria.** HVAC success criteria for the systems modeled in the IPE are based on plant-specific calculations performed in support of other analyses required by the U.S. Nuclear Regulatory Commission (NRC); e.g., Appendix R, Fire Safe Shutdown. Also see Reference A-1.

- **Safety Relief Valves (SRV) Operation for Pressure Control/Depressurization Success Criteria.** The success criteria used in the IPE for the SRVs are based on calculations performed in support of previously published PRAs, as described in NUREG/CR-4550, Volume 4.

References A-2 through A-15 refer to Tables A-2 through A-6.

REFERENCES

A-1. Hall, J. A., J. K. Liming, and D. W. Stillwell, "Browns Ferry Nuclear Plant Individual Plant Examination Supporting Analysis — Heating, Ventilating, and Air Conditioning Analysis," ERIN Engineering and Research, Inc., prepared for Tennessee Valley Authority, August 27, 1992.

A-2. Tennessee Valley Authority, "Browns Ferry Updated Final Safety Analysis Report," through Amendment 8.

A-3. U.S. Nuclear Regulatory Commission, "Analysis of Core Damage Frequency: Peach Bottom," NUREG/CR-4550, Vol. 4, August 1989.

A-4. U.S. Nuclear Regulatory Commission, "Anticipated Transient Without Scram; A Reappraisal," NUREG-0460.

A-5. General Electric Company, "Assessment of BWR Mitigation of ATWS, Volume II, NUREG-0460 Alternate 3," NEDO-24222, December 1979.

A-6. Harrington, R. M., and L. J. Oh, "The Effect of Small Capacity, High Pressure Injection Systems on TQUV Sequences at Browns Ferry Unit One," Oak Ridge National Laboratory, prepared for U.S. Nuclear Regulatory Commission, NUREG/CR-3179, September 1983.

A-7. Dallman, R. J., et al., "Severe Accident Sequence Analysis Program — Anticipated Transient without Scram Simulations for Browns Ferry Nuclear Plant Unit 1," EG&G, Idaho, Inc., prepared for U.S. Nuclear Regulatory Commission, NUREG/CR-4165, May 1987.

A-8. Technology for Energy Corporation, "IDCOR Technical Report 10.1: Containment Structural Capability of Light Water Reactor Power Plants," July 1983.

A-9. Burns, E. T., et al., "Inadequate Core Cooling Detection in Boiling Water Reactors," S. Levy Inc., SLI 8218, November 1982.

A-10. Calvert, J., et al., "Review of BWR Reactor Vessel Water Level Measurement Systems," SLI-8211, May 1982.

A-11. U.S. Nuclear Regulatory Commission, "Estimates of Early Containment Loads from Core Melt Accidents," NUREG-1079, December 1985.

A-12. Sonin, A. A., and J. H. Chun, "Small Scale Simulation of Vapor Discharge into Subcooled Liquid Pools," *Nuclear Engineering and Design*, 5 (1985), 353-362.

A-13. Sonin, A. A., *Nuclear Engineering and Design*, 65 (1981), 17-21.

A-14. Su, T. M., "Suppression Pool Temperature Limits for BWR Containments," U.S. Nuclear Regulatory Commission, NUREG-0783, September 1981.

A-15. Letter from A. A. Sonin (MIT) to D. J. Hanson (EG&G Idaho, Inc.), dated March 21, 1986.

Table A-1. Browns Ferry Event Tree General Success Criteria

System/Function	Success Criteria	References	Comments
1. Adequate Core Cooling and Prevention of the Onset of Core Damage	Core >2/3 Uncovered and Water Level Not Being Recovered	SLI-8218, SLI-8211	NEDC-30836P: Clad Temperature < 2,200°F 10 CFR 50.46 Limit
2. Reactor Pressure Vessel Integrity Maintained	RPV Pressure > Service Level C Limit of 1,500 psig LOCA Initiators RPV Rupture Initiator	NUREG-0460, NEDE-24222	
3. Containment Integrity Maintained	Containment Pressure > 128 psig Containment Unisolated Containment Temperature > 700°F	IDCOR Technical Report 10.1, NUREG-1079	
4. Containment Integrity for Anticipated Transient without Scram	Bulk Suppression Pool Temperature > 240°F	SONIN (11, 12, 13, 14)	

Table A-2. Summary of Browns Ferry Event Tree Functional Success Criteria

System/Function - Non ATWS	Success Criteria	References	Comments
1. Reactivity Control (RPS, ARI, and RPT)	Sufficient number of control rods to bring power to less than 4%. 69% to position 0. 50% to position 0 in checkerboard. No more than four in any cluster.	USAR 7.2 NUREG/CR-4550, Vol. 4 NUREG-0460	SLC and RPT for GT, SLOCA or MRI and RPT.
2. Reactor Pressure Control	Adequate pressure control through SRVs.	NUREG/CR-4550, Vol. 4	
a. General Transient and SLOCA	Main condenser available - no SRVs. Main condenser unavailable - three SRVs.	NUREG/CR-4550, Vol. 4	Condensate, condensate booster; and reactor feed pump; condenser circulating water and condenser vacuum.
b. Reclose	All open valves reclose.	NUREG/CR-4550, Vol. 4	
3. Inventory Makeup		NEDO-24708A	Also depressurize and one condensate pump.
a. High Pressure (SLOCA, GT)	RFW, HPCI, and RCIC	NUREG/CR-4550, Vol. 4	
High Pressure (MLOCA, etc.)	HPCI		HPCI (2 hours) or depressurize with three valves and one of four LPCI pumps.
b. Depressurization	MSIVs, TBVs, and condenser manually depressurize two SRVs. Depressurize through HPCI/RCIC steam lines.		
c. Low Pressure (LLOCA, etc.)	One condensate pump. One LPCI. One CS loop. One RHRSW.	NUREG/CR-4550, Vol.4	For SLOCA, GT: one of four LPCI (LOCA). Two CS pumps in one loop.
4. Containment Pressure Control	Vapor suppression and any of power conversion or one RHR heat exchanger loop (RHR and RHRSW).	NUREG/CR-4550, Vol.4	One of four RHR and heat exchanger (SPC or Spray) with one associated RHRSW.

Table A-3 (Page 1 of 6). Summary of Browns Ferry Event Tree Success Criteria — Frontline Systems

System/Function	Top Event	Success Criteria	References	Comments
Reactor Protection System			USAR 7.2	
Normal Scram Logic and Valves	RPS	Sufficient number of control rods to bring power to less than 4%.	NUREG/CR-4550, Vol. 4	Automatic or manual.
Operator Places Mode Switch in Refuel, Then Shutdown	OSW	Mode switch in refuel/shutdown prior to low pressure isolation of MSIVs.	NUREG/CR-4550, Vol. 4	
Main Steam System			USAR 11.5	
Turbine Trip	TB	Auto/manual trip of turbine. All four stop or all four control.	NUREG/CR-4550, Vol. 4	
MSIVs Remain Open	IVO	Two of two in any one of 4 steam lines for 24 hours.	NUREG/CR-4550, Vol. 4	
TBVs Relieve/Maintain Reactor Pressure	BVR	Nine valves open following trip, post-trip.	NUREG/CR-4550, Vol. 4	
Operator Action Use TBVs for Cooldown	OBC	Cooldown for 6 hours.		
Operator Inhibits MSIV Closure on Level 1 (ATWS)	OSV	Operator successful in inhibiting MSIV closure after ATWS.	NUREG/CR-4550, Vol. 4	
Operator Inhibits MSIV Closure on Level 1	OIV	Operator successful in inhibiting MSIV closure.	NUREG/CR-4550, Vol. 4	
Operator Action To Depressurize with TBVs	OBD	Operator successful in depressurizing.		
MSIVs Isolate on Low Steam Line Pressure or Vessel Level	MSVC	One of two MSIVs in each line close on isolation signal.		
Primary Containment Isolation System				
MSIVs Close on Demand	IVC	One of two in each of four steam lines.	USAR 4.6	
Primary Containment Isolation	CIS CIL	One of two valves in each modeled line closes and remains closed. CIL >3"; CIS <3".	USAR 5.2.3.5, 7.3	
Secondary Containment Isolation	BI	Isolates on demand with less than 12,000 cfm inleakage	USAR 1.7.3, 5.3.3.7	

Table A-3 (Page 2 of 6). Summary of Browns Ferry Event Tree Success Criteria — Frontline Systems				
System/Function	**Top Event**	**Success Criteria**	**References**	**Comments**
Condensate System			USAR 11.7	
Main Condenser Available	MCD	Remain available for 24 hours.	USAR 11.3, 11.4, 11.6	Includes support system.
One Condensate/Condensate Booster Pump	CD	One condensate and condensate booster pump for 24 hours.		Includes "short cycle" valves.
Switch for Availability of Condenser as a Heat Sink	HS	Depends on initiating event.		
Switch for Use of Condensate for Injection	CDA	Depends on initiating event.		
Depressurization/Safety Relief			USAR 4.4, 6.4.2, 6.5.2.3	
Sufficient SRVs Lift To Limit Reactor Pressure	RVO	Initiating event-specific; 9 of 13 for ATWS events; 2 of 13 for non-ATWS events.	NUREG/CR-4550, Vol. 4	Calculation in backup to Appendix R.
SRVs Reseat Following Lift	RVC	Thirteen of thirteen reseat on demand—ATWS events. Eight of eight reseat on demand—non-ATWS events.		
Operator Action To Depressurize Reactor Vessel Using SRVs	RVD	One to three SRVS open in remote manual or overpressure mode.		
Operator Inhibits ADS	OAD	Operator successfully inhibits ADS for ATWS events.		
Reactor Feedwater			USAR 11.8	
RFW Hardware	FH	One of three RFW pumps for 24 hours.		
Operator Trips All But One Running Feedwater Pump	OFT	Operator successfully trips all but one RFW pump.		
Automatic RFW or Operator Action To Prevent High Level Trip	FC	RFW isolated prior to vessel high level trip.		
Long-Term Control of RFW	OF	Manual control for 24 hours.		Condensate and condensate booster also required.
Level 8 Trip of RFW	L8F	All operating pumps trip.		
Operator Action To Restart RFW after Level 8 Trip	ORF	One pump restarts.		

Table A-3 (Page 3 of 6). Summary of Browns Ferry Event Tree Success Criteria — Frontline Systems

System/Function	Top Event	Success Criteria	References	Comments
Reactor Feedwater (continued)				
Operator Trips Feedwater	OFTR	Operator successfully trips RFW.		
Feedwater Trips on Vessel Level 8	L8TR	All operating pumps trip on Level 8.		
High Pressure Coolant Injection			USAR 6.4	
HPCI Start and Run for 6 Hours	HPI	Start (auto/manual) and operate for 6 hours from CST or SP.	NUREG/CR-4550, Vol. 4	
Level 8 HPCI/RCIC Trip	L8H	Automatic trip of HPCI/RCIC on Level 8 (cycle twice).		
HPCI Long Term	HPL	HPCI continues to operate for 18 hours.		May have two restarts if operator action fails.
Switch for 24 Hours HPCI/RCIC Availability	HRL			
Switch for 6 Hours HPCI/RCIC Availability	HR6			
Reactor Core Isolation Cooling			USAR 6.4	
RCIC Start and Run for 6 Hours	RCI	Start (auto/manual), inject for 6 hours from CST or SP.		
RCIC Long Term	RCL	Continue to operate for 18 hours		May have two restarts if operator action fails.
Isolate Steam Line Break Outside Containment	ISO	One of two RCIC steam supply isolation valves closes and remains closed for 24 hours.		
Recirculation System			USAR 7.9	
Recirculation Pump Trip	RPT	Both pumps trip.		
Loop I RDV Closes on Demand	DV1	Loop I isolate on demand.		
Loop II RDV Closes on Demand	DV2	Loop II isolate on demand.		
Standby Liquid Control System			USAR 3.8	
SLC Hardware	SL	One of two pumps.	NUREG/CR-4550, Vol. 4	ATWS rule satisfied by use of B-10.
Operator Initiates Standby Liquid Control	OSL	Operator successfully initiates SLC.		

Table A-3 (Page 4 of 6). Summary of Browns Ferry Event Tree Success Criteria — Frontline Systems				
System/Function	**Top Event**	**Success Criteria**	**References**	**Comments**
Control Rod Drive Hydraulic System			USAR	
Control Rod Drive Hydraulic Pump for Decay Heat Removal	CRD	One pump after short-term operation (6 hours) of HPCI/RCIC.	NUREG/CR-4550, Vol. 4	Two of two pumps in short term; 1 of 2 after ≈ 6 hours (4550). Used for non-LOCA sequences. Enhanced flow (two of two) used in some high pressure sequences.
Core Spray System			USAR 7.4, 6.4.3	
One CS Loop Injects	CS	One of two loops for 24 hours (two of two pumps and associated support per loop). One of two loops and one of two pumps (one of four) for 24 hours.	USAR, NUREG/CR-4550, Vol. 4	Two pumps in one loop — distribution from spray nozzles for LLOCA. Vessel inventory makeup after depressurization.
Standby Gas Treatment System			USAR 5.3.3.7	
Standby Gas Treatment System		Two of three trains.		
Residual Heat Removal System			USAR 4.8, 6.4.4	
RHR Injection from Pumps to Vessel (LPCI)	LPC	One of two paths for 24 hours.	NUREG/CR-4550, Vol. 4	One pump is adequate.
Hardware To Establish Shutdown Cooling	SD	Suction line and at least one pump path for 24 hours.		
Hardware To Establish Torus Cooling	SP	One of two paths for 24 hours (non-ATWS).		
Hardware To Establish Drywell Spray	DWS	One of two paths for 24 hours.		
RHR Pump A	RPA	One of four pump divisions (including heat exchanger and RHRSW) is required for success of RHR in shutdown cooling mode.		
RHR Heat Exchanger A	HXA	See above.		
RHR Pump C	RPC	See RHR pump A.		
RHR Heat Exchanger C	HXC	See RHR heat exchanger A.		
RHR Pump B	RPB	See RHR pump A.		
RHR Heat Exchanger B	HXB	See RHR heat exchanger A.		
RHR Pump D	RPD	See RHR pump A.		

Table A-3 (Page 5 of 6). Summary of Browns Ferry Event Tree Success Criteria — Frontline Systems

System/Function	Top Event	Success Criteria	References	Comments
Residual Heat Removal System (continued)				
RHR Heat Exchanger D	HXD	See RHR heat exchanger A.		
Cross-connect to Unit 3 RHR	U3	Not modeled, recovery action (guaranteed failure at this time, torus drained).		
Cross-connect to Unit 1 RHR	U1	RHRSW standby coolant supply to Unit 2 RHR Loop I available for 24 hours (includes operator action).		
Operator Action/Confirmatory HPCI and/or RCIC.	OHS	Start appropriate system before vessel level at Level 1 (SLOCA and GT).		
Operator Action To Maintain High Pressure Level Control (RFW, HPCI, RCIC)	OHC	Early high pressure control 6 hours (prior to Level 8).		
Operator Allows Level To Fall per Procedure	OAL	Operator follows procedures.		
Operator Action To Maintain High Pressure Level Control	OHL	Operator controls level for 18 hours.		
Operator Controls Low Pressure Inspection during ATWS	OLA	Operator successfully controls Low Pressure Inspection during ATWS.		
Switch To Use RFW/Condensate to Cooldown	OLC			
Operator Action To Establish Torus Cooling	OSP	Operator successfully establishes torus cooling.		
Operator Action To Establish Shutdown Cooling	OSD	Operator successfully establishes shutdown cooling.		
Operator Action To Maintain HPCI/RCIC minus SPC	OSP	Operator successfully maintains HPCI/RCIC without SP.		
Operator Action To Control Reactor Vessel Level	OLP	Operator successfully controls reactor vessel level using LPCI/CS.		
Operator Action To Establish Alternate Low Pressure Injection	OAI	Operator successfully establishes alternate Low Pressure Inspection.		

Table A-3 (Page 6 of 6). Summary of Browns Ferry Event Tree Success Criteria — Frontline Systems				
System/Function	**Top Event**	**Success Criteria**	**References**	**Comments**
Residual Heat Removal System (continued)				
Hardware To Maintain HPCI/RCIC Minus SPC	HR			
Hardware To Establish Suppression Pool Vent	VNT	Switch used in event trees.		
Hardware To Establish Alternate Low Pressure Injection	AI			RHRSW to RHR to RCS - standby coolant supply.

Table A-4 (Page 1 of 2). Browns Ferry Event Tree Success Criteria — Mechanical Support Systems

System/Function	Top Event	Success Criteria	References	Comments
Raw Cooling Water System			USAR 10.7	
Raw Cooling Water System	RCW	Two pumps for 24 hours.		
Emergency Equipment Cooling Water		Any two of four pumps supply 100% - operate for ≈ 24 hours.	USAR 10.10	
EECW Pump A3	EA	EECW pump A3.		
EECW Pump B3	EB	EECW pump B3.		
EECW Pump C3	EC	EECW pump C3.		
EECW Pump D3	ED	EECW pump D3.		
Reactor Building Closed Cooling Water System			USAR 10.6	
RBCCW	RBC	Two pump and two heat exchanger for 24 hours during normal operation. On LOSP coupled with accident signal, one of two normally operating pumps and one of two heat exchangers continue to operate, isolation valve 2-FCV-70-48 closes and remains closed for 24 hours.		
Drywell Control Air	DCA	Operate for 24 hours (one of two compressors).	USAR 10.14.4	
Plant Control Air System	PCA	Operate for 24 hours (two of four compressors, one dryer, three of three receivers).	USAR 10.14	
Condensate Storage Tank	CST	Maximum - 375 000 gallons. Minimum - 135 000 gallons.	USAR 11.9	CSTs capable of being manually crosstied.
Suppression Pool	TOR	Maximum - 127 000 ft^3. Minimum - 123 000 ft^3. Three or more strainers not plugged.	TS 5.2.3.3.1	Heat sink concerns.

Table A-4 (Page 2 of 2). Browns Ferry Event Tree Success Criteria — Mechanical Support Systems

System/Function	Top Event	Success Criteria	References	Comments
RHR Service Water System		RHR heat exchanger(s) supplied by at least one pump per heat exchanger.	USAR 10.9	Number depends on initiating event.
RHRSW Pump A2	SW2A	Operate for 24 hours.		
RHRSW Pump A1 (Swing Pump)	SW1A	Operate for 24 hours.		
RHRSW Pump B2	SW2B	Operate for 24 hours.		
RHRSW Pump B1 (Swing Pump)	SW1B	Operate for 24 hours.		
RHRSW Pump C2	SW2C	Operate for 24 hours.		
RHRSW Pump C1 (Swing Pump)	SW1C	Operate for 24 hours.		
RHRSW Pump D2	SW2D	Operate for 24 hours.		
RHRSW Pump D1 (Swing Pump)	SW1D	Operate for 24 hours.		

Table A-5. Browns Ferry Event Tree Success Criteria — SAI System				
System/Function	Top Event	Success Criteria	References	Comments
Vessel Instrument Tap I Vessel Instrument Tap II	VT1 VT2	Remain operable for 24 hours.	USAR 7.4	
Power Supply Division I Power Supply Division II	PX1 PX2	Remain operable for 24 hours.	USAR 7.4	
Rx-Level Signal Channel 58A Rx-Level Signal Channel 58B Rx-Level Signal Channel 58C Rx-Level Signal Channel 58D	LT1 LT2 LT3 LT4	Capable of developing a signal for t <24 hours.USAR 7.4	USAR 7.4	
Lower Level Actuation Logic	LV	Actuation Signal Developed 1/2-2.	USAR 7.4	
Division I Low Rx Pressure Permissive Division II Low Rx Pressure Permissive	NPI NPII	Permissive Signal Developed (1/2). Permissive Signal Developed (1/2).	USAR 7.4	
Level 3 Logic (RPS/PCIS/SCIS)	LVP	Trip signal developed 1/2-2.	USAR 7.4	
Drywell Instrument Tap I Drywell Instrument Tap II	DT1 DT2	Remain operable for t = <24 hours.	USAR 7.4	
CAS Drywell Pressure Signal	DW	Actuation Signal Developed 1/2-2.	USAR 7.4	
High Drywell Temperature Signal	DWP	Trip signal developed 1/2-2.	USAR 7.4	
Division I High Rx Pressure Signal Division II High Rx Pressure Signal	NH1 NH2	Signal Developed (2/2). Signal Developed (2/2).	USAR 7.4	
MSIV Low Rx Level Signal Channel 56A MSIV Low Rx Level Signal Channel 56B MSIV Low Rx Level Signal Channel 56C MSIV Low Rx Level Signal Channel 56D	LM1 LM2 LM3 LM4	Capable of developing a signal for t<24 hours Capable of developing a signal for t<24 hours Capable of developing a signal for t<24 hours Capable of developing a signal for t<24 hours	USAR 7.4 USAR 7.4 USAR 7.4 USAR 7.4	

Table A-6 (Page 1 of 2). Browns Ferry Event Tree Success Criteria — Electrical Support Systems

System/Function	Top Event	Success Criteria	References	Comments
Offsite Grid			USAR 8	
500-kV Supply	OG5	Remain energized for 24 hours.		
161-kV Supply	OG16			
4.16-kV Shutdown Boards			USAR 8.4	
4-kV SDBD A, 480V SDBD 1A	AA	Remain energized for 24 hours.		
4-kV SDBD B, 480V SDBD 2A	AB			
4-kV SDBD C, 480V SDBD 1B	AC			
4-kV SDBD D, 480V SDBD 2B	AD			
4-kV SDBD 3EA, 480V SDBD 3A	A3EA			
4-kV SDBD 3EB	A3EB			
4-kV SDBD 3EC, 480V SDBD 3B	A3EC			
4-kV SDBD 3ED	A3ED			
480V Reactor MOV Boards			USAR 8.5	
Reactor MOV 1A	RE	Remain energized for 24 hours.		
Reactor MOV 1B	RF			
Reactor MOV 1E	RG			
Reactor MOV 2A	RH			
Reactor MOV 2B	RI			
Reactor MOV 2C	RJ			
Reactor MOV 2D	RK			
Reactor MOV 2E	RL			
480V Diesel Auxiliary Boards			USAR 8.4	
DG Aux Bd A	RM	Remain energized for 24 hours.		
DG Aux Bd B	RN			
DG Aux Bd 3EA	RO			
DG Aux Bd 3EB	RP			

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Table A-6 (Page 2 of 2). Browns Ferry Event Tree Success Criteria — Electrical Support Systems

System/Function	Top Event	Success Criteria	References	Comments
250V DC Divisionalized Power			USAR 8.6	Station Blackout Report.
250V DC Subsystem 1-I	DA	One division in each unit supplies power for 4 (24) hours.		Four hours after station blackout; 24 hours after all other initiators.
250V DC Subsystem 1-II	DB			
250V DC Subsystem 2-I	DC			
250V DC Subsystem 2-II	DD			
250V DC Subsystem 3-I	DE,DF			
250V DC Subsystem 3-II	DG,DH			
20V AC Unit 1 and Unit 2 Preferred Power			USAR 8.7	
Unit 1 Preferred Power	DI	Remain energized for 24 hours.		
Unit 2 Preferred Power	DJ			
120V AC RPS A and B Power System			USAR 8.7	
RPS A	DK	Remain energized for 24 hours.		
RPS B	DL			
120V AC I&C Power			USAR 8.7	
I&C 1B	DM	Remain energized for 24 hours.		
I&C 2A	DN			
I&C 2B	DO			
250V DC Reactor MOV Boards			USAR 8.7	
Reactor MOV 1A	RA	Remain energized for 24 hours.		
Reactor MOV 2A	RB			
Reactor MOV 2B	RC			
Reactor MOV 2C	RD			

B. HUMAN ACTION ANALYSIS

This appendix presents the detailed methodology and results of the human actions evaluations performed in the Browns Ferry Nuclear Plant Probabilistic Risk Assessment (PRA). Section B.1 summarizes the types of actions evaluated and their use within the model. Sections B.2 and B.3 address errors during normal maintenance and testing that leave systems unavailable to perform their functions if an initiating event should occur. Sections B.4 and B.5 present the evaluation of actions by the operating crew as they dynamically respond to the plant conditions during the sequence of events following an initiating event. Finally, Sections B.6 and B.7 address actions to recover functions through alternate alignments or restoration of failed systems to service.

B.1 TYPES OF ACTIONS EVALUATED

Human errors and human solutions are a vital part of nuclear power plant operation and accident response. In fact, the causes for nearly all plant problems can ultimately be traced to some form of human fallibility, and nearly all plant problems can be solved by humans if they are provided with the appropriate information, guidance, and tools. Within the context of this PRA, however, the evaluation of human errors encompasses only those actions accomplished within the plant that directly:

- Impact the availability of support or frontline systems at the time of the initiating event.

- Mitigate against core damage or breach of primary containment during the sequence of events following the initiating event.

With this in mind, the following types of human actions are evaluated:

- **Routine Actions before an Initiating Event.** Routine actions considered in the PRA involve restoring a component or flow path to normal after completing the testing, inspection, or maintenance and ensuring that the sensing equipment is correctly aligned and calibrated for automatic response to emergency actuation conditions. Errors that are important to plant risk leave equipment disabled or in an undetected, misaligned state, causing it to be unavailable to accomplish its function on demand during an event sequence.

- **Actions That Can Cause Initiating Events.** Actions that can initiate plant transients are implicitly accounted for in the quantification of initiating event frequencies to the extent that these human actions are the cause of such events. Plant-specific data are used to assign total initiating event frequencies of which human errors are only one cause. Therefore, these types of human actions are addressed in the initiating event section and are not discussed further here.

- **Dynamic Operator Actions Accomplished during the Plant Response to an Initiator.** Guided by the plant emergency response procedures, the operators make active decisions and take appropriate actions in response to a complex series of stimuli during the sequence of events following an initiator. They are scenario specific and include well-defined tasks for manual initiation, control, and alignment of plant emergency equipment or selected backup systems. Usually, the operators must complete a particular activity within a specified period of time to avoid an unfavorable change in the state of the plant. These actions are an integral part of the plant response to the initiating event.

- **Recovery Actions.** Recovery actions generally involve recovery from failures that completely or partially disable the standard system response during a plant transient. They generally involve alignment of alternate systems or repair and restoration of the failed system. They are defined in procedures and supported by the training and knowledge of the operators and plant staff.

B.1.1 INCORPORATION OF HUMAN ACTIONS INTO THE PLANT MODEL

TVA's approach to human interaction modeling provides a systematic and consistent framework for identifying, evaluating, and documenting human responses at all levels of the study. The approach emphasizes a close coordination with plant operators and a thorough review of their procedures.

Quantified human error rates (HER) can be incorporated into the plant model in a number of ways, depending on the influence of the action on other events in the sequence and, in particular, how they impact the quantification of other events. The potential dependencies of HERs on other elements of the plant model can strongly affect how the action and subsequent events are quantified. There are three general types, as follows:

- Plant-human dependency accounts for the impact of the plant instrumentation and other performance indications on the ability of the operators to accomplish the action. They are scenario dependent and influence the degree of difficulty that the operators face when responding to the scenario.

- Human plant dependency accounts for those actions that can cause more than one system to fail. The event trees that TVA uses to express the plant response to an initiating event are an ideal vehicle to represent these dependencies. Once the impact of the action is identified, the affected systems are placed to the right of the action and are required to fail, given failure of the action.

- Human-human dependency involves the increased potential for making a series of errors once the first error is made. These dependencies are presented to the operators for consideration during the evaluation process.

Depending on the type of dependency involved, any one of the following approaches can be used to incorporate human actions into the overall risk model:

- An action may be included within the system model if the human error affects subsequent events in the sequence in the same way as hardware causes of system failure. Errors that occur before the initiating event fall into this category.

- If failure of an operator action that fails a system has a different effect on the subsequent response of the plant than a hardware failure, a separate top event must be used to represent the human action. Dynamic operator actions generally, but not always, fall into this category.

- Recovery actions are often appended to accident sequences as separate top events at the end of the sequence. In this way, they can be made very sequence specific and not alter the remainder of the model.

B.2 ROUTINE ACTIONS BEFORE AN INITIATING EVENT

Routine human actions considered in the PRA are system-specific activities performed by one or more operations staff members as part of their normal workday duties to align a safety function properly before leaving it in its ready condition. These include:

- Realignment of a component or flow path to normal after completing the testing, inspection, or maintenance.
- Removal of jumpers or other temporary system alterations to restore it back to service.
- Calibration and alignment of sensing equipment to ensure proper automatic response to emergency actuation conditions.

Errors that are important to plant risk cause the system to be unavailable to accomplish properly its function following an initiating event. Failure modes that could produce this condition:

- Leave safety-related equipment disabled or in an undetected misaligned state, causing it to fail to operate upon demand.
- Require automatic actuation signals to recover the proper alignment, if provided by the design. This adds an additional failure mode to the system since an additional transition will have to occur for system success. (As a practical matter, these are rather minor contributors to system unavailability.)

The system analyst is responsible for evaluating routine actions that cause equipment unavailability. This approach is used because the system analyst is familiar with the equipment, its location, control room alarms and indications, and detailed procedures impacting the maintenance and surveillance testing of the system.

Normally, only surveillance procedures are evaluated to identify specific causes of equipment unavailability. Maintenance procedures are evaluated only if the operability of the system is not verified by a surveillance procedure at the conclusion of the maintenance or repair activity.

Each surveillance procedure is subjected to a screening evaluation to determine if it can leave the system in an undetected failed state. The unavailability due to a test is not quantified if it can be shown that:

- The alignment of the system has not been changed by the test.
- The test brings the system into closer alignment with its active safety function configuration than its standby alignment.

- The alignment of the system is a displayed parameter in the control room subject to active monitoring by the operators.

- Equipment reconfiguration during periods of plant shutdown that are subject to verification of alignment during startup. Verifications contained in change of mode checklists fall into this category. Exceptions to this guideline are made when the human error is judged to be the primary contributor to the top event availability.

Those tests that are judged to have a potential for leaving the system in an unavailable state are assigned a "misalignment after test" designator of up to six digits to identify uniquely the test in the quantitative system model, as shown in the example below. A further discussion of alignments is contained in the system notebook.

For the quantification of system split fractions, the system analyst sets the "misalignment after test" designator equal to one of the generic error rates given in Table B-1. These error rates are derived in Reference B-1 for an average restoration within a group of typical testing situations following the methods developed by Swain and Guttman and documented in NUREG/CR-1278 (Reference B-2). Selection of the category of generic error rate is accomplished with the guidelines given in the table. The system analyst consults with the human action analyst when the assessment requires judgment regarding mixtures of restoration type, location, and complexity.

Recovery of equipment from its unavailable state is permitted if normal rounds or inspections that are explicitly covered in written procedures check the alignment. Specific reference must be made to the steps in the backup procedure that can reveal the presence of the disabled, misaligned, or improperly calibrated equipment prior to the end of the surveillance interval. Under these circumstances, the system analyst may reduce the unavailability due to the original error by the ratio of the rounds or inspection interval to the surveillance interval.

As an example of the quantification process, suppose test SI-4.0.5, a monthly test(frequency = 1 test per 730 hours), is judged to have the potential to leave valves misaligned. The alignment is independently verified at the end of the test and is verified by weekly rounds (discovery time = 168 hours) inspections. The resulting average unavailability would be written as:

RAATE = HS405*(168/730)

where

RAATE = alignment designator for Top Event <u>RA</u>, division <u>A</u>, <u>t</u>est <u>e</u>rror.

HS405 = human error designator assigned by the systems analyst for test SI-4.0.5 (failures per test).

The human error designator is then set equal to the generic error rate that describes the error being made. In this case, ZHERLL would be used to designate a realignment using controls, done at one local location, and having low complexity.

The recovery model assumes that the rounds inspection will detect the misalignment. Differences in time, procedures, and personnel doing the inspection are judged to make the dependence that of an independent checker in an active independent inspection. Since the written rounds inspection can be done at any time after the surveillance inspection up to the rounds inspection interval used in the above equation, the fraction assigned above is considered to be a conservative estimate of the impact of rounds inspection for reducing undetected misalignments.

The human actions analyst provides an advisory and oversight role for the systems analysts to ensure that the quantitative model for the error frequency evaluations is consistently performed for the modeled plant systems. The human actions analyst also develops the quantification of human error rates contained in Table B-1 using the methods developed by Swain and Guttman, and documented in NUREG/CR-1278 (Reference B-2).

TVA recognizes that the above approach to quantification is primarily a screening tool. If the impact of a human error during normal operations is found to be an important contributor to a risk-dominant accident sequence, it is subjected to an individually documented quantitative evaluation with plant personnel familiar with the procedure in question. The ultimate objective of this evaluation is to reduce the risk by identifying a means to reduce the potential for errors.

B.3 RESULTS OF ROUTINE ACTION EVALUATION

The systems analyses determined that the surveillance tests summarized in Table B-2 have sufficient enough potential to leave a component in an undetected unavailable state to warrant quantification. The table lists the system in which the component is modeled, the top events impacted by the test, the name and number of the test, a short description of error that could produce the unavailability and the database variable use to quantify the unavailability.

No routine human errors during surveillance tests prior to initiating events were found to be a significant contributor to risk.

B.4 METHODOLOGY FOR EVALUATION OF DYNAMIC OPERATOR ACTIONS

Dynamic operator actions that take place following an initiator are identified and qualitatively described during the construction of the plant model event trees. They are then presented to teams of licensed plant operators for evaluation and feedback.

Section B.4.1 describes the qualitative process by which the actions are identified and described. Section B.4.2 describes the procedure used to elicit operator evaluations within the context of the success likelihood index methodology (SLIM) (Reference B-3). Finally, Sections B.4.3 and B.4.4 summarize the quantification process.

B.4.1 QUALITATIVE EVALUATION

The purposes of the qualitative evaluation are to:

- Identify dynamic operator actions to include in the event sequence evaluation.

- Ensure that the impact of the success or failure of those actions are properly modeled.
- Develop descriptions of those actions in a form that will facilitate operator evaluation.

During event tree construction, a variety of operator tasks are considered for inclusion in the event sequence model. These include:

- Manual actions required in emergency procedures to bring the plant to a safe shutdown following an initiating event.
- Control of preferred cooling systems.
- Backup of automatically actuated and controlled systems.
- Immediate response to failures of active systems.

Once individual actions are identified for evaluation, the action boundary conditions, success criteria, and event scenario timing are identified and recorded on the Operator Response Form for each action. The Operator Response Form follows the format shown in Table B-3. The purpose of this form is to provide a consistent format to convey the context of the action to the operator teams who will evaluate its degree of difficulty and a short summary of what is required to accomplish it. Thermodynamic calculations supporting the timing considerations and arguments supporting engineering judgments regarding timing are contained in Appendix C.

The first two sections of the form set up the situation for the operators. They describe where in the event sequence model this action will take place and what indications the operators are expected to respond to in the control room. The next two sections describe what is involved in accomplishing the action, and those factors that compete for the operators' attention or divert them from the task. Two sections are then provided to describe what happens in the event sequence model if the action succeeds or fails. Finally, the time frame over which the action can be expected to be accomplished is addressed.

Plant-human dependencies are described explicitly on the Operator Response Form, both in the section that relates the action to the plant model and in the discussion of required actions and competing factors. This permits the assessment teams to understand the context of the action during the quantification of the action so that the dependencies can be reflected properly in the final error frequency.

The Operator Response Form presents human-human dependencies by asking the assessment teams to identify with the situation at hand and to consider how an operating team may have made previous errors from which they must recover. They are then asked to identify ways to recognize and recover from previous errors when quantifying the dependent action.

The completed operator action forms are reviewed by the plant operations staff. Review comments can both change the requirements of the action and generate modifications to the plant model. In addition, the relationship between the Operator Response Form and the plant event sequence model is explained to the operator evaluation teams during their initial briefing.

B.4.2 QUANTITATIVE EVALUATION

TVA uses an adaptation of SLIM to elicit the operator judgment and to convert their evaluations into quantitative error frequencies. SLIM is based on the following assumptions:

- The likelihood of operator error in a particular situation depends on the combined effects of a relatively small set of performance-shaping factors (PSF) that influence the operator's ability to accomplish the action successfully.
- Evaluators can address each of these PSFs independently so that the overall evaluation can be expressed as the sum of the results of each PSF to form a numerical likelihood index.
- The actual quantitative error rate is related to the numerical likelihood index by a logarithmic relationship.
- The logarithmic relationship can be calibrated on a situational basis by use of appropriately selected calibration tasks having generally accepted error rates.

The basis for the logarithmic relationship between the likelihood index and error rate is documented in References B-3 through B-5. Each of the other assumptions is addressed in the implementation procedure below.

TVA has adapted SLIM by defining a small set of generic PSFs that are judged to encompass the major focuses of cognitive activity. These PSFs were chosen after a review of both the instructions and examples of the SLIM documentation and the discussion of PSFs in Reference B-4. Seven PSFs have been chosen to relate the impact of:

- Conditions of the work setting under which the action must be accomplished. The PSFs are as follows:
  - Significant Preceding and Concurrent Actions
  - Plant Interface and Indications
  - Adequacy of Time To Accomplish the Action
- Requirements of the task itself. The PSFs are as follows:
  - Procedural Guidance
  - Complexity of the Task Relative to Resources, Coordination, and Location
- Psychological and cognitive condition of the operators. The PSFs are as follows:
  - Training and Experience Relative to the Action
  - Stress due to the Situation and Environmental Conditions

Performance-shaping factors are rated against two criteria:

- A score relates the degree to which the conditions of PSF help or hinder the operator to perform the action.

- A weight relates the relative influence of each PSF on the likelihood of the success of the action.

The evaluation of dynamic human errors with SLIM is made consistent across operator evaluation teams by the development of a set of forms and instructions to explain and expand on the rating procedures for the PSFs.

- Table B-4 provides detailed guidance regarding the definition, interpretation, and application of each PSF and the thought process that could lead to a specific degree of difficulty score.

- Table B-5 provides a summary of the definition of each PSF and detailed guidance regarding the thought process that could lead to a relative influence weight.

- Table B-6 summarizes the relationship between the scoring and weighting processes. The score addresses the actual conditions under which the action must be accomplished. The weight is equivalent to the operators stating how much the conditions relative to a specific PSF actually impact the potential for success or failure of the action. If it is not a factor that controls their ability to do the action, it is weighted low or insignificant.

The SLIM methodology has been modified so that the operators scale the degree of difficulty, rather than the potential for success, when they score the action. This change in orientation produces a failure likelihood index (FLI) rather than a success likelihood index. This approach has the advantage of quantitatively highlighting the causes of operator difficulty. A high score combined with a high weight produces a large FLI compared to other ratings. This permits efficient analysis of the operator's judgment regarding potential problem areas and trends, which is addressed in Section B.5.5.

The independence of the PSFs is addressed by the definition at the top of each form that emphasizes the different aspects of the cognitive process that each PSF is intended to address. The human action analyst explains the purpose and use of these forms to the operators during the initial evaluation session. In addition, he provides guidance and feedback to the operators during the evaluation sessions when it appears by the discussion that their interpretation of the PSFs may be losing focus.

Another major premise of the SLIM methodology is that the evaluation team can rate the weight and score independently. The thought process necessary to distinguish between these two orientations of the rating process is stressed in both Table B-7 and the initial training of the raters. In addition, the human actions analyst provides feedback regarding the broad qualitative interpretation of their ratings to the raters during the evaluation process.

During their evaluation of the actions, the operators are requested to consider a number of possible errors. These include:

- **Nonresponse Errors, Also Called Errors of Omission.** This would include problems generated by both the plant interface and the competition of other actions.

- **Time and Resource Limitations.** For certain actions, the operators are requested to identify the number of people and the coordination required to get the job done. The degree of difficulty will then be impacted by the personnel and communications they have available.

- **Nonviable Errors.** Under some conditions, the operators may correctly diagnose the accident scenario but select the wrong response. These errors are believed to be governed by operator slips; e.g., selecting the wrong controls for the tasks. The operators are requested to consider control room feedback problems that could keep such errors from being detected.

B.4.3 QUANTIFICATION PROCESS

The quantification process is done in a series of stages.

First, a normalized weight for each PSF is obtained by dividing the weight assigned by the group by the total of all the weights for that particular action.

The FLI is calculated by multiplying the normalized weight of the PSF by its score and adding that result to similar results for the other PSFs, or

$$FLI = \sum w_i S_i$$

where

i = PSF that has an influence on the error rate of the action.

w_i = weight of PSF_i, normalized so that $\sum w_i = 1$.

S_i = degree of difficulty score for PSF_i, from 0 to 10.

The normalized weights are then sorted to obtain groups of actions having similar PSF weight profiles. The actions are grouped by the following procedure:

- Actions are sorted by order of the precedence, starting with the PSF that has the highest average weight.

- Cut points are established between groups where the pattern of weight changes appears to shift the most. As a rule of thumb, one would like to obtain average differences in weights between groups of at least 5% to 10% for three of the PSFs.

- Grouping stops when the difference between the top and bottom weight within the sorted PSFs is less than .12.

- Minor adjustments and consolidations can be made after sorting based on consistency reviews and the availability of the calibration tasks needed for quantification (see below).

A separate quantification is done for each group of actions generated in the sorting process. The error rate of each action is estimated by comparing the overall FLI to a correlation that follows the relationship:

Logarithm (Human error rate) = A + B(FLI)

The coefficients of the correlation are obtained from a least squares fit of the FLI of calibration actions that have reasonable or generally accepted error rates in the industry. The calibration actions for a particular group are chosen to match the actions in the group using similarity of PSF weights as the selection criterion.

To provide error rates that are consistent with other studies, the calibration of the human error rate model uses well-defined actions obtained from evaluations for other PRAs and other statistical or analytical evidence of failure frequencies for these actions. These actions are obtained from PRA studies accomplished by a number of different organizations to avoid a systematic bias in the calibration HERs. A human interaction database encompasses these sources provides this documented evidence (Reference B-6). The calibration procedure should ensure that the numerical error rate estimates are realistic and consistent with available data, observed human behavior, and the results from comparable expert evaluations of similar activities.

The use of some combinations of calibration actions may produce human error rates of 1.0 per demand for FLI values of less than 10. When this occurs, all actions with a FLI above that value are quantified as being guaranteed to fail.

A series of spreadsheets are used to accomplish the quantification process. An example of the spreadsheet showing the resulting human error rates estimated for one group of actions is given in Table B-7.

B.4.4 COMBINING ESTIMATES OF EVALUATION GROUPS

Uncertainty distributions are developed for each evaluated human action error frequency by assigning a range factor to each group's estimate and merging the estimates of the individual groups together. The uncertainty bounds of the individual groups are established following the recommendations of Swain and Guttman (Reference B-2, Table 7-2), for nonroutine circumstances, which is judged to be representative of the transient situations to which the actions apply.

Swain and Guttman (Reference B-2) recommend a lognormal distribution with the following range factors:

Estimated Error Rate	Range Factor
> .001	5
< .001	10

The combined judgment of all of the groups is obtained by merging the distributions of the individual groups, giving equal weight to each group. The computer program BARP (Reference B-7) is used for this purpose. The merging process not only retains the uncertainty associated with the individual quantifications but also allows the uncertainty to increase when there is disagreement among the groups.

B.4.5 SUMMARY

The composite error rate resulting from the evaluation and the quantification of all of the operator groups are displayed in tabular format in Section B.5, along with tables and analyses of the ratings that produced them. This permits easy review, comparison, and identification of the most important factors influencing each assessment.

It is important to recognize that the quantification of human error rates is only a small portion of the information obtained from the SLIM approach. The trends of weights and scores provide much valuable information regarding the operator's judgment regarding the focus of safety-related actions and the difficulties involved in accomplishing them. The use of more than one group to do the evaluation shows how the perspective of actions can vary from group to group. The discussion within the group and the comments provided by them provide valuable insights that lead to more practical-oriented risk models. These points are expanded in the discussion of the evaluation results.

B.5 RESULTS OF DYNAMIC HUMAN ACTIONS ANALYSIS

The event sequence and systems evaluations identified the operator actions listed in Table B-8 as having a potentially important influence on the mitigation of severe core damage sequences. The reasoning for their explicit inclusion in the event sequence models is discussed in the description of the event sequence diagrams and the definition of the event tree top events in Sections 3.1.2 through 3.1.4. This section presents the

- Qualitative description of the tasks required to accomplish the actions successfully, and the conditions under which they must be accomplished.
- Quantitative evaluation of PSFs reflecting the operators' judgments regarding the degree of difficulty for successfully accomplishing the actions.
- Distributions of the HERs derived from the quantification evaluation using the adaption of the SLIM methodology discussed in Section B.4.
- Insights gained from the evaluation process, including a comparison of group evaluation perspectives and a trend analysis of the PSF ratings.

B.5.1 QUALITATIVE DESCRIPTION OF THE DYNAMIC HUMAN ACTIONS

Table B-9 presents the Operator Response Forms for each evaluated dynamic human action. The descriptions on the forms were developed by the human action analyst and licensed operators serving on the PRA team with information provided by the event sequence analysts regarding the conditions under which each action is demanded. The forms are written in accordance with the guidelines contained in Section B.4.1. Sufficient detail is provided to permit the operator groups evaluating the actions to recognize the context of the action. However, detailed evaluation of the PSFs is purposely omitted so that the operators can form their own judgments. The justifications of the time windows for the actions are presented in the top event definitions and Appendix C.

The dynamic human actions were also qualitatively evaluated by the three groups of licensed plant operators who performed the quantitative evaluation. These groups discussed the context of each action among themselves before quantitatively evaluating it. In some cases, the groups provided practical comments that assisted the event sequence analyst to improve the plant model. Wherever appropriate to clarify the evaluations, the operator comments are included in the group comparison and trend analysis in Section B.5.5.

B.5.2 QUANTITATIVE EVALUATIONS

The three operator groups quantitatively assessed the weight and degree of difficulty score of the seven PSFs in accordance with the guidelines in Section B.4.2 as summarized in Tables B-4 and B-5. These evaluations are summarized in Tables B-10 and B-11.

Each group's FLI evaluations are converted into HER estimates independently of the other two groups in accordance with the procedures outlined in Section B.4.3. After the failure rates for the individual groups are obtained, they are merged together, giving equal weight to each evaluation group.

The individual actions are grouped by similarity of weights into groups for quantitative evaluation against calibration actions. Calibration actions obtained from evaluations in other PRAs are used to benchmark the failure rates of each group. The identification of each calibration action, the basis for its failure frequency, and source of the calibration PSF weights and scores are documented in a calibration action database (Reference B-6). To keep the differences in judgments explicit, no adjustment is made to the normalized weights or individual PSF rating of either the rated actions or the calibration actions during this process. The resulting evaluations are given by individual rating group in Tables B-12 through B-14.

The operator groups at Browns Ferry took advantage of the flexibility provided them for weighting the individual PSFs of the human actions by varying the weight profiles of individual actions considerably, rather than looking for similarities in focus between actions, as suggested in the guidance forms. This led to a wide variety of weight profiles, some of which have no calibration actions with similar profiles. Consequently, some PSF weight profile groups were converted to HERs using best fit to weight profiles available. A notation is made on the evaluation form where judgment was used to find the best available fit.

The HERs used in the PRA are obtained from merging the individual groups of operator evaluations into composite quantitative estimates using the procedures outlined in Section B.4.4. These composite error rates are given in Table B-15. Because of time limitations, individual operator groups did not evaluate every action. The results tables state which groups contributed to the final evaluation of each action.

The estimates have large range factors because of both the assignment of uncertainty to the derived error rate of each group and the variability of ratings among the groups. Recall that the minimum range factor for any composite error rate is assumed to be at least 10 if any of the estimates derived from the group evaluations have a median value of less than 10^{-3} per demand, and 5 otherwise. When the estimates derived from the group evaluations diverge, the merging process produces broad distributions whose mean values tend to reflect the most conservative of the group evaluations. However, the entire distribution is retained so that the uncertainty can be accounted for explicitly if the human action appears in risk-dominant sequences that are subjected to uncertainty analysis.

The remainder of this section compares the evaluations of the groups and summarizes significant comments made during the elicitation process.

B.5.3 COMPARISON OF EVALUATION GROUPS

The average and the range of the FLIs assessed by the three operator groups are as follows:

Group	Average FLI	Highest FLI	Lowest FLI
1	3.64	7.11	1.11
2	3.95	7.57	1.93
3	2.73	6.00	1.58

Although not subjected to statistical tests, it appears that Group 3 was considerably more optimistic regarding the difficulty of the actions. A comparison of the trends in the evaluations indicates that this group rated the PSF for previous and concurrent actions more heavily than the other two groups. In conjunction with the higher weight, Group 3 also scored the PSF as strongly helping them to recognize the need to accomplish the action, as shown below.

Group Weight	Score	
1	0.15	4.3
2	0.13	4.0
3	0.17	2.4

In essence, Group 3 was quite confident that the context of the various scenarios would drive them to the correct actions. They maintained this opinion when the human action analysts described the implications of their ratings to them during the elicitation process.

B.5.4 DISCUSSION OF SIGNIFICANT DIFFERENCES IN EVALUATIONS

Each operator group brought its own perspective to the evaluation process. For some actions, this perspective produced a wide divergence among the error rates derived from the group evaluations. This section highlights some these differences and discusses the variation in perspective among the groups that caused them.

The following actions revealed divergence among the groups sufficient enough to produce a range factor of greater than 30 in the composite distribution. The discussion below compares the parts of the evaluations that influence the results. To better understand the context of each action, refer to the Operator Response Forms contained in Table B-9 The criteria against which the operators evaluated the actions are contained in Tables B-4 and B-5, and the actual evaluations are contained in Tables B-11 through B-15. If these actions appear in scenarios that are significant contributors to risk, the resolution of the points of view that produced the uncertainty is presented as part of the discussion of the results in Section 6.1.

- **OBD1 — Rapidly Depressurize with Turbine Bypass Valves after Loss of High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC).** Groups 1 and 3 rated this action as presenting some difficulties, resulting in median HERs in the low 10^{-3} per demand range. The large range factor arose from the comments of Group 2, who rated this action directly with an error rate of 0.3 per demand. In support of their evaluation, they brought up the following point.

  Group 2 stated that their primary concern is coming to the decision to rapidly depressurize before reaching -122". They have other options that they would exercise before rapidly depressurizing to low pressure that could close out this option. If there is no HPCI or RCIC, the operators will depressurize to 450 psig and do everything to maintain inventory with alternate systems, such as the control rod drive hydraulic system (CRDHS). Consequently, they judged that in 3 out of 10 scenarios in which they face this problem they may not consider the option to rapidly depressurize with the turbine bypass valves until they are lower than -122", despite the fact that 2-EOI-1(RC/P-3) allows them to depressurize on the anticipation of the requirement to emergency depressure.

  Once they reach -122" and the main steam isolation valves (MSIV) close, they have lost the option to depressurize. At this point, they would continue to try to get high pressure systems back on line and extend the amount of time required to get to -162". If they can slow the rate of decline down enough, the CRDHS turn level around before procedures require them to emergency depressurize at -162".

- **ODWS1 — Initiate Drywell Spray.** Groups 2 and 3 rated this action as presenting no problems. As a result, their evaluations were quantified to have a median error rate in the low 10^{-4} per demand range.

  Group 1 rated this action in the hindering range for all but the training PSF. As a result, their evaluation quantified to a median error rate of 1.7×10^{-2}. As no specific comments were recorded regarding this rating, the reasons for Group 1's high evaluation will be investigated only if the action appears in scenarios that are significant contributors to risk.

- **OF3 — Control Feedwater and Hotwell Level, Given Autocontrol Successful, but Three Feedwater Pumps are Still Operating.** This action is a followup to a previous action that called for the operators to trip two of the three feedwater pumps. The operator groups were asked to evaluate the chances that the operators would successfully be able to control the feedwater, given they initially failed to trip two of the pumps, but the automatic level controller was initially able to maintain level. The action becomes necessary as the cool down progresses to the point where the automatic control becomes erratic. The Operator Response Form recognizes that once they realize that they have to take control, the operators would trip two feedwater pumps and control reactor pressure vessel (RPV) level in the normal fashion.

  The operator evaluation discrepancies centered about the difficulties presented by the dependencies involved. The large range factor was due to Group 2, who rated the action as a guaranteed failure. They judged that the autocontroller would not be able to hold the RPV level below +55" if the operators did not trip two feedwater pumps. Even if it could, they would not have sufficient time to respond to a control anomaly involving all three pumps.

- **OHL2 — Recover and Control RPV Level and Pressure with HPCI and/or RCIC for up to 24 Hours, Given Short-Term Control Failed.** The Operator Response Form for this action states that at least one overfill and restart cycle on low-low level has occurred during the fist 6 hours. The operator evaluation discrepancies centered about the difficulties presented by the dependencies involved.

  The large range factor was due to Group 2, who rated the action with the judgment that whatever caused the operators to fail to catch the anomaly that led to the feedwater trip could also occur again. This resulted in their evaluation producing a median HER of 7.3×10^{-3} per demand.

  The other two groups considered the long period of time over which the two actions would take place would make them independent. Consequently, their ratings produced HERs from very close to 10^{-4} to the mid 10^{-4} per demand range.

- **OLA1 — Initiate and Control Low Pressure Injection to Maintain RPV Level between -190" and -162", Given ATWS.** Groups 1 and 2 rated this action as difficult to do, resulting in evaluations of 4×10^{-2} and 1.1×10^{-1} per demand, respectively.

  Group 3 focused on the fact that level control will be a major concern, and thus will get a primary focus of attention. In addition, they considered that they have good plant interfaces to accomplish the task and are well trained for it. Consequently, their assessment produced an HER of 4×10^{-4} per demand.

- **ORP2 — Start RHR and/or Core Spray pumps for Low Pressure Coolant Injection (LPCI), given RPV Makeup with High Pressure Systems Failed.** The three assessments of this action were about an order of magnitude apart from each other, reflecting a wide divergence in judgment regarding the problems to be faced. The discussion focuses on the highest and lowest evaluations.

Group 1 made the most pessimistic evaluation. Their increased weights and scores for previous and concurrent actions, complexity, and stress indicates that they were probably concerned about what else must be going in the control room in light of the high pressure safety injection failure. As a result, their evaluation produced a median HER of 4×10^{-2} per demand.

Group 3, on the other hand, expressed the judgment that the failure of the high pressure safety injection would key them to accomplish this action and make it clear that they must do it. This is reflected by the increased weight and decreased degree of difficulty for previous and concurrent actions. In fact, their FLI was almost the same as for ORP1, the not failed case. The HER for this action of 2×10^{-4} per demand is higher because the change in weights placed ORP2 in a different calibration group.

- **OSD1 — Align RHR for Shutdown Cooling.** Groups 1 and 3 rated this action as very easy to accomplish considering the amount of time available and the evolution of the transient at this point. Their assessments produced median HERs in the low 10^{-5} per demand range.

  Group 2 discussed other things that could be going on at the transition to shutdown cooling and reflected these competing factors in their rating. They discounted the amount of time available by weighting it low. As a result, their evaluation produced a median HER of 1.3×10^{-3} per demand.

  The human action analyst considers the Group 2 evaluation to be very pessimistic. The evaluation does not appear to account for the ability of the various members of the operating crew to back each other up over a long periods of time. This is perhaps a shortcoming of the evaluation method. When one action covers a long period of time, a method that does not take explicit credit for checking and followup can tend to produce higher HERs.

- **OSD2 — Align RHR for Shutdown Cooling, Given One Loop Unavailable.** The same comments as those given for OSD1 apply to this action.

- **OSL2 — Actuate Standby Liquid Control (SLC), Given Anticipated Transient without Scram (ATWS) with an Isolated Vessel.** Groups 1 and 2 rated this action in very close agreement, both being close to 1×10^{-2} per demand.

  The discrepancy arises because Group 3 considered this action to be the major focus of the operating crew, and thus assessed it as being easy to do. They assessed preceding and concurrent actions, procedures, and training as 1 out of 10 on the degree of difficulty scale, all being very helpful to accomplishing the action. The most difficulty was judged to be due to stress, and it was given a rating of 4. As a result the HER associated with their assessment was 1×10^{-4} per demand.

- **OSV1 — Bypass Low Low Low (-122") MSIV Closure Signal during ATWS Events.** Groups 1 and 2 rated this action as presenting little difficulty to the operators. They both judged that the EOIs make requirement for the action very clear. Furthermore, it has a very low complexity. In addition, the Group 2 operators said that they can reopen MSIVs after they close. Condenser vacuum will remain for about 5 to 30 minutes, depending on the conditions. This action was included in their evaluation as an option in the action to improve its probability of achieving the success state of the risk assessment. As a consequence, the Groups 1 and 2 assessments produced very low HERs in the mid 10^{-5} to low 10^{-4} per demand range.

Although Group 3 also considered the procedural guidance regarding the action to be very clear and helpful, they took a more pessimistic view of the action, especially with respect to plant interfaces and training, both of which they also weighted more heavily. This resulted in a median HER of 4×10^{-3} per demand.

B.5.5 EVALUATION OF PERFORMANCE-SHAPING FACTOR TRENDS

Table B-16 displays the operators' evaluations of the 20 highest FLI ratings with respect to each PSF category. The contribution of each PSF to the total FLI is established by multiplying the normalized weight of each PSF by its score. When the individual PSF FLIs are sorted, they can provide information regarding the types of actions the operators consider to present them with the most difficult problems with respect to that performance-shaping factor. These trends are discussed below in order from the overall highest to the lowest PSF contributor to the overall FLI. More than 20 ratings may be displayed when more than one evaluation produced the 20th highest PSF FLI. For these cases the list was simply extended to encompass all the actions having that same FLI.

- **Plant Man-Machines Interfaces and Indications of Condition (Average Contribution to FLI = 0.60).** This PSF was the highest contributor to the FLI of the seven PSFs. This ranking is consistent with comments made by the operators. For example, the Group 1 operators expressed it would be very worthwhile to include the basis for the level and the set point calibrations in training.

  The top two ranking actions were both OJC1 (Control RPV Level with Condensate Using Alternate Injection Path, Given Startup Bypass Valve Fails). This action responds to multiple failures and would not be expected to be required, except under extremely rare circumstances. In addition, there are currently no procedures that specifically refer to this option. Thus, actions to recover the bypass valve were judged to compete with this action.

  ATWS and post-ATWS level control actions encompassed 11 of the remaining rankings (actions OAL1, OLA1, OHS3, OHC4, and OF4). This reflects the fact that the operators must also be trying to regain or verify long-term reactivity control.

- **Task Complexity (Average Contribution to FLI = 0.58).** Two trends appeared for this PSF.

  Action OJC1 (Control RPV Level with Condensate Using Alternate Injection Path, Given Startup Bypass Valve Fails) was ranked high by all there groups. This action responds to a situation where there has been a previous failure and a variety of other means can be sought to inject water into the RPV. All these options, and the fact that the alternate means of using the condensate involves local manipulations and/or repeated cycle of fill and boil off, make the difficulty due to complexity high.

Seven actions requiring restart and/or control of RPV level between -162" and -190" (at or below top of active fuel) are ranked high. These actions include OAL1, OLA1, OCS3, OCH4, and OF4. This is a very understandable trend, because the inventory of water per inch of level declines by about a factor of 4 in the fuel region, and the margin for error is much lower since the inventory of water present in the RPV is very low.

- **Adequacy of Time To Accomplish Action (Average Contribution to FLI = 0.54).** Two trends were observed for this PSF.

  Action OPTR1 (Take Manual Control or Terminate Feedwater Flow, Given Feedwater Rampup) appeared as 2 of the top 5 rankings. Despite the assumed 5 minutes available stated in the Operator Response Form, Groups 2 and 3 were both concerned about the rate at which the rampup would occur and their ability to respond to it.

  The time element for regaining control of RPV level once it drops to -162" also appeared as a trend for this PSF. The groups expressed confidence that their training for this action is adequate, but they did express concern regarding the adequacy of plant interfaces for these actions. As the basis for level indications has been expressed concern under plant interfaces (see the comments on page B-19), these rankings reinforce the need for a review of level control, with perhaps some discussion of the time constant for level indication response.

- **Significant Preceding and Concurrent Actions (Average Contribution to FLI = 0.53).** There was only one trend exhibited regarding to this PSF.

  Groups 1 and 2 gave high ratings to rapid and emergency depressurization actions. Group 2 specifically commented about how their efforts to make maximum use of alternate high-pressure injection systems could permit the RPV level to fall below -122", the point at which they lose the option of depressurizing voluntarily with the turbine bypass valves (see the comments on OBD1 in Section B.5.4). In their comments they mention that they would do everything possible to inject with any high pressure source to extend the time to boil down, hoping that the decay heat will decline sufficiently to avoid depressurization. That action would have definitely been in the trend here if they had not given it a direct rating. In fact, that direct rating actually reflects the dominance of concurrent actions in the determination of a 3×10^{-1} per demand failure rate for Group 2's OBD1.

  In contrast to Groups 1 and 2, Group 3 judged that preceding and concurrent actions strongly assisted them in recognizing the need to depressurize. Recall from Section B.5.4 that Group 3 consistently rated this PSF as assisting them to accomplish the action. Their reasoning is also logical, because if all else fails, they will know that depressurization is the next step needed to get water on the core.

- **Stress (Average Contribution to FLI = 0.50).** The only trend observed for this PSF is that 10 of the actions require restart and/or control of RPV level between -162" and -190" (at or below top of active fuel). These actions include ORVD2, ORVD3, OAL1, OLA1, and OF4. This is a very understandable trend, because the inventory of water per inch of level declines by about a factor of 4 in the fuel region, and the margin for error is much lower since the inventory of water present in the RPV is very low.

It should be noted that of the 10 actions, the impact of stress was rated in the neutral zone of degree of difficulty. Consequently, the trend simply reflects a natural healthy respect for the situation.

- Training and Experience (Average Contribution to FLI = 0.37). The ratings exhibited one trend. Over half the high rankings involved actions to control the RPV level (actions OLA1, OJC1, OHL1, OF1, OF2, OF3, OF4, OCRD1, and OHC4). In fact, six of the actions involved control with feedwater (OF). Although referring to tripping two of three feedwater pumps, Group 1 commented that the simulator does not let the operators succeed at feedwater tasks very often.

- Procedural Guidance (Average Contribution to FLI = 0.36). In general, the operators rated the procedures as the most favorable performance-shaping factor. The operators commented that the new symptom-oriented procedures are assisting them to accomplish the actions modeled in the PRA much better than the older procedures.

None of the highest ranked actions weighted procedures heavily. Most weights were very near .14, which reflects the average when all PSFs are equally weighted. Consequently, it appears that the operators are using the procedures as guides.

Six actions receiving high ratings for degree of difficulty with respect to procedures involved requirements to control the RPV level at or near the top of the active core. At this point the operators are in the EOIs, and the instructions are very general.

B.6 RECOVERY ACTIONS

First, the key actions to be evaluated as recovery actions are identified by reviewing the sequences contributing to the core damage frequency. Both procedural-guided and nonprocedural-guided actions may be identified.

The nonprocedural-guided actions are discussed with plant operations representatives. The PRA team presents the scenarios of interest and describes when, in the course of the scenario, the existing procedures do not apply. The intent here is to ensure that only actions that are compatible with the operating philosophy are considered. Based on the comments of the operations representatives, the action boundary conditions, success criteria, and event scenario timing are identified for each response. The remainder of the qualitative model descriptions are then prepared to document all important factors affecting operator response. These qualitative descriptions will then be sent to the plant for review by plant operations staff. Review comments are incorporated and the necessary changes made to the decision models.

The quantitative models used for recovery actions involving manual backup or realignment tasks are the same as those identified earlier for operator dynamic actions considered in the first quantification.

The recovery actions involving repair and restoration of electric power during station blackout scenarios are modeled to account for the time-dependent likelihood of power recovery prior to core damage following a loss of all power. These actions are discussed in Section 3.3.3.4.

A scenario-specific analysis of the duration of repair versus the time available for repair is performed. For example, the likelihood of electric power recovery is computed as a function of time following the initial loss of AC power, which is then convoluted with the time available for repair before core damage occurs to determine the probability of successful recovery.

B.7 RESULTS OF RECOVERY ANALYSIS

The quantification of the plant model and subsequent analysis of the dominant sequences produced a number of opportunities for operator dynamic and recovery actions, as summarized in Table B-17. The reasoning for their explicit inclusion in the event sequence models is discussed in the description of the support system and frontline event trees in Sections 3.1.2 through 3.1.4.

The actions listed in Table B-17 explicitly exclude those accomplished explicitly to recover offsite power. Those actions are accounted for directly in the electric power recovery model, which is presented in Section 3.3.3.4.

This section presents the:

- Qualitative description of the tasks required to accomplish the actions successfully, and the conditions under which they must be accomplished.
- Quantitative evaluation of PSFs reflecting the operators' judgments regarding the degree of difficulty for successfully accomplishing the actions.
- Distributions of the human error rates derived from the quantitative evaluation using the adaption of the SLIM methodology discussed in Section B.4.
- Insights gained from the evaluation process.

B.7.1 QUALITATIVE DESCRIPTION OF THE DYNAMIC HUMAN ACTIONS

Table B-18 presents the Operator Response Forms for each evaluated recovery action. The descriptions on the forms were developed by the human action analyst and licensed operators serving on the PRA team, with information provided by the event sequence analysts regarding the conditions under which each action is demanded. The forms are written in accordance with the guidelines contained in Section B.4.1. Sufficient detail is provided to permit the operator group evaluating the actions to recognize the context of the action. However, detailed evaluation of the PSFs is purposely omitted so that the operators can form their own judgments. The justifications of the time windows for the actions are presented in the top event definitions and Appendix C.

The recovery actions were also qualitatively evaluated by the group of licensed plant operators who performed the quantitative evaluation. This group discussed the context of each action among themselves before quantitatively evaluating it. In some cases, the group provided practical comments that assisted the event sequence analyst to improve the plant model. Wherever appropriate to clarify the evaluations, the operator comments are discussed in the Operator Response Forms.

B.7.2 QUANTITATIVE EVALUATIONS

Only one group of licensed operators quantitatively assessed the recovery actions. The group assessed the actions using the same procedure followed for the dynamic human actions. These evaluations are summarized in Table B-19. The group's FLI evaluations are converted to HER estimates in accordance with the procedures outlined in Section B.4.3.

The individual actions are grouped by similarity of weights into groups for quantitative evaluation against calibration actions. Calibration actions obtained from evaluations in other PRAs are used to benchmark the failure rates of each group. The identification of each calibration action, the basis for its failure frequency, and source of the calibration PSF weights and scores are documented in a calibration action database (Reference B-6). To keep the differences in judgments explicit, no adjustment is made to the normalized weights or individual PSF rating of either the rated actions or the calibration actions during this process. The resulting evaluations are given in Table B-20.

The uncertainty of the evaluation group's estimates are established following the recommendations of Swain and Guttman (Reference B-2, Table 7-2) for nonroutine circumstances, which is judged to be representative of the transient situations to which the actions apply. The uncertainty in the range from .001 to .01 is broadened to a range factor of 7 to provide a better transition. The resulting range factors are:

HER Median Value	Range Factor
HER ≥ .01	5
.01 > HER ≥ .001	7
.001 > HER	10

The resulting distributions are given in Table B-21.

B.7.3 DISCUSSION OF RESULTS

The evaluation of the recovery actions indicated that the operators can be strongly influenced by the plant situation they face when they must recover from failures. The comparison of assigned weight and scale ratings of the individual actions provides this insight.

The evaluation of the PSF ratings and the resulting HERs supports the judgment of the PRA team that the operators have made reasonable judgments regarding their ability to mitigate against some of the scenarios identified during the quantification of the plant model.

B.8 REFERENCES

B-1. Dykes, A. A., PLG, Letter to R. McMahon, Tennessee Valley Authority, "Derivation of Screening Human Error Rates for Undetected System Unavailability Following Surveillance Testing," TVA-1418-PLG-24, August 27, 1992.

B-2. Swain, A. D., and H. E. Guttman, "Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications," prepared for U.S. Nuclear Regulatory Commission, NUREG/CR-1278, August 1983.

B-3. Embrey, D. E., et al., "SLIM-MAUD: An Approach to Assessing Human Error Probabilities Using Structured Expert Judgment," Brookhaven National Laboratory, prepared for U.S. Nuclear Regulatory Commission, NUREG/CR-3518, Vols. 1 - 2, March 1984.

B-4. Embrey, D. E., "The Use of Performance Shaping Factors and Quantified Expert Judgment in the Evaluation of Human Reliability: An Initial Appraisal," Brookhaven National Laboratory, prepared for the U.S. Nuclear Regulatory Commission, NUREG/CR-2986, May 1983.

B-5. Rosa, E. A., et al., "Application of SLIM-MAUD: A Test of an Interactive Computer-Based Method for Organizing Expert Assessment of Human Performance and Reliability," Brookhaven National Laboratory, prepared for U.S. Nuclear Regulatory Commission, NUREG/CR-4016, September 1985.

B-6. Dykes, A. A., PLG, Letter to R. McMahon, Tennessee Valley Authority, "Calibration Database for Dynamic Human Action Analysis," TVA-1418-PLG-25, August 27, 1992.

B-7. PLG, Inc., "BARP (Bayesian Reliability Program)," PLG-0625, Release 2, May 1991.

Table B-1 (Page 1 of 2). Generic Database Variables Used for System Analysis Screening of Preinitiating Event, Routine Human Error Caused, Undetected Unavailability following Maintenance and Testing

Location of Surveillance	Complexity (See Note 1 on Page 2)	Verification (See Note 2 on Page 2)	Type of Action					
			Realignment Using Manual Controls and Switches Provided by the Design		Realignment from Jumpered Circuits or Other Temporary Plant Modification		Calibrations Left Misaligned or at Unresponsive Setpoints	
			Variable (Note 3)	Mean	Variable	Mean	Variable	Mean
Control Room Area (Includes backs of panels and/or associated equipment)	Low	Yes	ZHERCL	2.0-3	ZHEJCL	1.8-3	ZHECCL	4.9-3
		No	•		•		•	
	Medium	Yes	ZHERCM	5.9-3	ZHEJCM	4.9-3	•	
		No	•		•		•	
	High	Yes	•		•		•	
		No	•		•		•	
Local (single location exterior to the control room area)	Low	Yes	ZHERLL	3.4-3	ZHEJLL	3.2-3	ZHECLL	6.2-3
		No	•		•		•	
	Medium	Yes	ZHERLM	1.5-2	ZHEJLM	1.2-2	•	
		No	•		•		•	
	High	Yes	•		•		•	
		No	•		•		•	
Multiple Locations (excluding the control room area)	Low	Yes	ZHERML	1.0-2	ZHEJML	9.6-3	ZHECML	1.6-2
		No	•		•		•	
	Medium	Yes	ZHERMM	3.2-2	ZHEJMM	2.7-2	•	
		No	•		•		•	
	High	Yes	•		•		•	
		No	•		•		•	

*Refer assessments not having a generic variable associated with it to the human action analyst for a system-specific evaluation. The bases and derivation of the distribution of each generic database variable is contained in Reference B-1.

Note: Exponential notation is indicated in abbreviated form; $2.0\text{-}3 = 2.0 \times 10^{-3}$.

Table B-1 (Page 2 of 2). Generic Database Variables Used for System Analysis Screening of Preinitiating Event, Routine Human Error Caused, Undetected Unavailability following Maintenance and Testing

Notes:

1. Complexity Guidance:

   Select low complexity only if it is clear that all criteria are satisfied.
   Select medium complexity only if no more than two low complexity criteria are out of tolerance.

   Low:
   - Single objective.
   - Very clear procedures (one action/step with individual checkoff, outline or columnar form, easy to interpret).
   - Less than 10 closely associated calibrations and/or restorations.
   - Items clearly marked and separated.
   - Small team working directly with each other.

   Medium:
   - Repetitive or coordinated objectives.
   - Clear procedures (one action/step, "critical steps" having checkoff, narrative form, easy to interpret).
   - Less than 10 restorations of varying types.
   - Items clearly marked in same general area.
   - Team in more than one location with dedicated communication.

   High:*
   - Diverse objectives.
   - More than 10 restorations.
   - Items ambiguously marked or in close proximity.
   - Team in multiple locations with intermittent communication.
   - Any consideration that make assignment of either low or medium complexity uncertain.

2. Verification Guidance:

   Yes: Second person verifies and signs off in a separate space provided for that purpose (low dependency between checker and testers).
   No: Two people working together verify realignment, or less. (Moderate or high dependency between checker and testers.)

3. Legend:

   ZHERLL
   - Complexity (low)
   - Location (single local)
   - Type of Action (realignment with controls)

*Refer assessments not having a generic variable associated with it to the human action analyst for a system-specific evaluation.

Table B-2 (Page 1 of 2). Summary of Routine Human Errors Included in the Systems Analyses To Account for Preinitiating Event, Routine Human Error Caused, Undetected Unavailability following Maintenance and Testing

System Notebook	Top Event	Test Number	Test Name	Database Variable	Description of Error
Core Spray	CS	2-SI-4.2.B-39AI(II)	Core Spray System Logic Functional Test Loop I (II)	ZHEJLL	Breaker left in racked out position.
Core Spray	CS	2-SI-4.2.B-39B	Core Spray System Logic Time Delay Relay Calibration	ZHEJLL	Failure to remove jumpers.
Core Spray	CS	2-SI-4.5.A.1.dI(II)	Core Spray Flow Rate Loop I (II)	ZHERCL	Failure to remotely restore valves to their normal position.
EECW	EE	0-SI-3.11	EECW Pump Baseline Data Acquistion and Evaluation	ZHERLL	Failure to fully reopen the pump manual discharge valve after completing the test.
EPS	DIES1	0-SI-4.9.A.1.a(A) also (B,C,D)	Diesel Generator A(B,C,D) Monthly Operability Test	ZHERCL	Failure to realign diesel exhaust fans.
EPS	DIES2	3-SI-4.9.A.1.a(3A) also (3B,3C,3D)	Diesel Generator 3A (3B,3C,3D) Monthly Operability Test	ZHERCL	Failure to realign diesel exhaust fans.
HPCI	HPI/HPCIS	2-SI-4.2.B-26	CSCS-Condensate Header Low Level Calibration	ZHEJLL	Failure to remove inhibits/boots from relay contacts.
HPCI	HPI/HPCIS	2-SI-4.2.B-26FT	CSCS-Condensate Header Low Level Functional Test	ZHEJLL	Failure to remove inhibits/boots from relay contacts.
HPCI	HPI/HPCIS	2-SI-4.2.B-27	HPCI Suppression Chamber High Level Instrumentation Calibration	ZHEJLL	Failure to remove inhibits/boots from relay contacts.
HPCI	HPI/HPCIS	2-SI-4.2.B-27FT	HPCI System Suppression Chamber High Level Instrumentation Functional Test	ZHEJLL	Failure to remove inhibits/boots from relay contacts.
HPCI	HPI/HPCIS	2-SI-4.2.B-42B	HPCI System Time Delay Relay Calibration	ZHEJLL	Failure to remove inhibits/boots from relay contacts.
HPCI	HPI/HPCIS	2-SI-4.5.E.1.C	HPCI System Moter Operated Valve Operability	ZHERCL	Failure to realign valves from the control room.
RCIC	See System Notebook	2-SI-4.5.F.1.C	RCIC System Motor Operated Valve Operability	ZHERLL	Failure to realign valves.
RHR	RP	2-SI-4.2.B-45AI (II)	Loop I (II) RHR Logic System Functional Test	ZHEJML	Failure to remove inhibits/boots from relays.

Table B-2 (Page 2 of 2). Summary of Routine Human Errors Included in the Systems Analyses To Account for Preinitiating Event, Routine Human Error Caused, Undetected Unavailability following Maintenance and Testing

System Notebook	Top Event	Test Number	Test Name	Database Variable	Description of Error
RHR	RP	2-SI-4.2.B-45BI (II)	Division I (II) RHR System Logic (LPCI) Mode Time Delay Relay Calibration	ZHEJML	Failure to Remove Inhibits/Boots from Relays.
Sec. Cont. Isol.	RBI	2-SI-4.2.A.9A,B	Reactor Building Ventilation Radiation Monitor 2-RM-90-142 (143) Calibration and Functional Test	ZHEJLL	Failure to remove banana jumpers that disable the reactor building isolation signal.
Sec. Cont. Isol.	RBI	2-SI-4.2.A.10FT	Reactor Building Ventilation Radiation Monitors RM-90-140, 141, 142, 143 Instrument Functional Test	ZHEJLL	Failure to remove banana jumpers that disable the reactor building isolation signal.
Sec. Cont. Isol.	RBI	2-SI-4.2.A.10A, B	Reactor Building Ventilation Radiation Monitors RM-90-140 (141) Calibration and Functional Test	ZHEJLL	Failure to remove banana jumpers that disable the reactor building isolation signal.

Table B-3. Guidance Regarding Information To Include in Operator Response Forms

TASK IDENTIFIER with the summary reproduced from operation action summary table.

PRECEDING EVENTS
- List initiating events after which action may be required.
- Briefly summarize sequence of events leading to action.
  - Base the sequences on event tree descriptions.
  - Bound the range of possibilities (identify if influenced by initiating event).
- Identify any abnormal plant responses that may complicate the situation.

INDICATIONS OF PLANT CONDITION
- List what the operating crew sees that permits diagnosis that the action is required.
- Estimate how long the condition could exist before indications sufficient for diagnosis are available to the operators.
- Describe parallel indications that can mask the action requirement.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Reference the procedure and steps that will be followed.
- State whether the task is an immediate memorized action.
- Briefly summarize the aspects of the action that could influence the operators' ability to diagnose and accomplish it.
- Identify considerations in addition to procedures that could influence likelihood of success.

CONCURRENT ACTIONS/COMPETING FACTORS
- Identify concurrent actions that could compete for attention.
- Briefly describe alarms, environmental conditions, and other distractions that could impact the operating shift's concentration and produce stress.
- Discuss important aspects of the operator team interactions.

INDICATION OF SUCCESSFUL COMPLETION/SUCCESS IMPACT
- Characterize plant state upon completion based on event tree success criteria.
- Describe how the operators can determine they have been successful.

FAILURE IMPACT
- Characterize the plant condition following failure to accomplish based on event tree success criteria.
- Identify later actions the operators have available to respond with once the plant has made a transition to the failed condition.

TIME CONSTRAINTS
- List thermal/hydraulic and physical/equipment response considerations that influence time available before transition to failed condition.
- Summarize what is known about time required to both diagnose and accomplish the tasks.

Table B-4 (Page 1 of 7). Guidance for Scoring the Degree of Difficulty Presented by Each PSF Associated with Each Dynamic Human Action

PSF: Task Complexity

Definition: This performance-shaping factor rates the effect of multiple requirements on task success. It can range through the entire gamut of coordination, multiple locations, remote operations, variety of tasks, and communications requirements. It also rates the availability of resources.

Scaling Guidance: Compare different types of complexity, or lack of complexity, by judging how much the operator is helped or hindered. Consider how the system is designed to avoid error if complex actions must be accomplished. Also consider the availability of resources to accomplish the various parts of the action.

Rating	Example of Thought Process That Might Produce This Rating
- 0	Very clearly understood and straightforward task with no interpretation of current situation required.
- 1	
- 2	Skill-based response by one operator with SRO concurrence that can be performed and verified at one location.
- 3	
- 4	
- 5	Series of tasks accomplished under direct control of one operator with SRO concurrence with a rule-based response.
- 6	
- 7	Knowledge-based response.
- 8	Tasks involving coordination of more than one operator at more than one location.
- 9	Tasks with contingencies that require coordinating decisions during different stages of the transient event and among multiple operators at multiple locations.
- 10	

Notes:

Table B-4 (Page 2 of 7). Guidance for Scoring the Degree of Difficulty Presented by Each PSF Associated with Each Dynamic Human Action

PSF: Plant Man-Machine Interface and Indications of Conditions

Definition: This performance-shaping factor relates the impact of the man-machine interface on the likelihood of success. It measures the degree to which the instruments, alarms and controls available to the operators at the time when the action must be accomplished assist them to preform the action.

Scaling Guidance:

Rating	Example of Thought Process That Might Produce This Rating
- 0	A wide variety of instruments and/or alarms focus the operators' attention on the blatant need to act and provide an easy method to do so. Feedback on success is obvious.
- 1	
- 2	Alarms and indications are clear and easily interpreted. Feedback is readily available close to the point of action.
- 3	
- 4	
- 5	Indications for this action are found within a familiar pattern of alarms, which operators are trained to diagnose.
- 6	
- 7	
- 8	Action requires that two or more operators work together because of controls and indications that are far apart.
- 9	
- 10	Indications confuse the operators and cause actions that could be wrong or inappropriate.

Notes:

Table B-4 (Page 3 of 7). Guidance for Scoring the Degree of Difficulty Presented by Each PSF Associated with Each Dynamic Human Action

PSF: Adequacy of Time To Accomplish Action

Definition: Measure of time required to act compared with the time available and the effect on success. The rating reflects the operator's confidence that the task can be accomplished in time to avert a change to a failed state.

Scaling Guidance: Judgment should be based on the time required compared with the time available to recognize, diagnose, and accomplish the action. Judgment about the length of these times may be reflected by noting the task description times. Both the absolute difference in time and the ratios of the time may be useful for making these judgments.

Rating	Example of Thought Process That Might Produce This Rating
- 0	Adequate time to accomplish action, bring in assistance if necessary, and correct errors.
- 1	Time is on the operator's side.
- 2	Enough time to complete procedures carefully and methodically with some outside assistance.
- 3	Enough time to complete procedures carefully and methodically if no outside assistance needed
- 4	
- 5	Enough time to complete at a normal speed and to verify results, but with limited time to correct significant errors.
- 6	
- 7	Success requires rapid, practiced operator actions with little time to correct anything but a small slip. Requires skillful and well-trained actions for success with any problem endangering the chance for success.
- 8	
- 9	
- 10	Time required about the same as time available. Operators can complete the task, but it will be a very close call.

Notes: If the time required to complete the action exceeds time available, the action is guaranteed to fail. Under these circumstances the reason why the action can not be done is documented and no PSF evaluation is required.

Table B-4 (Page 4 of 7). Guidance for Scoring the Degree of Difficulty Presented by Each PSF Associated with Each Dynamic Human Action

PSF: Significant Preceding and Concurrent Actions

Definition: Preceding and concurrent actions set the stage for the modeled action and make it necessary and obvious to the operators. They can also divert the operators' attention from this action or even cause failure. (If necessary, some strongly dependent failures may be accounted for by specific split fractions in the event trees.) Lack of preceding actions may create a surprise effect that should be accounted for in this performance-shaping factor.

Scaling Guidance:

Rating	Example of Thought Process That Might Produce This Rating
- 0	Previous actions focus operators on the urgent need to act.
- 1	There are no distractions from this action; it could also get close supervision and follow-up, if necessary.
- 2	
- 3	Operators are alerted to the need for possible action and are expecting it.
- 4	Another step in standard or procedure-based responses.
- 5	Action is not a surprise, but previous actions create some competition for operator attention.
- 6	
- 7	This is one of many concurrent actions and could possibly be overlooked. Operator is taking recovery actions from one or two previous problems.
- 8	Operators are busy with other work and this is an unexpected, unusual transient.
- 9	Previous operator problems create an unusual situation.
- 10	The need to accomplish this action is unexpected and inconsistent with previous actions.

Notes:

Table B-4 (Page 5 of 7). Guidance for Scoring the Degree of Difficulty Presented by Each PSF Associated with Each Dynamic Human Action

PSF: Procedural Guidance

Definition: This performance-shaping factor accounts for the extent to which plant procedures enhance the operator's ability to perform the action. The operator may have available not only step-by-step instructions but also guidance on when the action has been correctly done.

Scaling Guidance:

Rating	Example of Thought Process That Might Produce This Rating
- 0	Procedures are clear and definite. Operators can easily follow them.
- 1	
- 2	Procedures are clear and definite. Operators can easily follow them but clarity could be impacted by recent changes or other modifications.
- 3	
- 4	
- 5	Procedures are available. Some operator interpretation of procedures required to perform specific actions.
- 6	Sequence of steps in procedure may require operators to return a place that has been passed (eg. continuous action (WHEN) or retainment override steps)
- 7	Procedures are being used but because of the need to act, the operator can use them only as a backup check.
- 8	Action is a chance event for which procedures can give only vague guidance.
- 9	Procedures are poorly written and may be misleading.
- 10	There are no procedures for this action.

Notes:

Table B-4 (Page 6 of 7). Guidance for Scoring the Degree of Difficulty Presented by Each PSF Associated with Each Dynamic Human Action

PSF: Training and Experience

Definition: This performance-shaping factor measures the effect of the familiarity and confidence the operators have about the actions.

Scaling Guidance:

Rating	Example of Thought Process That Might Produce This Rating
- 0	Action is normally carried out during plant trip situations. Operators are thoroughly familiar with this action and competent at it.
- 1	Action is repeatedly carried out during simulator training. Operators are thoroughly familiar with this action and competent at it.
- 2	Actions that are normally carried out during typical plant trip situations can be easily applied to this situation. Operators are well trained.
- 3	Action is part of focus on safety functions. It is subject to thorough and repeated training.
- 4	Action receives emphasis during normal training.
- 5	Action is part of normal training, but receives no particular emphasis. Same action is used during surveillance testing.
- 6	Nonroutine action that is included in annual training. Surveillance test routinely carried out has different steps than the required action.
- 7	Nonroutine action that is included in annual training
- 8	Nonroutine action that is an option in annual or biannual training.
- 9	Nonroutine action that gets no simulator training
- 10	Action is unfamiliar or contrary to normal operational practice; e.g., defeating a safety system and no procedures.

Notes:

Table B-4 (Page 7 of 7). Guidance for Scoring the Degree of Difficulty Presented by Each PSF Associated with Each Dynamic Human Action

PSF: Stress

Definition: This performance-shaping factor accounts for the impact of adverse environmental conditions and situations that may endanger the operator or damage or contaminate either the plant or the environment. Depending on its nature and level, stress can serve as an incentive to accomplish the action, or provide a diversion of attention that increases the likelihood of failure.

Scaling Guidance: Rating should focus on how the presence of stress will affect the concentration of the operator on successfully accomplishing the action. In this context, stress can have both beneficial and detrimental effects, and it is the judge's responsibility to assess the relative importance of the two.

Rating	Example of Thought Process That Might Produce This Rating
- 0	Stress level has made the operators alert, but they are not yet threatened; provides best incentive to act.
- 1	
- 2	Stress level is enough to keep the operators alert.
- 3	
- 4	Stress level is moderate; operators are aware of potential consequences; situation is typical of training or experience.
- 5	Stress level is moderate; operators are aware of potential consequences; situation is unusual.
- 6	Concern about possible outcome is increasing.
- 7	Fatigue or the tediousness affect performance.
- 8	Potential loss is high if action is not successful; situation is unfamiliar. Consequences are high enough to create physical tension.
- 9	Action must be done under severe environmental conditions of heat and humidity, loud noise, or significant vibration.
- 10	Operators fight fear, tension and uncertainty while acting. Consequence could be high radiation exposure, significant release, core damage, or threat to life.

Notes:

Table B-5 (Page 1 of 7). Guidance for Assigning Relative Weights to the PSF Scores Associated with Each Dynamic Human Action

Significant Preceding and Concurrent Actions: The rating evaluates the impact of the preceding scenario and other concurrent actions for either focusing the operators on or distracting them from accomplishing the action.

The weight relates whether the above factors have any influence on the potential for the successful completion of this action.

Weight	Example of Thought Process
0 Insignificant	Other PSFs, such as time and indications, are so important to the success of this action that what else has previously occurred or is going on has no influence on the success of this action.
1 Low	Other PSFs, such as time and indications, are so important to the success of this action that what else has previously occurred or is going on has little influence on the success of this action.
2 Normal	The action must be accomplished in the context of what else is going on. We have no reason for considering it more or less important than other PSFs.
4 High	The context in which the requirement for this action arises is a prime influence in our potential for successfully completing it.

Table B-5 (Page 2 of 7). Guidance for Assigning Relative Weights to the PSF Scores Associated with Each Dynamic Human Action

Plant Man-Machine Interface and Indications of Conditions: Scaled on the ability of the man-machine interface to provide the information necessary to make the action a success.

The weight measures whether the above factors have any influence on the potential for the successful completion of this action.

Weight	Example of Thought Process
0 Insignificant	Other factors dominate so much that I do not care how bad or good the indications are because they are not going to change the likelihood of the success of this particular action.
1 Low	This is a skill-based action done in response to many alarms, with little or no diagnosis required. I can easily verify my action in a variety of ways.
2 Normal	Patterns of indications are required to take action and verify proper plant response, but no sophisticated diagnostics or control are required.
4 High	The success of the action is not possible without the proper response to feedback from the plant instruments. We must use specific parameters to diagnose the problem and/or control the plant.

Table B-5 (Page 3 of 7). Guidance for Assigning Relative Weights to the PSF Scores Associated with Each Dynamic Human Action

Adequacy of Time To Accomplish Action: Measure of how the relationship between the time required to recognize and to accomplish the action to the time available can influence the likelihood of success.

The weight relates whether the above factors have any influence on the potential for the successful completion of this action.

Weight	Example of Thought Process
0 Insignificant	Events evolve so gradually that the relationship between available and required time does not matter. If we fail to do the action, it will be due to reasons other than time.
1 Low	A slowly evolving situation in which there should be sufficient time to act. Under these circumstances, other PSFs would tend to be more important for determining the potential for successful accomplishment.
2 Normal	Task must be done within a fairly well-understood period of time that has some flexibility.
4 High	Time frame in which we must accomplish the action is well defined. The transitions that present the initial requirement to accomplish the action are not gradual. If the action is not accomplished, something definite will happen at a well-understood point in the transient.

Table B-5 (Page 4 of 7). Guidance for Assigning Relative Weights to the PSF Scores Associated with Each Dynamic Human Action

Procedural Guidance: The rating evaluates the extent to which the written procedures enhance the operator's ability to perform the task correctly.

The weight relates whether the above factors have any influence on the potential for the successful completion of this action.

Weight	Example of Thought Process
0 Insignificant	Immediate action task in which the operators do not have time, nor are expected, to refer to the procedure before acting.
1 Low	Specific skill-based actions for which procedures provide only general guidance regarding options.
2 Normal	Operators are tracking and responding to plant status using procedures, indications, and other cognitive resources.
4 High	Tasks that would be very difficult to accomplish without procedures.

Table B-5 (Page 5 of 7). Guidance for Assigning Relative Weights to the PSF Scores Associated with Each Dynamic Human Action	
Task Complexity: The rating evaluates how the presence or the lack of the following influences the potential for the success of this action: available resources, multiple objectives, coördination, communication, location of action, and sequencing of tasks. The weight relates whether the above factors have any influence on the potential for the successful completion of this action.	
<u>Weight</u>	<u>Example of Thought Process</u>
0 Insignificant	Other PSFs dominate the considerations of the action so much that the complexity (or lack of complexity) of this action has little or no influence on the potential for its failure.
1 Low	Other PSFs control the likelihood for the success of this action, but complexity does have some influence.
2 Normal	The number and sequencing of tasks and coordination necessary to accomplish them, along with other factors definitely have an influence.
4 High	It makes a big difference to us that this type of action is simple and straightforward, of normal complexity, or really hard to accomplish without communication, coordination, sequencing, etc.

Table B-5 (Page 6 of 7). Guidance for Assigning Relative Weights to the PSF Scores Associated with Each Dynamic Human Action

Training and Experience: The rating evaluates the degree to which familiarity, skill level, and confidence that the operators have regarding an action can influence its success.

The weight relates whether the above factors have any influence on the potential for the successful completion of this action.

Weight	Example of Thought Process
0 Insignificant	
1 Low	Simple actions that we are confident of being able to do when other factors are controlling whether we can do them.
2 Normal	Training and experience will have an influence on our ability to do this action, but many other factors are of similar importance.
4 High	Skill- or knowledge-based task for which the operators must rely on their training and experience to be successful.

Table B-5 (Page 7 of 7). Guidance for Assigning Relative Weights to the PSF Scores Associated with Each Dynamic Human Action

Stress. The rating evaluates the impact of the state of mind of the operators as they attempt to accomplish the action or their ability to successfully concentrate on the requirements summarized in the other six PSFs.

The weight relates whether the above factors have any influence on the potential for the successful completion of this action.

Weight	Example of Thought Process
0 Insignificant	
1 Low	Other PSFs are so important to the success of this action that our frame of mind has little influence.
2 Normal	Operators are tracking plant status and required responses during a transient.
4 High	Because of the nature of the situation (either environmental or threat), our frame of mind will have a strong impact on our ability to focus on the other PSFs that influence success.

Table B-6. Summary of the Relationship between the Scoring and Weighting Processes

Score: With respect to the things addressed by this PSF, are the conditions under which the action must be accomplished helping or hindering us to successfully complete it? In other words, we are rating the impact of the conditions on our ability to succeed in accomplishing the action. Interpretation of the range of scores

0-3 Helps

4-6 Is Neutral

7-10 Hinders

Weight: Does a variation between helping and hindering have more influence on the probability that we will successfully complete it than other PSFs? In other words, is this PSF a focus of the action? Do we key in on the things addressed by this PSF?

0 Insignificant compared to other PSFs.

1 Low: unimportant compared to other PSFs.

2 Normal: about the same as other PSFs.

4 High: much more important than other PSFs.

Weighting Thought Process

1. Initially set the weights of every PSF equal to 2.

2. Adjust weights of the PSFs only if you believe that their importance for judging the ease or difficulty of accomplishing the action is significantly (a factor of 2) greater or less than the other PSFs. The weights will be normalized so that the maximum overall failure likelihood index will be a 10, so the effect of increasing all of the weights is the same as increasing none.

3. Generally, actions requiring similar types of skills have the same PSF weights. Some examples of groups of actions where differences in the focus may require different PSF weights are as follows:

   - Immediate recognition and reaction.
   - Actions where diagnosis of need would dominate success.
   - Actions requiring a long sequence of manipulations.
   - Local actions involving coordination of activities.
   - Adjusting or controlling against indications.

Impact of Weight on How the Failure Likelihood Index Changes

Weight	Rating Change Producing the Same Change in the FLI
1	1 → 9
2	3 → 7
4	4 → 6

Table B-7. Example of a Spreadsheet Showing the Resulting Human Error Rates Estimated from the FLI of One Group of Dynamic Human Actions

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 3
Action Grouping Logic: A - All PSFs Equally Important

Action Code	Preceding & Other Actions Weight	Preceding & Other Actions Score	Plant Interfaces Weight	Plant Interfaces Score	Time Adequacy Weight	Time Adequacy Score	Procedures Weight	Procedures Score	Complexity Weight	Complexity Score	Training & Experience Weight	Training & Experience Score	Stress Weight	Stress Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.14	1.0E+00	0.00
OSD2	0.15	3	0.15	2	0.08	0	0.15	2	0.15	2	0.15	1	0.15	2	1.85	1.7E-05	-4.78
OHC3	0.14	2	0.14	3	0.14	1	0.14	1	0.14	2	0.14	1	0.14	4	2.00	2.1E-05	-4.68
OSD1	0.15	3	0.15	2	0.08	0	0.15	2	0.15	2	0.15	1	0.15	2	1.85	1.7E-05	-4.78
ORP1	0.14	3	0.14	2	0.14	3	0.14	2	0.14	2	0.14	1	0.14	2	2.14	2.6E-05	-4.58
ORVD1	0.15	3	0.15	2	0.08	1	0.15	2	0.15	1	0.15	5	0.15	2	2.38	3.8E-05	-4.43
OOCW1	0.15	7	0.15	5	0.08	1	0.15	2	0.15	1	0.15	1	0.15	2	2.85	7.5E-05	-4.12
OSP3	0.14	3	0.14	2	0.14	3	0.14	2	0.14	2	0.14	1	0.14	2	2.14	2.6E-05	-4.58
OSP1	0.14	3	.0.14	2	0.14	3	0.14	2	0.14	2	0.14	1	0.14	2	2.14	2.6E-05	-4.58
OHC2	0.14	2	0.14	3	0.14	1	0.14	1	0.14	3	0.14	1	0.14	4	2.14	2.6E-05	-4.58
OBC1	0.15	3	0.15	2	0.08	0	0.15	1	0.15	3	0.15	7	0.15	4	3.08	1.1E-04	-3.97
OHC1	0.14	2	0.14	3	0.14	1	0.14	1	0.14	3	0.14	1	0.14	4	2.14	2.6E-05	-4.58
MIN															0.00	1.0E-06	-5.99
Calibration Actions																	
Seabrook, ON	0.16	0	0.14	0	0.14	2	0.17	1	0.14	0	0.17	0	0.08	0	0.45	1.0E-06	-6.00
Oyster Crk ZHEMU1	0.17	7	0.13	5	0.15	2	0.18	5	0.12	5	0.15	4	0.10	6	4.84	1.3E-03	-2.89
Big Rock BR18B	0.17	5	0.12	5	0.13	5	0.17	5	0.12	5	0.12	5	0.17	6	5.17	1.0E-02	-2.00
STP HEO003	0.14	6	0.14	6	0.15	8	0.14	5	0.15	6	0.14	6	0.14	9	6.58	3.0E-02	-1.52
Limerick L4B	0.17	10	0.12	9	0.13	10	0.17	10	0.12	9	0.12	9	0.17	10	9.64	9.0E-01	-0.05

Regression Output:

Constant	-5.98
Std Err of Y Est	0.455
R Squared	0.968
No. of Observations	5
Degrees of Freedom	3

X Coefficient(s) 0.6555
Std Err of Coef. 0.0685

TABLEB7.BFN.08/30/92

Table B-8 (Page 1 of 4). Summary Descriptions of Dynamic Human Actions Evaluated for the Browns Ferry PRA

Top Event	Database Variable	Definition of Action	Time Constraints	Mean HER /Demand
OAD	HOAD1	Inhibit ADS actuation, Given ATWS with an Unisolated Vessel	Time to -122" dependent on suppression pool heatup, but approx. 10 min. Four min. provided by timer after reaching -122" for 14 min.	0.001460
OAD	HOAD2	Inhibit ADS Actuation, Given ATWS with an Isolated Vessel	Level drops to -122" within 2 minutes without injection, Cont. Press > 2.45 psig when RPV is isolated. Must inhibit prior to 95 sec-timeout.	0.001460
OAL	HOAL1	Allow RPV Level To Drop and Control at Top of Active Fuel, Given ATWS with Unisolated Vessel	Initiate when required in the event. Initiate and gain control of injection within 1 min of reaching -162" to avoid going below -190".	0.017100
OAL	HOAL2	Lower and Control RPV Level at Top of Active Fuel, Given ATWS with Isolated Vessel	Initiate and gain control of injection within 1 minute of reaching -162" to avoid going below -190".	0.018700
OBC	HOBC1	Cooldown with Turbine Bypass Valves, Given Either HPCI or RCIC Available	Not time sensitive - do as required during first 6 hours.	0.000792
OBD	HOBD1	Depressurize with TBVs after Loss of HPCI/RCIC	Approximately 15 minutes to boil down from -45" to -122" at 2% decay heat.	0.128000
CRD	HOCRD1	Align Enhanced Flow CRDHS, Given HPCI/RCIC Fail after 6 Hours	Not time sensitive - more than 90 minutes available to align second pump.	0.001310
CRD	HOCRD2	Align and Operate Enhanced Flow CRDHS, Given Enhanced Mode is Required (HPCI/RCIC Failed)	More than 45 minutes to reach top of active fuel with no injection at 2% decay heat.	0.001010
ODWS	HODWS1	Initiate Drywell Spray	Assume 20 to 60 minutes to avoid containment conditions that could result in release of radioactive materials into the environment.	0.009800
ODWS	HODWS2	Initiate Drywell Spray, Given ATWS	Assume 10 to 40 minutes to avoid containment conditions that could result in release of radioactive materials into the environment.	0.026800
OF	HOF1	Control One Feedwater Pump and Hotwell Level, Given Autocontrol was Successful	Monitor during cooldown (up to 24 hours). Respond to alarm within 5 minutes to avoid automatic trip.	0.000363
OF	HOF2	Control One Feedwater Pump and Hotwell Level, Given Autocontrol Fails	Continuous requirement during cooldown (up to 24 hours). Respond to alarm within 5 minutes to avoid automatic trip.	0.002630

Table B-8 (Page 2 of 4). Summary Descriptions of Dynamic Human Actions Evaluated for the Browns Ferry PRA

Top Event	Database Variable	Definition of Action	Time Constraints	Mean HER /Demand
OF	HOF3	Control Feedwater Pumps and Hotwell Level, Given Autocontrol is Successful, but Operators Initially Failed to Trip 2 Feedwater Pumps	Respond to alarm within approximately 2 minutes to avoid automatic trip.	0.331000
OF	HOF4	Restore and Control RPV Level with Feedwater Following Shutdown from ATWS	Continuous control during refill/cooldown (to 24 hours). Once normal level achieved, respond to alarm within 5 minutes to avoid auto trip at +55".	0.007580
OFT	HOFT1	Trip Two of Three Feedwater Pumps To Limit Feedwater Flow	Respond in approximately 2 minutes to avoid automatic trip of all 3 pumps.	0.001840
OHC	HOHC1	Control RPV Level and Pressure with HPCI and/or RCIC during First 6 Hours	Continuous requirement - react within 5 minutes of high level alarm to prevent automatic HPCI trip at +55".	0.000990
OHC	HOHC2	Control RPV Level and Press with HPCI during First 6 Hours, Given RCIC Failed or Insufficient	Continuous requirement - react within 5 minutes of high level alarm to prevent automatic HPCI trip at +55".	0.000972
OHC	HOHC3	Control RPV Level and Pressure with RCIC during First 6 Hours, Given HPCI Failed	Continuous requirement - react within 8 minutes after alarm to prevent automatic RCIC trip at +55".	0.000752
OHC	HOHC4	Control RPV Level with HPCI Following Shutdown from ATWS	Continuous requirement - after recovery of RPV level react within 5 minutes after alarm to prevent automatic HPCI trip at +55".	0.010300
OHL	HOHL1	Control RPV Level and Pressure with HPCI and/or RCIC 6 to 24 hours, Given Short Term Control Successful	Monitor cooldown. React to alarm within 15 minutes of indication to prevent automatic trip at +55".	0.001450
OHL	HOHL2	Recover and Control RPV Level and Pressure with HPCI and/or RCIC up to 24 hours, Given Short Term Control Failed	Continuous requirement - react to alarm within 15 minutes of indication to prevent automatic trip at +55".	0.004390
OHS	HOHS1	Initiate HPCI Following FW Failure, Given two Stuck Open Relief Valves	Estimate 10 to 15 minutes before MSIV closure at -122".	0.008500
OHS	HOHS2	Initiate HPCI/RCIC Following FW Failure, Given One or No Stuck-Open Relief Valves	Estimate 10 to 15 minutes before MSIV closure at -122".	0.000769

Table B-8 (Page 3 of 4). Summary Descriptions of Dynamic Human Actions Evaluated for the Browns Ferry PRA

Top Event	Database Variable	Definition of Action	Time Constraints	Mean HER /Demand
OHS	HOHS3	Initiate HPCI Following FW Failure during Recovery after ATWS	Restart within 5 minutes if RPV level is at top of active fuel to avoid falling to -190".	0.005320
OJC	HOJC1	Control RPV Level with Condensate by Alternate Means, Given Startup Bypass Valve Fails	Assume 30 minutes before other means of level control would be sought. Approx 2 hours to core uncovery if no means to cool core found.	0.032400
OLA	HOLA1	Control LPCI to Maintain Vessel Level at Top of Fuel, Given ATWS	Continuous requirement for close control until subcriticality and refill.	0.078100
OLC	HOLC1	Transfer to Condensate in Startup Bypass Mode, Feedwater is Available during Cooldown	Assume 30 minutes before other means of level control would be sought. Approx 2 hours to core uncovery if no means to cool core found.	0.000508
OLC	HOLC2	Place Condensate in Startup Bypass Mode, Given it was Maintained Operational during Cooldown and FW Failed	Assume 30 minutes before other means of level control would be sought. Approx 2 hours to core uncovery if no means to cool core found.	0.000700
OLP	HOLP1	Control RPV Level Using LPCI Mode of RHR or the Core Spray System	Initiate after cooldown. Not time sensitive - over two hours to core uncovery from normal RPV level with no injection.	0.001500
OPTR	HOPTR1	Terminate Feedwater Flow, Given Feedwater Rampup	One to two minutes after alarm to avoid RPV overfill to +114".	0.001870
ORF	HORF1	Restart and Control One Feedwater Pump Following +55" Trip	Approximately 30 minutes at 2% decay heat.	0.000421
ORP	HORP1	Start RHR and/or CS Pumps for LPI, Given High Pressure Injection Successful	Not time sensitive - at least 2 hours to boil down from normal level after normal cooldown.	0.000097
ORP	HORP2	Start RHR and/or CS Pumps for LPI, Given High Pressure Injection Fails	At least 20 minutes to align as level declines.	0.025600
RPS	HORPS1	Backup Automatic SCRAM Function with Pushbuttons and Manual ARI	Within one minute.	0.001200
RVD	HORVD1	Open One SRV To Assist HPCI or RCIC Cooldown	Not time sensitve - do as required.	0.001530
RVD	HORVD2	Emergency Depressurize by Manually Opening MSRVs, Given HPCI and RCIC Hardware Failed	5 to 10 minutes to recognize need to emergency depressurize. 3 to 5 minutes to -190" once -162" reached.	0.006700

Table B-8 (Page 4 of 4). Summary Descriptions of Dynamic Human Actions Evaluated for the Browns Ferry PRA

Top Event	Database Variable	Definition of Action	Time Constraints	Mean HER /Demand
RVD	HORVD3	Emergency Depressurize by Manually Opening MSRVs, Given HPCI/RCIC Control Failed	5 to 10 minutes to recognize need to emergency depressurize. 3 to 5 minutes to -190" once -162" reached.	0.055400
OSD	HOSD1	Align RHR for Shutdown Mode of Cooling	Not time sensitive - can be done over the course of hours.	0.000999
OSD	HOSD2	Align RHR for Shutdown Mode of Cooling, Given 1 Loop Unavailable	Not time sensitive - can be done over the course of hours.	0.001500
OSL	HOSL1	Actuate SLC, Given ATWS with Vessel Unisolated	3 to 5 minutes available to avoid level/power control requirement. Suppression pool reaches 170 degrees F in 20 minutes.	0.005530
OSL	HOSL2	Actuate SLC, Given ATWS with Vessel Isolated	At 50% power the suppression pool reaches 110 deg F in approximiately 2 minutes and 170 deg F in 7 minutes.	0.012200
OSP	HOSP1	Align RHR for Suppression Pool Cooling	Not time sensitive - approximately 1 1/2 hours before SP temperature exceeds 140 degrees F.	0.000077
OSP	HOSP2	Align RHR for Suppression Pool Cooling, Given ATWS	Approximately 10 minutes until HCTL if unit at 50% power.	0.005890
OSP	HOSP3	Align RHR for Suppression Pool Cooling, Given One Path Unavailable	Not time sensitive - much more than 1 hour before SP temperature exceeds 140 degrees F.	0.000069
OSV	HOSV1	Defeat MSIV Closure Logic, Given ATWS with Turbine Trip	Accomplish in first 10 minutes of transient - approximately 7 minutes before SP reaches 110 degrees F, forcing lowering of level.	0.002300
OSW	HOSW1	Transfer Mode Switch To Refuel/Shut Down in Response to Scram	Not time significant for typical pressure reduction rates.	0.000726
TB	HOTB1	Backup Main Turbine Trip	Do within 1 minute to avoid MSIV closure.	0.001490

Table B-9 (Page 1 of 48). Qualitative Descriptions of Dynamic Human Actions

HOAD1: Inhibit ADS Actuation, Given ATWS with an Unisolated Vessel

PRECEDING EVENTS
- Turbine trip initiating event requiring reactor scram.
- RPS fails to scram reactor.
- Manual backup of scram and ARI attempted, but hardware failure prevents insertion of control rods.

INDICATIONS OF PLANT CONDITION
- No indication of rods inserted past position 02.
- Suppression pool at 100°F and rising.
- Power levels remaining above 50%.
- RPV pressure at 1,050 psig.
- RPV level decreasing rapidly.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1, RC/Q-12 to 15.
- Decision that conditions are appropriate for SLC injection (suppression pool temp could go > 110°F prior to subcriticality).
- Manipulate appropriate key operated switches on Panel 2-9-3.
- Verify ADS locked out.

CONCURRENT ACTIONS/COMPETING FACTORS
- Initiate SLC (OSL1).
- Actions to avoid isolation (OSV1).
- Actions for alternate rod insertion (No credit taken).
- Actions to maintain RPV level until OSV1 is completed.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level of -122" passed without ADS.
- RPV pressure remains elevated for SLC injection.

FAILURE IMPACT
- Uncontrolled depressurization and refill of RPV with cold clean water leading to power spike and core damage.

TIME CONSTRAINTS
- 265 seconds (4 minutes) following initiation at -122".
- Time to -122" dependent on suppression pool heatup, but assume 10 minutes.

Table B-9 (Page 2 of 48). Qualitative Descriptions of Dynamic Human Actions

HOAD2: Inhibit ADS Actuation, Given ATWS with an Isolated Vessel

PRECEDING EVENTS
- Reactor on line at 100% power.
- MSIV closure initiating event requiring reactor scram.
- Recirculation pumps trip at 1,118 psig.
- RPS fails to scram reactor.
- Manual backup of scram and ARI attempted, but hardware failure prevents insertion of control rods.

INDICATIONS OF PLANT CONDITION
- No indication of rods inserted past 02 & APRM remaining above 50%
- Suppression pool at 110°F and rising.
- MSRVs are opening as necessary to maintain RPV pressure at 1,125 psig.
- RPV level at -45" and decreasing
- HPCI/RCIC injecting into RPV
- Containment pressure > 2.45 psig and rising slowly.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1, RC/Q-12 to 15
- Recognize ADS setpoint reached, or
- Decision that conditions are appropriate for SLC injection
- Manipulate appropriate key operated switches on Panel 2-9-3.
- Verify ADS locked out.

CONCURRENT ACTIONS/COMPETING FACTORS
- Initiate SLC (OSL1)
- Actions for manual rod insertion (No credit taken)
- Actions to allow RPV level to decline to top of active fuel (OAL1).

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level of -122" passed without ADS actuation.
- RPV pressure remains elevated for SLC injection.

FAILURE IMPACT
- Uncontrolled depressurization and refill of RPV with cold clean water leading to power spike and core damage.

TIME CONSTRAINTS
- Estimate that ADS actuates within approximately 2 minutes at RPV level = -122" and containment pressure > 2.45 psig.
- Complete inhibit prior to 95 second timeout.

Table B-9 (Page 3 of 48). Qualitative Descriptions of Dynamic Human Actions

HOAL1: Allow RPV Level to Drop to Top of Active Fuel, Given ATWS with an Unisolated Vessel

PRECEDING EVENTS
- Turbine trip initiating event requiring reactor scram, but not Group 1 isolation
- RPS fails to scram reactor.
- Manual backup of scram can not insert control rods.
- Decision that conditions are appropriate for SLC injection.
- SLC not yet able to reduce power below 5%.
- RFPT operating and feedwater injecting into core

INDICATIONS OF PLANT CONDITION
- Suppression pool temperature < 110°F, but rising steadily.
- MSRVs cycling to maintain RPV pressure at 1,125 psig, discharging 25% power to suppression pool.
- Radiation indications normal
- Condenser vacuum normal
- RPV level at +33" and steady

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- C5-8 through 13
- Terminate injection into core of all systems except SLC and CRD when suppression pool temp > 110°F.
- Maintain condensate on min bypass.
- Monitor RPV level (Refer to Caution #1 regarding instruments)
- Carefully initiate FW and control RPV at level satisfying C5.

CONCURRENT ACTIONS/COMPETING FACTORS
- Bypass MSIV closure signal prior to -122" (OIV1 = S)
- Monitoring SLC injection, perhaps switching pumps to increase injection rate.
- Actions to insert control rods per EOI-1, RC/Q-23

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level maintained at -162", or
- Power level decreases to below 5%, or
- All MSRVs closed and CP < 2.45 psig (power level could be as high as 30% if all bypass valves available to relieve heat load on suppression pool)

FAILURE IMPACT
- Power level remains high enough to place heat demand on suppression pool.
- Control of level at top of active fuel required with low pressure systems (OLA1).
- Suppression pool heatup rate remains high, with potential threat to primary containment.

TIME CONSTRAINTS
- Initiate when required event.
- Initiate and gain control of feedwater within 1 minute of reaching -166" to avoid going below -190".

Table B-9 (Page 4 of 48). Qualitative Descriptions of Dynamic Human Actions

HOAL2: Lower RPV Level to Top of Active Fuel, Given ATWS with an Isolated Vessel

PRECEDING EVENTS
- Initiating event requiring reactor scram, and Group 1 isolation.
- RPS fails to scram reactor.
- Manual backup of scram can not insert control rods.
- HPCI/RCIC initiate and inject into RPV.
- Decision that conditions are appropriate for SLC injection.
- SLC not yet able to reduce power below 5%.

INDICATIONS OF PLANT CONDITION
- Suppression pool temperature > 110°F
- Condenser not available.
- Radiation indications normal
- RPV level at -95" and decreasing

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- C5-8 through 13
- Terminate inject into core of all systems except SLC and CRD.
- Monitor RPV level (Refer to Caution #1 regarding instruments)
- [Initiate HPCI and control between -190" and -166".]

CONCURRENT ACTIONS/COMPETING FACTORS
- Monitoring SLC injection, perhaps switching pumps to increase injection rate.
- Actions to insert control rods per EOI-1, RC/Q-23

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level maintained at -162"
- Power level decreases to below 5%

FAILURE IMPACT
- Power level remains above 5%.
- Emergency depressurization and control of level at top of active fuel required (OLA1).
- Suppression pool heatup rate remains high, with potential threat to primary containment.

TIME CONSTRAINTS
- Initiate on the order of minutes into event.
- Initiate and gain control of injection within 1 minute of reaching -162" to avoid going below -190".

Table B-9 (Page 5 of 48). Qualitative Descriptions of Dynamic Human Actions

HOBC1,HOBD2: Cooldown with Turbine Bypass Valves, Given Either HPCI or RCIC Available

PRECEDING EVENTS

- Condition requiring reactor scram, but not Group 1 isolation (eg. loss of recirculation pump seal)
- Reactor scram from full power successful.
- RCIC initiates and provides high pressure injection.
- RPV pressure reduced to 900 psig and stabilized.
- RFPTs tripped and can not be restarted.
- Decision to proceed to cold shutdown to repair as soon as possible.

INDICATIONS OF PLANT CONDITION

- HPCI tagged out for maintenance.
- RCIC under flow control at max flow.
- RPV level slowing increasing as RCIC injects into core and test return line to CST

PROCEDURAL GUIDANCE/REQUIRED ACTIONS

- Adjust TBV pressure controller and monitor pressure, backup as necessary.
- Adjust setpoint to lower pressure, or slowly open manually with jacking device.
- Maintain cooldown rate of < 100°F/hour (EOI-1, RC/P-14)

CONCURRENT ACTIONS/COMPETING FACTORS

- Adjust RCIC flow and test return valve to maintain RPV level within +27" and +39"
- Trying to recover RFPTs.
- Other post trip activities per GOI-100-12A.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT

- Transition to condensate cooling at approx 300 psig (within 6 hours).

FAILURE IMPACT

- Requirement for longterm operation of RCIC (6-24 hours).

TIME CONSTRAINTS

- Not time sensitive — do as required during first 6 hours.

Table B-9 (Page 6 of 48). Qualitative Descriptions of Dynamic Human Actions

HOBD1: Rapidly depressurize With Turbine Bypass Valves After Loss of HPCI and RCIC

PRECEDING EVENTS
- Loss of all feedwater.
- Reactor scram from full power successful.
- Condenser autotransfer to minimum flow via AO-2-29 successful (CD = S)
- HPCI and RCIC fail to start manually and upon -45" low low reactor level signal (OHS = F)

INDICATIONS OF PLANT CONDITION
- RPV level at -45" and decreasing.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Inhibit ADS (EOI RC/L-7)
- Recognize that RPV level can not be maintained above -162" (RC/L-9)
- Line up low pressure systems to inject into RPV (EOI C1-4)
- Depressurize with TBVs on anticipation that emergency depressurization will be required (EOI-1, RC/P-3)

CONCURRENT ACTIONS/COMPETING FACTORS
- Align CRD in enhance flow mode (RC/L-4)
- Align SLC with test tank (RC/L-8)
- Attempt to recover HPCI or RCIC.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV pressure declines to condensate injection pressure.

FAILURE IMPACT
- MSIV closure.

TIME CONSTRAINTS
- Accomplish before -122" MSIV closure signal.
- Approximately 15 minutes* to boil down from -45" to -122" at 2% decay heat.

*An initial estimate of 20 minutes was given to the operators during their evaluations based on an operator rule of thumb that steam generation is 133,000 lbm per hour per percent power. This value accounts for the requirement to heat subcooled feedwater. The actual thermal-hydraulic parameters used above assumed that liquid available for boiling is saturated at 1,000 psia. The difference in available time has no impact on the evaluations performed by the operators.

Table B-9 (Page 7 of 48). Qualitative Descriptions of Dynamic Human Actions

HOCRD1: Align "Enhanced Flow" CRDHS, given HPCI/RCIC fail after 6 hours.

PRECEDING EVENTS
- Total loss of feedwater initiating event
- HPCI and/or RCIC over first 6 hours, but trip off before depressurization.

INDICATIONS OF PLANT CONDITION
- HPCI and RCIC not available.
- RPV low level alarm.
- RPV level at +24" and declining.
- RPV pressure > 450 psig.
- Condenser not available.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1 RC/L-4
- Start second CRD and align per Appx 5B
- Monitor CRDHS flow and RPV level as necessary to keep in normal range.

CONCURRENT ACTIONS/COMPETING FACTORS
- Normal rounds and shift changes when failures occur.
- GOI-100-12A activities.
- Trying to determine cause of HPCI and RCIC failure.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level returns to and remains in normal range.

FAILURE IMPACT
- Emergency depressurize if RPV level reaches -162" prior to being able to switch to shutdown cooling.
- Challenge to low pressure injection systems.

TIME CONSTRAINTS
- Not time sensitive — Estimate more than 90 minutes to align second pump.

Table B-9 (Page 8 of 48). Qualitative Descriptions of Dynamic Human Actions

HOCRD2: Align "Enhanced Flow" CRDHS, Given Enhanced Mode is Required (HPCI/RCIC failed)

PRECEDING EVENTS
- RCIC tagged out for maintenance
- Total loss of condensate and feedwater initiating event.
- Reactor scram and turbine trip successful.
- HPCI fails to initiate on demand.

INDICATIONS OF PLANT CONDITION
- HPCI and RCIC not available.
- RPV low level alarm.
- RPV level at +12" and declining.
- RPV pressure > 850 psig.
- Condenser not available.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1 RC/L-4
- Start second CRD and align per Appx 5B
- Monitor CRDHS flow and RPV level as necessary to keep in normal range.

CONCURRENT ACTIONS/COMPETING FACTORS
- Trying to determine cause of HPCI failure.
- GOI-100-12A activities.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level returns to and remains in normal range.

FAILURE IMPACT
- Emergency depressurize if RPV level reaches -162" prior to being able to switch to shutdown cooling.
- Challenge to low pressure injection systems.

TIME CONSTRAINTS
- Estimate at least 45 minutes before -162" reached at an average decay heat generation of 2%.

Table B-9 (Page 9 of 48). Qualitative Descriptions of Dynamic Human Actions
HODCW1: Restart at least 2 of 4 drywell coolers, given LOSP PRECEDING EVENTS • LOSP at full power. • All D/G start and run. • 480 v load shed implemented. INDICATIONS OF PLANT CONDITION • Drywell heating up slowly • High drywell pressure scram signal PROCEDURAL GUIDANCE/REQUIRED ACTIONS • Evaluate D/G availability to power drywell coolers. • Start all available drywell coolers. (EOI-2 DW/T-3) CONCURRENT ACTIONS/COMPETING FACTORS • Actions to recover power. INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT • Drywell pressure and temperature declines to acceptable values. FAILURE IMPACT • Impact to timing of challenge to containment integrity. TIME CONSTRAINTS • Not time sensitive • Assume approximately an hour available to recognize need for cooling before containment integrity is challenged.

Table B-9 (Page 10 of 48). Qualitative Descriptions of Dynamic Human Actions

HODWS1: Initiate Drywell Spray

PRECEDING EVENTS
- Medium LOCA inside containment.
- Successful reactor scram on high drywell pressure.
- Group 1 isolation successful.
- Suppression pool cooling successfully initiated.

INDICATIONS OF PLANT CONDITION
- Primary containment pressure = 15.0 psig
- HPCI and RCIC operating.
- RPV level stable at +33"
- Suppression pool temperature > 100°F.
- Drywell temperature = 150°F.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Check to insure in permissible range for initiation. (EOI-2 DW/T-8, PC/P-8)
- Open drywell spray valve on one RHR train.
- Align one RHR train for suppression pool cooling.
- Monitor CP and terminate when below 2.45 psig.
- Repeat when CP exceeds 11 psig again.

CONCURRENT ACTIONS/COMPETING FACTORS
- EOI-1 actions to maintain RPV parameters.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Drywell temperature declines to less than 160°F and remains there.

FAILURE IMPACT
- Threat to primary containment.

TIME CONSTRAINTS
- Assume 20 to 60 minutes* available to avoid containment challenge.

NOTES

Specific scenario analysis performing in the Level 2 portion of the PRA may impose more restrictive timing restrictions not considered by the operators (7/7/92).

*The Operator Response Form stated "tens of minutes" as the time constraint. The more specific range given here is intended to convey a better feeling for the rate at which a scenario could develop.

Table B-9 (Page 11 of 48). Qualitative Descriptions of Dynamic Human Actions

HODWS2: Initiate Drywell Spray, Given ATWS

PRECEDING EVENTS
- SLOCA initiating event results in high drywell pressuring in a Group 1 isolation.
- No reactor scram on high drywell pressure.
- Group 1 isolation successful.
- EOI-1 RC/Q activities successfully initiated.

INDICATIONS OF PLANT CONDITION
- RPV APRM > 50%
- Primary containment pressure > 2.45 psig
- HPCI and RCIC operating.
- RPV level declining past -70"
- Suppression pool temperature > 110°F.
- Drywell temperature = 250°F.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Check to insure in permissible range for initiation. (EOI-2 DW/T-8, PC/P-8)
- Open dry well spray valve.
- Align one RHR train for drywell spray and suppression pool.

CONCURRENT ACTIONS/COMPETING FACTORS
- EOI-1 RC/Q and C5 activities to shut down reactor and maintain suppression pool cooling (may require split flow between DW and SP).

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Drywell temperature declines to less than 140°F and remains there.

FAILURE IMPACT
- Threat to primary containment.

TIME CONSTRAINTS
- Assume tens of minutes to avoid containment damage.

Table B-9 (Page 12 of 48). Qualitative Descriptions of Dynamic Human Actions

HOF1: Control One Feedwater Pump and Hotwell Level Control, Given Autocontrol Successful

PRECEDING EVENTS
- Reactor scram and turbine trip successful upon "other" signal.
- Operators have tripped 2 or 3 RFPTs.
- RPV single element level control successful.
- Hotwell level maintained by dump back & makeup from unit CST.

INDICATIONS OF PLANT CONDITION
- RPV pressure declining below 930 psig to 350 psig.
- One RFPT pumping on bypass to condenser or RPV.
- At 350 psig RPV level can begin behaving erratically, and operators expect to have to control.
- RPV level high level alarm at +39".

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- 2-AOI-3-1; 2-GOI-100-12; 2-OI-3: 2-OI-2
- Monitor RPV level and take manual control if necessary to maintain level between +27" and +39"
- Provide adequate hotwell level control for those events involving significant inventory loss.

CONCURRENT ACTIONS/COMPETING FACTORS
- Long term control requirement.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level stabilizes at approx +33"
- Sufficiently depressurized to stop/secure RFPT and transfer to use of condensate on startup bypass valve (OLC1).

FAILURE IMPACT
- Challenge of the RFPT trip at +55"
- Restart challenge feedwater (ORF1) or HPCI/RCIC (OHS)
- HPCI/RCIC autostart demand should RPV level fall to -45"
- MSIV closure at -122".
- If hotwell level of concern, loss of suction to the condensate pumps on low hotwell level, loss of condenser vacuum on high hotwell level.

TIME CONSTRAINTS
- Assume approx 5 minutes to regain control once indication of high RPV level.

NOTE
As a bound, the PRA assumes that RPV could remain at high pressure for up to 24 hours after scram before transfer to condensate is possible.

Table B-9 (Page 13 of 48). Qualitative Descriptions of Dynamic Human Actions

HOF2: Control One Feedwater Pump and Hotwell Level, Given Autocontrol Failed

PRECEDING EVENTS
- Reactor scram and turbine trip successful upon "other" signal.
- Operators have tripped 2 or 3 RFPTs.
- RPV level autocontrol failed at high pressure.

INDICATIONS OF PLANT CONDITION
- RPV pressure declining below 1,000 psig.
- One RFPT pumping on bypass to condenser or RPV.
- RPV high level alarm.
- RPV level at +40" and increasing.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- 2-AOI-3-1; 2-GOI-100-12; 2-OI-3; 2-OI-2.
- Take manual control of running RFPT and maintain RPV at +33" using LC position.
- Maintain level with +27" and +39" by reducing flow to match decay heat steam generation using turbine bypass valves and other steam users.
- Provide adequate hotwell level control for those events involving significant inventory loss.

CONCURRENT ACTIONS/COMPETING FACTORS
- Long term control requirement - to 24 hours after scram (see OF1 note)

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- All RFPT indication lights GREEN
- Condensate system delivering water to RPV via startup bypass valve.
- RPV level stabilizes at approx +33"

FAILURE IMPACT
- Challenge of the RFPT trip at +55"; pumps must then successfully restart to maintain RPV level.
- Ultimately, spill over into steam lines at +110-113" with resulting loss of feedwater, HPCI and RCIC.
- Loss of suction to the condensate pumps on low hotwell level, loss of condenser vacuum on high hotwell level.

TIME CONSTRAINTS
- Assume approx 5 minutes from alarm to +55" trip once 2 feedwater pumps are tripped.
- Action requires constant vigilance while RPV pressure is high, up to 24 hours.

Table B-9 (Page 14 of 48). Qualitative Descriptions of Dynamic Human Actions

HOF3: Control Feedwater Pumps and Hotwell Level, Given Autocontrol is Successful, but Operators Initially Failed To Trip 2 Feedwater Pumps

PRECEDING EVENTS

- Reactor scram and turbine trip successful upon "other" signal.
- Operators have not tripped 2 or 3 RFPTs.
- Reactor at 1,000 psig and cool down begins via turbine bypass valves
- Hotwell level maintained by dump back & makeup from unit CST.
- RPV level varying between +27" and +39" with oscillations increasing.

INDICATIONS OF PLANT CONDITION

- RPV pressure declining below 900 psig.
- Three RFPs on minimum flow to condenser.
- One RFP intermittent flow to the RPV to maintain +33"
- RPV level alarm at +39".

PROCEDURAL GUIDANCE/REQUIRED ACTIONS

- 2-GOI-100-12; EOI-1(RC/Q); EOI-1(C5); 2-AOI-85.
- Trip 2 of 3 RFPTs
- If trip unsuccessful, back down on flow control bias and close discharge valves on 2 pumps (use min flow line only).
- Provide adequate hotwell level control for those events involving significant inventory loss.

CONCURRENT ACTIONS/COMPETING FACTORS

- Long term control requirement up to 24 hours (see OF1 note)

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT

- All RFPT indication lights GREEN
- Condensate system delivering water to RPV via startup bypass valve.
- RPV level stabilizes at approx +33"
- RPV pressure reduced to 200 psig and ready to place RFPT in startup bypass mode.

FAILURE IMPACT

- Challenge of the RFPT trip at +55"
- Loss of suction to the condensate pumps on low hotwell level, loss of condenser vacuum on high hotwell level.

TIME CONSTRAINTS

- Response in approximately 2 minutes to RFPT trip once +39" reached.

Table B-9 (Page 15 of 48). Qualitative Descriptions of Dynamic Human Actions

HOF4: Recover normal RPV level following successful shutdown from ATWS and control during cooldown

PRECEDING EVENTS
- Reactor turbine trip successful upon "other" signal.
- Reactor fails to scram.
- Condenser remains available on min flow to condenser.
- Operators bypass MSIV closure logic and lower level to control power.
- Reactor brought subcritical with SLC injection and level/power control. (OSL1 and OAL = S)

INDICATIONS OF PLANT CONDITION
- RPV level at -166" and increasing.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- 2-AOI-3-1; 2-GOI-100.12; 2-OI-3
- Restart one RFPT, if not restarted to maintain level at -166".
- Refill RPV at controlled rate to avoid recriticality.
- Maintain level "demand" equal to pressure drop "demand" using turbine bypass valves and other steam users.
- Stop/secure RFP at 300 psig
- Use startup bypass valve to manually control RPV level per 2-AOI-3.
- Provide adequate hotwell level control for those events involving significant inventory loss.

CONCURRENT ACTIONS/COMPETING FACTORS
- Long term control requirement - to 24 hours after shutdown.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- All RFPT indication lights GREEN
- Condensate system delivering water to RPV via startup bypass valve.
- RPV level stabilizes at approx +33"

FAILURE IMPACT
- Core damage if RPV level allowed to drop below -190".
- Challenge of the RFPT trip at +55" if RPV overfill.

TIME CONSTRAINTS
- Action requires constant vigilance over a 24 hour period.
- Once normal level achieved, respond in 5 minutes to avoid automatic trip at 55".

Table B-9 (Page 16 of 48). Qualitative Descriptions of Dynamic Human Actions

HOFT1: Trip 2 of 3 Feedwater Pumps to Limit Feedwater Flow

PRECEDING EVENTS
- Reactor has scramed due to reasons other than feedwater
- Mode switch to shutdown.

INDICATIONS OF PLANT CONDITION
- Reactor level > = +33" (Level indications: 6 on Panel 2-9-5)
- MSIVs are open
- All RFPTs are on automatic control and pumping to vessel

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- AOI-100-1; AOI-3-1; OI-3; AOI-1
- Recognize 1 RFP sufficient to maintain RPV level
- Switch to single element control.
- Lower tape set to avoid controller overshoot.
- Select 2 of 3 RFPTs to trip
- Trip the turbines
-

CONCURRENT ACTIONS/COMPETING FACTORS
- AOI-100-1 Requirements of reactor parameters
- Verify power < 5%
- Mode switch to shutdown
- Verify and acknowledge alarms

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- One RFP remains on steam without having challenged +55" level trip
- Reactor level at or near normal
- Steam flow/feedwater flow/level control at or near normal

FAILURE IMPACT
- Reactor feedwater autocontrol challenged
- Possible +55" (lvl 8) reactor feedwater turbine trip if autocontrol fails

TIME CONSTRAINTS
- Approximate 2 minutes before autocontrol is challenged to avoid +55" high level trip with three pumps
- Typically accomplished within the first minute.

Table B-9 (Page 17 of 48). Qualitative Descriptions of Dynamic Human Actions

HOHC1: Control RPV Level and Pressure with HPCI and/or RCIC During First 6 Hours

PRECEDING EVENTS
- Loss of feedwater event with successful scram and turbine trip
- Mode switch to shutdown (OSW1 = S)
- HPCI and RCIC successfully initiated (OHS2 = S)

INDICATIONS OF PLANT CONDITION
- RPV level indications available on Panels 2-9-3 and 2-9-5.
- RPV pressure indications available on Panels 2-9-3 and 2-9-5.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1(RC/L & RC/P); EOI-2(SP/T); GOI-100-12A
- Set flow controller to maintain adequate flow for steam wastage.
- Set test return valve to divert water to CST to prevent RPV overfill.
- Monitor RPV level and adjust test return valve and flow controller to maintain level within +27" and +39".
- Option to use either HPCI or RCIC or both for level and pressure control.

CONCURRENT ACTIONS/COMPETING FACTORS
- GOI-100-12A actions to achieve cold shutdown.
- Establish suppression pool cooling.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Continue long term cool down if HPCI or RCIC remains operational (OHL1) and TBV are not available.
- Transfer to shutdown cooling without necessity for RCIC to operate for 24 hours if MSRV available for use to assist cooldown (ORVD1 = S) (Operators have the option to use, but may not use MSRVs to assist depressurization.)

FAILURE IMPACT
- Challenge to +55" trip, with potential for spill into steam lines if not tripped, or failure to restart if HPCI/RCIC do trip.

TIME CONSTRAINTS
- Continuous requirement — react within approximately 5 minutes of indication increasing trend to prevent overfill. HPCR trip at +55".
- If controlling level with only RCIC approximately 15 minutes time available.

Table B-9 (Page 18 of 48). Qualitative Descriptions of Dynamic Human Actions

HOHC2: Control RPV Level and Pressure with HPCI During First 6 Hours, Given RCIC Failed or Insufficient

PRECEDING EVENTS
- Loss of feedwater event with successful scram and turbine trip
- Mode switch to shutdown (OSW1 = S)
- HPCI successfully initiated (OHS1 = S)

INDICATIONS OF PLANT CONDITION
- RPV level indications available on Panels 2-9-3 and 2-9-5.
- RPV pressure indications available on Panels 2-9-3 and 2-9-5.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1(RC/L & RC/P); EOI-2(SP/T); GOI-100-12A,
- Set flow controller to maintain adequate flow for steam wastage.
- Set test return valve to divert water to CST to prevent RPV overfill.
- Monitor RPV level and adjust test return valve and flow controller to maintain level within +27" and +39".

CONCURRENT ACTIONS/COMPETING FACTORS
- GOI-100-12A actions to achieve cold shutdown.
- Establish suppression pool cooling,

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Continue long term cool down if HPCI remains operational (OHL1), TBV are not available, and MSRV not used for assisting cooldown (ORVD1 = F)
- Transfer to shutdown cooling without necessity for HPCI to operate for 24 hours if MSRV.

FAILURE IMPACT
- Challenge to +55" trip, with potential for spill into steam lines if not tripped, or failure to restart if HPCI/RCIC do trip.

TIME CONSTRAINTS
- Continuous requirement react within approx 5 minutes of indication increasing trend to prevent HPCI trip at 55".

Table B-9 (Page 19 of 48). Qualitative Descriptions of Dynamic Human Actions

HOHC3: Control RPV Level and Pressure with RCIC During First 6 Hours, Given HPCI Failed

PRECEDING EVENTS
- Loss of feedwater event with successful scram and turbine trip.
- Mode switch to shutdown (OSW1 = S).
- RCIC successfully initiated (OHS2 = S).

INDICATIONS OF PLANT CONDITION
- RPV level indications available on Panels 2-9-3 and 2-9-5, no contradictions.
- HPCI indicates unavailable.
- RPV pressure indications available on Panels 2-9-3 and 2-9-5, no contradictions.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1 RC/L-4; GOI-100-12A.
- Set flow controller to maintain adequate flow for steam wastage.
- Set test return valve to divert water to CST to as necessary prevent RPV overfill.
- Monitor RPV level and adjust test return valve and flow controller to maintain level within +27" and +39".

CONCURRENT ACTIONS/COMPETING FACTORS
- GOI-100-12A actions to achieve cold shutdown.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Continue long term cool down if RCIC remains operational (OHL1), TBV are not available.
- Transfer to shutdown cooling without necessity for RCIC to operate for 24 hours if TBV available to depressurize.

FAILURE IMPACT
- Challenge to +55" trip, with potential for spill into steam lines if not tripped, or failure to restart if RCIC does trip.

TIME CONSTRAINTS
- Continuous requirement, react within approx 8 minutes* of indication increasing trend to prevent overfill.

*An initial estimate of 15 minutes was given to the operators during their evaluations based on the anticipation that the mismatch would result from a gradual decline in the demand for makeup water. This calculation is bounding. In the actual evaluation, the operators gave the same degree of difficulty score to the 5 and 15-minute time constraints in their evaluations of HOHC2 and HOHC3.

Table B-9 (Page 20 of 48). Qualitative Descriptions of Dynamic Human Actions

HOHC4: Restore and Control RPV Level with HPCI Following ATWS

PRECEDING EVENTS
- Loss of feedwater event with turbine trip.
- Failure to scram.
- HPCI successfully initiated (OHS3 = S).
- HPCI terminated when suppression pool temperature exceeds 110°F and level/power control initiated.
- SLC succeeds in making core subcritical.
- Subcriticality achieved when RPV near top of core.
- Restart HPCI and/or RCIC following ATWS successful (OHS4 = S).

INDICATIONS OF PLANT CONDITION
- RPV level at -162", indications available on Panels 2-9-3 and 2-9-5.
- RPV pressure at 1,040 psig, indications available on Panels 2-9-3 and 2-9-5.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Insure boron injected to 28% tank level (C5-23).
- Adjust flow controller to refill RPV in a controlled manner while insuring subcriticality maintained.
- Monitor RPV level and adjust test return valve and flow controller to maintain level within +27" and +39".
- Option to use either HPCI or RCIC or both for level and pressure control following restoration.

CONCURRENT ACTIONS/COMPETING FACTORS
- Verifying shutdown and reporting incident to management.
- Verifying suppression pool cooling.
- Maintaining RPV pressure below HCTL (RC/P-7)
- Verifying dry well temperature and pressure within limits (EOI-2).
- GOI-100-12A actions to achieve cold shutdown.

INDICATION OF SUCCESSFUL COMPLETION
- Continue long term cool down if HPCI or RCIC remains operational (OHL1) and TBV are not available.
- Transfer to shutdown cooling without necessity for HPCI to operate for 24 hours if MSRV available for use to assist cooldown (ORVD1 = S) (Operators have the option to use, but may not use MSRVs to assist depressurization.)

FAILURE IMPACT
- Core uncovery with fuel damage if control lost low.

TIME CONSTRAINTS
- Once restarted (OHS=S), action is a continuous requirement.
- After recovery of RPV level react within 5 minutes after alarm to prevent automatic HPCI trip at +55".

Table B-9 (Page 21 of 48). Qualitative Descriptions of Dynamic Human Actions

HOHL1: Control RPV Level and Pressure with HPCI and/or RCIC from 6 to 24 Hours

PRECEDING EVENTS
- Loss of feedwater event with successful scram and turbine trip.
- Mode switch to shutdown (OSW1 = S).
- HPCI and/or RCIC successfully controlled for first 6 hours (OHC1 = S).

INDICATIONS OF PLANT CONDITION
- RPV level indications available on Panels 2-9-3 and 2-9-5.
- RPV pressure indications available on Panels 2-9-3 and 2-9-5.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1 RC/L; GOI-100-12A.
- Set flow controller to maintain adequate flow for steam wastage.
- Set test return valve to divert water to CST to prevent RPV overfill.
- Monitor RPV level and adjust test return valve and flow controller to maintain level within +27" and +39".
- Option to use either HPCI or RCIC or both for level and pressure control, if available.

CONCURRENT ACTIONS/COMPETING FACTORS
- GOI-100-12A actions to achieve cold shutdown.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Transfer to shutdown cooling.

FAILURE IMPACT
- Challenge to +55" trip, with potential for spill into steam lines if not tripped, or failure to restart if HPCI/RCIC do trip.

TIME CONSTRAINTS
- Not time critical, but continuous requirement, react within approx 15 minutes of indication increasing trend to prevent overfill.

Table B-9 (Page 22 of 48). Qualitative Descriptions of Dynamic Human Actions

HOHL2: Recover and Control RPV Level and Pressure with HPCI and/or RCIC for Up to 24 Hours, Given Short-Term Control Failed

PRECEDING EVENTS
- Loss of feedwater event with successful scram and turbine trip.
- Mode switch to shutdown (OSW1 = S).
- At least one overfill of RPV with HPCI and/or RCIC during the first 6 hours (OHC = F).
- HPCI and/or RCIC successfully restarted on low low RPV level signal.

INDICATIONS OF PLANT CONDITION
- RPV level indications available on Panels 2-9-3 and 2-9-5.
- RPV pressure indications available on Panels 2-9-3 and 2-9-5.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1 RC/L-4; GOI-100-12A.
- Set flow controller to maintain adequate flow for steam wastage.
- Set test return valve to divert water to CST to prevent RPV overfill.
- Monitor RPV level and adjust test return valve and flow controller to maintain level within +27" and +39".
- Option to use either HPCI or RCIC or both for level and pressure control, if available.

CONCURRENT ACTIONS/COMPETING FACTORS
- GOI-100-12A actions to achieve cold shutdown.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Transfer to shutdown cooling.

FAILURE IMPACT
- Challenge to +55" trip, with potential for spill into steam lines if not tripped, or failure to restart if HPCI/RCIC do trip.

TIME CONSTRAINTS
- Continuous requirement, react within approx 15 minutes of indication increasing trend to prevent automatic trip at +55".

Table B-9 (Page 23 of 48). Qualitative Descriptions of Dynamic Human Actions

HOHS1: Initiate HPCI following Feedwater Failure, Given Two Stuck-Open Relief Valves

PRECEDING EVENTS
- Initiating event leads to reactor scram.
- RPV pressure rises to MSRV setpoint and remains as MSRVs cycle.
- Two MSRVs remain open after they lift.
- RPV level dropping as decay heat is removed from core.
- After a few minutes RPV pressure behavior changes to a continuous decreasing trend.

INDICATIONS OF PLANT CONDITION
- All three RFPTs not available.
- RPV pressure dropping from 1,000 psig through 900 psig.
- Low RPV level alarm.
- Suppression pool temperature rising.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Manually start HPCI and align for injection into RPV (RC/L-4).

CONCURRENT ACTIONS/COMPETING FACTORS
- 2-AOI-1-1, stuck open relief valve actions.
- Initiate suppression pool cooling (OSP1).

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level stabilized at +33".
- Transition to short term control of RPV level using HPCI (OHC2).

FAILURE IMPACT
- Challenge of automatic HPCI/RCIC initiation at -45".
- Challenge of CRD and depressurization if auto initiation fails.

TIME CONSTRAINTS
- Estimate approximately 5-10 minutes prior to automatic actuation at -45".

Table B-9 (Page 24 of 48). Qualitative Descriptions of Dynamic Human Actions

HOHS2: Initiate HPCI/RCIC following a Feedwater Failure, Given One or No Stuck-Open Relief Valves

PRECEDING EVENTS
- Initiating event leads to reactor scram.
- RPV level dropping as decay heat is removed from core.

INDICATIONS OF PLANT CONDITION
- Feedwater and condensate not available.
- Low RPV level alarm.
- Radiation levels normal.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Recognize conditions causing alarm.
- Select most suitable combination of HPCI/RCIC to maintain RPV level and begin cooldown (EOI-1, RC/L-4).
- Exercise options available to:
  - Manually start RCIC and align for injection into RPV.
  - Manually start HPCI and align for pressure control via recirculation to the CST.

CONCURRENT ACTIONS/COMPETING FACTORS
- Align RHR for suppression pool cooling.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level stabilized at +33".
- Transition to short term control of RPV level using HPCI/RCIC (OHC1 or OHC2).

FAILURE IMPACT
- Challenge of automatic HPCI/RCIC initiation at -45".
- Challenge of CRD and depressurization if auto initiation fails.

TIME CONSTRAINTS
- Estimate approximately 10-15 minutes prior to automatic actuation at -122".*

*The operators evaluated this action considering the time to automatic actuation at -45", which was estimated as 10 to 15 minutes and is conservative.

Table B-9 (Page 25 of 48). Qualitative Descriptions of Dynamic Human Actions

HOHS3: Initiate HPCI following Feedwater Failure during Recovery after an ATWS Event

PRECEDING EVENTS
- Initiating event leads to requirement for reactor scram.
- Control rods fail to insert given scram signal.
- Operators enter EOI-1, RC/Q and C5 to successfully bring the reactor to a subcritical condition by lowering RPV level and injecting boron.
- All injection into RPV terminated.

INDICATIONS OF PLANT CONDITION
- RPV level at -162" and decreasing rapidly.
- APRM indicates < 3%.
- Condensate available on min recirculation to the condenser.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Verify that SLC has injected so that boron tank < 28% (C5-).
- Attempt to restart a RFPT.
- Recognize that none of the RFPT can be started to provide RPV refill.
- Manually start HPCI and/or RCIC and align for injection into RPV.

CONCURRENT ACTIONS/COMPETING FACTORS
- Verifying shutdown and reporting incident to management.
- Verifying suppression pool cooling.
- Maintaining RPV pressure below HCTL (RC/P-7).
- Verifying dry well temperature and pressure within limits (EOI-2).
- GOI-100-12A actions to achieve cold shutdown.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level ceases to decline and begins to rise.
- Transition to recovery of level and control at normal levels (OHC4).

FAILURE IMPACT
- Core uncovery and damage.

TIME CONSTRAINTS
- Restart within approx 3-5 minutes to avoid level dropping below -190".

Table B-9 (Page 26 of 48). Qualitative Descriptions of Dynamic Human Actions

HOJC1: Control RPV Level with Condensate Using Alternate Injection Path, given Startup Bypass Valve Fails

PRECEDING EVENTS
- RFPTs successfully used to cooldown reactor.
- RPV pressure decreased to below 300 psig.
- Flow/level control difficult with RFPTs on auto or manual.
- Startup bypass valve 3-53 fails to open.

INDICATIONS OF PLANT CONDITION
- RPV level varying between +27" and +50".
- Operating RFPT becoming erratic.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- 2-AOI-32-2.
- Dispatch AUO to open and control locally handwheel operated manual valve.
- Communicate with AUO to establish proper throttle postion to maintain RPV level.
- AUO stays on station and changes position as necessary to respond to changes in flow demand.

OR

- Take manual control of the main feedwater suction and discharge valves of the operating turbine.
- Trip the operating RFPT and place it in a freewheeling mode to allow pass through of condensate water.
- Open the discharge valve and allow the RPV level to rise to +50".
- Close the discharge valve and verify that condensate min flow valve 2-29 opens to bypass flow to the condenser.
- Allow the RPV level to drop to +12", then repeat the cycle.
- Use TBVs to maintain cool down rate at 100°F/hr.

CONCURRENT ACTIONS/COMPETING FACTORS
- Seeking to recover the startup bypass valve.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- All RFPT indication lights GREEN.
- Condensate system delivering water to RPV via startup bypass valve.
- Manually maintaining level between +12 and +50" by cycling feedwater discharge valves using condensate booster pumps.
- Able to transfer to shutdown cooling without challenging ECCS systems.

FAILURE IMPACT
- Seek other means for intermediate and low pressure level control (CRD, HPCI, RCIC, LPCI, CS).

TIME CONSTRAINTS
- Assume a window of approx 30 minutes available for changeover once RFPT tripped prior to demand for CRD.
- Approximately 2 hours to core uncovery if not means to cool the core found.

Table B-9 (Page 27 of 48). Qualitative Descriptions of Dynamic Human Actions

HOLA1: Initiate and Control Low Pressure Injection to Maintain RPV Level Between -190" and -162", Given ATWS

PRECEDING EVENTS
- HPCI unavailable due to maintenance.
- MSIV closure results in ATWS.
- Suppression pool temperature quickly rises to > 110°F
- SLC initiated, but not yet able to reduce power to < 5%.
- RPV level has been reduced per C5-8 through 13 to -162".
- High pressure injection from RCIC, CRDs and SLC can not maintain RPV level above -190" (C5-15,16,20).

INDICATIONS OF PLANT CONDITION
- SLC tank level > 28%.
- Radiation indications in suppression pool rising.
- RPV level =< -190".

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Emergency depressurize per RC/P-4 and C2.
- Initiate LPCI injection while observing Caution #5.
- Monitor RPV level (Refer to Caution #1 regarding instruments).

CONCURRENT ACTIONS/COMPETING FACTORS
- Monitoring SLC injection.
- Actions to insert control rods per EOI-1, RC/Q-23.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level maintained at -162".
- Power level decreases to below 5%.
- SLC tank level < 28%.

FAILURE IMPACT
- Power spikes which ultimately result in core damage.

TIME CONSTRAINTS
- Control must be established in conjunction with depressurization.
- Continuous requirement for dose control until subcriticality and refill.

Table B-9 (Page 28 of 48). Qualitative Descriptions of Dynamic Human Actions

HOLC1: Transfer to Condensate in Startup Bypass Mode, Given Feedwater Cooldown was Successful

PRECEDING EVENTS
- One RFPT successfully used to cooldown reactor.
- RPV pressure decreased to below 300 psig via normal cool down.
- Flow/level control difficult with RFPT on auto or manual.

INDICATIONS OF PLANT CONDITION
- RPV level varying between +27" and +39".

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- 2-GOI-100-12; 2-AOI-3-1; OI-3.
- Trip 3rd RFPT & isolate discharge valves.
- Place level control LC 3-53 startup bypass in service.
- Set level setpoint at +33".

CONCURRENT ACTIONS/COMPETING FACTORS
- 2-GOI-100-12 shutdown actions.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- All RFPT indication lights GREEN.
- Condensate system delivering water to RPV via startup bypass valve.
- Level maintained via 3-53 LCV using condensate booster pumps at +33".

FAILURE IMPACT
- Seek other means for low pressure level control (CRD, condensate via manual bypass or main feedwater injection valves, LPCI, CS).

TIME CONSTRAINTS
- Assume a window of approx 30 minutes available for changeover once RFPT tripped prior to demand for CRD.
- Approx 2 hours to core uncovery if no means to cool core found.

Table B-9 (Page 29 of 48). Qualitative Descriptions of Dynamic Human Actions

HOLC2: Place Condensate System in Startup Bypass Mode, Given it was Maintained Operational following Feedwater Failure

PRECEDING EVENTS
- Initiating event requiring reactor scram and turbine trip.
- Feedwater lost, but condensate successfully transfers to Minimum flow and remains operational (OCD1 = S).
- Cooldown using HPCI and/or RCIC successful (OHC, OHL = S).

INDICATIONS OF PLANT CONDITION
- RPV level maintained between +27" and +39".
- RPV pressure declining past 350 psig.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- GOI-100-12A, para 5.45.1 per 2-OI-3.
- Place level control LC-5 startup bypass in service.
- Set level setpoint at +33".

CONCURRENT ACTIONS/COMPETING FACTORS
- Verifying suppression pool cooling and temp < 95°F.
- 2-GOI-100-12 shutdown actions.
- Reducing pressure to condensate startup head.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Unit continues cooldown on condensate system via startup bypass valve.

FAILURE IMPACT
- Challenge CRD, CS or LPCI as injection source.

TIME CONSTRAINTS
- Assume 30 minutes before other means of level control would be sought.
- Approx 2 hours to core uncovery if no means to cool core found.

NOTES
- It appears that GOI-100-12A will keep RPV cooling on HPCI or RCIC and transfer directly to shutdown cooling if feedwater failed.

Table B-9 (Page 30 of 48). Qualitative Descriptions of Dynamic Human Actions

HOLP1: Control RPV Level Using LPCI Mode of RHR or the Core Spray System

PRECEDING EVENTS
- General transient initiating event.
- Successful depressurization.
- Condensate not available.

INDICATIONS OF PLANT CONDITION
- RPV pressure at or below 320 psi, but not low enough for shutdown cooling.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1 (RC/L-4).
- Verify suppression pool level is above 9.5 feet.
- Control and maintain flow is safe area of NPSH limits.
- Maintain RPV level between +12" and +51".

CONCURRENT ACTIONS/COMPETING FACTORS
- Shutdown activities.

INDICATION OF SUCCESSFUL COMPLETION
- Continue cooldown, safe cold shutdown achieved (PRA success state).

FAILURE IMPACT
- Alternate injection source required to avoid core melt. (Currently not modeled in the plant model, because failure of OLP1 is not appearing in the dominant sequence list.)

TIME CONSTRAINTS
- Long term equipment with slowly evolving scenario.

NOTES
- Not directly quantified with operators. Quantify with the same distribution as OSD2 (Align RHR for shutdown cooling mode of cooling, given 1 loop available).
- The action involves controlling level at low pressure over the long term with a prior hardware failure.

Table B-9 (Page 31 of 48). Qualitative Descriptions of Dynamic Human Actions

HOPTR1: Take Manual Control or Terminate Feedwater Flow, Given Feedwater Rampup

PRECEDING EVENTS
- Feedwater controller drifts high.
- RPV level begins to increase at power.

INDICATIONS OF PLANT CONDITION
- Abnormal RPV high level alarm.
- RPV level indicates +39" and rising.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Recognize cause of problem is feedwater flow, not RPV level instrumentation.
- Manually take control of feedwater to reduce flow.
- Maintain RPV level within acceptable limits while maintenance repairs controller.
- If manual control can not maintain level, Decide that reactor must be shutdown.
- Manually initiate HPCI/RCIC flow to insure source of high pressure flow to RPV.
- Terminate feedwater flow by tripping all three feedwater pumps.

CONCURRENT ACTIONS/COMPETING FACTORS
- Level control will be primary focus if this occurs.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Reactor subcritical.
- Reactor on HPCI/RCIC cooling.

FAILURE IMPACT
- Loss of all feedwater pumps at +55" trip point.
- Initiate shutdown procedures.
- Challenge to HPCI/RCIC to start.

TIME CONSTRAINTS
- One or two minutes* after alarm to avoid RPV overfill to +114".

*The time constraint originally given to the operators was 5 minutes, based on a more gradual transition to the mismatch condition. However, the impact of the shorter period of 1 to 2 minutes is expected to have little or no impact on the original operator evaluations for the following reasons. First, the licensed SRO member of the PRA team judges that 15 seconds is a conservative estimate of the time required to trip the feedwater pumps once the mismatch is recognized. Second, since the unit is at power, and the RPV level is one of the critical parameters closely monitored by the operators, 45 seconds provides adequate time to recognize the condition. The additional 4 minutes given to the operators in the initial evaluation would not significantly increase their likelihood of recognizing the situation if they did not do so in the first 45 seconds. Third, the three groups actually scored the degree of difficulty of the PSF for time adequacy as 4, 6, and 8. This indicates that all groups recognized that time would be a concern and at least one appears to have chosen to consider the possibility of rapid fill rates in their evaluation. Considering the above discussion, the range of evaluations for the time PSF is judged to be reasonable by both the human action analyst and the licensed SRO. Therefore, the overall quantitative evaluation was not changed.

Table B-9 (Page 32 of 48). Qualitative Descriptions of Dynamic Human Actions

HORF1: Restart and Control One Reactor Feedwater Pump following a +55" Trip

PRECEDING EVENTS
- Reactor scram for "other" reasons.
- One or more RFPTS not tripped (OFT=F) with subsequent control failure (OF=F).
- RPV level rises to +55", resulting in trip of all running RFPTs (L8F=S).

INDICATIONS OF PLANT CONDITION
- RPV pressure remains > 300 psig.
- RPV level = +55".
- Panel 2-9-5 indicates 2 of 3 hi-hi level relays have tripped (red lights lit).
- MSIVs open.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- 2-AOI-3-1; 2-OI-3; GOI-100-12.
- Reset at least 2 of 3 level trips on Panel 2-9-5.
- Run MSC & MGU of the tripped RFPT to min stop.
- Wait and observe the RPV level decrease to <55".
- Restart RFPT.

CONCURRENT ACTIONS/COMPETING FACTORS
- Normal post trip 2-GOI-100-12 activities.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RFPT trip is cleared.
- RFP supplying water to RPV with level maintained at +33".

FAILURE IMPACT
- Makeup required from HPCI/RCIC.

TIME CONSTRAINTS
- Time available from +55" to -45" RPV level is approx 30 minutes.

Table B-9 (Page 33 of 48). Qualitative Descriptions of Dynamic Human Actions

HORP1: Start RHR and/or CS Pumps for LPCI or Suppression Pool Cooling, Given RPV Makeup with High Pressure Systems Successful

PRECEDING EVENTS
- Reactor scram for any one of a variety of causes.
- MSIV closure and RPV isolation occurs.
- HPCI/RCIC initiated and being used for RPV makeup.
- MSRVs opened to lower RPV pressure to 930 psig.

INDICATIONS OF PLANT CONDITION
- HPCI maintaining RPV level being maintained +33".
- RPV pressure above 500 psig.
- Suppression pool temperature rising.
- Suppression pool temperature alarm if suppression pool temperature > 95°F.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Recognize need for suppression pool cooling and eventual shutdown cooling.
- Align RHR service water to the RHR heat exchangers.
- Start an RHR pump in preparation for suppression pool cooling and shutdown cooling.
- Monitor pump parameters to verify that it is functioning properly and will not become damaged and unavailable.

CONCURRENT ACTIONS/COMPETING FACTORS
- Still maintaining level.
- Normal GOI-100-12 shutdown activities.
- Investigating cause of scram.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Indication of pump start and flow.
- Able to align for suppression pool cooling, LPCI, or shutdown cooling as needed.

FAILURE IMPACT
- Low pressure cooling system not available if auto initiation fails.
- Suppression pool temperature increases with potential for primary containment overpressure failure.
- Eventual loss of core cooling leading to fuel damage.

TIME CONSTRAINTS
- Not time sensitive, at least 2 hours to boil down from normal level after normal cooldown.

Table B-9 (Page 34 of 48). Qualitative Descriptions of Dynamic Human Actions

HORP2: Start RHR and/or CS Pumps for LPCI, Given RPV Makeup with High Pressure Systems Failed

PRECEDING EVENTS
- Reactor scram for any one of a variety of causes.
- MSIV closure and RPV isolation occurs.
- MSRVs opened to cycle RPV pressure between 1,110 and 930 psig.
- HPCI and RCIC unavailable.
- Only one CRD pump available.

INDICATIONS OF PLANT CONDITION
- Alarms associated with high pressure injection system failures.
- RPV level declining past -122".
- Suppression pool temperature > 95°F.
- High suppression pool temperature alarm.
- Low low low RPV alarm and ADS signal (actuation inhibited).

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- C1-4.
- Align one RHR pump for suppression pool cooling (OSP1).
- Lineup one RHR pump for LPCI.
- Lineup CS for injection.
- Start RHR pumps in preparation for emergency depressurization.
- Start the CS pumps in preparation for emergency depressurization.

CONCURRENT ACTIONS/COMPETING FACTORS
- Continue to try to get high pressure systems on line until -162".
- Monitor drywell temperature and containment pressure to determine cooling requirements.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Indication of pump start and flow.
- Able to align for LPCI and CS.
- Able to establish suppression pool cooling with one RHR loop.

FAILURE IMPACT
- Eventual core damage.
- Challenge to containment integrity.

TIME CONSTRAINTS
- Tens of minutes available to align as level drops.
- Initiate within 5 minute of reaching -162" to avoid going below -192".

NOTES

- This action will be used for all requirements to start RHR and CS pumps with failed. high pressure systems for any reason.

Table B-9 (Page 35 of 48). Qualitative Descriptions of Dynamic Human Actions

HORPS1: Backup Automatic Scram Function with Push Buttons and ARI

PRECEDING EVENTS
- Reactor on line at 100% power.
- Setpoint requiring reactor trip met or exceeded.
- Reactor did not auto scram.

INDICATIONS OF PLANT CONDITION
- Parameters that should have initiated scram indicate scram conditions.
- Rod position indicators show no movement.
- Some scram indication lights lit, others not lit.
- Other parameters normal.
- Power above 55%.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Decision to scram reactor based on out of tolerance indications.
- EOI-1.
- Push scram buttons on Panel 2-9-5.
- Mode switch to shutdown.
- Initiate ARI if scram still not achieved.

CONCURRENT ACTIONS/COMPETING FACTORS
- Potential for numerous alarms.
- Attempting to correct cause of anomaly if it was a trend.
- Mode switch to shutdown (Action OSW1).

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- All rods in.
- Power decreasing to < 5% APRM.

FAILURE IMPACT
- ATWS in progress.
- Severity of ATWS depends on availability of main condenser and initiating event.

TIME CONSTRAINTS
- Within 1 minute.

Table B-9 (Page 36 of 48). Qualitative Descriptions of Dynamic Human Actions

HORVD1: Cycle One1 MSRV To Assist HPCI or RCIC Cooldown

PRECEDING EVENTS
- Successful reactor scram and turbine trip.
- RPV isolated.
- Operators initiate RCIC and maintain level control over first four hours (OHC1 = S).
- Bounding situation: HPCI failed due to RMOV BD 2A deenergized.

INDICATIONS OF PLANT CONDITION
- RPV level slowly varying over a range from +28" to +38".
- RPV pressure at 900 psig and decreasing very slowly.
- CRD pumps operating (RED light indication).

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1, RC/L-1, RC/P-15 through 18.
- Decide that depressurization needs assistance.
- Open one MSRV as necessary to reduce RPV pressure.
- Cycle opening of valves among steam lines to maintain temperature balance in suppression pool.
- Maintain cooldown rate of less than 100°F per hour.

CONCURRENT ACTIONS/COMPETING FACTORS
- Attempting to recover RMOV BD 2A.
- Initiate suppression pool cooling (OSP).

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Transition to shutdown cooling within 6 hours, thus avoiding long term requirement for RCIC control.

FAILURE IMPACT
- Requirement for RCIC operation and control for up to 24 hours.

TIME CONSTRAINTS
- Not time sensitive. Do as required.

NOTES
- If used for HPCI, this action refers to reducing pressure below the RHR shutdown cooling interlock.

Table B-9 (Page 37 of 48). Qualitative Descriptions of Dynamic Human Actions

HORVD2: Emergency Depressurize by Manually Opening MSRVs, Given High Pressure Injection Hardware Fails

PRECEDING EVENTS
- MSIV closure at full power due to high radiation.
- Successful reactor scram and turbine trip.
- HPCI fails due to RMOV 2A deenergized.
- RCIC fails to initiate due to hardware failure.
- Alternate injection systems unable to maintain level.

INDICATIONS OF PLANT CONDITION
- RPV level below +12" and declining.
- Condensate system trips.
- RPV pressure being lowered with MSRVs to increase CRD and SLC injection flow.
- Only one CRD pump available (CRDHS in enhanced mode failed).
- RMOV BD 2A deenergized (No lights on 1-4, 1-22, 1-41).
- HPCI and RCIC not operable.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1, RC/L-9 to C1; EOI-1, RC/P-4.
- Insure 2 or more low pressure injection systems aligned.
- Continue trying to inject into RPV with high pressure systems until RPV level reaches -162". (RC/L-4 and RC/L-8).
- Emergency depressurize per C2.

CONCURRENT ACTIONS/COMPETING FACTORS
- Trying to establish sufficient flow to maintain RPV level at high pressure.
- Trying to recover RMOV BD 2A.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Depressurization enables RPV level to be maintained by LPCI or core spray.

FAILURE IMPACT
- Core damage at high pressure if failed to depressurize at -162".

TIME CONSTRAINTS
- Assume approximately 30 minutes to recognize need to emergency depressurize as water lowers.
- Approximately 3 to 5 minutes* to -190" once -162" reached.

*The operators evaluated this action with the time constraint that 5 minutes are available to initiate depressurization once TAF is achieved. As they will have been working to reestablish cooling while the level declined and the action can be done quickly, the difference in time is judged to have an insignificant impact on their evaluations.

Table B-9 (Page 38 of 48). Qualitative Descriptions of Dynamic Human Actions

HORVD3: Emergency Depressurize by Manually Opening MSRVs, Given HPCI/RCIC Fails High Pressure Injection Due to Operator Control Failure

NOTE: Evaluation of this action requires you to put yourself in a situation where things have not gone well. Please ask yourselves how these errors could happen given your experience on the simulator or in the plant and assist us in building an accurate recovery scenario.

PRECEDING EVENTS
- MSIV closure at full power due to high radiation in reactor building and high steam flow in one main steam line.
- Successful reactor scram and turbine trip.
- HPCI not available due to RMOV 2A deenergized.
- RCIC initiates but operators can not control level (OHC=F).
- RCIC trips on high RPV level and can not be restarted.
- Condensate system not available.

INDICATIONS OF PLANT CONDITION
- RPV level below -145" and declining.
- RPV pressure at 1,040 psig and oscillating as MSRVs cycle.
- Only one CRD pump available.
- Groups 1, 2, 3, 6, and 8 isolation signals present.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1, RC/L-9 to C1; EOI-1, RC/P-4.
- Recognize the "bad day" situation in light of previous errors.
- Insure 2 or more low pressure injection systems aligned.
- Continue trying to inject into RPV with high pressure systems until RPV level reaches -162". (RC/L-4 and RC/L-8).
- Emergency depressurize per C2.

CONCURRENT ACTIONS/COMPETING FACTORS
- Alarm/control room conditions that diverted operators from proper control of RCIC.
- Attempt to recover RCIC showed impossible environmental condition.
- Attempt to recover RMOV 2A.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Depressurization enables RPV level to be maintained by LPCI or core spray.

FAILURE IMPACT
- Core damage at high pressure if failed to depressurize at -162".

TIME CONSTRAINTS
- Assume 5-10 minutes to become aware of need to emergency depressurize.
- Approximately 5 minutes for RPV to boil down to -90" from -162".
- Time constraints sensitive to failure modes of HPCI/RCIC. Limiting case would be failure at low RPV levels with approximately 30 minutes to core uncovery.

Table B-9 (Page 39 of 48). Qualitative Descriptions of Dynamic Human Actions

HOSD1: Align RHR for Shutdown Cooling

PRECEDING EVENTS
- Successful depressurization about to be completed following a reactor scram.
- During normal shutdowns, flushing, venting, etc.

INDICATIONS OF PLANT CONDITION
- RPV pressure = 120 psig.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- OI-74.
- Realign electrical system to normal alignment from App R alignment.
- Close SP suction.
- Align shutdown cooling suction.

CONCURRENT ACTIONS/COMPETING FACTORS

- Complete depressurization as required by system used (HPCI/RCIC/condensate).

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV pressure decreases to RHR shutdown injection pressure and stabilizes.
- Long term cold shutdown achieved - success state of IPE model.

FAILURE IMPACT
- Eventual reduction of RPV inventory, followed by heatup and damage to core.

TIME CONSTRAINTS
- Not time sensitive.

NOTES
- Would the difficulty be different if the operator failed to initiate suppression pool cooling when required?

Table B-9 (Page 40 of 48). Qualitative Descriptions of Dynamic Human Actions

HOSD2: Align RHR for Shutdown Cooling, Given One Loop Unavailable

PRECEDING EVENTS

- Successful depressurization about the complete following a reactor scram.

INDICATIONS OF PLANT CONDITION

- RPV pressure = 120 psig.
- No indications from valve 47.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS

- OI-74.

CONCURRENT ACTIONS/COMPETING FACTORS

- Complete depressurization as required by system used.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT

- RPV pressure decreases to RHR shutdown injection pressure and stabilizes.
- Long term cold shutdown achieved - success state of IPE model.

FAILURE IMPACT

- Eventual reduction of RPV inventory, followed by heatup and damage to core.

TIME CONSTRAINTS

- Not time sensitive; can be done over the course of hours.

NOTES

- Is there any reason to believe this action is more difficult than OSD1?

Table B-9 (Page 41 of 48). Qualitative Descriptions of Dynamic Human Actions

HOSL1: Actuate SLC, Given ATWS with an Unisolated Vessel

PRECEDING EVENTS
- Initiating event requiring turbine trip and reactor scram.
- RPS fails to scram reactor.
- Manual backup of scram and ARI can not insert control rods due to hardware failure.
- Recirculation pumps tripped.
- Manual bypass of MSIV successful (OSV1 = S).
- High pressure makeup provided by feedwater or HPCI.

INDICATIONS OF PLANT CONDITION
- Feedwater injecting into RPV.
- No indication of rods inserted past position 02.
- Power levels remaining above 50%.
- Suppression pool at 100°F and rising (25% power dumping to torus).
- Turbine bypass removing 25-30% of power.
- MSRVs cycling to maintain RPV pressure at 1,050 psig.
- RPV level rising to +55" and erratic

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1, RC/Q-12 to 20: 2-AOI-100-1.
- Decision that conditions are appropriate for SLC injection (Suppression pool temp could go > 110°F prior to subcriticality).
- Place key in SLC initiation switch and turn.
- Insure injection flow into RPV.

CONCURRENT ACTIONS/COMPETING FACTORS
- Gaining control of feedwater.
- Inhibit ADS if not already accomplished (C5-2, RC/Q-15) (Action OAD1).
- Actions to avoid isolation (OSV1).
- Actions for manual rod insertion.
- Actions to maintain RPV level until MSIVs can be jumpered open (OSV1).
- Monitoring SP temp in anticipation of lowering level to provide level/power control.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Boron tank level begins to lower.
- Power APRM begins to decrease.
- Reactor becomes subcritical within approximately 15 minutes.

FAILURE IMPACT
- Suppression pool temperature reaches 110°F and level/power control required. (C5-5).
- Alternate means of shutdown required.
- Challenge level control for 24 hours while finding an alternate means to shutdown.

TIME CONSTRAINTS
- Assume 3-5 minutes after failure to scram to avoid level/power control requirement.
- Suppression pool reaches 170°F in approximately 20 minutes if reactor remains at 55% power in an unisolated mode.

Table B-9 (Page 42 of 48). Qualitative Descriptions of Dynamic Human Actions

HOSL2: Actuate SLC, Given ATWS with an Isolated Vessel

PRECEDING EVENTS
- Group 1 isolation event requiring reactor scram.
- RPS fails to scram reactor.
- Manual backup of scram and ARI can not insert control rods due to hardware failure.

INDICATIONS OF PLANT CONDITION
- No indication of rods inserted past position 02.
- Recirculation pumps tripped, but power levels remaining at 55%.
- HPCI/RCIC injecting into RPV.
- MSRVs are opening as necessary to maintain RPV pressure below 1,125 psig.
- Suppression pool temperature > 110°F and rising.
- RPV level at -20" decreasing.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1, RC/Q-12 to 20: 2-AOI-100-1.
- Decision that conditions are appropriate for SLC injection (suppression pool temp could go > 110°F prior to subcriticality).
- Place key in SLC initiation switch and turn.
- Insure injection flow into RPV.

CONCURRENT ACTIONS/COMPETING FACTORS
- Inhibit ADS if not already accomplished (C5-2, RC/Q-15) (Action OAD1).
- Actions for manual rod insertion.
- Actions to control RPV level.
- Level/power control required (C5-5).
- Actions to insure that all 4 RHR pumps to be on suppression pool cooling.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Boron tank level begins to lower.
- Power APRM begins to decrease.
- Reactor becomes subcritical within approximately 15 minutes.

FAILURE IMPACT
- Challenge level control for 24 hours while finding an alternate means to shutdown.
- Core melt if alternate means of shutdown also fail.
- Eventual overpressure failure of containment.

TIME CONSTRAINTS
- Suppression pool reaches 110°F in approximately 2 minutes* and 170°F in approximately 7 minutes* if reactor remains at 55% power in an isolated mode.

*An original estimate of 3 minutes to 110°F and 10 minutes to 170°F was used during the operator evaluations. This was based on an operator rule of thumb that one SRV at full flow (discharging 6% power to the suppression pool) raised the temperature of the suppression pool at a rate of 1°F per minute. The slightly shorter times obtained by the thermal-hydraulic calculation are judged to have no impact on the evaluations.

Table B-9 (Page 43 of 48). Qualitative Descriptions of Dynamic Human Actions

HOSP1: Align RHR for Suppression Pool Cooling

PRECEDING EVENTS
- Scenario in which MSIVs close requiring pressure relief to suppression pool.
- HPCI or RCIC providing RPV level control.

INDICATIONS OF PLANT CONDITION
- Suppression pool high temperature alarm.
- Suppression pool temperature indicates +95°F.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-2 SP/T-1 monitor and control suppression pool temp below 95°F using available cooling.

CONCURRENT ACTIONS/COMPETING FACTORS
- Monitoring EOI-1 requirements.
- Maintaining RPV level.
- Investigating cause of trip.
- GOI-100-12A requirements.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Suppression pool temperature stabilizes and begins to decline.

FAILURE IMPACT
- Suppression pool exceeds heat capacity temperature limit.
- RCIC NPSH not assured if suppression pool > 140°F.
- Eventual failure of HPCI.
- Eventual challenge to primary containment integrity.

TIME CONSTRAINTS
- Suppression pool temperature rise rate < 1°F/min if isolated and just RCIC available (see OI-71,73).
- Time available > 1 hour.
- Not time sensitive.

Table B-9 (Page 44 of 48). Qualitative Descriptions of Dynamic Human Actions

HOSP2: Align RHR for Suppression Pool Cooling, Given ATWS

PRECEDING EVENTS
- Scenario in which MSIVs close requiring pressure relief to suppression pool.
- HPCI or RCIC providing RPV level control.

INDICATIONS OF PLANT CONDITION
- Suppression pool high temperature alarm.
- Suppression pool temperature > +110°F.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Align all available pumps associated heat exchangers to the suppression pool cooling mode.

CONCURRENT ACTIONS/COMPETING FACTORS
- Attempting to reopen MSIVs and reestablish condenser heat sink (EOI-1, RC/P-8)
- Trying to get the rods in.
- Initiating and monitoring SLC injection.
- Suppression pool cooling will have little impact during ATWS, [need to define where it impacts after ATWS.]

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Suppression pool temperature rate of rise declines slightly, providing a few additional minutes before emergency depressurization required.

FAILURE IMPACT
- Suppression pool exceeds heat capacity temperature limit.
- Procedures require defeat of automatic swapover if temp > 140°F.
- HPCI fails if suppression pool > 190°F (210-260°F per NUREG/CR-4550)
- Eventual challenge to primary containment integrity.

TIME CONSTRAINTS
- Suppression pool temperature rise rate is approximately 1-2°F/min during ATWS if unit remains at 50% power.
- Assume time available to establish cooling approximately 10 minutes* before HCTL. (If ATWS continues, this action has no impact.

*The original time of 40 minutes was given to the operators who used the wrong heatup rate to determine the time available for this action. This error could lead to evaluations using lower failure rates than might be expected for a 10-minute time constraint under ATWS conditions. However, since suppression pool cooling will be effective only if the operators succeed in making the reactor subcritical, the time constraint they were given is judged to not impact the evaluation results significantly.

Table B-9 (Page 45 of 48). Qualitative Descriptions of Dynamic Human Actions

HOSP3: Align RHR for Suppression Pool Cooling, Given one Loop Unavailable

PRECEDING EVENTS
- Scenario in which MSIVs close requiring pressure relief to suppression pool.
- HPCI or RCIC providing RPV level control.

INDICATIONS OF PLANT CONDITION
- Suppression pool high temperature alarm.
- Suppression pool temperature indicates +95°F.
- Valve 71 failed closed.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-2 SP/T-1 monitor and control suppression pool temp below 95°F using available cooling.
- Recognize that chosen path may be on minimum flow.

CONCURRENT ACTIONS/COMPETING FACTORS
- Monitoring EOI-1 requirements.
- Maintaining RPV level.
- Investigating cause of trip.
- GOI-100-12A requirements.
- Attempting to recover failed loop.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Suppression pool temperature stabilizes and begins to decline.

FAILURE IMPACT
- Suppression pool exceeds heat capacity temperature limit.
- RCIC NPSH not assured if suppression pool > 140°F
- Eventual challenge to primary containment integrity.

TIME CONSTRAINTS
- suppression pool temperature rise rate = ___°F/min if isolated and just RCIC available.
- Time available > 1 hour
- Not time sensitive

NOTES
- Is there something that would make this action more difficult than OSP1.

Table B-9 (Page 46 of 48). Qualitative Descriptions of Dynamic Human Actions

HOSV1: Bypass Low Low Low (-122") MSIV Closure Signal During ATWS Events

PRECEDING EVENTS
- Initiating event resulting in turbine trip, but MSIVs remained open.
- RPS fails to scram reactor.
- Manual backup of scram can not insert control rods.
- Decision that conditions are appropriate for SLC injection.

INDICATIONS OF PLANT CONDITION
- APRM reading 55% power.
- Feedwater available.
- MSRVs cycling to maintain RPV pressure at 1,125 psig, discharging 25% power to suppression pool.
- Suppression pool temperature rising and passes 95°F
- Radiation indications normal.
- Condenser vacuum normal.
- RPV level being decreasing towards -105".

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI- 1 RC/P-8, Appx 8A.
- Verify conditions permit bypass.
- Locally install four jumpers.

CONCURRENT ACTIONS/COMPETING FACTORS
- Initiating and insuring SLC injection (OSL1).
- Actions to insert control rods per EOI-1, RC/Q-23.
- Controlling feedwater to keep RPV level as low as possible while also maintaining MSIVs open.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Condenser maintained as heat sink as RPV level drops through -122".

FAILURE IMPACT
- MSIV closure with increased demand on suppression pool heat capacity.
- Necessity to lower RPV level if suppression pool temp > 110°F.
- Threat to primary containment.

TIME CONSTRAINTS
- Time estimated for suppression pool to reach 110°F is 8 minutes.

Table B-9 (Page 47 of 48). Qualitative Descriptions of Dynamic Human Actions

HOSW1: Transfer Mode Switch to Refuel/Shutdown in Response to a Scram

PRECEDING EVENTS
- Conditions requiring scram exist.
- Reactor has been successfully tripped.

INDICATIONS OF PLANT CONDITION
- Rods indicate scram condition.
- Power is decreasing.
- Reactor level lower than normal due to collapse of voids.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- 2-AOI-100-1.
- Immediate action.

CONCURRENT ACTIONS/COMPETING FACTORS
- Verify rods in (one rod permissive light in refuel mode).
- Verify power decreasing.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Mode switch in shutdown position.
- MSIVs remain open as pressure declines.

FAILURE IMPACT
- MSIVs close when reactor pressure =< 850 psig.

TIME CONSTRAINTS
- Not significant for typical pressure reduction rates.

Table B-9 (Page 48 of 48). Qualitative Descriptions of Dynamic Human Actions

HOTB1: Backup Main Turbine Trip

PRECEDING EVENTS
- Main turbine on line, loaded at 60 cycles.
- Unit reactor scrams due to "other" signals.
- Turbine fails to trip off line.

INDICATIONS OF PLANT CONDITION
- Reactor pressure decreasing.
- Reactor power decreasing.
- Reactor level may or may not be recovering.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- AOI 100-1.
- Push Turbine Trip button, Panel 2-9-7.
- Verify main steam stop valves close & combined stop valves close.
- Trip EHC pumps if valves still open.

CONCURRENT ACTIONS/COMPETING FACTORS
- Verify turbine bypass valves open to bypass steam to condenser when pressure recovers.
- Verify/acknowledge alarms causing scram.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- All turbine stop valves close.
- Annunciator indicates turbine tripped.
- Low side generator breaker opens (breaker 224).
- Megawatts = 0.

FAILURE IMPACT
- MSIVs will be required to close to prevent uncontrolled depressurization.
- Reverse power trip challenged.

TIME CONSTRAINTS
- Assume 1 minute to avoid MSIV closure.

Table B-10 (Page 1 of 3). Raw Weights and Scores of Actions Evaluated by the Three Groups of Licensed Browns Ferry Operators

BFN Group 1 Human Action Evaluations - Raw Weights

ID	Actions		Indic		Time		Proced		Complex		Train		Stress		Tot
Code	W	S	W	S	W	S	W	S	W	S	W	S	W	S	Wgt
OAD1	2	2	2	3	2	1	2	1	4	2	2	1	2	4	16
OAD2	2	2	2	3	2	1	2	1	4	2	2	1	2	4	16
OAL1	3	6	2	7	2	5	2	7	2	8	2	3	2	6	15
OAL2	3	6	2	7	2	5	2	7	2	8	2	3	2	6	15
OBC1	2	4	2	7	2	1	2	0	2	7	2	1	2	4	14
OBD1	2	3	3	7	2	2	2	0	3	7	2	1	2	2	16
OCRD1	2	5	2	4	2	1	2	0	2	2	2	3	2	2	14
OCRD2	2	6	2	4	2	1	2	0	2	2	2	3	2	2	14
ODCW1	2	3	2	3	2	1	2	0	2	1	2	1	2	1	14
ODWS1	3	6	3	7	2	7	2	7	3	8	2	1	2	6	17
ODWS2	3	7	3	8	2	8	2	7	3	9	2	1	3	8	18
OF1	2	4	2	4	2	1	2	0	2	3	2	5	2	4	14
OF2	2	8	2	4	2	3	2	1	2	5	2	5	2	4	14
OF3	2	4	2	4	2	1	0	8	2	4	1	9	2	4	11
OF4	2	0	3	7	2	4	2	1	3	8	2	1	2	2	16
OFT1	2	4	2	2	2	3	0	1	2	2	4	2	2	0	14
OHC1	2	3	2	4	2	3	2	0	2	6	2	1	2	4	14
OHC2	2	3	2	4	2	3	2	0	2	5	2	1	2	4	14
OHC3	2	3	2	4	2	3	2	0	2	5	2	1	2	4	14
OHC4	2	3	3	8	2	5	2	0	3	8	2	1	2	4	16
OHL1	2	3	2	4	2	3	2	0	2	6	2	1	2	4	14
OHL2	2	3	2	4	2	3	2	0	2	6	2	1	2	3	14
OHS1	2	1	3	8	2	7	2	7	3	8	2	3	2	6	16
OHS2	2	4	2	4	2	3	2	7	2	3	2	1	2	6	14
OHS3	2	4	3	7	2	3	2	0	3	7	2	1	2	2	16
OJC1	2	6	2	4	2	2	2	8	3	8	2	9	2	5	15
OLA1	3	8	3	8	2	7	2	7	3	8	2	3	2	6	17
OLC1	2	4	2	4	2	1	2	0	2	3	2	2	2	2	14
OLC2	2	5	2	4	2	1	2	0	2	3	2	2	2	2	14
OPTR1	2	4	2	2	2	4	2	0	2	3	2	8	2	3	14
ORF1	2	4	2	5	2	1	2	1	2	4	2	1	2	4	14
ORP1	2	4	2	4	2	1	2	0	2	1	2	1	2	1	14
ORP2	3	7	3	7	2	7	2	7	3	9	2	3	3	8	18
ORPS1	2	2	2	0	4	1	1	0	2	2	2	1	2	2	15
ORVD1	3	7	2	5	2	6	2	1	2	5	2	1	2	1	15
ORVD2	3	8	2	5	2	6	2	7	2	5	2	1	2	6	15
ORVD3	2	9	2	9	2	7	2	7	2	7	2	1	2	6	14
OSD1	2	4	2	4	2	1	2	0	2	1	2	1	2	1	14
OSD2	2	4	2	4	2	1	3	0	2	1	2	1	2	1	15
OSL1	3	5	2	4	2	4	2	7	2	2	2	3	2	6	15
OSL2	3	7	2	6	2	6	2	7	2	2	2	3	2	6	15
OSP1	2	4	2	4	2	3	2	0	2	1	2	1	2	1	14
OSP2	3	6	2	6	2	5	2	7	3	7	2	1	2	6	16
OSP3	2	4	2	4	2	1	2	0	2	1	2	1	2	1	14
OSV1	2	2	2	3	2	2	2	1	2	2	2	4	2	3	14
OSW1	2	2	2	3	2	1	2	0	4	0	4	0	2	4	18
OTB1	2	1	2	4	2	4	2	0	4	2	4	0	2	3	18

Table B-10 (Page 2 of 3). Raw Weights and Scores of Actions Evaluated by the Three Groups of Licensed Browns Ferry Operators

BFN Group 2 Human Action Evaluations - Raw Weights

ID	Actions W	Actions S	Interface W	Interface S	Time W	Time S	Proced W	Proced S	Complex W	Complex S	Training W	Training S	Stress W	Stress S	Tot Wgt.
OAD1	2	3	2	5	1	2	2	1	2	2	2	1	3	4	14
OAD2	2	3	2	5	1	2	2	1	2	2	2	1	3	4	14
OAL1	2	5	2	6	2	7	2	6	2	8	2	3	2	8	14
OAL2	2	5	3	6	3	7	2	6	2	8	2	3	3	8	17
OBC1	2	4	2	4	2	2	2	3	2	6	2	4	2	5	14
OBD1	Direct Estimate of Failure Rate = 0.3/demand														0
OCRD1	2	4	2	2	1	3	2	2	2	2	2	4	2	4	13
OCRD2	3	5	3	5	2	3	2	2	2	2	2	4	3	4	17
ODCW1	2	5	3	4	2	4	2	4	2	2	2	4	2	4	15
ODWS1	2	3	2	2	2	3	2	5	2	3	2	4	2	4	14
ODWS2	3	7	3	6	2	4	2	5	2	2	2	4	3	5	17
OF1	2	4	2	2	2	0	2	2	2	2	2	3	2	4	14
OF2	2	4	2	2	3	5	1	6	2	4	2	4	2	4	14
OF3	Judged unable to accomplish within allowed timeframe.														0
OF4	2	5	3	8	1	2	2	6	2	8	3	4	3	5	16
OFT1	2	3	2	2	3	6	0	NR	1	4	2	1	2	4	12
OHC1	1	2	3	2	2	2	2	3	2	7	2	4	2	2	14
OHC2	1	2	3	2	2	2	2	3	2	7	2	4	2	2	14
OHC3	1	2	3	2	2	2	2	3	3	7	2	4	2	2	15
OHC4	2	3	2	8	1	4	2	6	2	8	2	4	2	6	13
OHL1	2	5	2	4	2	2	2	4	2	6	2	6	2	6	14
OHL2	2	5	2	4	2	7	2	7	2	6	2	5	2	6	14
OHS1	2	4	3	4	2	3	2	1	2	2	2	1	2	4	15
OHS2	1	1	2	2	2	3	2	2	2	3	2	3	2	2	13
OHS3	2	3	3	8	3	5	2	6	2	8	2	4	3	5	17
OJC1	1	8	3	8	2	2	2	10	3	8	1	9	2	2	14
OLA1	2	8	4	8	3	7	3	6	3	9	4	7	4	8	23
OLC1	2	4	2	2	2	2	2	4	2	3	2	4	2	3	14
OLC2	2	4	2	2	2	2	2	4	2	3	2	4	2	3	14
OPTR	1	1	2	1	3	6	0	NR	0		2	3	3	3	11
ORF1	2	4	2	3	2	3	1	4	2	2	2	1	2	3	13
ORP1	2	3	2	3	2	3	2	2	2	2	2	1	2	4	14
ORP2	2	3	3	6	3	6	2	6	3	7	2	4	3	4	18
ORPS1	1	3	1	2	4	6	0	NR	2	2	2	1	1	4	11
ORVD1	2	3	2	2	2	3	2	4	2	7	2	3	2	2	14
ORVD2	2	4	2	3	2	4	2	6	2	2	2	3	2	4	14
ORVD3	2	9	2	9	3	8	3	6	3	8	3	4	4	8	20
OSD1	3	2	2	4	1	2	2	3	2	6	3	4	2	4	15
OSD2	3	2	2	2	1	2	2	3	2	6	3	4	2	4	15
OSL1	2	5	2	7	3	8	1	2	2	2	3	3	2	5	15
OSL2	2	5	2	7	4	10	1	2	2	2	3	3	1	5	15
OSP1	2	3	2	2	2	2	2	2	1	2	3	1	2	2	14
OSP2	2	5	2	3	2	3	0	NR	2	2	2	1	2	5	12
OSP3	2	3	2	2	2	2	2	2	1	2	3	1	2	2	14
OSV1	2	7	2	7	3	2	4	1	2	0	2	3	0	NR	15
OSW1	2	4	2	2	2	2	0	NR	2	2	2	2	2	2	12
OTB1	2	4	2	2	3	2	0	NR	2	2	2	2	2	3	13

Table B-10 (Page 3 of 3). Raw Weights and Scores of Actions Evaluated by the Three Groups of Licensed Browns Ferry Operators

BFN Group 3 Human Action Evaluations - Raw Weights

ID Code	Actions W	Actions S	Interface W	Interface S	Time W	Time S	Proced W	Proced S	Complex W	Complex S	Training W	Training S	Stress W	Stress S	Tot Wgt
OAD1	2	2	2	2	3	4	2	1	2	2	2	1	2	2	15
OAD2	2	2	2	2	3	4	2	1	2	2	2	1	2	2	15
OAL1	4	1	4	2	3	4	2	5	2	8	2	3	2	2	19
OAL2	4	1	4	2	4	6	2	5	2	8	2	3	2	2	20
OBC1	2	3	2	2	1	0	2	1	2	3	2	7	2	4	13
OBD1	3	1	2	2	4	9	2	3	3	6	2	4	2	5	18
OCRD1	3	5	2	2	1	1	2	2	2	2	2	4	2	1	14
OCRD2	3	2	2	2	2	2	2	2	2	4	2	4	2	2	15
ODCW1	2	7	2	5	1	1	2	2	2	1	2	1	2	2	13
ODWS1	3	1	2	1	3	3	2	2	2	5	2	2	2	4	16
ODWS2	3	1	2	1	4	5	2	2	2	5	2	2	2	5	17
OF1	2	3	2	3	1	2	2	3	3	2	3	2	2	2	15
OF2	2	6	2	3	2	3	1	1	3	2	3	4	2	2	15
OF3	1	7	2	1	1	1	2	2	2	1	2	1	1	1	11
OF4	3	1	1	2	2	2	2	2	2	2	2	1	2	2	14
OFT1	1	3	2	2	2	3	1	1	3	1	2	2	1	2	12
OHC1	2	2	2	3	2	1	2	1	2	3	2	1	2	4	14
OHC2	2	2	2	3	2	1	2	1	2	3	2	1	2	4	14
OHC3	2	2	2	3	2	1	2	1	2	2	2	1	2	4	14
OHC4	3	1	3	7	4	7	2	3	2	3	2	4	2	4	18
OHL1	3	1	2	4	3	3	2	3	2	3	2	3	2	4	16
OHL2	3	1	2	4	3	3	2	3	2	3	2	3	2	4	16
OHS1	2	2	1	2	2	3	2	1	2	2	3	1	2	2	14
OHS2	3	2	1	2	2	3	2	1	2	2	3	1	2	2	15
OHS3	3	1	3	7	4	7	2	3	2	3	2	1	2	2	18
OJC1	2	2	3	8	2	2	1	10	2	8	2	4	2	2	14
OLA1	4	1	4	2	3	5	2	3	3	3	2	1	2	4	20
OLC1	2	4	1	2	1	1	2	2	1	0	2	2	1	0	10
OLC2	2	3	2	2	1	1	2	2	1	1	2	5	1	0	11
OPTR1	4	0	1	2	4	8	0	NR	2	2	2	4	2	2	15
ORF1	3	3	1	1	1	1	2	1	2	1	2	1	1	2	12
ORP1	2	3	2	2	2	3	2	2	2	2	2	1	2	2	14
ORP2	3	1	2	2	3	3	2	3	2	3	2	1	2	2	16
ORPS1	4	0	1	1	4	6	0	NR	4	1	2	0	3	2	18
ORVD1	2	3	2	2	1	1	2	2	2	1	2	5	2	2	13
ORVD2	3	1	2	2	3	6	2	2	3	2	2	1	2	4	17
ORVD3	3	1	2	6	4	7	2	2	3	2	2	1	2	4	18
OSD1	2	3	2	2	1	0	2	2	2	2	2	1	2	2	13
OSD2	2	3	2	2	1	0	2	2	2	2	2	1	2	2	13
OSL1	4	1	3	2	3	3	2	1	2	2	2	1	2	4	18
OSL2	4	0	3	2	3	3	2	1	2	2	2	1	2	4	18
OSP1	2	3	2	2	2	3	2	2	2	2	2	1	2	2	14
OSP2	3	3	2	2	3	5	2	2	2	2	2	1	2	4	16
OSP3	2	3	2	2	2	3	2	2	2	2	2	1	2	2	14
OSV1	2	7	4	8	3	2	4	1	3	5	3	7	1	2	20
OSW1	3	0	1	6	3	4	0	NR	1	0	1	0	2	2	11
OTB1	2	7	2	4	2	3	0	NR	1	1	1	4	2	2	10

Table B-11 (Page 1 of 3). Normalized Weights and Scores of Actions Evaluated by the Three Groups of Licensed Browns Ferry Operators

BFN Group 1 Human Action Evaluations - Normalized Weights

ID Code	Actions W	Actions S	Indic. W	Indic. S	Time W	Time S	Procedure W	Procedure S	Complex W	Complex S	Train W	Train S	Stress W	Stress S	FLI
Average	0.15	4.3	0.15	4.8	0.14	3.2	0.13	2.4	0.16	4.4	0.14	2.1	0.14	3.7	3.64
OAD1	0.13	2	0.13	3	0.13	1	0.13	1	0.25	2	0.13	1	0.13	4	2.00
OAD2	0.13	2	0.13	3	0.13	1	0.13	1	0.25	2	0.13	1	0.13	4	2.00
OAL1	0.20	6	0.13	7	0.13	5	0.13	7	0.13	8	0.13	3	0.13	6	6.00
OAL2	0.20	6	0.13	7	0.13	5	0.13	7	0.13	8	0.13	3	0.13	6	6.00
OBC1	0.14	4	0.14	7	0.14	1	0.14	0	0.14	7	0.14	1	0.14	4	3.43
OBD1	0.13	3	0.19	7	0.13	2	0.13	0	0.19	7	0.13	1	0.13	2	3.63
OCRD1	0.14	5	0.14	4	0.14	1	0.14	0	0.14	2	0.14	3	0.14	2	2.43
OCRD2	0.14	6	0.14	4	0.14	1	0.14	0	0.14	2	0.14	3	0.14	2	2.57
ODCW1	0.14	3	0.14	3	0.14	1	0.14	0	0.14	1	0.14	1	0.14	1	1.43
ODWS1	0.18	6	0.18	7	0.12	7	0.12	7	0.18	8	0.12	1	0.12	6	6.18
ODWS2	0.17	7	0.17	8	0.11	8	0.11	7	0.17	9	0.11	1	0.17	8	7.11
OF1	0.14	4	0.14	4	0.14	1	0.14	0	0.14	3	0.14	5	0.14	4	3.00
OF2	0.14	8	0.14	4	0.14	3	0.14	1	0.14	5	0.14	5	0.14	4	4.29
OF3	0.18	4	0.18	4	0.18	1	0.00	8	0.18	4	0.09	9	0.18	4	3.91
OF4	0.13	0	0.19	7	0.13	4	0.13	1	0.19	8	0.13	1	0.13	2	3.81
OFT1	0.14	4	0.14	2	0.14	3	0.00	1	0.14	2	0.29	2	0.14	0	2.14
OHC1	0.14	3	0.14	4	0.14	3	0.14	0	0.14	6	0.14	1	0.14	4	3.00
OHC2	0.14	3	0.14	4	0.14	3	0.14	0	0.14	5	0.14	1	0.14	4	2.86
OHC3	0.14	3	0.14	4	0.14	3	0.14	0	0.14	5	0.14	1	0.14	4	2.86
OHC4	0.13	3	0.19	8	0.13	5	0.13	0	0.19	8	0.13	1	0.13	4	4.63
OHL1	0.14	3	0.14	4	0.14	3	0.14	0	0.14	6	0.14	1	0.14	4	3.00
OHL2	0.14	3	0.14	4	0.14	3	0.14	0	0.14	6	0.14	1	0.14	3	2.86
OHS1	0.13	1	0.19	8	0.13	7	0.13	7	0.19	8	0.13	3	0.13	6	6.00
OHS2	0.14	4	0.14	4	0.14	3	0.14	7	0.14	3	0.14	1	0.14	6	4.00
OHS3	0.13	4	0.19	7	0.13	3	0.13	0	0.19	7	0.13	1	0.13	2	3.88
OJC1	0.13	6	0.13	4	0.13	2	0.13	8	0.20	8	0.13	9	0.13	5	6.13
OLA1	0.18	8	0.18	8	0.12	7	0.12	7	0.18	8	0.12	3	0.12	6	6.94
OLC1	0.14	4	0.14	4	0.14	1	0.14	0	0.14	3	0.14	2	0.14	2	2.29
OLC2	0.14	5	0.14	4	0.14	1	0.14	0	0.14	3	0.14	2	0.14	2	2.43
OPTR1	0.14	4	0.14	2	0.14	4	0.14	0	0.14	3	0.14	8	0.14	3	3.43
ORF1	0.14	4	0.14	5	0.14	1	0.14	1	0.14	4	0.14	1	0.14	4	2.86
ORP1	0.14	4	0.14	4	0.14	1	0.14	0	0.14	1	0.14	1	0.14	1	1.71
ORP2	0.17	7	0.17	7	0.11	7	0.11	7	0.17	9	0.11	3	0.17	8	7.06
ORPS1	0.13	2	0.13	0	0.27	1	0.07	0	0.13	2	0.13	1	0.13	2	1.20
ORVD1	0.20	7	0.13	5	0.13	6	0.13	1	0.13	5	0.13	1	0.13	1	3.93
ORVD2	0.20	8	0.13	5	0.13	6	0.13	7	0.13	5	0.13	1	0.13	6	5.60
ORVD3	0.14	9	0.14	9	0.14	7	0.14	7	0.14	7	0.14	1	0.14	6	6.57
OSD1	0.14	4	0.14	4	0.14	1	0.14	0	0.14	1	0.14	1	0.14	1	1.71
OSD2	0.13	4	0.13	4	0.13	1	0.20	0	0.13	1	0.13	1	0.13	1	1.60
OSL1	0.20	5	0.13	4	0.13	4	0.13	7	0.13	2	0.13	3	0.13	6	4.47
OSL2	0.20	7	0.13	6	0.13	6	0.13	7	0.13	2	0.13	3	0.13	6	5.40
OSP1	0.14	4	0.14	4	0.14	3	0.14	0	0.14	1	0.14	1	0.14	1	2.00
OSP2	0.19	6	0.13	6	0.13	5	0.13	7	0.19	7	0.13	1	0.13	6	5.56
OSP3	0.14	4	0.14	4	0.14	1	0.14	0	0.14	1	0.14	1	0.14	1	1.71
OSV1	0.14	2	0.14	3	0.14	2	0.14	1	0.14	2	0.14	4	0.14	3	2.43
OSW1	0.11	2	0.11	3	0.11	1	0.11	0	0.22	0	0.22	0	0.11	4	1.11
OTB1	0.11	1	0.11	4	0.11	4	0.11	0	0.22	2	0.22	0	0.11	3	1.78

Table B-11 (Page 2 of 3). Normalized Weights and Scores of Actions Evaluated by the Three Groups of Licensed Browns Ferry Operators

BFN Group 2 Human Action Evaluations - Normalized Weights

	Actions W	Actions S	Interface W	Interface S	Time W	Time S	Proced W	Proced S	Complex W	Complex S	Training W	Training S	Stress W	Stress S	FLI
Average	0.13	4.0	0.16	4.0	0.15	3.7	0.12	3.4	0.14	4.2	0.15	3.3	0.15	4.0	3.95
OAD1	0.14	3	0.14	5	0.07	2	0.14	1	0.14	2	0.14	1	0.21	4	2.71
OAD2	0.14	3	0.14	5	0.07	2	0.14	1	0.14	2	0.14	1	0.21	4	2.71
OAL1	0.14	5	0.14	6	0.14	7	0.14	6	0.14	8	0.14	3	0.14	8	6.14
OAL2	0.12	5	0.18	6	0.18	7	0.12	6	0.12	8	0.12	3	0.18	8	6.29
OBC1	0.14	4	0.14	4	0.14	2	0.14	3	0.14	6	0.14	4	0.14	5	4.00
OBD1	Direct Estimate of Failure Rate = 0.3/demand														
OCRD1	0.15	4	0.15	2	0.08	3	0.15	2	0.15	2	0.15	4	0.15	4	3.00
OCRD2	0.18	5	0.18	5	0.12	3	0.12	2	0.12	2	0.12	4	0.18	4	3.76
ODCW1	0.13	5	0.20	4	0.13	4	0.13	4	0.13	2	0.13	4	0.13	4	3.87
OWS1	0.14	3	0.14	2	0.14	3	0.14	5	0.14	3	0.14	4	0.14	4	3.43
OWS2	0.18	7	0.18	6	0.12	4	0.12	5	0.12	2	0.12	4	0.18	5	4.94
OF1	0.14	4	0.14	2	0.14	0	0.14	2	0.14	2	0.14	3	0.14	4	2.43
OF2	0.14	4	0.14	2	0.21	5	0.07	6	0.14	4	0.14	4	0.14	4	4.07
OF3	Judged unable to accomplish within allowed timeframe.														
OF4	0.13	5	0.19	8	0.06	2	0.13	6	0.13	8	0.19	4	0.19	5	5.69
OFT1	0.17	3	0.17	2	0.25	6	0.00	NR	0.08	4	0.17	1	0.17	4	3.50
OHC1	0.07	2	0.21	2	0.14	2	0.14	3	0.14	7	0.14	4	0.14	2	3.14
OHC2	0.07	2	0.21	2	0.14	2	0.14	3	0.14	7	0.14	4	0.14	2	3.14
OHC3	0.07	2	0.20	2	0.13	2	0.13	3	0.20	7	0.13	4	0.13	2	3.40
OHC4	0.15	3	0.15	8	0.08	4	0.15	6	0.15	8	0.15	4	0.15	6	5.69
OHL1	0.14	5	0.14	4	0.14	2	0.14	4	0.14	6	0.14	6	0.14	6	4.71
OHL2	0.14	5	0.14	4	0.14	7	0.14	7	0.14	6	0.14	5	0.14	6	5.71
OHS1	0.13	4	0.20	4	0.13	3	0.13	1	0.13	2	0.13	1	0.13	4	2.80
OHS2	0.08	1	0.15	2	0.15	3	0.15	2	0.15	3	0.15	3	0.15	2	2.38
OHS3	0.12	3	0.18	8	0.18	5	0.12	6	0.12	8	0.12	4	0.18	5	5.65
OJC1	0.07	8	0.21	8	0.14	2	0.14	10	0.21	8	0.07	9	0.14	2	6.64
OLA1	0.09	8	0.17	8	0.13	7	0.13	6	0.13	9	0.17	7	0.17	8	7.57
OLC1	0.14	4	0.14	2	0.14	2	0.14	4	0.14	3	0.14	4	0.14	3	3.14
OLC2	0.14	4	0.14	2	0.14	2	0.14	4	0.14	3	0.14	4	0.14	3	3.14
OPTR	0.09	1	0.18	1	0.27	6	0.00	NR	0.00	0	0.18	3	0.27	3	3.27
ORF1	0.15	4	0.15	3	0.15	3	0.08	4	0.15	2	0.15	1	0.15	3	2.77
ORP1	0.14	3	0.14	3	0.14	3	0.14	2	0.14	2	0.14	1	0.14	4	2.57
ORP2	0.11	3	0.17	6	0.17	6	0.11	6	0.17	7	0.11	4	0.17	4	5.28
ORPS1	0.09	3	0.09	2	0.36	6	0.00	NR	0.18	2	0.18	1	0.09	4	3.55
ORVD1	0.14	3	0.14	2	0.14	3	0.14	4	0.14	7	0.14	3	0.14	2	3.43
ORVD2	0.14	4	0.14	3	0.14	4	0.14	6	0.14	2	0.14	3	0.14	4	3.71
ORVD3	0.10	9	0.10	9	0.15	8	0.15	6	0.15	8	0.15	4	0.20	8	7.30
OSD1	0.20	2	0.13	4	0.07	2	0.13	3	0.13	6	0.20	4	0.13	4	3.60
OSD2	0.20	2	0.13	2	0.07	2	0.13	3	0.13	6	0.20	4	0.13	4	3.33
OSL1	0.13	5	0.13	7	0.20	8	0.07	2	0.13	2	0.20	3	0.13	5	4.87
OSL2	0.13	5	0.13	7	0.27	10	0.07	2	0.13	2	0.20	3	0.07	5	5.60
OSP1	0.14	3	0.14	2	0.14	2	0.14	2	0.07	2	0.21	1	0.14	2	1.93
OSP2	0.17	5	0.17	3	0.17	3	0.00	NR	0.17	2	0.17	1	0.17	5	3.17
OSP3	0.14	3	0.14	2	0.14	2	0.14	2	0.07	2	0.21	1	0.14	2	1.93
OSV1	0.13	7	0.13	7	0.20	2	0.27	1	0.13	0	0.13	3	0.00	NR	2.93
OSW1	0.17	4	0.17	2	0.17	2	0.00	NR	0.17	2	0.17	2	0.17	2	2.33
OTB1	0.15	4	0.15	2	0.23	2	0.00	NR	0.15	2	0.15	2	0.15	3	2.46

Table B-11 (Page 3 of 3). Normalized Weights and Scores of Actions Evaluated by the Three Groups of Licensed Browns Ferry Operators

BFN Group 3 Human Action Evaluations - Normalized Weights

ID Code	Actions W	Actions S	Interface W	Interface S	Time W	Time S	Proced W	Proced S	Complex W	Complex S	Training W	Training S	Stress W	Stress S	FLI
Average	0.17	2.4	0.14	2.8	0.16	3.2	0.12	2.0	0.14	2.6	0.14	2.2	0.13	2.6	2.63
OAD1	0.13	2	0.13	2	0.20	4	0.13	1	0.13	2	0.13	1	0.13	2	2.13
OAD2	0.13	2	0.13	2	0.20	4	0.13	1	0.13	2	0.13	1	0.13	2	2.13
OAL1	0.21	1	0.21	2	0.16	4	0.11	5	0.11	8	0.11	3	0.11	2	3.16
OAL2	0.20	1	0.20	2	0.20	6	0.10	5	0.10	8	0.10	3	0.10	2	3.60
OBC1	0.15	3	0.15	2	0.08	0	0.15	1	0.15	3	0.15	7	0.15	4	3.08
OBD1	0.17	1	0.11	2	0.22	9	0.11	3	0.17	6	0.11	4	0.11	5	4.72
OCRD1	0.21	5	0.14	2	0.07	1	0.14	2	0.14	2	0.14	4	0.14	1	2.71
OCRD2	0.20	2	0.13	2	0.13	2	0.13	2	0.13	4	0.13	4	0.13	2	2.53
ODCW1	0.15	7	0.15	5	0.08	1	0.15	2	0.15	1	0.15	1	0.15	2	2.85
ODWS1	0.19	1	0.13	1	0.19	3	0.13	2	0.13	5	0.13	2	0.13	4	2.50
ODWS2	0.18	1	0.12	1	0.24	5	0.12	2	0.12	5	0.12	2	0.12	5	3.12
OF1	0.13	3	0.13	3	0.07	2	0.13	3	0.20	2	0.20	2	0.13	2	2.40
OF2	0.13	6	0.13	3	0.13	3	0.07	1	0.20	2	0.20	4	0.13	2	3.13
OF3	0.09	7	0.18	1	0.09	1	0.18	2	0.18	1	0.18	1	0.09	1	1.73
OF4	0.21	1	0.07	2	0.14	2	0.14	2	0.14	2	0.14	1	0.14	2	1.64
OFT1	0.08	3	0.17	2	0.17	3	0.08	1	0.25	1	0.17	2	0.08	2	1.92
OHC1	0.14	2	0.14	3	0.14	1	0.14	1	0.14	3	0.14	1	0.14	4	2.14
OHC2	0.14	2	0.14	3	0.14	1	0.14	1	0.14	3	0.14	1	0.14	4	2.14
OHC3	0.14	2	0.14	3	0.14	1	0.14	1	0.14	2	0.14	1	0.14	4	2.00
OHC4	0.17	1	0.17	7	0.22	7	0.11	3	0.11	3	0.11	4	0.11	4	4.44
OHL1	0.19	1	0.13	4	0.19	3	0.13	3	0.13	3	0.13	3	0.13	4	2.88
OHL2	0.19	1	0.13	4	0.19	3	0.13	3	0.13	3	0.13	3	0.13	4	2.88
OHS1	0.14	2	0.07	2	0.14	3	0.14	1	0.14	2	0.21	1	0.14	2	1.79
OHS2	0.20	2	0.07	2	0.13	3	0.13	1	0.13	2	0.20	1	0.13	2	1.80
OHS3	0.17	1	0.17	7	0.22	7	0.11	3	0.11	3	0.11	1	0.11	2	3.89
OJC1	0.14	2	0.21	8	0.14	2	0.07	10	0.14	8	0.14	4	0.14	2	5.00
OLA1	0.20	1	0.20	2	0.15	5	0.10	3	0.15	3	0.10	1	0.10	4	2.60
OLC1	0.20	4	0.10	2	0.10	1	0.20	2	0.10	0	0.20	2	0.10	0	1.90
OLC2	0.18	3	0.18	2	0.09	1	0.18	2	0.09	1	0.18	5	0.09	0	2.36
OPTR1	0.27	0	0.07	2	0.27	8	0.00	NR	0.13	2	0.13	4	0.13	2	3.33
ORF1	0.25	3	0.08	1	0.08	1	0.17	1	0.17	1	0.17	1	0.08	2	1.58
ORP1	0.14	3	0.14	2	0.14	3	0.14	2	0.14	2	0.14	1	0.14	2	2.14
ORP2	0.19	1	0.13	2	0.19	3	0.13	3	0.13	3	0.13	1	0.13	2	2.13
ORPS1	0.22	0	0.06	1	0.22	6	0.00	NR	0.22	1	0.11	0	0.17	2	1.94
ORVD1	0.15	3	0.15	2	0.08	1	0.15	2	0.15	1	0.15	5	0.15	2	2.38
ORVD2	0.18	1	0.12	2	0.18	6	0.12	2	0.18	2	0.12	1	0.12	4	2.65
ORVD3	0.17	1	0.11	6	0.22	7	0.11	2	0.17	2	0.11	1	0.11	4	3.50
OSD1	0.15	3	0.15	2	0.08	0	0.15	2	0.15	2	0.15	1	0.15	2	1.85
OSD2	0.15	3	0.15	2	0.08	0	0.15	2	0.15	2	0.15	1	0.15	2	1.85
OSL1	0.22	1	0.17	2	0.17	3	0.11	1	0.11	2	0.11	1	0.11	4	1.94
OSL2	0.22	0	0.17	2	0.17	3	0.11	1	0.11	2	0.11	1	0.11	4	1.72
OSP1	0.14	3	0.14	2	0.14	3	0.14	2	0.14	2	0.14	1	0.14	2	2.14
OSP2	0.19	3	0.13	2	0.19	5	0.13	2	0.13	2	0.13	1	0.13	4	2.88
OSP3	0.14	3	0.14	2	0.14	3	0.14	2	0.14	2	0.14	1	0.14	2	2.14
OSV1	0.10	7	0.20	8	0.15	2	0.20	1	0.15	5	0.15	7	0.05	2	4.70
OSW1	0.27	0	0.09	6	0.27	4	0.00	0	0.09	0	0.09	0	0.18	2	2.00
OTB1	0.20	7	0.20	4	0.20	3	0.00	0	0.10	1	0.10	4	0.20	2	3.70

Table B-12 (Page 1 of 8). Quantification of Operator Group 1 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 1
Action Grouping Logic: A - All PSFs Equally Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.14	1.0E+00	0.00
OHL1	0.14	3	0.14	4	0.14	3	0.14	0	0.14	6	0.14	1	0.14	4	3.00	9.5E-05	-4.02
OLC2	0.14	5	0.14	4	0.14	1	0.14	0	0.14	3	0.14	2	0.14	2	2.43	4.0E-05	-4.40
OF2	0.14	8	0.14	4	0.14	3	0.14	1	0.14	5	0.14	5	0.14	4	4.29	6.6E-04	-3.18
ORF1	0.14	4	0.14	5	0.14	1	0.14	1	0.14	4	0.14	1	0.14	4	2.86	7.7E-05	-4.12
OCRD1	0.14	5	0.14	4	0.14	1	0.14	0	0.14	2	0.14	3	0.14	2	2.43	4.0E-05	-4.40
OLC1	0.14	4	0.14	4	0.14	1	0.14	0	0.14	3	0.14	2	0.14	2	2.29	3.2E-05	-4.49
OPTR1	0.14	4	0.14	2	0.14	4	0.14	0	0.14	3	0.14	8	0.14	3	3.43	1.8E-04	-3.74
OHS2	0.14	4	0.14	4	0.14	3	0.14	7	0.14	3	0.14	1	0.14	6	4.00	4.3E-04	-3.37
OOCW1	0.14	3	0.14	3	0.14	1	0.14	0	0.14	1	0.14	1	0.14	1	1.43	8.9E-06	-5.05
OHC1	0.14	3	0.14	4	0.14	3	0.14	0	0.14	6	0.14	1	0.14	4	3.00	9.5E-05	-4.02
OSP1	0.14	4	0.14	4	0.14	3	0.14	0	0.14	1	0.14	1	0.14	1	2.00	2.1E-05	-4.68
OHC2	0.14	3	0.14	4	0.14	3	0.14	0	0.14	5	0.14	1	0.14	4	2.86	7.7E-05	-4.12
OSV1	0.14	2	0.14	3	0.14	2	0.14	1	0.14	2	0.14	4	0.14	3	2.43	4.0E-05	-4.40
OHC3	0.14	3	0.14	4	0.14	3	0.14	0	0.14	5	0.14	1	0.14	4	2.86	7.7E-05	-4.12
ORVD3	0.14	9	0.14	9	0.14	7	0.14	7	0.14	7	0.14	1	0.14	6	6.57	2.1E-02	-1.68
OBC1	0.14	4	0.14	7	0.14	1	0.14	0	0.14	7	0.14	1	0.14	4	3.43	1.8E-04	-3.74
OSP3	0.14	4	0.14	4	0.14	1	0.14	0	0.14	1	0.14	1	0.14	1	1.71	1.4E-05	-4.87
OCRD2	0.14	6	0.14	4	0.14	1	0.14	0	0.14	2	0.14	3	0.14	2	2.57	5.0E-05	-4.30
OF1	0.14	4	0.14	4	0.14	1	0.14	0	0.14	3	0.14	5	0.14	4	3.00	9.5E-05	-4.02
ORP1	0.14	4	0.14	4	0.14	1	0.14	0	0.14	1	0.14	1	0.14	1	1.71	1.4E-05	-4.87
OSD1	0.14	4	0.14	4	0.14	1	0.14	0	0.14	1	0.14	1	0.14	1	1.71	1.4E-05	-4.87
OHL2	0.14	3	0.14	4	0.14	3	0.14	0	0.14	6	0.14	1	0.14	3	2.86	7.7E-05	-4.12
MIN															0	1.0E-06	-5.99
Calibration Actions																	
Seabrook, ON	0.16	0	0.14	0	0.14	2	0.17	1	0.14	0	0.17	0	0.08	0	0.45	1.0E-06	-6.00
Oyster Crk ZHEMU1	0.17	7	0.13	5	0.15	2	0.18	5	0.12	5	0.15	4	0.10	6	4.84	1.3E-03	-2.89
Big Rock BR18B	0.17	5	0.12	5	0.13	5	0.17	5	0.12	5	0.12	5	0.17	6	5.17	1.0E-02	-2.00
STP HE0003	0.14	6	0.14	6	0.15	8	0.14	5	0.15	6	0.14	6	0.14	9	6.58	3.0E-02	-1.52
Limerick L4B	0.17	10	0.12	9	0.13	10	0.17	10	0.12	9	0.12	9	0.17	10	9.64	9.0E-01	-0.05

Regression Output:

Constant	-5.98
Std Err of Y Est	0.455
R Squared	0.968
No. of Observations	5
Degrees of Freedom	3
X Coefficient(s)	0.6555
Std Err of Coef.	0.0685

Table B-12 (Page 2 of 8). Quantification of Operator Group 1 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 1
Action Grouping Logic: B - Time Important, Procedures Not Important

Action Code	Preceding & Other Actions Weight	Preceding & Other Actions Score	Plant Interfaces Weight	Plant Interfaces Score	Time Adequacy Weight	Time Adequacy Score	Procedures Weight	Procedures Score	Complexity Weight	Complexity Score	Training & Experience Weight	Training & Experience Score	Stress Weight	Stress Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.83	1.0E+00	0.00
OF3	0.18	4	0.18	4	0.18	1	0.00	8	0.18	4	0.09	9	0.18	4	3.91	2.2E-03	-2.65
ORPS1	0.13	2	0.13	0	0.27	1	0.07	0	0.13	2	0.13	1	0.13	2	1.20	1.4E-04	-3.86
MIN															0.00	4.0E-05	-4.40
Calibration Actions																	
Fermi HERS1	0.13	7	0.13	2	0.25	4	0.10	3	0.13	2	0.13	2	0.13	6	3.77	5.3E-04	-3.28
DC Cook ZHEOX1	0.13	1	0.13	2	0.25	7	0.10	2	0.13	5	0.13	3	0.13	6	4.16	3.2E-03	-2.49
Oyster Crk ZHEME2	0.14	4	0.21	9	0.20	5	0.08	3	0.11	2	0.16	4	0.10	4	4.95	2.9E-02	-1.54
EST_MAX															10.00	9.0E-01	-0.05

Regression Output:

Constant	-4.40
Std Err of Y Est	0.613
R Squared	0.870
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	0.4480
Std Err of Coef.	0.1222

Table B-12 (Page 3 of 8). Quantification of Operator Group 1 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 1
Action Grouping Logic: C - Interface and Complexity Important

Action Code	Preceding & Other Actions Weight	Preceding & Other Actions Score	Plant Interfaces Weight	Plant Interfaces Score	Time Adequacy Weight	Time Adequacy Score	Procedures Weight	Procedures Score	Complexity Weight	Complexity Score	Training & Experience Weight	Training & Experience Score	Stress Weight	Stress Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	9.7E-01	-0.01
OF4	0.13	0	0.19	7	0.13	4	0.13	1	0.19	8	0.13	1	0.13	2	3.81	1.4E-03	-2.85
OHS3	0.13	4	0.19	7	0.13	3	0.13	0	0.19	7	0.13	1	0.13	2	3.88	1.5E-03	-2.82
OBD1	0.13	3	0.19	7	0.13	2	0.13	0	0.19	7	0.13	1	0.13	2	3.63	1.2E-03	-2.94
OOWS1	0.18	6	0.18	7	0.12	7	0.12	7	0.18	8	0.12	1	0.12	6	6.18	1.7E-02	-1.77
OHS1	0.13	1	0.19	8	0.13	7	0.13	7	0.19	8	0.13	3	0.13	6	6.00	1.4E-02	-1.85
ORP2	0.17	7	0.17	7	0.11	7	0.11	7	0.17	9	0.11	3	0.17	8	7.06	4.3E-02	-1.36
OHC4	0.13	3	0.19	8	0.13	5	0.13	0	0.19	8	0.13	1	0.13	4	4.63	3.3E-03	-2.48
OLA1	0.18	8	0.18	8	0.12	7	0.12	7	0.18	8	0.12	3	0.12	6	6.94	3.8E-02	-1.42
OSP2	0.19	6	0.13	6	0.13	5	0.13	7	0.19	7	0.13	1	0.13	6	5.56	8.9E-03	-2.05
OOWS2	0.17	7	0.17	8	0.11	8	0.11	7	0.17	9	0.11	1	0.17	8	7.11	4.6E-02	-1.34
MIN															0.00	2.5E-05	-4.60
Calibration Actions																	
Plant B MSOB*	0.00	0	0.29	0	0.14	0	0.00	0	0.14	1	0.29	1	0.14	1	0.57	7.8E-05	-4.11
Oyster Crk ZHEMU1	0.17	7	0.13	5	0.15	2	0.18	5	0.12	5	0.15	4	0.10	6	4.84	1.3E-03	-2.89
STP HE0003	0.14	6	0.14	6	0.15	8	0.14	5	0.15	6	0.14	6	0.14	9	6.58	3.0E-02	-1.52
Big Rock BR20B	0.11	7	0.22	8	0.11	7	0.22	8	0.11	7	0.11	8	0.12	8	7.67	1.0E-01	-1.00
Limerick L4B	0.17	10	0.12	9	0.13	10	0.17	10	0.12	9	0.12	9	0.17	10	9.64	9.0E-01	-0.05

* Plant B MSOB selected as a calibration action because of its high weight for the Plant Interfaces PSF and its low FLI. No other suitable actions were available in that range.

Regression Output:

Constant	-4.59
Std Err of Y Est	0.335
R Squared	0.967
No. of Observations	5
Degrees of Freedom	3
X Coefficient(s)	0.4584
Std Err of Coef.	0.0488

Table B-12 (Page 4 of 8). Quantification of Operator Group 1 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 1
Action Grouping Logic: D - Actions Important (quantified with wrong set of calibration actions)

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	6.7E-01	-0.18
OSL1	0.20	5	0.13	4	0.13	4	0.13	7	0.13	2	0.13	3	0.13	6	4.47	4.0E-03	-2.40
OAL1	0.20	6	0.13	7	0.13	5	0.13	7	0.13	8	0.13	3	0.13	6	6.00	1.6E-02	-1.78
OAL2	0.20	6	0.13	7	0.13	5	0.13	7	0.13	8	0.13	3	0.13	6	6.00	1.6E-02	-1.78
ORVD2	0.20	8	0.13	5	0.13	6	0.13	7	0.13	5	0.13	1	0.13	6	5.60	1.1E-02	-1.94
ORVD1	0.20	7	0.13	5	0.13	6	0.13	1	0.13	5	0.13	1	0.13	1	3.93	2.4E-03	-2.61
OSL2	0.20	7	0.13	6	0.13	6	0.13	7	0.13	2	0.13	3	0.13	6	5.40	9.5E-03	-2.02
MIN															0.00	6.4E-05	-4.19
Calibration Actions																	
Big Rock BR5	0.11	5	0.22	6	0.07	5	0.11	5	0.16	6	0.22	6	0.11	6	5.71	1.4E-02	-1.85
Crystal River	0.11	9	0.22	9	0.07	9	0.16	9	0.11	8	0.22	9	0.11	9	8.89	1.6E-01	-0.80
EST_MAX															10.00	9.0E-01	-0.05

The above median values were used as this group's evaluations to quantify the indicated actions for use in the plant model. The actions shown were inadvertently used to calibrate the quantification curve, and the error was not discovered until the final review of the documentation. The corrected median values quantified with the proper calibration actions are given on the next sheet. The differences between the two sets of median values are not considered significant to the risk assessment.

Regression Output:

Constant	-4.19
Std Err of Y Est	0.222
R Squared	0.970
No. of Observations	3
Degrees of Freedom	1
X Coefficient(s)	0.4018
Std Err of Coef.	0.0705

Table B-12 (Page 5 of 8). Quantification of Operator Group 1 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 1
Action Grouping Logic: D - Actions Important (corrected calibration actions)

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.27	1.0E+00	0.00
OSL1	0.20	5	0.13	4	0.13	4	0.13	7	0.13	2	0.13	3	0.13	6	4.47	2.7E-03	-2.57
OAL1	0.20	6	0.13	7	0.13	5	0.13	7	0.13	8	0.13	3	0.13	6	6.00	1.8E-02	-1.75
OAL2	0.20	6	0.13	7	0.13	5	0.13	7	0.13	8	0.13	3	0.13	6	6.00	1.8E-02	-1.75
ORVD2	0.20	8	0.13	5	0.13	6	0.13	7	0.13	5	0.13	1	0.13	6	5.60	1.1E-02	-1.96
ORVD1	0.20	7	0.13	5	0.13	6	0.13	1	0.13	5	0.13	1	0.13	1	3.93	1.4E-03	-2.85
OSL2	0.20	7	0.13	6	0.13	6	0.13	7	0.13	2	0.13	3	0.13	6	5.40	8.5E-03	-2.07
MIN															0.00	1.1E-05	-4.96
Calibration Actions																	
ANO 1 IREP A2	0.24	2	0.12	2	0.24	3	0.00	0	0.16	2	0.12	2	0.12	2	2.24	1.0E-04	-4.00
DC Cook ZHEOB1	0.24	5	0.12	7	0.12	6	0.12	7	0.14	4	0.12	6	0.14	8	6.00	5.5E-02	-1.26
Limerick L4B	0.17	10	0.12	9	0.13	10	0.17	10	0.12	9	0.12	9	0.17	10	9.64	9.0E-01	-0.05

* The impact of the correction of calibration actions is minimal. All median HER's except OAL1 and OAL2 declined. Actions OAL1 and OAL2 increased slightly from 1.6E-02 to 1.8E-02. With the assigned range factor of 5, this change is considered insignificant. The original quantification has not been changed.

Regression Output:

Constant	-4.95
Std Err of Y Est	0.596
R Squared	0.956
No. of Observations	3
Degrees of Freedom	1
X Coefficient(s)	0.5354
Std Err of Coef.	0.1140

Table B-12 (Page 6 of 8). Quantification of Operator Group 1 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 1
Action Grouping Logic: E - Complexity Important

Action Code	Preceding & Other Actions Weight	Preceding & Other Actions Score	Plant Interfaces Weight	Plant Interfaces Score	Time Adequacy Weight	Time Adequacy Score	Procedures Weight	Procedures Score	Complexity Weight	Complexity Score	Training & Experience Weight	Training & Experience Score	Stress Weight	Stress Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	8.3E-01	-0.08
OAD2	0.13	2	0.13	3	0.13	1	0.13	1	0.25	2	0.13	1	0.13	4	2.00	6.0E-04	-3.22
OJC1	0.13	6	0.13	4	0.13	2	0.13	8	0.20	8	0.13	9	0.13	5	6.13	2.5E-02	-1.60
OAD1	0.13	2	0.13	3	0.13	1	0.13	1	0.25	2	0.13	1	0.13	4	2.00	6.0E-04	-3.22
MIN															0.00	9.9E-05	-4.00
Calibration Actions																	
DC Cook ZHEOS1	0.11	2	0.11	2	0.22	3	0.11	5	0.23	1	0.11	5	0.11	4	2.87	1.5E-03	-2.82
Big Rock BR5	0.11	5	0.22	6	0.07	5	0.11	5	0.16	6	0.22	6	0.11	6	5.71	1.4E-02	-1.85
EST_MAX															10.00	9.0E-01	-0.05

Regression Output:

Constant	-4.00
Std Err of Y Est	0.110
R Squared	0.996
No. of Observations	3
Degrees of Freedom	1
X Coefficient(s)	0.3922
Std Err of Coef.	0.0218

Table B-12 (Page 7 of 8). Quantification of Operator Group 1 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 1
Action Grouping Logic: F - Complexity and Training Important

Action Code	Preceding & Other Actions Weight	Preceding & Other Actions Score	Plant Interfaces Weight	Plant Interfaces Score	Time Adequacy Weight	Time Adequacy Score	Procedures Weight	Procedures Score	Complexity Weight	Complexity Score	Training & Experience Weight	Training & Experience Score	Stress Weight	Stress Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	6.4E-01	-0.19
OFT1	0.14	4	0.14	2	0.14	3	0.00	1	0.14	2	0.29	2	0.14	0	2.14	1.7E-04	-3.76
OTB1	0.11	1	0.11	4	0.11	4	0.11	0	0.22	2	0.22	0	0.11	3	1.78	1.2E-04	-3.92
OSW1	0.11	2	0.11	3	0.11	1	0.11	0	0.22	0	0.22	0	0.11	4	1.11	5.9E-05	-4.23
MIN															0.00	1.9E-05	-4.73
Calibration Actions*																	
Plant B MSOB	0.00	0	0.29	0	0.14	0	0.00	0	0.14	1	0.29	1	0.14	1	0.57	7.8E-05	-4.11
Diablo Cyn ZHERT1	0.00	0	0.29	3	0.14	4	0.00	0	0.14	4	0.29	3	0.14	4	3.42	3.0E-04	-3.52
Fermi OF1	0.00	5	0.29	3	0.14	5	0.00	7	0.14	8	0.29	4	0.14	6	4.69	8.8E-04	-3.06
Big Rock BR5	0.11	5	0.22	6	0.07	5	0.11	5	0.16	6	0.22	6	0.11	6	5.71	1.4E-02	-1.85
EST_MAX															10.00	9.0E-01	-0.05

* Available calibration actions with a high weight for the training PSF also had a high weight for the Plant Interfaces PSF. This set of calibration actions was used as a best available fit for the weight profile of the above group of actions.

Regression Output:

Constant	-4.73
Std Err of Y Est	0.431
R Squared	0.946
No. of Observations	5
Degrees of Freedom	3

X Coefficient(s) 0.4539
Std Err of Coef. 0.0625

Table B-12 (Page 8 of 8). Quantification of Operator Group 1 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 1
Action Grouping Logic: G - Procedures Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	8.1E-01	-0.09
OSD2	0.13	4	0.13	4	0.13	1	0.20	0	0.13	1	0.13	1	0.13	1	1.60	8.3E-04	-3.08
MIN															0.00	2.2E-04	-3.65
Calibration Actions																	
Grand Gulf GG3	0.11	2	0.22	2	0.11	2	0.22	3	0.11	2	0.11	3	0.12	2	2.33	1.5E-03	-2.82
Indian Pt IP12	0.17	3	0.12	4	0.13	3	0.17	4	0.12	4	0.12	4	0.17	4	3.70	5.0E-03	-2.30
Big Rock BR20B	0.11	7	0.22	8	0.11	7	0.22	8	0.11	7	0.11	8	0.12	8	7.67	1.0E-01	-1.00
EST_MAX															10.00	9.0E-01	-0.05

Regression Output:	
Constant	-3.64
Std Err of Y Est	0.068
R Squared	0.998
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	0.3555
Std Err of Coef.	0.0112

Table B-13 (Page 1 of 8). Quantification of Operator Group 2 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 2
Action Grouping Logic: A

Action Code	Preceding & Other Actions Weight	Preceding & Other Actions Score	Plant Interfaces Weight	Plant Interfaces Score	Time Adequacy Weight	Time Adequacy Score	Procedures Weight	Procedures Score	Complexity Weight	Complexity Score	Training & Experience Weight	Training & Experience Score	Stress Weight	Stress Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.14	1.0E+00	0.00
OLA1	0.09	8	0.17	8	0.13	7	0.13	6	0.13	9	0.17	7	0.17	8	7.57	9.3E-02	-1.03
ORP1	0.14	3	0.14	3	0.14	3	0.14	2	0.14	2	0.14	1	0.14	4	2.57	5.0E-05	-4.30
OLC1	0.14	4	0.14	2	0.14	2	0.14	4	0.14	3	0.14	4	0.14	3	3.14	1.2E-04	-3.93
OAL1	0.14	5	0.14	6	0.14	7	0.14	6	0.14	8	0.14	3	0.14	8	6.14	1.1E-02	-1.96
ORF1	0.15	4	0.15	3	0.15	3	0.08	4	0.15	2	0.15	1	0.15	3	2.77	6.7E-05	-4.17
OLC2	0.14	4	0.14	2	0.14	2	0.14	4	0.14	3	0.14	4	0.14	3	3.14	1.2E-04	-3.93
OAL2	0.12	5	0.18	6	0.18	7	0.12	6	0.12	8	0.12	3	0.18	8	6.29	1.4E-02	-1.86
ORVD2	0.14	4	0.14	3	0.14	4	0.14	6	0.14	2	0.14	3	0.14	4	3.71	2.8E-04	-3.55
OHS3	0.12	3	0.18	8	0.18	5	0.12	6	0.12	8	0.12	4	0.18	5	5.65	5.2E-03	-2.29
OOWS1	0.14	3	0.14	2	0.14	3	0.14	5	0.14	3	0.14	4	0.14	4	3.43	1.8E-04	-3.74
OF1	0.14	4	0.14	2	0.14	0	0.14	2	0.14	2	0.14	3	0.14	4	2.43	4.0E-05	-4.40
OBC1	0.14	4	0.14	4	0.14	2	0.14	3	0.14	6	0.14	4	0.14	5	4.00	4.3E-04	-3.37
OHL1	0.14	5	0.14	4	0.14	2	0.14	4	0.14	6	0.14	6	0.14	6	4.71	1.3E-03	-2.90
OHL2	0.14	5	0.14	4	0.14	7	0.14	7	0.14	6	0.14	5	0.14	6	5.71	5.7E-03	-2.24
OCRD2	0.18	5	0.18	5	0.12	3	0.12	2	0.12	2	0.12	4	0.18	4	3.76	3.0E-04	-3.52
OHS2	0.08	1	0.15	2	0.15	3	0.15	2	0.15	3	0.15	3	0.15	2	2.38	3.8E-05	-4.43
ORVD1	0.14	3	0.14	2	0.14	3	0.14	4	0.14	7	0.14	3	0.14	2	3.43	1.8E-04	-3.74
OOWS2	0.18	7	0.18	6	0.12	4	0.12	5	0.12	2	0.12	4	0.18	5	4.94	1.8E-03	-2.75
ORP2	0.11	3	0.17	6	0.17	6	0.11	6	0.17	7	0.11	4	0.17	4	5.28	3.0E-03	-2.53
ORVD3	0.10	9	0.10	9	0.15	8	0.15	6	0.15	8	0.15	4	0.20	8	7.30	6.3E-02	-1.20
MIN															0	1.0E-06	-5.99
Calibration Actions																	
Seabrook, OH	0.16	0	0.14	0	0.14	2	0.17	1	0.14	0	0.17	0	0.08	0	0.45	1.0E-06	-6.00
Oyster Crk ZHEMU1	0.17	7	0.13	5	0.15	2	0.18	5	0.12	5	0.15	4	0.10	6	4.84	1.3E-03	-2.89
Big Rock BR18B	0.17	5	0.12	5	0.13	5	0.17	5	0.12	5	0.12	5	0.17	6	5.17	1.0E-02	-2.00
STP HE0003	0.14	6	0.14	6	0.15	8	0.14	5	0.15	6	0.14	6	0.14	9	6.58	3.0E-02	-1.52
Limerick L4B	0.17	10	0.12	9	0.13	10	0.17	10	0.12	9	0.12	9	0.17	10	9.64	9.0E-01	-0.05

Regression Output:

Constant	-5.98
Std Err of Y Est	0.455
R Squared	0.968
No. of Observations	5
Degrees of Freedom	3
X Coefficient(s)	0.6555
Std Err of Coef.	0.0685

Table B-13 (Page 2 of 8). Quantification of Operator Group 2 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 2
Action Grouping Logic: B - Time Important, Procedures Not Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.83	1.0E+00	0.00
OTB1	0.15	4	0.15	2	0.23	2	0.00	0	0.15	2	0.15	2	0.15	3	2.46	5.0E-04	-3.30
OSW1	0.17	4	0.17	2	0.17	2	0.00	0	0.17	2	0.17	2	0.17	2	2.33	4.4E-04	-3.36
ORPS1	0.09	3	0.09	2	0.36	6	0.00	0	0.18	2	0.18	1	0.09	4	3.55	1.5E-03	-2.81
OSP2	0.17	5	0.17	3	0.17	3	0.00	0	0.17	2	0.17	1	0.17	5	3.17	1.0E-03	-2.98
OSL1	0.13	5	0.13	7	0.20	8	0.07	2	0.13	2	0.20	3	0.13	5	4.87	6.0E-03	-2.22
OF2	0.14	4	0.14	2	0.21	5	0.07	6	0.14	4	0.14	4	0.14	4	4.07	2.6E-03	-2.58
OSL2	0.13	5	0.13	7	0.27	10	0.07	2	0.13	2	0.20	3	0.07	5	5.60	1.3E-02	-1.89
MIN															0.00	4.0E-05	-4.40
Calibration Actions																	
Fermi HERS1	0.13	7	0.13	2	0.25	4	0.10	3	0.13	2	0.13	2	0.13	6	3.77	5.3E-04	-3.28
DC Cook ZHEOX1	0.13	1	0.13	2	0.25	7	0.10	2	0.13	5	0.13	3	0.13	6	4.16	3.2E-03	-2.49
Oyster Crk ZHEME2	0.14	4	0.21	9	0.20	5	0.08	3	0.11	2	0.16	4	0.10	4	4.95	2.9E-02	-1.54
EST_MAX															10.0	9.0E-01	-0.05

Regression Output:

Constant	-4.40
Std Err of Y Est	0.613
R Squared	0.870
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	0.4480
Std Err of Coef.	0.1222

Table B-13 (Page 3 of 8). Quantification of Operator Group 2 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 2
Action Grouping Logic: D - Training Important, Time Not Important

Action Code	Preceding & Other Actions Weight	Preceding & Other Actions Score	Plant Interfaces Weight	Plant Interfaces Score	Time Adequacy Weight	Time Adequacy Score	Procedures Weight	Procedures Score	Complexity Weight	Complexity Score	Training & Experience Weight	Training & Experience Score	Stress Weight	Stress Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	6.7E-01	-0.18
OAD2	0.14	3	0.14	5	0.07	2	0.14	1	0.14	2	0.14	1	0.21	4	2.71	7.9E-04	-3.10
OSD1	0.20	2	0.13	4	0.07	2	0.13	3	0.13	6	0.20	4	0.13	4	3.60	1.8E-03	-2.75
OSD2	0.20	2	0.13	2	0.07	2	0.13	3	0.13	6	0.20	4	0.13	4	3.33	1.4E-03	-2.85
OHC4	0.15	3	0.15	8	0.08	4	0.15	6	0.15	8	0.15	4	0.15	6	5.69	1.2E-02	-1.91
OAD1	0.14	3	0.14	5	0.07	2	0.14	1	0.14	2	0.14	1	0.21	4	2.71	7.9E-04	-3.10
OCRD1	0.15	4	0.15	2	0.08	3	0.15	2	0.15	2	0.15	4	0.15	4	3.00	1.0E-03	-2.99
OF4	0.13	5	0.19	8	0.06	2	0.13	6	0.13	8	0.19	4	0.19	5	5.69	1.2E-02	-1.91
MIN															0.00	6.4E-05	-4.19
Calibration Actions																	
Big Rock BR5	0.11	5	0.22	6	0.07	5	0.11	5	0.16	6	0.22	6	0.11	6	5.71	1.4E-02	-1.85
Crystal River	0.11	9	0.22	9	0.07	9	0.16	9	0.11	8	0.22	9	0.11	9	8.89	1.6E-01	-0.80
EST_MAX															10.00	9.0E-01	-0.05

Regression Output:

Constant	-4.19
Std Err of Y Est	0.222
R Squared	0.970
No. of Observations	3
Degrees of Freedom	1
X Coefficient(s)	0.4018
Std Err of Coef.	0.0705

TABLEB13.BFN:07/09/92

Table B-13 (Page 4 of 8). Quantification of Operator Group 2 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 2
Action Grouping Logic: E - Interface and Complexity Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	5.7E-01	-0.24
OHC3	0.07	2	0.20	2	0.13	2	0.13	3	0.20	7	0.13	4	0.13	2	3.40	2.9E-03	-2.54
OJC1	0.07	8	0.21	8	0.14	2	0.14	10	0.21	8	0.07	9	0.14	2	6.64	3.9E-02	-1.41
MIN															0.00	1.9E-04	-3.73
Calibration Actions																	
Grand Gulf GG3	0.11	2	0.22	2	0.11	2	0.22	3	0.11	2	0.11	3	0.12	2	2.33	1.5E-03	-2.82
Big Rock BR5	0.11	5	0.22	6	0.07	5	0.11	5	0.16	6	0.22	6	0.11	6	5.71	1.4E-02	-1.85
Crystal River	0.11	9	0.22	9	0.07	9	0.16	9	0.11	8	0.22	9	0.11	9	8.89	1.6E-01	-0.80
EST_MAX															10.00	9.0E-01	-0.05

Regression Output:

Constant	-3.72
Std Err of Y Est	0.210
R Squared	0.980
No. of Observations	4
Degrees of Freedom	2

X Coefficient(s) 0.3484
Std Err of Coef. 0.0351

TABLEB13.BFN.07/09/92

Table B-13 (Page 5 of 8). Quantification of Operator Group 2 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 2
Action Grouping Logic: H - Training Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.19	1.0E+00	0.00
OSP3	0.14	3	0.14	2	0.14	2	0.14	2	0.07	2	0.21	1	0.14	2	1.93	3.2E-05	-4.50
OSP1	0.14	3	0.14	2	0.14	2	0.14	2	0.07	2	0.21	1	0.14	2	1.93	3.2E-05	-4.50
MIN															0.00	2.0E-06	-5.69
Calibration Actions																	
Seabrook, ON	0.16	0	0.14	0	0.14	2	0.17	1	0.14	0	0.17	0	0.08	0	0.45	1.0E-06	-6.00
Big Rock L2C	0.11	4	0.22	4	0.07	5	0.11	4	0.16	4	0.22	4	0.11	4	4.07	1.0E-03	-3.00
Browns Ferry BF9	0.11	5	0.20	5	0.11	5	0.16	5	0.11	5	0.22	5	0.09	5	5.00	2.1E-02	-1.68
EST_MAX															10.00	1.0E+00	0.00

Regression Output:

Constant	-5.69
Std Err of Y Est	0.856
R Squared	0.924
No. of Observations	4
Degrees of Freedom	2

X Coefficient(s) 0.6194
Std Err of Coef. 0.1255

Table B-13 (Page 6 of 8). Quantification of Operator Group 2 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 2
Action Grouping Logic: I - Interfaces Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	9.6E-01	-0.02
OHS1	0.13	4	0.20	4	0.13	3	0.13	1	0.13	2	0.13	1	0.13	4	2.80	6.9E-04	-3.16
OHC1	0.07	2	0.21	2	0.14	2	0.14	3	0.14	7	0.14	4	0.14	2	3.14	9.7E-04	-3.01
OHC2	0.07	2	0.21	2	0.14	2	0.14	3	0.14	7	0.14	4	0.14	2	3.14	9.7E-04	-3.01
OOCW1	0.13	5	0.20	4	0.13	4	0.13	4	0.13	2	0.13	4	0.13	4	3.87	2.0E-03	-2.70
MIN															0.00	4.1E-05	-4.39
Calibration Actions																	
Plant B MSOB*	0.00	0	0:29	0	0.14	0	0.00	0	0.14	1	0.29	1	0.14	1	0.57	7.8E-05	-4.11
Fermi OF1*	0.00	5	0.29	3	0.14	5	0.00	7	0.14	8	0.29	4	0.14	6	4.69	8.8E-04	-3.06
Oyster Crk ZHEME2	0.14	4	0.21	9	0.20	5	0.08	3	0.11	2	0.16	4	0.10	4	4.95	2.9E-02	-1.54
Big Rock BR20B	0.11	7	0.22	8	0.11	7	0.22	8	0.11	7	0.11	8	0.12	8	7.67	1.0E-01	-1.00
EST_MAX															10.00	9.0E-01	-0.05

* Plant B MSOB and Fermi OF1 calibration actions were used because of their high weights in the Plant Interface PSF and the fact that all the actions being evaluated are in the low FLI range.

Regression Output:	
Constant	-4.38
Std Err of Y Est	0.574
R Squared	0.906
No. of Observations	5
Degrees of Freedom	3
X Coefficient(s)	0.4370
Std Err of Coef.	0.0810

Table B-13 (Page 7 of 8). Quantification of Operator Group 2 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 2
Action Grouping Logic: J - Time and Stress Important, Procedures and Complexity Not Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.68	1.0E+00	0.00
OPTR	0.09	1	0.18	1	0.27	6	0.00	0	0.00	0	0.18	3	0.27	3	3.27	1.8E-03	-2.76
OFT1	0.17	3	0.17	2	0.25	6	0.00	0	0.08	4	0.17	1	0.17	4	3.50	2.2E-03	-2.66
MIN															0.00	6.9E-05	-4.16
Calibration Actions																	
Plant B MSOB	0.00	0	0.29	0	0.14	0	0.00	0	0.14	1	0.29	1	0.14	1	0.57	7.8E-05	-4.11
DC Cook ZHEOX1	0.13	1	0.13	2	0.25	7	0.10	2	0.13	5	0.13	3	0.13	6	4.16	3.2E-03	-2.49
Oyster Crk ZHEME2	0.14	4	0.21	9	0.20	5	0.08	3	0.11	2	0.16	4	0.10	4	4.95	2.9E-02	-1.54
EST_MAX															10.00	9.0E-01	-0.05

Regression Output:

Constant	-4.16
Std Err of Y Est	0.406
R Squared	0.962
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	0.4301
Std Err of Coef.	0.0604

TABLEB13.BFN.07/09/92

Table B-13 (Page 8 of 8). Quantification of Operator Group 2 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 2
Action Grouping Logic: K - Time and Procedures Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.78	1.0E+00	0.00
OSV1	0.13	7	0.13	7	0.20	2	0.27	1	0.13	0	0.13	3	0.00	0	2.93	2.9E-04	-3.54
MIN															0.00	8.7E-06	-5.06
Calibration Actions*																	
Fermi OE1	0.22	6	0.12	4	0.22	4	0.12	4	0.12	4	0.12	5	0.08	4	4.56	2.6E-03	-2.59
Oyster Crk ZHEMU1	0.17	7	0.13	5	0.15	2	0.18	5	0.12	5	0.15	4	0.10	6	4.84	1.3E-03	-2.89
STP HEOR05	0.22	7	0.12	7	0.22	8	0.12	5	0.12	8	0.12	8	0.08	6	7.14	1.0E-01	-1.00
EST_MAX															10.00	9.0E-01	-0.05

* No calibation actions were available with both the Time and Procedures PSF's weighted high. This set of calibration actions was used as a best available fit for the weight profile of the above group of actions.

Regression Output:

Constant	-5.06
Std Err of Y Est	0.375
R Squared	0.947
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	0.5174
Std Err of Coef.	0.0858

Table B-14 (Page 1 of 9). Quantification of Operator Group 3 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 3
Action Grouping Logic: A - All PSFs Equally Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.14	1.0E+00	0.00
OSD2	0.15	3	0.15	2	0.08	0	0.15	2	0.15	2	0.15	1	0.15	2	1.85	1.7E-05	-4.78
OHC3	0.14	2	0.14	3	0.14	1	0.14	1	0.14	2	0.14	1	0.14	4	2.00	2.1E-05	-4.68
OSD1	0.15	3	0.15	2	0.08	0	0.15	2	0.15	2	0.15	1	0.15	2	1.85	1.7E-05	-4.78
ORP1	0.14	3	0.14	2	0.14	3	0.14	2	0.14	2	0.14	1	0.14	2	2.14	2.6E-05	-4.58
ORVD1	0.15	3	0.15	2	0.08	1	0.15	2	0.15	1	0.15	5	0.15	2	2.38	3.8E-05	-4.43
OOCW1	0.15	7	0.15	5	0.08	1	0.15	2	0.15	1	0.15	1	0.15	2	2.85	7.5E-05	-4.12
OSP3	0.14	3	0.14	2	0.14	3	0.14	2	0.14	2	0.14	1	0.14	2	2.14	2.6E-05	-4.58
OSP1	0.14	3	0.14	2	0.14	3	0.14	2	0.14	2	0.14	1	0.14	2	2.14	2.6E-05	-4.58
OHC2	0.14	2	0.14	3	0.14	1	0.14	1	0.14	3	0.14	1	0.14	4	2.14	2.6E-05	-4.58
OBC1	0.15	3	0.15	2	0.08	0	0.15	1	0.15	3	0.15	7	0.15	4	3.08	1.1E-04	-3.97
OHC1	0.14	2	0.14	3	0.14	1	0.14	1	0.14	3	0.14	1	0.14	4	2.14	2.6E-05	-4.58
MIN															0.00	1.0E-06	-5.99
Calibration Actions																	
Seabrook, ON	0.16	0	0.14	0	0.14	2	0.17	1	0.14	0	0.17	0	0.08	0	0.45	1.0E-06	-6.00
Oyster Crk ZHEMU1	0.17	7	0.13	5	0.15	2	0.18	5	0.12	5	0.15	4	0.10	6	4.84	1.3E-03	-2.89
Big Rock BR18B	0.17	5	0.12	5	0.13	5	0.17	5	0.12	5	0.12	5	0.17	6	5.17	1.0E-02	-2.00
STP HE0003	0.14	6	0.14	6	0.15	8	0.14	5	0.15	6	0.14	6	0.14	9	6.58	3.0E-02	-1.52
Limerick L4B	0.17	10	0.12	9	0.13	10	0.17	10	0.12	9	0.12	9	0.17	10	9.64	9.0E-01	-0.05

Regression Output:

Constant	-5.98
Std Err of Y Est	0.455
R Squared	0.968
No. of Observations	5
Degrees of Freedom	3

X Coefficient(s) 0.6555
Std Err of Coef. 0.0685

Table B-14 (Page 2 of 9). Quantification of Operator Group 3 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 3
Action Grouping Logic: B - Time and Actions Important, Procedures Not Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	1.2E+00	0.08
RPS1	0.22	0	0.06	1	0.22	6	0.00	0	0.22	1	0.11	0	0.17	2	1.94	2.9E-04	-3.53
OPTR1	0.27	0	0.07	2	0.27	8	0.00	0	0.13	2	0.13	4	0.13	2	3.33	1.2E-03	-2.91
OSW1	0.27	0	0.09	6	0.27	4	0.00	0	0.09	0	0.09	0	0.18	2	2.00	3.1E-04	-3.51
MIN															0.00	4.0E-05	-4.40
Calibration Actions*																	
Fermi HERS1	0.13	7	0.13	2	0.25	4	0.10	3	0.13	2	0.13	2	0.13	6	3.77	5.3E-04	-3.28
DC Cook ZHEOX1	0.13	1	0.13	2	0.25	7	0.10	2	0.13	5	0.13	3	0.13	6	4.16	3.2E-03	-2.49
Oyster Crk ZHEME2	0.14	4	0.21	9	0.20	5	0.08	3	0.11	2	0.16	4	0.10	4	4.95	2.9E-02	-1.54
EST_MAX															10.00	9.0E-01	-0.05

* No calibration actions were available with high PSF weights for both Time and Preceding and Concurrent Actions. The actions selected focused on time, while also considering the highest available weights in preceding actions as the second priority. This set of calibration actions was used as a best available fit for the weight profile of the above group of actions.

Regression Output:	
Constant	-4.40
Std Err of Y Est	0.613
R Squared	0.870
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	0.4480
Std Err of Coef.	0.1222

Table B-14 (Page 3 of 9). Quantification of Operator Group 3 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 3
Action Grouping Logic: D - Actions Important (quantified with wrong set of calibration actions)

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	6.7E-01	-0.18
ORF1	0.25	3	0.08	1	0.08	1	0.17	1	0.17	1	0.17	1	0.08	2	1.58	2.8E-04	-3.56
OLC1	0.20	4	0.10	2	0.10	1	0.20	2	0.10	0	0.20	2	0.10	0	1.90	3.7E-04	-3.43
OLC2	0.18	3	0.18	2	0.09	1	0.18	2	0.09	1	0.18	5	0.09	0	2.36	5.7E-04	-3.24
OCRD1	0.21	5	0.14	2	0.07	1	0.14	2	0.14	2	0.14	4	0.14	1	2.71	7.9E-04	-3.10
OF4	0.21	1	0.07	2	0.14	2	0.14	2	0.14	2	0.14	1	0.14	2	1.64	2.9E-04	-3.53
OCRD2	0.20	2	0.13	2	0.13	2	0.13	2	0.13	4	0.13	4	0.13	2	2.53	6.7E-04	-3.18
MIN															0.00	6.4E-05	-4.19
Calibration Actions																	
Big Rock BR5	0.11	5	0.22	6	0.07	5	0.11	5	0.16	6	0.22	6	0.11	6	5.71	1.4E-02	-1.85
Crystal River	0.11	9	0.22	9	0.07	9	0.16	9	0.11	8	0.22	9	0.11	9	8.89	1.6E-01	-0.80
EST_MAX															10.00	9.0E-01	-0.05

The above median values were used as this group's evaluations to quantify the indicated actions for use in the plant model. The actions shown were inadvertently used to calibrate the quantification curve, and the error was not discovered until the final review of the documentation. The corrected median values quantified with the proper calibration actions are given on the next sheet. The differences between the two sets of median values are not considered significant to the risk assessment.

Regression Output:	
Constant	-4.19
Std Err of Y Est	0.222
R Squared	0.970
No. of Observations	3
Degrees of Freedom	1
X Coefficient(s)	0.4018
Std Err of Coef.	0.0705

Table B-14 (Page 4 of 9). Quantification of Operator Group 3 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 3
Action Grouping Logic: D - Actions Important (corrected calibration actions)

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.27	1.0E+00	0.00
ORF1	0.25	3	0.08	1	0.08	1	0.17	1	0.17	1	0.17	1	0.08	2	1.58	7.7E-05	-4.11
OLC1	0.20	4	0.10	2	0.10	1	0.20	2	0.10	0	0.20	2	0.10	0	1.90	1.1E-04	-3.94
OLC2	0.18	3	0.18	2	0.09	1	0.18	2	0.09	1	0.18	5	0.09	0	2.36	2.0E-04	-3.69
OCRD1	0.21	5	0.14	2	0.07	1	0.14	2	0.14	2	0.14	4	0.14	1	2.71	3.1E-04	-3.51
OF4	0.21	1	0.07	2	0.14	2	0.14	2	0.14	2	0.14	1	0.14	2	1.64	8.3E-05	-4.08
OCRD2	0.20	2	0.13	2	0.13	2	0.13	2	0.13	4	0.13	4	0.13	2	2.53	2.5E-04	-3.60
MIN															0.00	1.1E-05	-4.96
Calibration Actions																	
ANO 1 IREP A2	0.24	2	0.12	2	0.24	3	0.00	0	0.16	2	0.12	2	0.12	2	2.24	1.0E-04	-4.00
DC Cook ZHEOB1	0.24	5	0.12	7	0.12	6	0.12	7	0.14	4	0.12	6	0.14	8	6.00	5.5E-02	-1.26
Limerick L4B	0.17	10	0.12	9	0.13	10	0.17	10	0.12	9	0.12	9	0.17	10	9.64	9.0E-01	-0.05

* The impact of the correction of calibration actions is minimal. All median HER's declined. The original quantification has not been changed.

Regression Output:

Constant	-4.95
Std Err of Y Est	0.596
R Squared	0.956
No. of Observations	3
Degrees of Freedom	1
X Coefficient(s)	0.5354
Std Err of Coef.	0.1140

Table B-14 (Page 5 of 9). Quantification of Operator Group 3 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 3
Action Grouping Logic: E - Complexity Inportant

Action Code	Preceding & Other Actions Weight	Preceding & Other Actions Score	Plant Interfaces Weight	Plant Interfaces Score	Time Adequacy Weight	Time Adequacy Score	Procedures Weight	Procedures Score	Complexity Weight	Complexity Score	Training & Experience Weight	Training & Experience Score	Stress Weight	Stress Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	8.3E-01	-0.08
OFT1	0.08	3	0.17	2	0.17	3	0.08	1	0.25	1	0.17	2	0.08	2	1.92	5.6E-04	-3.25
MIN															0.00	9.9E-05	-4.00
Calibration Actions																	
DC Cook ZHEOS1	0.11	2	0.11	2	0.22	3	0.11	5	0.23	1	0.11	5	0.11	4	2.87	1.5E-03	-2.82
Big Rock BR5	0.11	5	0.22	6	0.07	5	0.11	5	0.16	6	0.22	6	0.11	6	5.71	1.4E-02	-1.85
EST_MAX															10.00	9.0E-01	-0.05

Regression Output:

Constant	-4.00
Std Err of Y Est	0.110
R Squared	0.996
No. of Observations	3
Degrees of Freedom	1
X Coefficient(s)	0.3922
Std Err of Coef.	0.0218

Table B-14 (Page 6 of 9). Quantification of Operator Group 3 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 3
Action Grouping Logic: F - Training Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	6.4E-01	-0.19
OF1b	0.13	3	0.13	3	0.07	2	0.13	3	0.20	2	0.20	2	0.13	2	2.40	2.3E-04	-3.64
OF1a	0.13	3	0.13	4	0.06	2	0.06	5	0.19	9	0.25	9	0.19	4	6.00	9.8E-03	-2.01
OF2	0.13	6	0.13	3	0.13	3	0.07	1	0.20	2	0.20	4	0.13	2	3.13	4.9E-04	-3.31
MIN															0.00	1.9E-05	-4.73
Calibration Actions																	
Plant B MSOB	0.00	0	0.29	0	0.14	0	0.00	0	0.14	1	0.29	1	0.14	1	0.57	7.8E-05	-4.11
Diablo Cyn ZHERT1	0.00	0	0.29	3	0.14	4	0.00	0	0.14	4	0.29	3	0.14	4	3.42	3.0E-04	-3.52
Fermi OF1	0.00	5	0.29	3	0.14	5	0.00	7	0.14	8	0.29	4	0.14	6	4.69	8.8E-04	-3.06
Big Rock BR5	0.11	5	0.22	6	0.07	5	0.11	5	0.16	6	0.22	6	0.11	6	5.71	1.4E-02	-1.85
EST_MAX															10.00	9.0E-01	-0.05

Regression Output:

Constant	-4.73
Std Err of Y Est	0.431
R Squared	0.946
No. of Observations	5
Degrees of Freedom	3
X Coefficient(s)	0.4539
Std Err of Coef.	0.0625

Table B-14 (Page 7 of 9). Quantification of Operator Group 3 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 3
Action Grouping Logic: H - Training Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	1.1E+00	0.03
OHS1	0.14	2	0.07	2	0.14	3	0.14	1	0.14	2	0.21	1	0.14	2	1.79	2.6E-04	-3.59
MIN															0.00	4.2E-05	-4.38
Calibration Actions*																	
Big Rock L2C	0.11	4	0.22	4	0.07	5	0.11	4	0.16	4	0.22	4	0.11	4	4.07	1.0E-03	-3.00
Browns Ferry BF9	0.11	5	0.20	5	0.11	5	0.16	5	0.11	5	0.22	5	0.09	5	5.00	2.1E-02	-1.68
EST_MAX															10.00	9.0E-01	-0.05

* No calibration actions were available that combine a high weight for the Training PSF and low weight for the Plant Interfaces PSF. This set of calibration actions was used as a best available fit for the weight profile of the above group of actions.

Regression Output:

Constant	-4.37
Std Err of Y Est	0.651
R Squared	0.902
No. of Observations	3
Degrees of Freedom	1
X Coefficient(s)	0.4409
Std Err of Coef.	0.1445

Table B-14 (Page 8 of 9). Quantification of Operator Group 3 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 3
Action Grouping Logic: I - Actions Important and Time Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.16	1.0E+00	0.00
OAD1	0.13	2	0.13	2	0.20	4	0.13	1	0.13	2	0.13	1	0.13	2	2.13	2.2E-04	-3.66
OHC4	0.17	1	0.17	7	0.22	7	0.11	3	0.11	3	0.11	4	0.11	4	4.44	3.5E-03	-2.46
OSP2	0.19	3	0.13	2	0.19	5	0.13	2	0.13	2	0.13	1	0.13	4	2.88	5.3E-04	-3.28
ORVD3	0.17	1	0.11	6	0.22	7	0.11	2	0.17	2	0.11	1	0.11	4	3.50	1.1E-03	-2.95
OHL1	0.19	1	0.13	4	0.19	3	0.13	3	0.13	3	0.13	3	0.13	4	2.88	5.3E-04	-3.28
OSL2	0.22	0	0.17	2	0.17	3	0.11	1	0.11	2	0.11	1	0.11	4	1.72	1.3E-04	-3.88
OHL23	0.19	1	0.13	4	0.19	3	0.13	3	0.13	3	0.13	3	0.13	4	2.88	5.3E-04	-3.28
OAL1	0.21	1	0.21	2	0.16	4	0.11	5	0.11	8	0.11	3	0.11	2	3.16	7.4E-04	-3.13
OWS1	0.19	1	0.13	1	0.19	3	0.13	2	0.13	5	0.13	2	0.13	4	2.50	3.4E-04	-3.47
ORVD2	0.18	1	0.12	2	0.18	6	0.12	2	0.18	2	0.12	1	0.12	4	2.65	4.0E-04	-3.40
OWS2	0.18	1	0.12	1	0.24	5	0.12	2	0.12	5	0.12	2	0.12	5	3.12	7.1E-04	-3.15
OSL1	0.22	1	0.17	2	0.17	3	0.11	1	0.11	2	0.11	1	0.11	4	1.94	1.7E-04	-3.76
OHS3	0.17	1	0.17	7	0.22	7	0.11	3	0.11	3	0.11	1	0.11	2	3.89	1.8E-03	-2.75
OAL2	0.20	1	0.20	2	0.20	6	0.10	5	0.10	8	0.10	3	0.10	2	3.60	1.3E-03	-2.90
OLA1	0.20	1	0.20	2	0.15	5	0.10	3	0.15	3	0.10	1	0.10	4	2.60	3.8E-04	-3.42
ORP2	0.19	1	0.13	2	0.19	3	0.13	3	0.13	3	0.13	1	0.13	2	2.13	2.1E-04	-3.67
OBD1	0.17	1	0.11	2	0.22	9	0.11	3	0.17	6	0.11	4	0.11	5	4.72	4.9E-03	-2.31
MIN															0.00	1.7E-05	-4.78
Calibration Actions																	
ANO 1 IREP A2	0.24	2	0.12	2	0.24	3	0.00	0	0.16	2	0.12	2	0.12	2	2.24	1.0E-04	-4.00
Oconee, OPRA-8	0.15	5	0.15	5	0.12	4	0.16	1	0.12	5	0.12	6	0.19	7	4.74	1.0E-02	-2.00
DC Cook ZHEOB1	0.24	5	0.12	7	0.12	6	0.12	7	0.14	4	0.12	6	0.14	8	6.00	5.5E-02	-1.26
Limerick L4B	0.17	10	0.12	9	0.13	10	0.17	10	0.12	9	0.12	9	0.17	10	9.64	9.0E-01	-0.05

Regression Output:

Constant	-4.77
Std Err of Y Est	0.491
R Squared	0.941
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	0.5219
Std Err of Coef.	0.0921

Table B-14 (Page 9 of 9). Quantification of Operator Group 3 Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 2
Evaluation Team: 3
Action Grouping Logic: J - Interfaces Important, Procedures Not Important

Action Code	Preceding & Other Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	9.2E-01	-0.03
OJC1	0.14	2	0.21	8	0.14	2	0.07	10	0.14	8	0.14	4	0.14	2	5.00	6.2E-03	-2.21
OTB1	0.20	7	0.20	4	0.20	3	0.00	0	0.10	1	0.10	4	0.20	2	3.70	1.7E-03	-2.78
MIN															0.00	4.1E-05	-4.38
Calibration Actions																	
Plant B MSOB*	0.00	0	0.29	0	0.14	0	0.00	0	0.14	1	0.29	1	0.14	1	0.57	7.8E-05	-4.11
Fermi OF1*	0.00	5	0.29	3	0.14	5	0.00	7	0.14	8	0.29	4	0.14	6	4.69	8.8E-04	-3.06
Oyster Crk ZHEME2	0.14	4	0.21	9	0.20	5	0.08	3	0.11	2	0.16	4	0.10	4	4.95	2.9E-02	-1.54
EST_MAX															10.00	9.0E-01	-0.05

* Two available calibration actions with high weights for the Plant Interfaces PSF also have high weights for the Training PSF. This set of calibration actions was used as a best available fit for the weight profile of the above group of actions.

Regression Output:

Constant	-4.38
Std Err of Y Est	0.702
R Squared	0.895
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	0.4350
Std Err of Coef.	0.1051

Table B-15 (Page 1 of 2). Composite Human Error Rates Used for Quantification of the Browns Ferry PRA

Action Code	BFN1 Median HER	BFN2 Median HER	BFN3 Median HER	Composite Human Error Rate				
				Mean	5th Percentile	50th Percentile	95th Percentile	Range Factor
HOAD1	6.0-04	7.9-04	2.2-04	1.46-03	2.73-05	3.45-04	4.13-03	12
HOAD2	6.0-04	7.9-04	2.2-04	1.46-03	2.73-05	3.45-04	4.13-03	12
HOAL1	1.6-02	1.4-02	7.4-04	1.71-02	1.18-04	5.71-03	4.42-02	19
HOAL2	1.6-02	1.7-02	1.3-03	1.87-02	3.15-04	6.17-03	4.61-02	12
HOBC1	2.3-04	5.5-04	1.1-04	7.92-04	1.58-05	2.00-04	2.25-03	13
HOBD1	1.2-03	3.0-01	4.9-03	1.28-01	2.88-04	4.08-03	4.82-01	41
HOCRD1	5.2-05	1.0-03	7.9-04	1.31-03	1.00-05	3.63-04	3.83-03	20
HOCRD2	6.4-05	3.8-04	6.7-04	1.01-03	1.19-05	2.20-04	3.04-03	17
HODCW1	1.2-05	2.0-03	7.5-05	1.15-03	2.51-06	6.99-05	4.35-03	43
HODWS1	1.7-02	2.3-04	3.4-04	9.80-03	2.60-05	5.08-04	3.66-02	38
HODWS2	4.6-02	2.2-03	7.1-04	2.68-02	1.10-04	2.12-03	9.20-02	29
HOF1	1.2-04	5.2-05	2.3-04	3.63-04	8.06-06	9.75-05	1.09-03	13
HOF2	8.4-04	2.6-03	4.9-04	2.63-03	5.62-05	8.00-04	7.66-03	12
HOF3	2.2-03	1.0+00	1.6-04	3.31-01	3.20-05	1.80-03	1.00+00	177
HOF4	1.4-03	1.2-02	2.9-04	7.58-03	4.61-05	1.21-03	2.37-02	23
HOFT1	1.7-04	2.2-03	5.6-04	1.84-03	2.90-05	5.42-04	5.78-03	15
HOHC1	1.2-04	9.7-04	2.6-05	9.90-04	4.84-06	1.04-04	3.07-03	28
HOHC2	9.9-05	9.7-04	2.6-05	9.72-04	4.66-06	9.12-05	3.04-03	28
HOHC3	9.9-05	1.2-03	2.1-05	7.52-04	3.98-06	9.23-05	2.67-03	27
HOHC4	3.3-03	1.2-02	3.5-03	1.03-02	5.47-04	3.65-03	2.72-02	7
HOHL1	1.2-04	1.6-03	5.3-04	1.45-03	2.22-05	4.38-04	4.44-03	15
HOHL2	9.9-05	7.1-03	5.3-04	4.39-03	1.82-05	5.03-04	1.54-02	30
HOHS1	1.4-02	6.9-04	2.6-04	8.50-03	3.46-05	8.24-04	3.04-02	30
HOHS2	5.5-04	4.9-05	2.6-04	7.69-04	9.26-06	1.59-04	2.23-03	17
HOHS3	1.5-03	6.4-03	1.8-03	5.32-03	2.63-04	1.80-03	1.49-02	8
HOJC1	2.5-02	2.8-02	6.2-03	3.24-02	1.42-03	1.21-02	8.55-02	8
HOLA1	3.8-02	1.1-01	3.8-04	7.81-02	6.15-05	2.02-02	2.16-01	59
HOLC1	4.2-05	1.5-04	3.7-04	5.08-04	7.26-06	1.11-04	1.46-03	15

Note: Exponential notation is indicated in abbreviated form; e.g., 6.0-04 = 6.0×10^{-04}.

TABLEB15.BFN.07/09/92

Table B-15 (Page 2 of 2). Composite Human Error Rates Used for Quantification of the Browns Ferry PRA								
Action Code	BFN1 Median HER	BFN2 Median HER	BFN3 Median HER	Composite Human Error Rate				
				Mean	5th Percentile	50th Percentile	95th Percentile	Range Factor
HOLC2	5.2-05	1.5-04	5.7-04	7.00-04	8.99-06	1.36-04	2.05-03	17
HOPTR1	2.3-04	1.8-03	1.2-03	1.87-03	3.83-05	6.85-04	4.51-03	11
HORF1	9.9-05	8.7-05	2.8-04	4.21-04	1.00-05	1.10-04	1.22-03	12
HORP1	1.8-05	6.4-05	2.6-05	9.69-05	2.51-06	2.51-05	2.85-04	12
HORP2	4.3-02	3.7-03	2.1-04	2.56-02	3.47-05	2.68-03	8.84-02	50
HORPS1	1.4-04	1.5-03	2.9-04	1.20-03	2.21-05	3.48-04	3.77-03	14
HORVD1	2.4-03	2.3-04	3.8-05	1.53-03	6.94-06	2.02-04	5.34-03	29
HORVD2	1.1-02	3.6-04	4.0-04	6.70-03	3.49-05	7.15-04	2.11-02	25
HORVD3	2.6-02	7.6-02	1.1-03	5.54-02	2.69-04	1.43-02	1.75-01	25
HOSD1	1.8-05	1.8-03	1.7-05	9.99-04	2.43-06	3.37-05	3.78-03	44
HOSD2	8.3-04	1.4-03	1.7-05	1.50-03	3.64-06	3.46-04	4.66-03	38
HOSL1	4.0-03	6.0-03	1.7-04	5.53-03	3.32-05	2.06-03	1.64-02	23
HOSL2	9.5-03	1.3-02	1.3-04	1.22-02	2.48-05	4.45-03	3.87-02	40
HOSP1	2.7-05	3.2-05	2.6-05	7.65-05	2.51-06	2.51-05	2.18-04	10
HOSP2	8.9-03	1.0-03	5.3-04	5.89-03	7.69-05	1.10-03	1.88-02	16
HOSP3	1.8-05	3.2-05	2.6-05	6.86-05	2.47-06	2.17-05	1.97-04	10
HOSV1	5.2-05	2.9-04	3.6-03	2.30-03	9.84-06	2.86-04	8.09-03	31
HOSW1	5.9-05	4.4-04	3.1-04	7.26-04	1.01-05	1.69-04	2.13-03	15
HOTB1	1.2-04	5.0-04	1.7-03	1.49-03	2.21-05	4.43-04	4.61-03	15

Note: Exponential notation is indicated in abbreviated form; e.g., 6.0-04 = 6.0×10^{-04}.

TABLEB15.BFN.07/09/92

Table B-16 (Page 1 of 7). Results of Sorts of a Composite of Operators' Evaluations To Display the Most Difficult 20 Actions with Respect to Each Performance-Shaping Factor Category

Sorted on: Plant Interfaces

Evaluation Group	Action Code	Other Actions			Interfaces			Time Adequancy			Procedures			Complexity			Training			Stress			Total
		W	S	FLI	W	S	FLI	W	S	FLI	W	S	FLI	W	S	FLI	W	S	FLI	W	S	FLI	FLI
BFN3	OJC1	0.14	2	0.29	0.21	8	1.71	0.14	2	0.29	0.07	10	0.71	0.14	8	1.14	0.14	4	0.57	0.14	2	0.29	5.00
BFN2	OJC1	0.07	8	0.57	0.21	8	1.71	0.14	2	0.29	0.14	10	1.43	0.21	8	1.71	0.07	9	0.64	0.14	2	0.29	6.64
BFN3	OSV1	0.10	7	0.70	0.20	8	1.60	0.15	2	0.30	0.20	1	0.20	0.15	5	0.75	0.15	7	1.05	0.05	2	0.10	4.70
BFN1	OHS1	0.13	1	0.13	0.19	8	1.50	0.13	7	0.88	0.13	7	0.88	0.19	8	1.50	0.13	3	0.38	0.13	6	0.75	6.00
BFN1	OHC4	0.13	3	0.38	0.19	8	1.50	0.13	5	0.63	0.13	0	0.00	0.19	8	1.50	0.13	1	0.13	0.13	4	0.50	4.63
BFN2	OF4	0.13	5	0.63	0.19	8	1.50	0.06	2	0.13	0.13	6	0.75	0.13	8	1.00	0.19	4	0.75	0.19	5	0.94	5.69
BFN1	OLA1	0.18	8	1.41	0.18	8	1.41	0.12	7	0.82	0.12	7	0.82	0.18	8	1.41	0.12	3	0.35	0.12	6	0.71	6.94
BFN2	OHS3	0.12	3	0.35	0.18	8	1.41	0.18	5	0.88	0.12	6	0.71	0.12	8	0.94	0.12	4	0.47	0.18	5	0.88	5.65
BFN2	OLA1	0.09	8	0.70	0.17	8	1.39	0.13	7	0.91	0.13	6	0.78	0.13	9	1.17	0.17	7	1.22	0.17	8	1.39	7.57
BFN1	ODWS2	0.17	7	1.17	0.17	8	1.33	0.11	8	0.89	0.11	7	0.78	0.17	9	1.50	0.11	1	0.11	0.17	8	1.33	7.11
BFN1	OBD1	0.13	3	0.38	0.19	7	1.31	0.13	2	0.25	0.13	0	0.00	0.19	7	1.31	0.13	1	0.13	0.13	2	0.25	3.63
BFN1	OHS3	0.13	4	0.50	0.19	7	1.31	0.13	3	0.38	0.13	U	0.00	0.19	7	1.31	0.13	1	0.13	0.13	2	0.25	3.88
BFN1	OF4	0.13	0	0.00	0.19	7	1.31	0.13	4	0.50	0.13	1	0.13	0.19	8	1.50	0.13	1	0.13	0.13	2	0.25	3.81
BFN1	ORVD3	0.14	9	1.29	0.14	9	1.29	0.14	7	1.00	0.14	7	1.00	0.14	7	1.00	0.14	1	0.14	0.14	6	0.86	6.57
BFN1	ODWS1	0.18	6	1.06	0.18	7	1.24	0.12	7	0.82	0.12	7	0.82	0.18	8	1.41	0.12	1	0.12	0.12	6	0.71	6.18
BFN2	OHC4	0.15	3	0.46	0.15	8	1.23	0.08	4	0.31	0.15	6	0.92	0.15	8	1.23	0.15	4	0.62	0.15	6	0.92	5.69
BFN1	ORP2	0.17	7	1.17	0.17	7	1.17	0.11	7	0.78	0.11	7	0.78	0.17	9	1.50	0.11	3	0.33	0.17	8	1.33	7.06
BFN3	OHC4	0.17	1	0.17	0.17	7	1.17	0.22	7	1.56	0.11	3	0.33	0.11	3	0.33	0.11	4	0.44	0.11	4	0.44	4.44
BFN3	OHS3	0.17	1	0.17	0.17	7	1.17	0.22	7	1.56	0.11	3	0.33	0.11	3	0.33	0.11	1	0.11	0.11	2	0.22	3.89
BFN2	OAL2	0.12	5	0.59	0.18	6	1.06	0.18	7	1.24	0.12	6	0.71	0.12	8	0.94	0.12	3	0.35	0.18	8	1.41	6.29

Table B-16 (Page 2 of 7). Results of Sorts of a Composite of Operators' Evaluations To Display the Most Difficult 20 Actions with Respect to Each Performance-Shaping Factor Category

Sorted on: Complexity

Evaluation Group	Action Code	Other Actions W	S	FLI	Interfaces W	S	FLI	Time Adequancy W	S	FLI	Procedures W	S	FLI	Complexity W	S	FLI	Training W	S	FLI	Stress W	S	FLI	Total FLI
BFN2	OJC1	0.07	8	0.57	0.21	8	1.71	0.14	2	0.29	0.14	10	1.43	0.21	8	1.71	0.07	9	0.64	0.14	2	0.29	6.64
BFN3	OF1a	0.13	3	0.38	0.13	4	0.50	0.06	2	0.13	0.06	5	0.31	0.19	9	1.69	0.25	9	2.25	0.19	4	0.75	6.00
BFN1	OJC1	0.13	6	0.80	0.13	4	0.53	0.13	2	0.27	0.13	8	1.07	0.20	8	1.60	0.13	9	1.20	0.13	5	0.67	6.13
BFN1	OHS1	0.13	1	0.13	0.19	8	1.50	0.13	7	0.88	0.13	7	0.88	0.19	8	1.50	0.13	3	0.38	0.13	6	0.75	6.00
BFN1	OOWS2	0.17	7	1.17	0.17	8	1.33	0.11	8	0.89	0.11	7	0.78	0.17	9	1.50	0.11	1	0.11	0.17	8	1.33	7.11
BFN1	OHC4	0.13	3	0.38	0.19	8	1.50	0.13	5	0.63	0.13	0	0.00	0.19	8	1.50	0.13	1	0.13	0.13	4	0.50	4.63
BFN1	OF4	0.13	0	0.00	0.19	7	1.31	0.13	4	0.50	0.13	1	0.13	0.19	8	1.50	0.13	1	0.13	0.13	2	0.25	3.81
BFN1	ORP2	0.17	7	1.17	0.17	7	1.17	0.11	7	0.78	0.11	7	0.78	0.17	9	1.50	0.11	3	0.33	0.17	8	1.33	7.06
BFN1	OLA1	0.18	8	1.41	0.18	8	1.41	0.12	7	0.82	0.12	7	0.82	0.18	8	1.41	0.12	3	0.35	0.12	6	0.71	6.94
BFN1	OOWS1	0.18	6	1.06	0.18	7	1.24	0.12	7	0.82	0.12	7	0.82	0.18	8	1.41	0.12	1	0.12	0.12	6	0.71	6.18
BFN2	OHC3	0.07	2	0.13	0.20	2	0.40	0.13	2	0.27	0.13	3	0.40	0.20	7	1.40	0.13	4	0.53	0.13	2	0.27	3.40
BFN1	OHS3	0.13	4	0.50	0.19	7	1.31	0.13	3	0.38	0.13	0	0.00	0.19	7	1.31	0.13	1	0.13	0.13	2	0.25	3.88
BFN1	OSP2	0.19	6	1.13	0.13	6	0.75	0.13	5	0.63	0.13	7	0.88	0.19	7	1.31	0.13	1	0.13	0.13	6	0.75	5.56
BFN1	OBD1	0.13	3	0.38	0.19	7	1.31	0.13	2	0.25	0.13	0	0.00	0.19	7	1.31	0.13	1	0.13	0.13	2	0.25	3.63
BFN2	OHC4	0.15	3	0.46	0.15	8	1.23	0.08	4	0.31	0.15	6	0.92	0.15	8	1.23	0.15	4	0.62	0.15	6	0.92	5.69
BFN2	ORVD3	0.10	9	0.90	0.10	9	0.90	0.15	8	1.20	0.15	6	0.90	0.15	8	1.20	0.15	4	0.60	0.20	8	1.60	7.30
BFN2	OLA1	0.09	8	0.70	0.17	8	1.39	0.13	7	0.91	0.13	6	0.78	0.13	9	1.17	0.17	7	1.22	0.17	8	1.39	7.57
BFN2	ORP2	0.11	3	0.33	0.17	6	1.00	0.17	6	1.00	0.11	6	0.67	0.17	7	1.17	0.11	4	0.44	0.17	4	0.67	5.28
BFN3	OJC1	0.14	2	0.29	0.21	8	1.71	0.14	2	0.29	0.07	10	0.71	0.14	8	1.14	0.14	4	0.57	0.14	2	0.29	5.00
BFN2	OAL1	0.14	5	0.71	0.14	6	0.86	0.14	7	1.00	0.14	6	0.86	0.14	8	1.14	0.14	3	0.43	0.14	8	1.14	6.14

Table B-16 (Page 3 of 7). Results of Sorts of a Composite of Operators' Evaluations To Display the Most Difficult 20 Actions with Respect to Each Performance-Shaping Factor Category

Sorted on: Time Adequacy

Evaluation	Action	Other Actions			Interfaces			Time Adequancy			Procedures			Complexity			Training			Stress			Total
Group	Code	W	S	FLI	W	S	FLI	W	S	FLI	W	S	FLI	W	S	FLI	W	S	FLI	W	S	FLI	FLI
BFN2	OSL2	0.13	5	0.67	0.13	7	0.93	0.27	10	2.67	0.07	2	0.13	0.13	2	0.27	0.20	3	0.60	0.07	5	0.33	5.60
BFN2	ORPS1	0.09	3	0.27	0.09	2	0.18	0.36	6	2.18	0.00	0	0.00	0.18	2	0.36	0.18	1	0.18	0.09	4	0.36	3.55
BFN3	OPTR1	0.27	0	0.00	0.07	2	0.13	0.27	8	2.13	0.00	0	0.00	0.13	2	0.27	0.13	4	0.53	0.13	2	0.27	3.33
BFN3	OBD1	0.17	1	0.17	0.11	2	0.22	0.22	9	2.00	0.11	3	0.33	0.17	6	1.00	0.11	4	0.44	0.11	5	0.56	4.72
BFN2	OPTR1	0.09	1	0.09	0.18	1	0.18	0.27	6	1.64	0.00	0	0.00	0.00	0	0.00	0.18	3	0.55	0.27	3	0.82	3.27
BFN2	OSL1	0.13	5	0.67	0.13	7	0.93	0.20	8	1.60	0.07	2	0.13	0.13	2	0.27	0.20	3	0.60	0.13	5	0.67	4.87
BFN3	OHC4	0.17	1	0.17	0.17	7	1.17	0.22	7	1.56	0.11	3	0.33	0.11	3	0.33	0.11	4	0.44	0.11	4	0.44	4.44
BFN3	OHS3	0.17	1	0.17	0.17	7	1.17	0.22	7	1.56	0.11	3	0.33	0.11	3	0.33	0.11	1	0.11	0.11	2	0.22	3.89
BFN3	ORVD3	0.17	1	0.17	0.11	6	0.67	0.22	7	1.56	0.11	2	0.22	0.17	2	0.33	0.11	1	0.11	0.11	4	0.44	3.50
BFN2	OFT1	0.17	3	0.50	0.17	2	0.33	0.25	6	1.50	0.00	0	0.00	0.08	4	0.33	0.17	1	0.17	0.17	4	0.67	3.50
BFN3	ORPS1	0.22	0	0.00	0.06	1	0.06	0.22	6	1.33	0.00	0	0.00	0.22	1	0.22	0.11	0	0.00	0.17	2	0.33	1.94
BFN2	OAL2	0.12	5	0.59	0.18	6	1.06	0.18	7	1.24	0.12	6	0.71	0.12	8	0.94	0.12	3	0.35	0.18	8	1.41	6.29
BFN3	OAL2	0.20	1	0.20	0.20	2	0.40	0.20	6	1.20	0.10	5	0.50	0.10	8	0.80	0.10	3	0.30	0.10	2	0.20	3.60
BFN2	ORVD3	0.10	9	0.90	0.10	9	0.90	0.15	8	1.20	0.15	6	0.90	0.15	8	1.20	0.15	4	0.60	0.20	8	1.60	7.30
BFN3	OWS2	0.18	1	0.18	0.12	1	0.12	0.24	5	1.18	0.12	2	0.24	0.12	5	0.59	0.12	2	0.24	0.12	5	0.59	3.12
BFN3	OSW1	0.27	0	0.00	0.09	6	0.55	0.27	4	1.09	0.00	0	0.00	0.09	0	0.00	0.09	0	0.00	0.18	2	0.36	2.00
BFN2	OF2	0.14	4	0.57	0.14	2	0.29	0.21	5	1.07	0.07	6	0.43	0.14	4	0.57	0.14	4	0.57	0.14	4	0.57	4.07
BFN3	ORVD2	0.18	1	0.18	0.12	2	0.24	0.18	6	1.06	0.12	2	0.24	0.18	2	0.35	0.12	1	0.12	0.12	4	0.47	2.65
BFN2	OAL1	0.14	5	0.71	0.14	6	0.86	0.14	7	1.00	0.14	6	0.86	0.14	8	1.14	0.14	3	0.43	0.14	8	1.14	6.14
BFN1	ORVD3	0.14	9	1.29	0.14	9	1.29	0.14	7	1.00	0.14	7	1.00	0.14	7	1.00	0.14	1	0.14	0.14	6	0.86	6.57

Table B-16 (Page 4 of 7). Results of Sorts of a Composite of Operators' Evaluations To Display the Most Difficult 20 Actions with Respect to Each Performance-Shaping Factor Category

Sorted on: Preceding and Concurrent Actions

Evaluation Group	Action Code	Other Actions W	S	FLI	Interfaces W	S	FLI	Time Adequancy W	S	FLI	Procedures W	S	FLI	Complexity W	S	FLI	Training W	S	FLI	Stress W	S	FLI	Total FLI
BFN1	ORVD2	0.20	8	1.60	0.13	5	0.67	0.13	6	0.80	0.13	7	0.93	0.13	5	0.67	0.13	1	0.13	0.13	6	0.80	5.60
BFN1	OLA1	0.18	8	1.41	0.18	8	1.41	0.12	7	0.82	0.12	7	0.82	0.18	8	1.41	0.12	3	0.35	0.12	6	0.71	6.94
BFN1	OSL2	0.20	7	1.40	0.13	6	0.80	0.13	6	0.80	0.13	7	0.93	0.13	2	0.27	0.13	3	0.40	0.13	6	0.80	5.40
BFN3	OTB1	0.20	7	1.40	0.20	4	0.80	0.20	3	0.60	0.00	0	0.00	0.10	1	0.10	0.10	4	0.40	0.20	2	0.40	3.70
BFN1	ORVD1	0.20	7	1.40	0.13	5	0.67	0.13	6	0.80	0.13	1	0.13	0.13	5	0.67	0.13	1	0.13	0.13	1	0.13	3.93
BFN1	ORVD3	0.14	9	1.29	0.14	9	1.29	0.14	7	1.00	0.14	7	1.00	0.14	7	1.00	0.14	1	0.14	0.14	6	0.86	6.57
BFN2	OWS2	0.18	7	1.24	0.18	6	1.06	0.12	4	0.47	0.12	5	0.59	0.12	2	0.24	0.12	4	0.47	0.18	5	0.88	4.94
BFN1	OAL1	0.20	6	1.20	0.13	7	0.93	0.13	5	0.67	0.13	7	0.93	0.13	8	1.07	0.13	3	0.40	0.13	6	0.80	6.00
BFN1	OAL2	0.20	6	1.20	0.13	7	0.93	0.13	5	0.67	0.13	7	0.93	0.13	8	1.07	0.13	3	0.40	0.13	6	0.80	6.00
BFN1	ORP2	0.17	7	1.17	0.17	7	1.17	0.11	7	0.78	0.11	7	0.78	0.17	9	1.50	0.11	3	0.33	0.17	8	1.33	7.06
BFN1	ODWS2	0.17	7	1.17	0.17	8	1.33	0.11	8	0.89	0.11	7	0.78	0.17	9	1.50	0.11	1	0.11	0.17	8	1.33	7.11
BFN1	OF2	0.14	8	1.14	0.14	4	0.57	0.14	3	0.43	0.14	1	0.14	0.14	5	0.71	0.14	5	0.71	0.14	4	0.57	4.29
BFN1	OSP2	0.19	6	1.13	0.13	6	0.75	0.13	5	0.63	0.13	7	0.88	0.19	7	1.31	0.13	1	0.13	0.13	6	0.75	5.56
BFN3	OOCW1	0.15	7	1.08	0.15	5	0.77	0.08	1	0.08	0.15	2	0.31	0.15	1	0.15	0.15	1	0.15	0.15	2	0.31	2.85
BFN3	OCRD1	0.21	5	1.07	0.14	2	0.29	0.07	1	0.07	0.14	2	0.29	0.14	2	0.29	0.14	4	0.57	0.14	1	0.14	2.71
BFN1	ODWS1	0.18	6	1.06	0.18	7	1.24	0.12	7	0.82	0.12	7	0.82	0.18	8	1.41	0.12	1	0.12	0.12	6	0.71	6.18
BFN1	OSL1	0.20	5	1.00	0.13	4	0.53	0.13	4	0.53	0.13	7	0.93	0.13	2	0.27	0.13	3	0.40	0.13	6	0.80	4.47
BFN2	OSV1	0.13	7	0.93	0.13	7	0.93	0.20	2	0.40	0.27	1	0.27	0.13	0	0.00	0.13	3	0.40	0.00	0	0.00	2.93
BFN2	ORVD3	0.10	9	0.90	0.10	9	0.90	0.15	8	1.20	0.15	6	0.90	0.15	8	1.20	0.15	4	0.60	0.20	8	1.60	7.30
BFN2	OCRD2	0.18	5	0.88	0.18	5	0.88	0.12	3	0.35	0.12	2	0.24	0.12	2	0.24	0.12	4	0.47	0.18	4	0.71	3.76

Table B-16 (Page 5 of 7). Results of Sorts of a Composite of Operators' Evaluations To Display the Most Difficult 20 Actions with Respect to Each Performance-Shaping Factor Category

Sorted on: Stress

Evaluation Group	Action Code	Other Actions W	S	FLI	Interfaces W	S	FLI	Time Adequancy W	S	FLI	Procedures W	S	FLI	Complexity W	S	FLI	Training W	S	FLI	Stress W	S	FLI	Total FLI
BFN2	ORVD3	0.10	9	0.90	0.10	9	0.90	0.15	8	1.20	0.15	6	0.90	0.15	8	1.20	0.15	4	0.60	0.20	8	1.60	7.30
BFN2	OAL2	0.12	5	0.59	0.18	6	1.06	0.18	7	1.24	0.12	6	0.71	0.12	8	0.94	0.12	3	0.35	0.18	8	1.41	6.29
BFN2	OLA1	0.09	8	0.70	0.17	8	1.39	0.13	7	0.91	0.13	6	0.78	0.13	9	1.17	0.17	7	1.22	0.17	8	1.39	7.57
BFN1	OOWS2	0.17	7	1.17	0.17	8	1.33	0.11	8	0.89	0.11	7	0.78	0.17	9	1.50	0.11	1	0.11	0.17	8	1.33	7.11
BFN1	ORP2	0.17	7	1.17	0.17	7	1.17	0.11	7	0.78	0.11	7	0.78	0.17	9	1.50	0.11	3	0.33	0.17	8	1.33	7.06
BFN2	OAL1	0.14	5	0.71	0.14	6	0.86	0.14	7	1.00	0.14	6	0.86	0.14	8	1.14	0.14	3	0.43	0.14	8	1.14	6.14
BFN2	OF4	0.13	5	0.63	0.19	8	1.50	0.06	2	0.13	0.13	6	0.75	0.13	8	1.00	0.19	4	0.75	0.19	5	0.94	5.69
BFN2	OHC4	0.15	3	0.46	0.15	8	1.23	0.08	4	0.31	0.15	6	0.92	0.15	8	1.23	0.15	4	0.62	0.15	6	0.92	5.69
BFN2	OWS2	0.18	7	1.24	0.18	6	1.06	0.12	4	0.47	0.12	5	0.59	0.12	2	0.24	0.12	4	0.47	0.18	5	0.88	4.94
BFN2	OHS3	0.12	3	0.35	0.18	8	1.41	0.18	5	0.88	0.12	6	0.71	0.12	8	0.94	0.12	4	0.47	0.18	5	0.88	5.65
BFN1	OHS2	0.14	4	0.57	0.14	4	0.57	0.14	3	0.43	0.14	7	1.00	0.14	3	0.43	0.14	1	0.14	0.14	6	0.86	4.00
BFN2	OAD1	0.14	3	0.43	0.14	5	0.71	0.07	2	0.14	0.14	1	0.14	0.14	2	0.29	0.14	1	0.14	0.21	4	0.86	2.71
BFN2	OHL1	0.14	5	0.71	0.14	4	0.57	0.14	2	0.29	0.14	4	0.57	0.14	6	0.86	0.14	6	0.86	0.14	6	0.86	4.71
BFN2	OAD2	0.14	3	0.43	0.14	5	0.71	0.07	2	0.14	0.14	1	0.14	0.14	2	0.29	0.14	1	0.14	0.21	4	0.86	2.71
BFN1	ORVD3	0.14	9	1.29	0.14	9	1.29	0.14	7	1.00	0.14	7	1.00	0.14	7	1.00	0.14	1	0.14	0.14	6	0.86	6.57
BFN2	OHL2	0.14	5	0.71	0.14	4	0.57	0.14	7	1.00	0.14	7	1.00	0.14	6	0.86	0.14	5	0.71	0.14	6	0.86	5.71
BFN2	OSP2	0.17	5	0.83	0.17	3	0.50	0.17	3	0.50	0.00	0	0.00	0.17	2	0.33	0.17	1	0.17	0.17	5	0.83	3.17
BFN2	OPTR1	0.09	1	0.09	0.18	1	0.18	0.27	6	1.64	0.00	0	0.00	0.00	0	0.00	0.18	3	0.55	0.27	3	0.82	3.27
BFN1	OAL1	0.20	6	1.20	0.13	7	0.93	0.13	5	0.67	0.13	7	0.93	0.13	8	1.07	0.13	3	0.40	0.13	6	0.80	6.00
BFN1	OSL1	0.20	5	1.00	0.13	4	0.53	0.13	4	0.53	0.13	7	0.93	0.13	2	0.27	0.13	3	0.40	0.13	6	0.80	4.47

TABLEB16.BFN.07/09/92

Table B-16 (Page 6 of 7). Results of Sorts of a Composite of Operators' Evaluations To Display the Most Difficult 20 Actions with Respect to Each Performance-Shaping Factor Category

Sorted on: Training and Experience

Evaluation Group	Action Code	Other Actions W	S	FLI	Interfaces W	S	FLI	Time Adequancy W	S	FLI	Procedures W	S	FLI	Complexity W	S	FLI	Training W	S	FLI	Stress W	S	FLI	Total FLI
BFN3	OF1a	0.13	3	0.38	0.13	4	0.50	0.06	2	0.13	0.06	5	0.31	0.19	9	1.69	0.25	9	2.25	0.19	4	0.75	6.00
BFN2	OLA1	0.09	8	0.70	0.17	8	1.39	0.13	7	0.91	0.13	6	0.78	0.13	9	1.17	0.17	7	1.22	0.17	8	1.39	7.57
BFN1	OJC1	0.13	6	0.80	0.13	4	0.53	0.13	2	0.27	0.13	8	1.07	0.20	8	1.60	0.13	9	1.20	0.13	5	0.67	6.13
BFN1	OPTR1	0.14	4	0.57	0.14	2	0.29	0.14	4	0.57	0.14	0	0.00	0.14	3	0.43	0.14	8	1.14	0.14	3	0.43	3.43
BFN3	OBC1	0.15	3	0.46	0.15	2	0.31	0.08	0	0.00	0.15	1	0.15	0.15	3	0.46	0.15	7	1.08	0.15	4	0.62	3.08
BFN3	OSV1	0.10	7	0.70	0.20	8	1.60	0.15	2	0.30	0.20	1	0.20	0.15	5	0.75	0.15	7	1.05	0.05	2	0.10	4.70
BFN3	OLC2	0.18	3	0.55	0.18	2	0.36	0.09	1	0.09	0.18	2	0.36	0.09	1	0.09	0.18	5	0.91	0.09	0	0.00	2.36
BFN2	OHL1	0.14	5	0.71	0.14	4	0.57	0.14	2	0.29	0.14	4	0.57	0.14	6	0.86	0.14	6	0.86	0.14	6	0.86	4.71
BFN1	OF3	0.18	4	0.73	0.18	4	0.73	0.18	1	0.18	0.00	8	0.00	0.18	4	0.73	0.09	9	0.82	0.18	4	0.73	3.91
BFN3	OF2	0.13	6	0.80	0.13	3	0.40	0.13	3	0.40	0.07	1	0.07	0.20	2	0.40	0.20	4	0.80	0.13	2	0.27	3.13
BFN2	OSD1	0.20	2	0.40	0.13	4	0.53	0.07	2	0.13	0.13	3	0.40	0.13	6	0.80	0.20	4	0.80	0.13	4	0.53	3.60
BFN2	OSD2	0.20	2	0.40	0.13	2	0.27	0.07	2	0.13	0.13	3	0.40	0.13	6	0.80	0.20	4	0.80	0.13	4	0.53	3.33
BFN3	ORVD1	0.15	3	0.46	0.15	2	0.31	0.08	1	0.08	0.15	2	0.31	0.15	1	0.15	0.15	5	0.77	0.15	2	0.31	2.38
BFN2	OF4	0.13	5	0.63	0.19	8	1.50	0.06	2	0.13	0.13	6	0.75	0.13	8	1.00	0.19	4	0.75	0.19	5	0.94	5.69
BFN1	OF2	0.14	8	1.14	0.14	4	0.57	0.14	3	0.43	0.14	1	0.14	0.14	5	0.71	0.14	5	0.71	0.14	4	0.57	4.29
BFN2	OHL2	0.14	5	0.71	0.14	4	0.57	0.14	7	1.00	0.14	7	1.00	0.14	6	0.86	0.14	5	0.71	0.14	6	0.86	5.71
BFN1	OF1	0.14	4	0.57	0.14	4	0.57	0.14	1	0.14	0.14	0	0.00	0.14	3	0.43	0.14	5	0.71	0.14	4	0.57	3.00
BFN2	OJC1	0.07	8	0.57	0.21	8	1.71	0.14	2	0.29	0.14	10	1.43	0.21	8	1.71	0.07	9	0.64	0.14	2	0.29	6.64
BFN2	OCRD1	0.15	4	0.62	0.15	2	0.31	0.08	3	0.23	0.15	2	0.31	0.15	2	0.31	0.15	4	0.62	0.15	4	0.62	3.00
BFN2	OHC4	0.15	3	0.46	0.15	8	1.23	0.08	4	0.31	0.15	6	0.92	0.15	8	1.23	0.15	4	0.62	0.15	6	0.92	5.69

Table B-16 (Page 7 of 7). Results of Sorts of a Composite of Operators' Evaluations To Display the Most Difficult 20 Actions with Respect to Each Performance-Shaping Factor Category

Sorted on: Procedures

Evaluation Group	Action Code	Other Actions W	S	FLI	Interfaces W	S	FLI	Time Adequancy W	S	FLI	Procedures W	S	FLI	Complexity W	S	FLI	Training W	S	FLI	Stress W	S	FLI	Total FLI
BFN2	OJC1	0.07	8	0.57	0.21	8	1.71	0.14	2	0.29	0.14	10	1.43	0.21	8	1.71	0.07	9	0.64	0.14	2	0.29	6.64
BFN1	OJC1	0.13	6	0.80	0.13	4	0.53	0.13	2	0.27	0.13	8	1.07	0.20	8	1.60	0.13	9	1.20	0.13	5	0.67	6.13
BFN1	OHS2	0.14	4	0.57	0.14	4	0.57	0.14	3	0.43	0.14	7	1.00	0.14	3	0.43	0.14	1	0.14	0.14	6	0.86	4.00
BFN2	OHL2	0.14	5	0.71	0.14	4	0.57	0.14	7	1.00	0.14	7	1.00	0.14	6	0.86	0.14	5	0.71	0.14	6	0.86	5.71
BFN1	ORVD3	0.14	9	1.29	0.14	9	1.29	0.14	7	1.00	0.14	7	1.00	0.14	7	1.00	0.14	1	0.14	0.14	6	0.86	6.57
BFN1	OAL2	0.20	6	1.20	0.13	7	0.93	0.13	5	0.67	0.13	7	0.93	0.13	8	1.07	0.13	3	0.40	0.13	6	0.80	6.00
BFN1	OSL2	0.20	7	1.40	0.13	6	0.80	0.13	6	0.80	0.13	7	0.93	0.13	2	0.27	0.13	3	0.40	0.13	6	0.80	5.40
BFN1	OSL1	0.20	5	1.00	0.13	4	0.53	0.13	4	0.53	0.13	7	0.93	0.13	2	0.27	0.13	3	0.40	0.13	6	0.80	4.47
BFN1	OAL1	0.20	6	1.20	0.13	7	0.93	0.13	5	0.67	0.13	7	0.93	0.13	8	1.07	0.13	3	0.40	0.13	6	0.80	6.00
BFN1	ORVD2	0.20	8	1.60	0.13	5	0.67	0.13	6	0.80	0.13	7	0.93	0.13	5	0.67	0.13	1	0.13	0.13	6	0.80	5.60
BFN2	OHC4	0.15	3	0.46	0.15	8	1.23	0.08	4	0.31	0.15	6	0.92	0.15	8	1.23	0.15	4	0.62	0.15	6	0.92	5.69
BFN2	ORVD3	0.10	9	0.90	0.10	9	0.90	0.15	8	1.20	0.15	6	0.90	0.15	8	1.20	0.15	4	0.60	0.20	8	1.60	7.30
BFN1	OSP2	0.19	6	1.13	0.13	6	0.75	0.13	5	0.63	0.13	7	0.88	0.19	7	1.31	0.13	1	0.13	0.13	6	0.75	5.56
BFN1	OHS1	0.13	1	0.13	0.19	8	1.50	0.13	7	0.88	0.13	7	0.88	0.19	8	1.50	0.13	3	0.38	0.13	6	0.75	6.00
BFN2	OAL1	0.14	5	0.71	0.14	6	0.86	0.14	7	1.00	0.14	6	0.86	0.14	8	1.14	0.14	3	0.43	0.14	8	1.14	6.14
BFN2	ORVD2	0.14	4	0.57	0.14	3	0.43	0.14	4	0.57	0.14	6	0.86	0.14	2	0.29	0.14	3	0.43	0.14	4	0.57	3.71
BFN1	OLA1	0.18	8	1.41	0.18	8	1.41	0.12	7	0.82	0.12	7	0.82	0.18	8	1.41	0.12	3	0.35	0.12	6	0.71	6.94
BFN1	ODWS1	0.18	6	1.06	0.18	7	1.24	0.12	7	0.82	0.12	7	0.82	0.18	8	1.41	0.12	1	0.12	0.12	6	0.71	6.18
BFN2	OLA1	0.09	8	0.70	0.17	8	1.39	0.13	7	0.91	0.13	6	0.78	0.13	9	1.17	0.17	7	1.22	0.17	8	1.39	7.57
BFN1	ODWS2	0.17	7	1.17	0.17	8	1.33	0.11	8	0.89	0.11	7	0.78	0.17	9	1.50	0.11	1	0.11	0.17	8	1.33	7.11

Table B-17 (Page 1 of 2). Summary of Browns Ferry Recovery Actions Incorporated into the Plant Model

Top Event	Database Variable	Definition of Action	Time Constraints	Mean HER /Demand
CIS	HOCIS1	Ensure That Various Normally Closed Valves are Closed, Given Group 6 Isolation is Required	At least one hour available after Group 6 isolation before release of radioactive materials in containment begins.	0.003620
OEE	HOEE1	Align and Start One RHRSW Swing Pump, Given LOSP and Insufficient EECW to Diesel Generators	Five minutes available before diesel generator exceeds design temperature.	0.000506
OEE	HOEE2	Align and Start One RHRSW Swing Pump, Given LOSP, ATWS, and Insufficient EECW to Diesel Generators	Five minutes available before diesel generator exceeds design temperature.	0.016100
OFLRB	HOFLRB	Identify and Isolate Leak in Either North or South EECW Header	20 to 30 minutes to avoid flooding RHR, CS, HPCI and RCIC.	0.003020
PCA	HOPCA1	Manually Start Two Air Compressors, Given Loss of Offsite Power	One hour before MSRV air reservoir is depleted.	0.001150
OR480	HOR480	Align 480V RMOV Board 2A (2B) to Alternate Source	More than 2 hours after RHR needed for core cooling, depending on cooldown rate.	0.001090
ORP	HORP3	Start RHR/Core Spray Pumps for Low Pressure Injection, Given LOSP, Loss of D/Gs, and Power Recovered within 6 Hours	Core uncovery within 30 minutes if the AC power were not recovered.	0.043600
OSPR	HOSPRC	Manually Close LPCI Injection Valves To Restore Suppression Pool Cooling	First indication of requirement 2 to 4 hours into transient. Suppression pool rises from 95 deg. F to 140 deg. F in 4 hours at 1% decay heat.	0.000226
OSPR	HOSPRO	Manually Open Valves To Align RHR for Suppression Pool Cooling	First indication of requirement 2 to 4 hours into transient. Suppression pool rises to unacceptable temperature in 12 additional hours.	0.000480
U1	HOU11	Crosstie Unit 1 Pumps and Heat Exchanger to Unit 2 Torus, Given Flood in Reactor Building Basement, Unit 2 Condenser Unavailable	Thirty minutes to avoid core uncovery if injection into RPV lost during the initial phase of the flood.	0.016100
U1	HOU12	Align Alternate Sources of Water To Maintain RPV Level, Given a Leak in the Torus Ring Header and Condensate/Feedwater Lost in Unit 2	Thirty minutes if injection into RPV lost during initial phase of flood.	0.043600
UB	HOUB1	Restore Power to Both Units 1 and 2 Unit Board (4 kv), Given Loss of Main Electrical Feed to that Unit	15 to 20 minutes available before diesel generators required.	0.002820

Table B-17 (Page 2 of 2). Summary of Browns Ferry Recovery Actions Incorporated into the Plant Model

Top Event	Database Variable	Definition of Action	Time Constraints	Mean HER /Demand
UB	HOUB2	Restore Power to Both Units 1 and 2 Unit Boards (4 kV), Given Loss of 500 kV Grid	15 to 20 minutes available before diesel generators required to operate in the model.	0.005030
OVS	HOVS1	Close a Valve To Isolate a High/Low Pressure Leak that Occurs during Surveillance Testing of a CS or LPCI Injection Line	Assume 2 minutes for failure mechanisms in low pressure line to propagate sufficiently to require reactor SCRAM and safety system actuation.	0.001600
OVS	HOVS2	Respond To Inadvertent Failure of High/Low Pressure Interface Valve in the CS or LPCI Injection Lines during Normal Operations	Assume 2 minutes for failure mechanisms in low pressure line to propagate sufficiently to require reactor SCRAM and safety system actuation.	0.004230

Table B-18 (Page 1 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOCIS1: Insure Various Normally Closed Valves are Closed, Given Group 6 Isolation is Required

PRECEDING EVENTS
- Conditions exist in which some containment penetration valves are open.
- Initiating event requiring reactor trip.

INDICATIONS OF PLANT CONDITION
- Group 6 isolation conditions exist.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Verify that containment penetrations are isolated.

CONCURRENT ACTIONS/COMPETING FACTORS
- EOI-1 requirements.

INDICATION OF SUCCESSFUL COMPLETION
- Containment Integrity Maintained.

FAILURE IMPACT
- Breach of containment.

TIME CONSTRAINTS
- At least an hour before containment challenge.

NOTES
- Not directly quantified with operators. Quantified with the following distribution:

  Median = 1.8E-03, Range Factor 7

- Justification: This is the median of for OSPRO1 times 10, with the proper range factor for the resulting error range. As we can not be sure where the valve controls are located (within the control room, in a back area of the control room, locally) we use a value for locally manipulated valves. The factor of 10 accounts for multiple valves.

Table B-18 (Page 2 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOEE1: Align and Start One RHRSW Swing Pump for EECW, Given Loss of Offsite Power and Insufficient EECW to Diesel Generators

PRECEDING EVENTS
- Loss of offsite power initiating event.
- SCRAM successful.
- Diesel generators start successfully.
- Three or more EECW pumps fail to restart.

INDICATIONS OF PLANT CONDITION
- Panel 2-9-20, Alarm array 2-XA-55-20A, alarms 7, 14, 21, 28 & 35 in a vertical row show low EECW flow and pressures.
- Diesel generator hot engine alarms.
- No RHRSW A3, B3, C3, D3 running alarms on D/G panels.
- Numerous other alarms associated with LOSP and SCRAM.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Recognize that the DG's are overheating or EECW is not functioning.
- Align RHRSW pump C1 & D1 with MOVs 0-FCV-67-48 & 49 from panel 920 (limit switch automatically ties pump to D/G autosequencer).
- Not enough time to manipulate manual valves A1 & B1.

CONCURRENT ACTIONS/COMPETING FACTORS
- Verifying basic safety functions per EOI-1.
- Verifying that loads the DG support are sequencing on.

INDICATION OF SUCCESSFUL COMPLETION
- RHRSW pumps C1 & D1 indication cycles to RED on panel 2-9-3.
- Diesel generators continue to run.

FAILURE IMPACT
- Loss of diesel generators due to over heating approximately 5 minutes after loss of offsite power.
- Loss of all AC power.

TIME CONSTRAINTS
- 5 minutes available before diesel generators exceed design temperature.

Table B-18 (Page 3 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOEE2: Align and Start One RHRSW Swing Pump for EECW, Given Loss of Offsite Power, ATWS, and Insufficient EECW to Diesel Generators

PRECEDING EVENTS
- Loss of offsite power initiating event.
- SCRAM not successful.
- Diesel generators start successfully.
- Three or more EECW pumps fail to restart.

INDICATIONS OF PLANT CONDITION
- Power level remaining above 5%.
- Control rod indications show rods not inserted.
- Panel 2-9-20, Alarm array 2-XA-55-20A, alarms 7, 14, 21, 28 & 35 in a vertical row show low EECW flow and pressures.
- High average suppression pool temperature alarm.
- Diesel generator hot engine alarms.
- No RHRSW A3, B3, C3, D3 running alarms on D/G panels.
- Numerous other alarms associated with ATWS with isolated vessel and LOSP.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Enter EOI-2, which focuses on use of EECW cooling.
- Recognize that EECW is not functioning.
- Recognize that the DG's are overheating.
- Align RHRSW pump C1 & D1 with MOVs 0-FCV-67-48 & 49 from panel 920 (limit switch automatically ties pump to D/G autosequencer).
- Not enough time to manipulate manual valves A1 & B1.

CONCURRENT ACTIONS/COMPETING FACTORS
- Responding to ATWS situation per EOI-1.
- Verifying that loads the DG support are sequencing on.

INDICATION OF SUCCESSFUL COMPLETION/SUCCESS IMPACT
- RHRSW pumps C1 & D1 indication cycles to RED on panel 2-9-3.
- Diesel generators continue to run.

FAILURE IMPACT
- Loss of diesel generators due to over heating approximately 5 minutes after loss of offsite power.
- Loss of all AC power.

TIME CONSTRAINTS
- 5 minutes available before diesel generators exceed design temperature.

Table B-18 (Page 4 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOFLRB: Identify and Isolate Leak in Either North or South EECW Header

PRECEDING EVENTS
- Unit at 100% power during normal operations.
- Break in the EECW is the initiating event.

INDICATIONS OF PLANT CONDITION
- Sump level high alarm in rad waste.
- Both pumps running on both floor and equipment drain.
- May see a low indication in the EECW pressure and flow on panel 9-20, as well as alarms.
- Amperage to EECW pump motors high.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-3 SC/L-9 Isolate the EECW system that is leaking.
- Dispatch an AUO to investigate.
- AUO reports back the location and attempts to close off the leak if he can.
- Notify Unit 1 operator to close sectionalizing valves as necessary to isolate the break.

CONCURRENT ACTIONS/COMPETING FACTORS
- Orderly shutdown of reactor would be judged necessary based on the magnitude of the break.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Loss of one EECW header, but no loss of other equipment due to flooding.

FAILURE IMPACT
- Loss of Loss of RHR, CS, HPCI, and RCIC due to flooding.

TIME CONSTRAINTS
- 20-30 minutes to isolate to have only a header impact.

Table B-18 (Page 5 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOPCA1: Manually Start Two Air Compressors, Given Loss of Offsite Power

PRECEDING EVENTS
- LOSP initiating event.
- Diesel generators start and successfully load.
- Air compressors do not start, as they are not in the autostart sequence.
- MSIVs close.
- RCIC starts and maintains RPV level.
- RPV pressure control maintained by manual cycling of MSRVs.

INDICATIONS OF PLANT CONDITION
- MSRV air reservoir pressure low.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Recognize condition.
- Manually start two air compressors.

CONCURRENT ACTIONS/COMPETING FACTORS
- Actions to regain offsite power.
- EOI activities.

INDICATION OF SUCCESSFUL COMPLETION
- Ability to continue to manually control RPV pressure.

FAILURE IMPACT
- Challenge to mechanical SRV function.

TIME CONSTRAINTS
- Assume 1 hour before MSRV air reservoir is depleted.
- Design capacity of air reservoir is 5 open/close cycles for 6 valves, for a total of 30 cycles.

NOTES
- Not directly quantified with operators. Quantified with same distribution as ODCW1 (Restart at least 2 of 4 drywell coolers, given LOSP).
- The two actions both involve the manual actuation of two pieces of equipment under the same time constraints.

Table B-18 (Page 6 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOR4801: Align 480V RMOV Board 2A (2B) to Alternate Source

PRECEDING EVENTS
- General transient initiating event (not a medium or large LOCA).
- Any general transient initiator.
- Successful shutdown and initial response with HPCI/RCIC.
- Failure of power to either RMOV board, either at the initiating event or by failing during cooldown.
- Cooldown successful to low pressure system cutin pressure, but CRD and HPCI/RCIC fail in the long term.
- Additional multiple failures during cooldown results in only one train of RHR being available for long term cooling.

INDICATIONS OF PLANT CONDITION
- One 480 volt RMOV board deenergized.
- Half SCRAM signal.
- PCIS deenergized.
- High RHR area temperature alarm on panel 9-3.
- Plant process computer report of RHR motor winding temperature high.
- Alternate source of power available.
- No indications from containment cooling valves.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Recognize the loss of room coolers is due to power source.
- Transfer to alternate power source per OI-57.

CONCURRENT ACTIONS/COMPETING FACTORS
- Trying to recover any alternate source of core cooling.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RMOV board is reenergized, resulting in power to the RHR and CS pump cooler fans.
- RHR motor does not fail due to overheating.
- Safe long term shutdown achieved.

FAILURE IMPACT
- Unable to recover ventilation to RHR and CS, results in eventual overheating and failure.
- Eventual depletion of RPV inventory and core uncovery if no alternate source of injection activated.

TIME CONSTRAINTS
- 3-4 hours available after shutdown (Basis: RHR not needed until cooldown complete).
- If low pressure not successful, approx 2-6 hours before onset of core damage, depending on cooldown rate.

Table B-18 (Page 7 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HORP3: Start RHR/Core Spray Pumps for Low Pressure Injection, Given LOSP, Failure of Diesel Generators, and Power is Recovered in 6 Hours

PRECEDING EVENTS
- LOSP initiating event.
- Successful reactor SCRAM.
- EECW fails, causing all DG's to burn up. (OEE1 = F).
- HPCI/RCIC startup and function successfully.
- Operators maintain control of HPCI/RCIC when AC not available.
- Batteries gradually discharge and fail at 4 hours, causing loss of HPCI/RCIC.
- RPV level gradually lowering.

INDICATIONS OF PLANT CONDITION
- Offsite power indications reenergize.
- RPV level approaching -162".
- Suppression pool temperature > 95°F.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-1 (RC/L-4).
- Align and initiate RHR or core spray pumps for low pressure injection.
- Start at least one primary EECW pump as needed to maintain acceptable room temperatures.

CONCURRENT ACTIONS/COMPETING FACTORS
- Initiate suppression pool cooling.
- Site emergency still in effect.
- Coordination with TSC required.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level returns to normal level.

FAILURE IMPACT
- Requirement to cycle low pressure injection.
- Unable to maintain suppression pool cooling.

TIME CONSTRAINTS
- Assume a 30 minute time window in which to act when offsite power is finally recovered prior to losing batteries.

Table B-18 (Page 8 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOSPRC1: Manually Close LPCI Injection Valves To Restore Suppression Pool Cooling

PRECEDING EVENTS
- Any general transient initiator.
- Cooldown in progress.
- Main heat sink not available. However, condensate pumps available to drain the hotwell to provide RPV level control.
- Operators recognized the need for suppression pool cooling (OSP=S), but normal hardware failed to achieve realignment.

INDICATIONS OF PLANT CONDITION
- High suppression pool average temperature alarm.
- LPCI valves 74-FCV-53 and 74-FCV-67 indicate RED.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Recognize that SPC was not achieved by attempts at normal valve realignment.
- In the control room, close one of either 74-FCV-52 or 74-FCV-66.

CONCURRENT ACTIONS/COMPETING FACTORS
- Maintain RPV level with the other train of RHR or HPCI/RCIC as the cooldown situation dictates. (Failures are localized to SPC flowpaths).

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- One of LPCI valves 74-FCV-52 or 74-FCV-66 indicate GREEN and the other RED.

FAILURE IMPACT
- Suppression pool reaches temperature that prevents effective core cooling.

TIME CONSTRAINTS
- Alarm occurs approx 2 to 4 hours into transient.
- Establish SPC within up to 12 hours after alarm, as suppression pool temperature rises very gradually.

Table B-18 (Page 9 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOSPRO1: Manually Open Valves To Align RHR for Suppression Pool Cooling

PRECEDING EVENTS

- Any general transient initiator.
- Successful cooldown to < 212°F. or cooldown in progress.
- Main heat sink not available. However, condensate pumps available to drain the hotwell to provide RPV level control.
- Operators have recognized that swapover from LPCI to suppression pool cooling was not achieved by normal hardware operation and started realignment (OSPRO1 = S).

INDICATIONS OF PLANT CONDITION

- High suppression pool temperature alarm.
- LPCI valves 74-FCV-52 indicate RED (GREEN) and 74-FCV-66 indicate GREEN (RED).
- Valves 74-FCV-71, 74-FCV-73, 74-FCV-57 and 74-FCV-59 indicate GREEN.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS

- Control room notify AUO to manually align SPC.
- AUO must accomplish the following by manual valve manipulation:
  - Open valves 74-FCV-71 and 74-FCV-73 if 74-FCV-66 closed.

    or
  - Open valves 74-FCV-57 and 74-FCV-59 if 74-FCV-52 closed.

CONCURRENT ACTIONS/COMPETING FACTORS

- Local working environment.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT

- Valves 74-FCV-53 and 74-FCV-67 indicate GREEN.
- Valves 74-FCV-71, 74-FCV-73, 74-FCV-57 and 74-FCV-59 indicate RED
- Suppression pool temperature begins to lower.

FAILURE IMPACT

- Suppression pool reaches temperature that prevents effective core cooling.

TIME CONSTRAINTS

- Alarm occurs approx 2 to 4 hours into transient.
- Establish SPC within up to 12 hours after alarm, as suppression pool temperature rises very gradually.

Table B-18 (Page 10 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOU11: Crosstie Unit 1 Pumps and Heat Exchanger to Unit 2 Torus To Provide Core Cooling following a Flood Caused by a Leak in the EECW Header, Condenser is Not Available as a Heat Sink in Unit 2

PRECEDING EVENTS
- Unit at 100% power operating under normal conditions.
- Leak occurs in either the north or south EECW header.
- Operators fail to isolate header before loss of RHR, CS and HPCI/RCIC due to flooding of equipment (OFLRB1 = F).
- Feedwater, condensate and main heat sink fails during initial plant transient in response to flood.

INDICATIONS OF PLANT CONDITION
- High water level alarms in RHR, CS and HPCI/RCIC areas.
- Erratic indications of condition from RHR, CS and HPCI/RCIC.
- Suppression pool level and temperature normal.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- 2-OI-74, Section 8.18, 20, 22 as applicable.
- OI-2 Appendix.

CONCURRENT ACTIONS/COMPETING FACTORS
- Using available alternate sources of water to maintain RPV level per EOI-1.
- Actions to shutdown reactor.
- Still attempting to isolate the EECW leak and/or shutdown of EECW.
- High temperature alarms on equipment serviced by EECW.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level and pressure control maintained with a stable source of water from Unit 1.

FAILURE IMPACT
- Loss of ability to maintain RPV level leading to core uncovery and fuel damage.

TIME CONSTRAINTS
- Approximately 30 minutes if injection into RPV lost during initial phase of flood.

Table B-18 (Page 11 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOU12: Align Alternate Sources of Water To Maintain RPV Level, Given a Leak in the Torus Ring Header, and Condensate/Feedwater Lost in Unit 2

PRECEDING EVENTS
- Unit at 100% power operating under normal conditions.
- Failure of Unit 2 tours ring header floods the unit 2 basement.
- Unit 2 torus begins draining into the basement of the reactor building.
- EOI entry conditions met and reactor SCRAMed.
- Equipment in the basement of the reactor fails due to flooding.
- Feedwater, condensate and main heat sink fails during initial plant transient in response to flood.

INDICATIONS OF PLANT CONDITION
- Secondary containment floor drain level > 66".
- High water level alarms in RHR, CS and HPCI/RCIC areas.
- Erratic indications of condition from RHR, CS and HPCI/RCIC.
- Suppression pool level declines to below -6.25".
- RPV level declining below normal range.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- EOI-2 low suppression pool level.
- EOI-3 High secondary drain level.
- Emergency depressurize while there is still enough water in the suppression pool to accept the heat sink.
- RCIC can be used until the water drowns it. (RCIC is on a pedestal).
- Align enhanced CRD.
- AUO line up condensate transfer pump to pump water.

CONCURRENT ACTIONS/COMPETING FACTORS
- Containment pressure rises as heat sink lost and may be the prime concern.
- Site emergency and TSC established.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- RPV level and pressure control maintained with a stable source of water from Unit 1.
- Containment overpressurization not threatened.

FAILURE IMPACT
- Loss of ability to maintain RPV level leading to core uncovery and fuel damage.

TIME CONSTRAINTS
- Approximately 30 minutes if injection into RPV lost during initial phase of flood.
- Expect more time since torus will not drain dry immediately.

Table B-18 (Page 12 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOUB1: Restore Power to Either the Unit 1 (Unit 2) Unit Board (4-kV), Given Loss of Main Electrical Feed to that Unit

PRECEDING EVENTS
- Any general transient initiator except LOSP or loss of 500-kV grid.
- Loss of feed hardware to one unit.
- Reactor scram successful.
- Conditions not sufficient to cause fast bus transfer.
- HPCI/RCIC start and control level.

INDICATIONS OF PLANT CONDITION
- 161-kV switchyard power available.
- Unit 1 Unit Board deenergized.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- OI-57A.
- Insure SD Boards in manual.
- Clear breaker from main electrical feed.
- Close breaker from alternate source (Unit Start Bus).

CONCURRENT ACTIONS/COMPETING FACTORS
- Immediate actions upon SCRAM.

INDICATION OF SUCCESSFUL COMPLETION
- Power available to Unit Boards 1A, 1B, 2A, 2B.

FAILURE IMPACT
- Diesel Generators required to accomplish the recovery.

TIME CONSTRAINTS
- Assume 15-20 minutes available before the diesel generators are required.

Table B-18 (Page 13 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOUB2: Restore Power to Both the Unit 1 and Unit 2 Unit Boards (4-kV), Given Loss of 500-kV grid

PRECEDING EVENTS
- Any general transient initiator.
- Loss of 500-kV grid.
- Reactor scram successful.
- Conditions not sufficient to cause fast bus transfer.
- HPCI/RCIC start and control level.

INDICATIONS OF PLANT CONDITION
- 161-kV switch yard power available.
- Unit 1 and Unit 2 Unit Boards deenergized.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- AOI-57.
- Verify breakers from the 400-kV grid source are opened.
- Insure SD Boards in manual.
- Close breakers from alternate source (Unit Start Bus).

CONCURRENT ACTIONS/COMPETING FACTORS
- Immediate actions upon SCRAM.

INDICATION OF SUCCESSFUL COMPLETION
- Power available to Unit Boards 1A, 1B, 2A, 2B.

FAILURE IMPACT
- Diesel Generators required to accomplish the recovery.

TIME CONSTRAINTS
- Assume 15-20 minutes available after loss of 500 kv before the diesel generators are required.

Table B-18 (Page 14 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOVS1: Close a Valve To Isolate High/Low Pressure Leak that Occurs during Surveillance Testing of a CS or LPCI Injection Path

PRECEDING EVENTS
- Begin surveillance testing of a CS or LPCI injection path normally closed valve by closing a normally open valve in same path.
- Manually cycle the normally closed valve open.

INDICATIONS OF PLANT CONDITION
- Low pressure system pressure indications off scale high.
- Rad waste receiving more water than usual.
- Sumps overflowing.
- High temperature effects on piping and paint.
- Selected area air temperatures may increase.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Recognize that symptoms coming from high/low pressure interface failure.
- Close appropriate valves to reestablish pressure boundary.
- Bleed off excess pressure to suppression pool.

CONCURRENT ACTIONS/COMPETING FACTORS
- Personnel performing the test are in the location to observe impact of pressurization and perhaps be impacted by it.
- Response to the individual indications prior to tieing them together.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Termination of an interfacing LOCA accident prior to SCRAM.

FAILURE IMPACT
- Interfacing LOCA initiated.

TIME CONSTRAINTS
- Assume 2 minutes is available before low pressure failure mechanisms can propagate sufficiently to require reactor SCRAM and safety system actuation.

Table B-18 (Page 15 of 15). Operator Response Forms Used To Evaluate Recovery Actions

HOVS2: Respond To Inadvertent Failure of High/Low Pressure Interface Valve in the CS or Low Pressure Injection during Normal Operations

PRECEDING EVENTS
- Unit at 100% power and functioning normally.
- No testing in the RHR/CS/LPCI systems.

INDICATIONS OF PLANT CONDITION
- Low pressure system pressure indications off scale high.
- Rad waste receiving more water than usual.
- Sumps overflowing.
- High temperature effects on piping and paint.
- Selected area air temperatures may increase.

PROCEDURAL GUIDANCE/REQUIRED ACTIONS
- Recognize that symptoms coming from high/low pressure interface failure.
- Close appropriate valves to reestablish pressure boundary.
- Bleed off excess pressure to suppression pool.

CONCURRENT ACTIONS/COMPETING FACTORS
- Response to the individual indications prior to tieing them together.

INDICATION OF SUCCESSFUL COMPLETION AND SUCCESS IMPACT
- Termination of interfacing LOCA accident prior to SCRAM.

FAILURE IMPACT
- Interfacing LOCA initiated.

TIME CONSTRAINTS
- Assume 2 minutes is available before low pressure failure mechanisms can propagate sufficiently to require reactor SCRAM and safety system actuation.

Table B-19. Raw and Normalized Weights and Scores of Actions Evaluated by the Team of Licensed Operators Evaluating Recovery Actions

BFN Recovery Human Action Evaluations

ID	Actions W	Actions S	Interface W	Interface S	Time W	Time S	Procedure W	Procedure S	Complex W	Complex S	Training W	Training S	Stress W	Stress S	Tot Wgt
OEE1	4	4	2	2	3	2	0	NR	3	1	2	6	2	3	16
OEE2	4	8	2	6	4	7	0	NR	2	1	2	6	3	6	17
OFLRB1	1	1	1	1	4	5	0	10	2	2	2	3	2	3	12
OR4801	3	2	3	0	2	2	2	0	2	0	2	1	2	2	16
ORP3	4	6	3	7	3	5	2	2	4	7	2	4	2	8	20
OSPRC1	2	1	3	0	1	0	0	10	2	2	1	4	2	1	11
OSPRO1	2	1	3	0	1	0	0	10	2	3	1	4	2	4	11
OU11	2	6	2	7	2	6	4	1	3	7	2	5	2	5	17
OU12	2	3	2	8	3	7	3	2	4	9	2	3	2	8	18
OUB1	3	4	3	0	2	0	2	1	2	3	2	5	2	4	16
OUB2	3	5	3	0	2	1	2	1	2	4	2	5	2	6	16
OVS1	2	0	2	0	3	5	0	10	2	1	2	4	2	2	13
OVS2	2	1	2	3	3	6	0	10	2	2	2	4	2	4	13

BFN Recovery Human Action Evaluations

ID	Actions W	Actions S	Interface W	Interface S	Time W	Time S	Procedure W	Procedure S	Complex W	Complex S	Training W	Training S	Stress W	Stress S	FLI
ID	0.17	3	0.16	3	0.17	4	0.07	4	0.16	3	0.12	4	0.14	4	3.38
OEE1	0.25	4	0.13	2	0.19	2	0.00	NR	0.19	1	0.13	6	0.13	3	2.94
OEE2	0.24	8	0.12	6	0.24	7	0.00	NR	0.12	1	0.12	6	0.18	6	6.12
OFLRB1	0.08	1	0.08	1	0.33	5	0.00	10	0.17	2	0.17	3	0.17	3	3.17
OR4801	0.19	2	0.19	0	0.13	2	0.13	0	0.13	0	0.13	1	0.13	2	1.00
ORP3	0.20	6	0.15	7	0.15	5	0.10	2	0.20	7	0.10	4	0.10	8	5.80
OSPRC1	0.18	1	0.27	0	0.09	0	0.00	10	0.18	2	0.09	4	0.18	1	1.09
OSPRO1	0.18	1	0.27	0	0.09	0	0.00	10	0.18	3	0.09	4	0.18	4	1.82
OU11	0.12	6	0.12	7	0.12	6	0.24	1	0.18	7	0.12	5	0.12	5	4.88
OU12	0.11	3	0.11	8	0.17	7	0.17	2	0.22	9	0.11	3	0.11	8	5.94
OUB1	0.19	4	0.19	0	0.13	0	0.13	1	0.13	3	0.13	5	0.13	4	2.38
OUB2	0.19	5	0.19	0	0.13	1	0.13	1	0.13	4	0.13	5	0.13	6	3.06
OVS1	0.15	0	0.15	0	0.23	5	0.00	10	0.15	1	0.15	4	0.15	2	2.23
OVS2	0.15	1	0.15	3	0.23	6	0.00	10	0.15	2	0.15	4	0.15	4	3.54

Table B-20 (Page 1 of 5). Quantification of Recovery Action Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 1
Evaluation Team: Recovery
Action Grouping Logic: R1 - Preceding and Concurrent Actions and Plant Interface Important

Action Code	Preceding & Conc. Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score.	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.94	1.0E+00	0.00
OUB2	0.19	5	0.19	0	0.13	1	0.13	1	0.13	4	0.13	5	0.13	6	3.06	2.5E-03	-2.61
OUB1	0.19	4	0.19	0	0.13	0	0.13	1	0.13	3	0.13	5	0.13	4	2.38	1.4E-03	-2.87
ORP3	0.20	6	0.15	7	0.15	5	0.10	2	0.20	7	0.10	4	0.10	8	5.80	2.7E-02	-1.57
OR4801	0.19	2	0.19	0	0.13	2	0.13	0	0.13	0	0.13	1	0.13	2	1.00	4.1E-04	-3.39
MIN															0.00	1.7E-04	-3.77
Calibration Actions																	
Oconee, OPRA-8	0.15	5	0.15	5	0.12	4	0.16	1	0.12	5	0.12	6	0.19	7	4.74	1.0E-02	-2.00
STP HEOR05	0.22	7	0.12	7	0.22	8	0.12	5	0.12	8	0.12	8	0.08	6	7.14	1.0E-01	-1.00
EST_MAX															10.00	1.0E+00	0.00

Regression Output:

Constant	-3.76
Std Err of Y Est	0.071
R Squared	0.997
No. of Observations	3
Degrees of Freedom	1

X Coefficient(s) 0.3793
Std Err of Coef. 0.0192

Table B-20 (Page 2 of 5). Quantification of Recovery Action Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 1
Evaluation Team: Recovery
Action Grouping Logic: R2 - Procedures and Complexity Important

Action Code	Preceding & Conc. Actions Weight	Preceding & Conc. Actions Score	Plant Interfaces Weight	Plant Interfaces Score	Time Adequacy Weight	Time Adequacy Score	Procedures Weight	Procedures Score	Complexity Weight	Complexity Score	Training & Experience Weight	Training & Experience Score	Stress Weight	Stress Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															9.84	1.0E+00	0.00
OU12	0.11	3	0.11	8	0.17	7	0.17	2	0.22	9	0.11	3	0.11	8	5.94	2.7E-02	-1.57
OU11	0.12	6	0.12	7	0.12	6	0.24	1	0.18	7	0.12	5	0.12	5	4.88	1.0E-02	-2.00
MIN															0.00	1.1E-04	-3.96
Calibration Actions																	
Grand Gulf GG3	0.11	2	0.22	2	0.11	2	0.22	3	0.11	2	0.11	3	0.12	2	2.33	1.5E-03	-2.82
Oyster Crk ZHEMU1	0.17	7	0.13	5	0.15	2	0.18	5	0.12	5	0.15	4	0.10	6	4.84	4.0E-03	-2.40
Beaver Valley ZHE	0.17	9	0.00	2	0.17	4	0.17	5	0.17	8	0.17	8	0.17	9	7.17	1.2E-01	-0.92
Limerick L4B	0.17	10	0.12	9	0.13	10	0.17	10	0.12	9	0.12	9	0.17	10	9.64	9.0E-01	-0.05

Regression Output:

Constant	-3.96
Std Err of Y Est	0.326
R Squared	0.957
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	0.4033
Std Err of Coef.	0.0602

TABLEB20.BFN.07/09/92

Table B-20 (Page 3 of 5). Quantification of Recovery Action Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 1
Evaluation Team: Recovery
Action Grouping Logic: R3 - Preceding and Concurrent Actions and Time Important

Action Code	Preceding & Conc. Actions Weight	Score	Plant Interfaces Weight	Score	Time Adequacy Weight	Score	Procedures Weight	Score	Complexity Weight	Score	Training & Experience Weight	Score	Stress Weight	Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	9.3E-01	-0.03
OEE1	0.25	4	0.13	2	0.19	2	0.00	NR	0.19	1	0.13	6	0.13	3	2.94	1.9E-04	-3.71
OEE2	0.24	8	0.12	6	0.24	7	0.00	NR	0.12	1	0.12	6	0.18	6	6.12	8.8E-03	-2.06
MIN															0.00	5.7E-06	-5.25
Calibration Actions																	
ANO 1 IREP A2	0.24	2	0.12	2	0.24	3	0.00	0	0.16	2	0.12	2	0.12	2	2.24	1.0E-04	-4.00
Calvert Clf CC7	0.24	4	0.12	5	0.24	5	0.00	0	0.16	5	0.12	4	0.12	4	4.52	1.0E-03	-3.00
EST_MAX															10.00	1.0E+00	0.00

Regression Output:

Constant	-5.24
Std Err of Y Est	0.139
R Squared	0.997
No. of Observations	3
Degrees of Freedom	1
X Coefficient(s)	0.5213
Std Err of Coef.	0.0246

TABLEB20.BFN.07/09/92

Table B-20 (Page 4 of 5). Quantification of Recovery Action Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 1
Evaluation Team: Recovery
Action Grouping Logic: R4 - Time Important, Procedures Not Important

Action Code	Preceding & Conc. Actions Weight	Preceding & Conc. Actions Score	Plant Interfaces Weight	Plant Interfaces Score	Time Adequacy Weight	Time Adequacy Score	Procedures Weight	Procedures Score	Complexity Weight	Complexity Score	Training & Experience Weight	Training & Experience Score	Stress Weight	Stress Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	9.4E-01	-0.03
OVS2	0.15	1	0.15	3	0.23	6	0.00	10	0.15	2	0.15	4	0.15	4	3.54	2.1E-03	-2.68
OVS1	0.15	0	0.15	0	0.23	5	0.00	10	0.15	1	0.15	4	0.15	2	2.23	6.0E-04	-3.22
OFLRB1	0.08	1	0.08	1	0.33	5	0.00	10	0.17	2	0.17	3	0.17	3	3.17	1.5E-03	-2.84
MIN															0.00	7.2E-05	-4.14
Calibration Actions																	
DC Cook ZHEOS1	0.11	2	0.11	2	0.22	3	0.11	5	0.23	1	0.11	5	0.11	4	2.87	1.5E-03	-2.82
Beaver Valley ZHE	0.13	1	0.13	2	0.25	7	0.11	2	0.13	5	0.13	3	0.13	6	4.15	2.5E-03	-2.61
STP HEOR07	0.11	5	0.11	7	0.22	6	0.11	4	0.23	5	0.11	5	0.11	6	5.44	1.3E-02	-1.89
EST_MAX															10.00	1.0E+00	0.00

Regression Output:

Constant	-4.14
Std Err of Y Est	0.160
R Squared	0.989
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	0.4114
Std Err of Coef.	0.0297

Table B-20 (Page 5 of 5). Quantification of Recovery Action Evaluations into Human Error Rates

Dynamic Human Action Evaluation for: Browns Ferry Nuclear Plant, Unit 1
Evaluation Team: Recovery
Action Grouping Logic: R5 - Plant Interfaces Important, Procedures Not Important

Action Code	Preceding & Conc. Actions Weight	Preceding & Conc. Actions Score	Plant Interfaces Weight	Plant Interfaces Score	Time Adequacy Weight	Time Adequacy Score	Procedures Weight	Procedures Score	Complexity Weight	Complexity Score	Training & Experience Weight	Training & Experience Score	Stress Weight	Stress Score	FLI	P(fail)	LOG(P(fail))
Rated Actions																	
MAX															10.00	6.4E-01	-0.19
OSPRC1	0.18	1	0.27	0	0.09	0	0.00	10	0.18	2	0.09	4	0.18	1	1.09	8.5E-05	-4.07
OSPRO1	0.18	1	0.27	0	0.09	0	0.00	10	0.18	3	0.09	4	0.18	4	1.82	1.8E-04	-3.75
MIN															0.00	2.9E-05	-4.54
Calibration Actions																	
Big Rock BR5	0.11	5	0.22	6	0.07	5	0.11	5	0.16	6	0.22	6	0.11	6	5.71	1.4E-02	-1.85
Fermi OL1	0.11	8	0.22	8	0.07	5	0.11	9	0.16	8	0.22	7	0.11	9	7.79	2.8E-02	-1.55
EST_MAX															10.00	1.0E+00	0.00

Regression Output:

Constant	-4.54
Std Err of Y Est	0.488
R Squared	0.879
No. of Observations	3
Degrees of Freedom	1

X Coefficient(s) 0.4349
Std Err of Coef. 0.1608

Table B-21. Recovery Human Error Rate Distributions Used for Quantification of the Browns Ferry PRA

Database Variable	Brief Description	Top Event	Mean HER/ Demand	5th	Median HER/ Demand	95th
HOCIS1	Ensure That Various Normally Closed Valves are Closed, Given Group 6 Isolation is Required	CIS	0.003620	0.000242	0.001750	0.012200
HOEE1	Align and Start One RHRSW Swing Pump, Given LOSP and Insufficient EECW to Diesel Generators	OEE	0.000506	0.000018	0.000184	0.001840
HOEE2	Align and Start One RHRSW Swing Pump, Given LOSP, ATWS, and Insufficient EECW to Diesel Generators	OEE	0.016100	0.001900	0.009780	0.048700
HOFLRB	Identify and Isolate Leak in Either North or South EECW Header	OFLRB	0.003020	0.000202	0.001460	0.010200
HOLP1	Control RPV Level Using LPCI Mode of RHR or the Core Spray System	OLP	0.001500	0.000004	0.000346	0.004660
HOPCA1	Manually Start Two Air Compressors, Given Loss of Offsite Power	PCA	0.001150	0.000003	0.000070	0.004350
HOR480	Align 480V RMOV Board (2B) to Alternate Source	OR480	0.001090	0.000039	0.000398	0.003970
HORP3	Start RHR/Core Spray Pumps for Low Pressure Injection, Given LOSP, Loss of D/Gs, and Power Recovered within 6 Hours.	ORP	0.043600	0.005140	0.026400	0.131000
HOSPRC	Manually Close LPCI Injection Valves To Restore Suppression Pool Cooling.	OSPR	0.000226	0.000008	0.000082	0.000823
HOSPRO	Manually Open Valves To Align RHR for Suppression Pool Cooling.	OSPR	0.000480	0.000017	0.000175	0.001740
HOU11	Crosstie Unit 1 Pumps and Heat Exchanger to Unit 2 Torus, Given Flood in Reactor Building Basement, Unit 2 Condenser Unavailable.	OU1	0.016100	0.001900	0.009780	0.048700
HOU12	Align Alternate Sources of Water To Maintain RPV Level, Given a Leak in the Torus Ring Header, Condenser Lost as a Heat Sink in Unit 2	OU1	0.043600	0.005140	0.026400	0.131000
HOUB1	Restore Power to Both Units 1 and 2 Unit Board (4 kv), Given Loss of Main Electrical Feed to that Unit	UB	0.002820	0.000188	0.001360	0.009510
HOUB2	Restore Power to Both Units 1 and 2 Unit Boards (4 kV), Given Loss of 500 kV Grid	UB	0.005030	0.000337	0.002440	0.017000
HOVS1	Close a Valve To Isolate a High/Low Pressure Leak that Occurs during Surveillance Testing of a CS or LPCI Injection Line	OVS	0.001600	0.000057	0.000582	0.005810
HOVS2	Respond To Inadvertent Failure of High/Low Pressure Interface Valve in the CS or LPCI Injection Lines during Normal Operations.	OVS	0.004230	0.000283	0.002050	0.014300

C. THERMAL-HYDRAULIC CALCULATIONS AND TIMING JUSTIFICATIONS FOR DYNAMIC AND RECOVERY OPERATOR ACTIONS

This appendix presents the reasoning and simplified thermal-hydraulic analyses to support the selection of time windows for the human actions that appear in the event sequence models. The individual action definitions are listed in alphabetical order by type (dynamic or recovery) as they appear in Section 3.3.3 and Appendix B with the time constraints that apply to the risk model. Accident sequences have been classified into two categories: dynamic and recovery. These actions differ primarily by when they were identified and incorporated into the plant model. Dynamic actions were identified during the initial construction of the model and were evaluated by three operator teams. Recovery actions were identified during the review of the preliminary quantifications and address actions that reduce the frequency of important accident sequences in those preliminary quantifications. The recovery actions were evaluated by one group of operators. The dynamic actions are listed in Section C.1, while the recovery actions are listed in Section C.2.

The time constraints presented on the Operator Response Forms are not an explicit variable used to obtain the human error rate (HER) directly from a correlation. Rather, they provide information for one of the performance-shaping factors considered by the operators during their evaluation. During the elicitation process, they are asked to use the time constraints as a guide for the evaluation of the degree of difficulty of the action. It forms one of the bases by which they formulate the context of the action for the evaluation process. Because of this, the preciseness of the time constraints is not as important as it would be if an explicit time-dependent correlation were used to quantify the HERs.

To expedite the preparation of Operator Response Forms and the interview of operator teams, best estimates of the time available for the hypothesized actions were made by the plant modelers, licensed operators, and the human action analyst preparing the forms. As Appendix C was developed to verify the time constraints, some discrepancies between the best estimate times and those determined by thermal-hydraulic calculations were found after the operators completed their evaluations based on the initial estimates. Each of these discrepancies is identified below with a footnote number. The footnotes assess the impact of the discrepancy on the evaluated failure rate. As discussed above, the time constraints are only one input that the operators use to assess the degree of difficulty of the action. Therefore, the discrepancies generally have an insignificant impact on the evaluation results.

Many justifications are based on the rate of change of fluid levels in the reactor pressure vessel (RPV). These rates are dependent on the volume of fluid available per unit height. Table C-1 (based on Reference C-1) calculates these volumes, and the results of two important regions are shown on the following page.

Region	Average Volume (gallons per inch of level indication)
Active Fuel	95 (includes downcomer)
Top of Active Fuel (TAF) to Bottom of Steam Dryer Panels	200 (excludes volumes due to internal structures)

C.1 DYNAMIC ACTIONS

HOAD1: **Inhibit Automatic Depressurization System (ADS) actuation, Given Anticipated Transient without Scram (ATWS) with an Unisolated Vessel**

Timing: **Time to -122" dependent on suppression pool heatup, but approximately 10 minutes. Four minutes are provided by the timer after reaching -122", for a total of 14 minutes.**

This action applies to scenarios in which the RPV is not isolated and feedwater remains available. The limiting condition is the requirement to lower the RPV level for power control once the suppression pool temperature is above 110° F (EOI, C5-5).

Under unisolated conditions, the turbine bypass valves (TBV) can dissipate approximately 30% of full power. If the reactor is at 50% power, the additional 20% will be absorbed by the suppression pool. Using the operators' rule of thumb that the suppression pool rises 1° per open safety relief valve (6% power) per minute, Table C-2 indicates that the requirement to lower the level will be reached at approximately 9 minutes if the suppression pool is initially at 80°F.

Once injection is terminated, the RPV level will drop to -122" within approximately 2 minutes (see Table C-3). Given these two times, 10 minutes provides a reasonable time frame during which the condition for timer initiation can be reached. Four minutes is provided by the timer once -122" is reached, for a total of 14 minutes.

Using the heat balance calculations in Table C-2 to verify the rule-of-thumb, the requirement to lower level will be reached at approximately 6 minutes if the suppression pool is initially at 80°F, resulting in a total of 8 minutes until -122" is reached. As the key to this action is the response to the ADS timer, the difference in the rule-of-thumb time versus the thermal-hydraulic time is judged to not impact the operator evaluations. In addition, the time for the RPV level to decline does not account for the decrease in power achieved by lowering the level. That relationship can significantly lengthen the time required to boil down to -122". This would tend to lengthen the time constraint to the 10 minutes given to the operators.

HOAD2: Inhibit ADS Actuation, Given ATWS with an Isolated Vessel

Timing: Level drops to -122" within 2 minutes without injection; primary containment pressure > 2.45 psig when isolated. Must inhibit prior to 95-second timeout.

When the RPV is isolated, feedwater is not available to maintain level, and the RPV will boil down to -122" after approximately 1 to 2 minutes (see Table C-3). When the stated pressure and level conditions both exist, the timer delay is lowered to 95 seconds.

HOAL1: Allow RPV Level To Drop and Control at Top of Active Fuel, Given ATWS with Unisolated Vessel

Timing: Initiate when required in the event. Initiate and gain control of injection within 1 minute of reaching -162" to avoid going below -190".

When the water level is at the top of active fuel, the power/level relation is assumed to have reduced the power level to the range of 5% or lower (Reference C-2, p. B-14-27). There are approximately 95 gallons per inch of water in the RPV in the region of the active fuel. Using these values, Table C-4 estimates that approximately 1 minute is available to gain control before -190" is reached.

HOAL2: Lower and Control RPV Level at Top of Active Fuel, Given ATWS with Isolated Vessel

Timing: Initiate and gain control of injection within 1 minute of reaching -162" to avoid going below -190".

The suppression pool will heat up to 110°F within 3 to 5 minutes if all of the heat generated during the ATWS is discharged to it (Table C-2).

Justification for time constraint to regain level control is the same as action HOAL1. The critical time restraint for the action is judged to be gaining control of the level in the region of the active fuel.

HOBC1: Cooldown with Turbine Bypass Valves, Given Either HPCI or RCIC Available

Timing: Not time sensitive; do as required during first 6 hours.

This action is intended to assist cooldown, given that there is difficulty in achieving the desired cooldown rate with the pressure control capability of high pressure coolant injection (HPCI) not available. The operators were asked to rate their ability to achieve the desired result over the 6-hour cooldown period. Success simply makes it unnecessary for HPCI or reactor core isolation cooling (RCIC) to operate for more than a 6-hour mission period.

HOBD1: **Depressurize with TBVs after Loss of HPCI/RCIC**

Timing: **Approximately 15 minutes[1] to boil down from -45" to -122" at 2% decay heat.**

Operator alert for action at -45" was taken because that is the automatic initiation point for HPCI and RCIC. Failure of automatic initiation will force them to consider alternative measures to cool the core. Table C-5 indicates that approximately 16 minutes are available until -122" is reached, the MSIVs close, and the option to depressurize with the TBVs is no longer available. (The time is extended to 26 minutes if the control rod drive hydraulic system (CRDHS) is operational.) The option to bypass main steam isolation valve (MSIV) closure is available only during an ATWS.

HOCRD1: **Align "Enhanced Flow" CRDHS, Given HPCI/RCIC Fail after 6 Hours**

Timing: **Not time sensitive; more than 90 minutes available to align second pump.**

At 6 hours after shutdown, the decay heat will have declined to less than 0.8% of full power, and it will continue to decline. This action is required in the probabilistic risk assessment (PRA) model for those scenarios where the pressure has not declined. Under these circumstances, Table C-6 indicates that normal flow of approximately 150 gpm from the one control rod drive (CRD) pump will maintain flow for at least 15 hours.

The PRA model made the conservative assumption that enhanced flow would be required if the RPV were not depressurized in the first 6 hours. The time constraint of 90 minutes given to the operators is also very conservative. It was set at this value to relate to the operators that a large amount of time is available to accomplish this action.

HOCRD2: **Align and Operate "Enhanced Flow" CRDHS, Given Enhanced Mode Is Required (HPCI/RCIC failed)**

Timing: **More than 45 minutes to reach top of active fuel, with no injection at 2% decay heat.**

The calculations in Table C-6 indicate that over 56 minutes is required to boil down to the top of active fuel if the decay heat averages 2% of full power, given that one CRD is running. Thus, the 45-minute time window used was conservative.

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[1]An initial estimate of 20 minutes was given to the operators during their evaluations based on an operator rule of thumb that steam generation is 133,000 lbm per hour per percent power. This value accounts for the requirement to heat subcooled feedwater. The actual thermal-hydraulic parameters used above assumed that liquid available for boiling is saturated at 1,000 psia. The difference in available time has no impact on the evaluations performed by the operators.

HODWS1: Initiate Drywell Spray

Timing: Assume 20 to 60 minutes[2] to avoid primary containment conditions that could result in release of radioactive materials into the environment.

This time constraint was given to the operators to indicate that the majority of more frequent accident sequences result in slowly evolving primary containment challenge scenarios. Given this most likely result, the operators were asked to consider the action with some degree of flexibility to act.

The actual timing for this action is scenario dependent. This evaluation is performed as part of the Level 2 analysis. The time constraint given to the operators was selected after discussion with Level 2 analysts having experience on other PRAs as being a reasonable representation of the situation that the operators would be expected to encounter.

HODWS2: Initiate Drywell Spray, Given ATWS

Timing: Assume 10 to 40 minutes to avoid primary containment conditions that could result in release of radioactive materials into the environment.

The reasoning for this action is similar to action HODWS1. As the success of maintaining primary containment integrity depends on achieving subcriticality in a reasonable period of time, the time constraints were stated the same as that action. In this case, the operators were asked to recognize the additional heat that had been added to the primary containment; however, but for the reasons stated in the second paragraph of the HODWS1 justification, the time constraints were kept very general.

HOF1: Control One Feedwater Pump and Hotwell Level, Given Autocontrol was Successful

Timing: Monitor during cooldown (up to 24 hours). Respond to alarm within 5 minutes to avoid automatic trip.

The time available for response depends on the magnitude of mismatch between steam demand and feedwater flow. If the RPV level alarms at +39" and automatically trips at +55", a 5-minute response time corresponds to a mismatch of approximately:

$$\text{Mismatch of flow rates} + (200\ \text{gal/in})(16\ \text{inches})/5\ \text{min} = 640\ \text{gal/min}$$

At 1% power, the feedwater flow necessary to maintain RPV level is approximately (using enthalpies of 1,200 Btu/lbm for steam boiled during cooldown and 80 Btu/lbm for the feedwater):

$$\text{flow} = \frac{(33\text{MWt})\ (3.413 \times 10^6\text{Btu/hr-MWt})\ (.0162\text{ft}^3\text{/lbm})\ (7.48\text{gal/ft}^3)}{(1{,}120\text{Btu/lbm})\ (60\text{min/hr})} = 203\ \text{gal/min}$$

[2]The Operator Response Form stated "tens of minutes" as the time constraint. The more specific range given here is intended to convey a better feeling for the rate at which a scenario could develop.

Therefore, the response time assumes that the anomaly could increase flow from approximately 200 to over (200 + 640=) 840 gpm, or four times normal flow.

HOF2: **Control One Feedwater Pump and Hotwell Level, Given Autocontrol Fails**

Timing: **Continuous requirement during cooldown (up to 24 hours). Respond to alarm within 5 minutes to avoid automatic trip.**

Reasoning for time constraint is the same as for action HOF1.

HOF3: **Control Feedwater Pumps and Hotwell Level, Given Autocontrol is Successful but Operators Initially Failed To Trip Two Feedwater Pumps**

Timing: **Respond in approximately 2 minutes to avoid automatic trip.**

This is a backup to the automatic control to stop feedback oscillations. The mismatch necessary to achieve an automatic trip at +55" within 2 minutes will be 2.5 times that of action HOF1, or 1,600 gal/min. This is eight times the amount of flow needed to maintain level.

HOF4: **Restore and Control RPV Level with Feedwater Following Shutdown from ATWS**

Timing: **Continuous control during refill/cooldown (to 24 hours). Once normal level achieved, respond in 5 minutes to avoid automatic trip at +55".**

As level is being restored, this action requires continual control. Once ATWS is terminated and level is restored, the requirement for feedwater to offset decay heat declines to normal levels. Consequently, the reasoning for response time constraints becomes the same as for.action HOF1.

HOFT1: **Trip Two of Three Feedwater Pumps To Limit Feedwater Flow**

Timing: **Respond in approximately 2 minutes to avoid automatic trip of all 3 pumps.**

The time constraint for this action is dependent on the initial level of the RPV following shrinkage and the degree to which the feedwater controller has responded to the transient. For example, if the RPV level immediately after trip is +5", a mismatch exceeding [50 inches) (200 gal/in)/2 min =] 5,500 gallons per minute would be required to produce an automatic trip within 2 minutes. Based on discussion with operators who have experienced plant trips, 2 minutes is judged to be a reasonable time constraint for this action.

HOHC1: **Control RPV Level and Pressure with HPCI and/or RCIC during First 6 Hours**

Timing: **Continuous requirement; react within 5 minutes of high level alarm to prevent automatic HPCI trip at +55".**

This action is accomplished after the operators have successfully initiated HPCI/RCIC injection in action HOHS1. The time constraints for controlling are based on potential mismatch of flow. If the RPV level alarms at +39" and automatically trips at +55", a 5-minute response time corresponds to a mismatch of approximately:

Mismatch of flow rates + (200 gal/in)(16 inches)/5 min = 640 gal/min

At 1% power, the feedwater flow necessary to maintain RPV level is approximately [using enthalpies of 1,200 Btu/lbm for steam boiled during cooldown and 60 Btu/lbm (corresponding to 90°F) for water drawn from the condensate storage tank (CST)]:

$$\text{flow} = \frac{(33\text{MWt})\ (3.41\times10^{6}\text{Btu/hr-MWt})\ (.0162\text{ft}^{3}/\text{lbm})\ (7.48\text{gal/ft}^{3})}{(1{,}140\text{Btu/lbm})\ (60\text{min/hr})} = 198\ \text{gal/min}$$

Therefore, the response time assumes that the anomaly could increase flow from approximately 200 to (198 + 640=) 838 gpm.

HOHC2: **Control RPV Level and Press with HPCI during First 6 Hours, Given RCIC Failed or Insufficient**

Timing: **Continuous requirement; react within 5 minutes of high level alarm to prevent automatic HPCI trip at +55".**

Reasoning for this time constraint is the same as for action HOHC1. As the operators are controlling injection by splitting discharge from the HPCI pump between the RPV and recirculation to the CST, a mismatch of flow involving the design flow of the HPCI is not used as a time constraint for this action.

HOHC3: **Control RPV Level and Pressure with RCIC during First 6 Hours, Given HPCI Failed**

Timing: **Continuous requirement; react within 8 minutes[3] after alarm to prevent automatic RCIC trip at +55".**

At 1% decay heat, RCIC must supply approximately 200 gpm to the RPV. The rated flow rate for RCIC is 600 gpm, for a mismatch of 400 gpm. Given a high level alarm at +39" and high level trip at +55", the time constraint for response to anomalies is:

$$\text{time} = \frac{(200\ \text{gal/inches})\ (55''-39'')}{(400\text{gal/min})} = 8\ \text{minutes}$$

[3]An initial estimate of 15 minutes was given to the operators during their evaluations based on the anticipation that the mismatch would result from a gradual decline in the demand for makeup water. This calculation is bounding. In the actual evaluation, the operators gave the same degree of difficulty score to the 5 and 15-minute time constraints in their evaluations of HOHC2 and HOHC3.

HOHC4: **Control RPV Level with HPCI following Shutdown from ATWS**

Timing: **Continuous requirement; after recovery of RPV level, react within 5 minutes after alarm to prevent automatic HPCI trip at +55".**

As level is being restored, this action requires continual control. Once ATWS is terminated and level is restored, the requirement for feedwater to offset decay heat declines to normal levels. Consequently, the reasoning for response time constraints becomes the same as for action HOHC1.

HOHL1: **Control RPV Level and Pressure with HPCI and/or RCIC 6 to 24 hours, Given Short-Term Control Successful**

Timing: **Monitor cooldown. React to alarm within 15 minutes of indication to prevent automatic trip at +55".**

During the 6 to 24-hour time frame, the decay heat will decline to from approximately 0.8% to 0.5%, given long-term operation prior to shutdown. Under these conditions, the makeup rates to the RPV will be lower. If the HPCI is operating, it will be on recirculation. Although gross failures of HPCI control that would result in direct injection of the HPCI discharge into the RPV would result in a much shorter response time requirement, the judgment of the operators indicated that 15 minutes would be a reasonable time for response to typical control mismatches at these later times.

HOHL2: **Recover and Control RPV Level and Pressure with HPCI and/or RCIC up to 24 Hours, Given Short-Term Control Failed**

Timing: **Continuous requirement; react to alarm within 15 minutes of indication to prevent automatic trip at +55".**

As the decay heat generation considerations are the same as for action HOHL1, the time constraints for that action also apply here.

HOHS1: **Initiate HPCI Following Feedwater Failure, Given Two Stuck-Open Relief Valves**

Timing: **Estimate 10 to 15 minutes before MSIV closure at -122".**

When two SRVs are stuck open, the rate that the liquid level drops depends on the amount and rate of depressurization. Assuming that the RPV depressurizes to 350 psia, Table C-7 indicates that approximately 65 inches of the RPV inventory could boil off during that process. Using the resulting level as a starting point for RPV level reduction due to decay heat, Table C-7 indicates that -122" will be reached in approximately 16 to 27 minutes, depending on injection by the CRDHS. Thus, the estimate of 10 to 15 minutes is conservative.

HOHS2: Initiate HPCI/RCIC following Feedwater Failure, Given One or No Stuck Open Relief Valves

Timing: Estimate 10 to 15 minutes before MSIV closure at -122"[4]

At 2% decay heat generation, Table C-8 shows that approximately 26 minutes are available before the RPV level reaches -122" if the initial level following shrinkage is approximately +0". Water provided by the normally operating CRDHS will lengthen the time available to 42 minutes. The criteria given above correspond more closely with the risk model because success is achieved if HPCI/RCIC can gain control of RVP level to avoid MSIV closure.

HOHS3: Initiate HPCI following Feedwater Failure during Recovery after ATWS

Timing: Restart within 5 minutes if at top of active fuel to avoid level below -190".

Loss of feedwater is assumed to occur on attempt to restart the feedwater pumps at the top of the active fuel (-162"). Table C-9 estimates that the time required for the water level to decline to -190" is approximately 3 minutes, assuming a decay heat generation rate of 2% and no injection into the core. If the CRDHS are operating an injection rate of 200 gpm, the time will be extended to 5 minutes.

HOJC1: Control RPV Level with Condensate by Alternate Means, Given Startup Bypass Valve Fails

Timing: Assume 30 minutes before other means of level control would be sought. Approximately 2 hours to core uncovery if no means to cool core found.

The demand for condensate occurs at approximately 350 psia. It is assumed that by the time cooldown has progressed to this point, the reactor will be shut down for 6 hours. Under these conditions, the decay heat will be less than 1%. Table C-10 shows that approximately 2 hours are required to boil down to the top of the active fuel, given no other injection into the core.

HOLA1: Control LPCI To Maintain Vessel Level at Top of Fuel, Given ATWS

Timing: Continuous requirement for close control until subcriticality and refill.

The time constraints for action HOAL1 indicate that injection must be initiated and controlled within 1 minute. This action is a continuation of that action, and the operators judged the time constraints of the action based on the requirement to respond to level/power changes continually.

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[4]The operators evaluated this action considering the time to automatic actuation at -45", which was estimated as 10 to 15 minutes and is conservative.

HOLC1: Transfer to Condensate in Startup Bypass Mode; Feedwater is Available during Cooldown

Timing: Assume 30 minutes before other means of level control would be sought. Approximately 2 hours to core uncovery if no means to cool core found.

Justification is the same as for action HOJC1.

HOLC2: Place Condensate in Startup Bypass Mode, Given it was Maintained Operational during Cooldown and Feedwater Failed

Timing: Assume 30 minutes before other means of level control would be sought. Approximately 2 hours to core uncovery if no means to cool core found.

Justification is the same as for action HOJC1.

HOLP1: Control RPV Level Using LPCI Mode of RHR or the Core Spray System

Timing: Initiate after cooldown. Not time sensitive; over 2 hours to core uncovery from normal RPV level with no injection.

Assuming that cooldown takes 4 hours or longer, the decay heat will have declined to approximately 0.9% full power. At this heat generation rate, RPV level will decline at a rate slightly lower than that given in Table C-10, which leads to more than 2 hours being available.

HOPTR1: Terminate Feedwater Flow, Given Feedwater Rampup

Timing: One to two minutes[5] after alarm to avoid RPV overfill to +114"

The action modeled by HOPTR1 considers initiating events resulting from catastrophic feedwater controller failures that cause overfeed of the RPV. In response to this event,

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[5]The time constraint originally given to the operators was 5 minutes, based on a more gradual transition to the mismatch condition. However, the impact of the shorter period of 1-2 minutes is expected to have little or no impact on the original operator evaluations for the following reasons. First, the licensed SRO member of the PRA team judges that 15 seconds is a conservative estimate of the time required to trip the feedwater pumps once the mismatch is recognized. Second, since the unit is at power, and the RPV level is one of the critical parameters closely monitored by the operators, 45 seconds provides adequate time to recognize the condition. The additional 4 minutes given to the operators in the initial evaluation would not significantly increase their likelihood of recognizing the situation if they did not do so in the first 45 seconds. Third, the three groups actually scored the degree of difficulty of the PSF for time adequacy as 4, 6, and 8. This indicates that all groups recognized that time would be a concern and at least one appears to have chosen to consider the possibility of rapid fill rates in their evaluation. Considering the above discussion, the range of evaluations for the time PSF is judged to be reasonable by both the human action analyst and the licensed SRO. Therefore, the overall quantitative evaluation was not changed.

either the automatic trip function or this operator action must succeed to avoid spilling water into the main steam line and failing HPCI/RCIC. If it is assumed that feedwater controller failures usually result in flow rates of 115% to 135% full flow, excess flow can jump to between 15% and 35% of normal feedwater flow. At 1,000 psia, the time available before overfill to the main steam line due to excess flow would then be

$$35\%\ t = \frac{(200\,\text{gal/inch})\ (60\,\text{min/hr})\ (114''-39'')}{(1.33\times 10^{+7}\,\text{lbm/hr})\ (.35)\ (.0216\,\text{ft}^3/\text{lbm})(7.48\,\text{gal/ft}^3)} = 1.2 \text{ minutes to overfill}$$

$$15\%\ t = \frac{(200\,\text{gal/inch})\ (60\,\text{min/hr})\ (114''-39'')}{(1.33\times 10^{+7}\,\text{lbm/hr})\ (.15)\ (.0216\,\text{ft}^3/\text{lbm})(7.48\,\text{gal/ft}^3)} = 2.7 \text{ minutes to overfill}$$

Consequently, a time constraint of 1 to 2 minutes may be reasonably applied to gross failures of the controller. This is judged to provide sufficient time for feedwater pumps to run down and stop injecting.

HORF1: **Restart and Control One Feedwater Pump Following +55" Trip**

Timing: **Approximately 30 minutes at 2% decay heat.**

The success of this action avoids the automatic start signal at -45". The limiting case for the time constraint is following failure to avoid the feedwater trip initially (action HOFT1), when the decay heat is at its maximum. Table C-11 estimates that with 2% decay heat and saturated water at 1,000 psia in the RPV, approximately 38 to 60 minutes are required to boil down to -122". The automatic initiation will occur at -45". Either the automatic initiation or the operator action can avoid closure of the MSIVs at -122", if they are open. The time constraint of 30 minutes is considered a reasonable representation of response requirement to the operators for these conditions.

HORP1: **Start RHR and/or Core Spray Pumps for Low Pressure Coolant Injection (LPCI), Given High Pressure Injection Successful**

Timing: **Not time sensitive; at least 2 hours to boil down from normal level after normal cooldown.**

Justification is the same as for action HOJC1.

HORP2: **Start Residual Heat Removal (RHR) and/or Core Spray Pumps for LPCI, Given High Pressure Injection Fails**

Timing: **At least 20 minutes to align as level declines.**

If high pressure injection fails, the reactor is assumed to remain at 1,000 psia. Table C-12 indicates that approximately 25 to 40 minutes are available from -45", where failure of the automatic initiation of HPCI/RCIC would be one additional cue to the operators for the necessity of this action, until the top of active fuel is reached.

HORPS1: **Backup Automatic SCRAM Function with Pushbuttons and Manual Alternate Rod Insertion (ARI)**

Timing: **Within 1 minute.**

The timing for this action is assigned judgmentally to represent a reasonable time frame in which a successful reactor scram can avoid the major challenges of an ATWS event.

HORVD1: **Open One Safety Relief Valve (SRV) To Assist HPCI or RCIC Cooldown**

Timing: **Not time sensitive; do as required.**

This action questions whether the operators' use of MSRVs to assist cooldown to avoid the requirement to operate the HPCI/RCIC more than 6 hours. The action is done as necessary to maintain the desired cooldown rate. It is included to justify the use of a mission time of 6 hours for the HPCI and RCIC when both shutdown cooling and MSRVs are available.

HORVD2: **Rapidly Depressurize by Manually Opening MSRVs, Given HPCI and RCIC Hardware Failed**

Timing: **5 to 10 minutes to recognize need to emergency depressurize. 3 to 5 minutes[6] to -190" once -162" reached.**

The timing justification for action HORP2 stated that if high pressure injection fails, the reactor is assumed to remain at 1,000 psia. Table C-12 indicates that approximately 25 minutes are available from the automatic initiation of HPCI/RCIC until the top of active fuel is reached. The time constraint of 5 to 10 minutes for recognizing that emergency depressurization is required provides the time required for action HORP2 to be accomplished. Once the level drops to the top of active fuel, Table C-9 indicates that the operators have from 3 to 5 minutes to initiate depressurization before -190" is reached.

HORVD3: **Emergency Depressurize by Manually Opening MSRVs, Given HPCI/RCIC Control Failed**

Timing: **5 to 10 minutes to recognize need to emergency depressurize. 3 to 5 minutes to -190" once -162" reached.**

Justification is the same as action HORVD2.

[6] The operators evaluated this action with the time constraint that 5 minutes are available to initiate depressurization once TAF is achieved. As they will have been working to reestablish cooling while the level declined and the action can be done quickly, the difference in time is judged to have an insignificant impact on their evaluations.

HOSD1: **Align RHR for Shutdown Mode of Cooling**

Timing: **Not time sensitive; can be done over the course of hours.**

The operators have the option to switch to shutdown cooling over a wide period of time. Under these circumstances, factors other than time constraints would impact the success of the action.

HOSD2: **Align RHR for Shutdown Mode of Cooling, Given One Loop Unavailable**

Timing: **Not time sensitive; can be done over the course of hours.**

The operators have the option to switch to shutdown cooling over a wide period of time. Under these circumstances, factors other than time constraints would impact the success of the action.

HOSL1: **Actuate Standby Liquid Control (SLC), Given ATWS with Unisolated Vessel**

Timing: **3 to 5 minutes available to avoid level/power control requirement. Suppression pool reaches 170°F in 20 minutes.**

If the reactor remains at 50% power in an unisolated mode, the TBVs are capable of discharging approximately 30% of full-power flow to the condenser. The remaining 20% is discharged to the suppression pool. Table C-2 indicates that the heatup rate under these conditions is approximately 4.7°F per minute. Using this rate of heatup, the suppression pool will reach 110°F in approximately 6 minutes and 170°F in approximately 19 minutes with no suppression pool cooling.

With the RPV in an unisolated condition, if the operators can initiate SLC minutes before the suppression pool reaches 110°F, the reactor power may decline to the point where the bypass valves and condenser can handle the power level. The 3 to 5-minute time frame was judgmentally assigned to encompass this option.

HOSL2: **Actuate SLC, Given ATWS with Vessel Isolated**

Timing: **At 50% power, the suppression pool reaches 110°F in approximately 2 minutes[7] and 170°F in 7 minutes.**

If the reactor remains at 50% power in an isolated mode, all generated heat must be discharged to the suppression pool. Table C-2 indicates that the heatup rate under these conditions is approximately 12°F per minute. Using this rate of heatup, the suppression pool will reach 110°F in approximately 2 minutes and 170°F in approximately 7 minutes with no suppression pool cooling.

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[7]An original estimate of 3 minutes to 110°F and 10 minutes to 170°F was used during the operator evaluations. This was based on an operator rule of thumb that one SRV at full flow (discharging 6% power to the suppression pool) raised the temperature of the suppression pool at a rate of 1°F per minute. The slightly shorter times obtained by the thermal-hydraulic calculation are judged to have no impact on the evaluations.

HOSP1: Align RHR for Suppression Pool Cooling

Timing: Not time sensitive; approximately 1 1/2 hours before suppression pool temperature exceeds 140°F.

Using the parameters for suppression pool heatup from Table C-13, the suppression pool will heat up at a rate of approximately 0.5°F per minute. At this rate, it will take approximately 94 minutes to heat up from the alarm temperature of 95°F to 140°F. The 140°F temperature limit was selected to correspond to the upper limit of the RCIC upper design limit (Browns Ferry FSAR, Table 4.7-1; Reference C-3).

HOSP2: Align RHR for Suppression Pool Cooling, Given ATWS

Timing: Approximately 10 minutes[8] until heat capacity temperature limit (HCTL) if unit at 50% power.

The heatup rate for the suppression pool is the same as for action HOSL2, or approximately 12°F per minute at 50% power. The HCTL for the suppression pool is dependent on the RPV pressure but is 180°F at high pressure, where the reactor is expected to be during an ATWS with MSIVs closed. Under these conditions, suppression pool cooling should be initiated within 10 minutes.

A review of the evaluations indicates that the operators have accounted for the shorter period of time available for this action. In addition, since the RHR heat exchangers are not sized for an ATWS, the impact of suppression pool cooling will be significant to the risk model only if the operators are successful in making the reactor subcritical. In this case, the time window calculated above under the assumption of a 50% power level will be extremely conservative. Consequently, the evaluations of the operators with respect to the 40-minute time constraint are considered to be reasonable.

HOSP3: Align RHR for Suppression Pool Cooling, Given one Path Unavailable

Timing: Not time sensitive; much more than 1 hour before suppression pool temperature exceeds 140°F.

Justification is the same as for action HOSP1.

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[8] The original time of 40 minutes was given to the operators who used the wrong heatup rate to determine the time available for this action. This error could lead to evaluations using lower failure rates than might be expected for a 10-minute time constraint under ATWS conditions. However, since suppression pool cooling will be effective only if the operators succeed in making the reactor subcritical, the time constraint they were given is judged to not impact the evaluation results significantly.

HOSV1: Defeat MSIV Closure Logic, Given ATWS with Turbine Trip

Timing: Accomplish in first 10 minutes of transient; approximately 7 minutes before suppression pool reaches 110°F, forcing lowering of level.

The justification for the time constraints of action HOAD1 applies to this action.

The action is used in the risk model when both feedwater and the condenser are available. Consequently, RPV level can be maintained until the Emergency Operating Instructions (EOI) require power/level control when the suppression pool reaches 110°F. At that time injection must be terminated for power/level control. These conditions are very similar to those used for establishing the time constraints for action HOAD1.

HOSW1: Transfer Mode Switch To Refuel/Shut Down in Response to Scram

Timing: Not time significant for typical pressure reduction rates.

Under most transient conditions, the time frame during which this action must be done depends on when the operators decide to depressurize. Their comments and evaluations reflected the fact that time is not a dominant consideration for the success of the action.

HOTB1: Backup Main Turbine Trip

Timing: Do within 1 minute to avoid MSIV closure.

The risk model assumes that an uncontrolled depressurization will lead to core damage. If the turbine fails to trip, two lines of defense are available: backup turbine trip and automatic closure of the MSIVs. The 1-minute time constraint was assumed to provide a reasonable minimum time during which the operators would recognize excessive depressurization symptoms and trip the turbine to avoid MSIV closure.

C.2 RECOVERY ACTIONS

HOCIS1: Ensure That Various Normally Closed Valves are Closed, Given Group 6 Isolation is Required

Timing: Assume at least 1 hour available after Group 6 isolation before release of radioactive materials into primary containment begins.

This action was hypothesized to account for closing valves that are normally closed during operations but could be temporarily opened for various purposes. Under these circumstances, the personnel responsible for the activity would close them in the event of a transient interrupting the activity.

HOEE1: **Align and Start One Residual Heat Removal Service Water (RHRSW) Swing Pump, Given Loss of Offsite Power (LOSP) and Insufficient Essential Emergency Cooling Water (EECW) to Diesel Generators**

Timing: **Five minutes available before diesel generator exceeds design temperature.**

Reference C-4 estimates that there are 5.7 minutes available for an EECW pump to be started manually before the jacket water temperature of a fully loaded diesel generator will exceed a temperature of 208°F. This is based on a linear extrapolation of actual heatup measurements to the setpoint of the thermostatic valve. The opening of this valve establishes jacket water flow through the heat exchanger that provides cooling by the EECW system.

HOEE2: **Align and Start One RHRSW Swing Pump, Given LOSP, ATWS, and Insufficient EECW to Diesel Generators**

Timing: **Five minutes available before diesel generator exceeds design temperature.**

Justification is the same as for action HOEE1.

HOFLRB: **Identify and Isolate Leak in Either North or South EECW Header**

Timing: **20 to 30 minutes to avoid flooding RHR, Core Spray, HPCI, and RCIC.**

This time is based on a hypothesized size of the break in the flooding analysis that would cause the impact stated above.

HOPCA1: **Manually Start Two Air Compressors, Given Loss of Offsite Power**

Timing: **Assume 1 hour before MSRV air reservoir is depleted.**

When required to maintain pressure under loss of offsite power conditions, the operators will select a range of pressure from about 800 to 1,050 psia. From operator experience on the simulator with only RCIC, the initial cycle rate will be at least 3 to 5 minutes and will gradually increase until the RCIC can maintain pressure control. Consequently, the time estimate is conservative. (Also, the control air receiver tank and the nitrogen system can resupply the MSRV reservoirs, if it is available.)

HOR480: **Align 480V Reactor Motor-Operated Valve (RMOV) Board (2B) to Alternate Source**

Timing: **More than 2 hours after RHR needed for core cooling, depending on cooldown rate.**

The 2 to 6-hour time constraint is based on HPCI/RCIC/CRDHS all failing at some point after 6 hours into the scenario. At this point, the decay heat will be below 0.8% full power, and RPV level will decline at a rate below 0.75 inches per minute. Consequently, it will take more than approximately 4 hours for the RPV level to decline from normal level of +30" to the top of active fuel at -162".

HORP3: Start RHR/Core Spray Pumps for Low Pressure Injection, Given LOSP, Loss of diesel generator, and Power Recovered within 6 Hours

Timing: Assume core uncovery within 30 minutes if AC power were not recovered.

The HPCI and RCIC pumps are assumed to operate for approximately 4 hours, at which time the decay heat will have declined to less than 0.9% of full power. At this point in time, the RPV level takes over 2 hours to decline to the top of active fuel. For this action, AC power is assumed to be recovered 30 minutes prior to the onset of core uncovery.

HOSPRC: Manually Close LPCI Injection Valves To Restore Suppression Pool Cooling

Timing: First indication of requirement 2 to 4 hours into transient. Suppression pool rises from 95°F to 140°F in 4 hours at 1% decay heat.

High suppression pool temperature alarms at 95°F. RCIC oil cooling system is challenged when the suppression pool temperature reaches 140°F. Using these temperature limits, Table C-14 documents the suppression pool heatup calculations used to estimate the time.

HOSPRO: Manually Open Valves To Align RHR for Suppression Pool Cooling

Timing: First indication of requirement 2 to 4 hours into transient. Suppression pool rises to unacceptable temperatures in 12 additional hours.

Justification is the same as for action HOSPRC.

HOU11: Crosstie Unit 1 Pumps and Heat Exchanger to Unit 2 Torus, Given Flood in Reactor Building Basement; Unit 2 Condenser Unavailable

Timing: Thirty minutes to avoid core uncovery if injection into RPV lost during the initial phase of the flood.

The calculation in Table C-6 indicates that approximately 35 minutes are available until the RPV level declines to -162". A time of 30 minutes was given to the operators to account for a time period in which the cues may not be available to permit the operators to recognize that their primary sources of cooling are in fact flooded.

HOU12: Align Alternate Sources of Water To Maintain RPV Level, Given a Leak in the Torus Ring Header, and Condensate/Feedwater Lost in Unit 2

Timing: Thirty minutes if injection into RPV lost during initial phase of flood.

Justification is the same as for action HOU11.

HOUB1: **Restore Power to the Unit 1(2) Unit Board (4 kV), Given Loss of Main Electrical Feed to that Unit**

Timing: **15 to 20 minutes available before diesels generators required.**

This action is called on during a loss of offsite power in which the HPCI and RCIC have failed. Under these circumstances, if the above action is not accomplished or a diesel generator does not start and run reliably, there is no injection into the core. Under these conditions, the RPV liquid level declines to top of active fuel in approximately 35 minutes (see Table C-6).

The above recovery action is provided in the model so that successful core cooling can be achieved without the requirement for the diesel generators. The time constraint of 15 to 20 minutes for recovery of power to the unit board is assigned to provide the operators with time to verify the alignment of alternate injection systems once AC power is available.

HOUB2: **Restore Power to Both the Units 1 and 2 Unit Boards (4 kV), Given Loss of 500-kV Grid**

Timing: **15 to 20 minutes available before diesel generators required to operate in the model.**

Justification is the same as for action HOUB1.

HOVS1: **Close a Valve To Isolate a High/Low Pressure Leak that Occurs during Surveillance Testing of a Core Spray or LPCI Injection Line**

Timing: **Assumes 2 minutes for failure mechanisms in low pressure line to propagate sufficiently to require reactor scram and safety system actuation.**

As the size of the breach can vary, 2 minutes was judgmentally assigned to represent what is considered to be a reasonable time for the operators to respond.

HOVS2: **Respond To Inadvertent Failure of High/Low Pressure Interface Valve in the Core Spray or LPCI Injection Lines during Normal Operations**

Timing: **Assumes 2 minutes for failure mechanisms in low pressure line to propagate sufficiently to require reactor scram and safety system actuation.**

Justification is the same as for action HOVS1.

C.3 REFERENCES

C-1. General Electric Drawing 719E426, "Reactor Primary System WTS and VOLS."

C-2. GE Owners Group, EPG, Rev 4.

C-3. Tennessee Valley Authority, "Browns Ferry Nuclear Plant Updated Final Safety Analysis Report," revised by Amendment 8.

C-4. BFN BFEP-M3 Calculation, RIMS Accession Number B22 860416 108, "Diesel Generator Temp. Rise at Full Load," April 16, 1986.

Table C-1. Calculation of Selected Fluid Volumes in the Reactor Pressure Vessel Used to Justify Operator Time Constraints

```
                RPV ID      251 inches
RPV empty Volume....      28.63 ft3/in
RPV empty Volume            214 gal/in
Vol of solids from top of active core to bottom of steam dryer panels
    (Regions correspond to GE Drawing 719E426)
                     H   185.55 ft3 (upper core grid)
                     J    40.09 ft3
                     K    46.79 ft3
                     L    71.32 ft3
                     M    13.06 ft3
                     N    24.95 ft3
                     R   158.27 ft3 (steam separators)
                 Total   540.03 ft3
Elev above Vessel 0         635 in to bottom of steam dryer panels
Elev above Vessel 0         379 in to top of upper core grid
Elev above Vessel 0         361 in to top of active fuel

Water (gal/in) -  average from TAF to bottom of steam dryer panels
Vol of solids in RPV        2.0 ft3/in
Vol of solids in RPV         15 gal/in
Vol of fluid in RPV         199 gal/in average from TAF to bottom of steam dryer

Water (gal/in) -  average from top of upper core grid to bottom of steam dryer
Vol of solids in RPV        1.5 ft3/in
Vol of solids in RPV         11 gal/in
Vol of fluid in RPV         203 gal/in

Water (gal/in) -  average within the upper core grid
Vol solids in grid          9.8 ft3/in
Vol solids in grid           74 gal/in
Vol of fluid in grid        141 gal/in
```

Conclusions:

1. The rule-of-thumb of 200 gal/in for fluid volume above the core is accurate.

2. The rate of level decline will increase by about 40% as level drops to within 20" of the top of active fuel.

Fluid volume per inch in active core (from Reference C-2, GE Drawing 719E426)

	Total	Solid	Fluid (ft3)
Volume to TAF	7317.4	5077.7	2239.7
Volume to BAF	4509.5	4099.7	409.8
Volume in active fuel region	2807.9	978	1829.9 ft3

```
  Height of active core =      144 in
   Volume of fluid/inch =     12.7 ft3/in
   Volume of fluid/inch =       95 gal/in
```

Table C-2. Actions HOAD1, HOAD2, HOSL1, and HOSL1: Heat Up of the Suppression Pool During an ATWS

By operator rule-of-thumb of 1 degree/min per SRV full flow (6% power)

Action: HOAD1 (unisolated RPV)

Given the heatup range,
110 degrees F SP end temperature
80 degrees F SP start temperature
20 % power
By the rule-of-thumb, the heatup rate is
3.3 degrees/min
With this rate it takes
9.0 minutes for temperature to rise.

Heatup rate of suppression pool during an ATWS
By thermal-hydraulics with 1 Btu/lbm/deg F

9.50E+05 gal in suppession pool
1.61E-02 ft3/lbm at 80 deg F
7.89E+06 lbm in suppession pool
7.89E+06 Btu/deg F of temperature rise.
3293 MWt/Unit
1.87E+08 Btu/min if unit at full power
20 % Percent power
4.7 Degees/minute temperature rise

Given the heatup range,
110 degrees F SP end temperature
80 degrees F SP start temperature
it takes
6.3 Minutes to heat over the range.

Action: HOAD2 (isolated RPV)

Given the heatup range,
110 degrees F SP end temperature
80 degrees F SP start temperature
30 % power
By the rule-of-thumb, the heatup rate is
5.0 degrees/min
With this rate it takes
6.0 minutes for temperature to rise.

Heatup rate of suppression pool during an ATW
By thermal-hydraulics with 1 Btu/lbm/deg F

9.50E+05 gal in suppession pool
1.61E-02 ft3/lbm at 80 deg F
7.89E+06 lbm in suppession pool
7.89E+06 Btu/deg F of temperature rise.
3293 MWt/Unit
1.87E+08 Btu/min if unit at full power
50 % Percent power
11.9 Degees/minute temperature rise

Given the heatup range,
110 degrees F SP end temperature
80 degrees F SP start temperature
it takes
2.5 Minutes to heat over the range.

Table C-3. Actions HOAD1 and HOAD2: Time for RPV to Reach -122" during an ATWS, Given Loss of All Injection to Core

RPV level calculations for 1,000 psia

Action HOAD1, HOAD2

30	inches RPV start level (after shrinkage if applicable)
152	inches normal to -122 inches
200	Gal/in in RPV at normal level
30,400	Gal in RPV from normal to -122 inches
0.02159	ft3/lbm for sat liquid at 1,000 psia
6.2	lb/gal at 1000 psia
188,243	lbm available for boil down
8,663,769	lbm/hr at 50 % power & 173,275 lbm/hr/%power based on Hfg of 650 Btu/lbm for pressure of 1,000 psia.
144,396	lbm/min boil down rate
116.59	in/min boil down rate
1.3	min to -122 " without injection
0	HPCI flow gpm
0	RCIC flow gpm
100	CRD flow gpm
830	Total flow lbm/min from CST water at 90 degrees F
1134	Btu/lbm enthalpy change for CRD injected water

Pumping Time	Coolant Pumped	Additional Time	Power Level	Time wo/Inj	Time w/Inj
1.3	1,083	0.0	50	1.3	1.3
0.0	11	0.0			
0.0	0	0.0			
0.0	0	0.0			
0.0	0	0.0			
0.0	0	0.0			
0.0	0	0.0			
0.0	0	0.0			
0.0	0	0.0			
0.0	0	0.0			

Table C-4. Action HOAL1: Time for RPV to Decline to -190" From Top of Active Fuel, Given ATWS at 5% Power

RPV level calculations in region of the active core at 1,000 psia
Actions: HOAL1, HOAL2

-162	Start level
28	in from start to -190 inches
95	Gal/in in RPV in the region of active fuel (including downcomer)
2,660	Gal in RPV from start to -190 inches
0.02159	ft3/lbm for sat liquid at 1,000 psia
6.2	lb/gal at 1000 psia
16,471	lbm available for boil down
866,377	lbm/hr at 5 % power & 173,275 lbm/hr/%power based on Hfg of 650 Btu/lbm at a pressure of 1,000 psia.
14,440	lbm/min boil down rate
1.1	min to -190 " without injection
0	HPCI flow gpm
0	RCIC flow gpm
170	CRD flow gpm (from CST at 90 deg F)
1,412	Total flow lbm/min (using 0.0161 ft3/lbm)
1134	Btu/lbm enthalpy change for CRD injected water.

Pumping Time	Coolant Pumped	Additional Time	Power Level	Time wo/Inj	Time w/Inj
1.1	1,610	0.2	5	1.1	1.4
0.2	275	0.0			
0.0	47	0.0			
0.0	8	0.0			
0.0	1	0.0			
0.0	0	0.0			
0.0	0	0.0			
0.0	0	0.0			
0.0	0	0.0			
0.0	0	0.0			

Table C-5. Action HOBD1: Time for RPV to Decline from -45" to -122", Given Decay Heat Generation Is 2% Power

RPV level calculations for 1,000 psia

Action HOBD1

-45	inches RPV start level (after shrinkage if applicable)
77	inches normal to -122 inches
200	Gal/in in RPV at normal level
15,400	Gal in RPV from normal to -122 inches
0.02159	ft3/lbm for sat liquid at 1,000 psia
6.2	lb/gal at 1000 psia
95,360	lbm available for boil down
346,551	lbm/hr at 2 % power & 173,275 lbm/hr/%power based on Hfg of 650 Btu/lbm for pressure of 1,000 psia.
5,776	lbm/min boil down rate
4.66	in/min boil down rate
16.5	min to -122 " without injection
0	HPCI flow gpm
0	RCIC flow gpm
150	CRD flow gpm
1,246	Total flow lbm/min from CST water at 90 degrees F
1134	Btu/lbm enthalpy change for CRD injected water

Pumping Time	Coolant Pumped	Additional Time	Power Level	Time wo/Inj	Time w/Inj
16.5	20,564	6.2	2	16.5	26.5
6.2	7,737	2.3			
2.3	2,911	0.9			
0.9	1,095	0.3			
0.3	412	0.1			
0.1	155	0.0			
0.0	58	0.0			
0.0	22	0.0			
0.0	8	0.0			
0.0	3	0.0			

Table C-6. Actions HOCRD2, HOU11, HOU12, HOUB1, and HOUB2: Time for the RPV to Decline to -162" if RPV Injection Is Lost When Decay Heat Is 1% or 2% and the RPV Is at 1,000 psia

RPV level calculations for 1,000 psia

Actions: HOCRD1

0	inches RPV start level (after shrinkage)
162	inches normal to -162 inches
200	Gal/in in RPV at normal level
32,400	Gal in RPV from normal to -162 inches
0.02159	ft3/lbm for sat liquid at 1,000 psia
6.2	lb/gal at 1000 psia
200,628	lbm available for boil down
138,620	lbm/hr at 0.8 % power & 173,275 lbm/hr/%pwr based on Hfg of 650 Btu/lbm for pressure of 1,000 psia.
2,310	lbm/min boil down rate
1.87	in/min boil down rate
86.8	min to -162 " without injection
0	HPCI flow gpm
0	RCIC flow gpm
150	CRD flow gpm
1,246	Total flow lbm/min from CST water at 90 deg F
1134	Btu/lbm enthalpy change for CRD injected water

Pumping Time min	Coolant Pumped lbm	Additional Time min
86.8	108,163	81.7
81.7	101,734	76.8
76.8	95,687	72.3
72.3	90,000	68.0
68.0	84,651	63.9
63.9	79,619	60.1
60.1	74,887	56.5
56.5	70,436	53.2
53.2	66,249	50.0
50.0	62,312	47.1
47.1	58,608	44.3
44.3	55,125	41.6
41.6	51,848	39.2
39.2	48,766	36.8
36.8	45,868	34.6
34.6	43,142	32.6

Power Level % full	Time wo/inj min	Time w/inj min
0.8	86.8	912.9

NOTE: Time available is limited by number of iterations.

RPV level calculations for 1,000 psia

Actions: HOCRD2, HOU11, HOU12, HOUB1, HOUB2

0	inches RPV start level (after shrinkage)
162	inches normal to -162 inches
200	Gal/in in RPV at normal level
32,400	Gal in RPV from normal to -162 inches
0.02159	ft3/lbm for sat liquid at 1,000 psia
6.2	lb/gal at 1000 psia
200,628	lbm available for boil down
346,551	lbm/hr at 2 % power & 173,275 lbm/hr/%power based on Hfg of 650 Btu/lbm for pressure of 1,000 psia.
5,776	lbm/min boil down rate
4.66	in/min boil down rate
34.7	min to -162 " without injection
0	HPCI flow gpm
0	RCIC flow gpm
150	CRD flow gpm
1,246	Total flow lbm/min from CST water at 90 deg F
1134	Btu/lbm enthalpy change for CRD injected water

Pumping Time min	Coolant Pumped lbm	Additional Time min
34.7	43,265	13.1
13.1	16,277	4.9
4.9	6,124	1.8
1.8	2,304	0.7
0.7	867	0.3
0.3	326	0.1
0.1	123	0.0
0.0	46	0.0
0.0	17	0.0
0.0	7	0.0

Power Level % full	Time wo/inj min	Time w/inj min
2	34.7	55.7

Table C-7. Action HOHS1: Time for RPV to Decline to -122" from Normal Operating Level, Given RPV Depressurizes to 350 psia Due to Stuck-Open Relief Valves

RPV level calcuations for stuck open relief valves.
Action OSH1
Assume that the RPV depressurizes to 350 psia

0	in Start RPV level
32,400	gal above the core
37,981	gal to TAF (see Table C-1)
492,013	lbm in RPV
542.4	Btu/lbm hf at 1,000 psia
409.9	Btu/lbm hf at 350 psia
133	Btu/lbm given up to depressure
65,191,682	Btu to dissipate
720	Btu/lbm to boil (approx average between hfg at 1,000 & 350 psia)
90,544	extra lbm boiled
12,952	extra gal boiled
65	extra inches lost
-65	inches RPV start level after depressuization
57	inches normal to -122 inches
200	Gal/in in RPV at normal level
11,448	Gal in RPV from normal to -122 inches
0.019124	ft3/lbm for sat liquid at 1,000 psia
7.0	lb/gal at 1000 psia
80,029	lbm available for boil down
283,343	lbm/hr at 2 % power & 141,672 lbm/hr/%power based on Hfg of 795 Btu/lbm at 350 psia
4,722	lbm/min boil down rate
16.9	min to -122 " without injection
0	HPCI flow gpm
0	RCIC flow gpm
150	CRD flow gpm
1,246	Total flow lbm/min from CST water at 90 degrees F
1134	Btu/lbm enthalpy change for CRD injected water

Pumping Time	Coolant Pumped lbm	Additional Time	Power Level	Time wo/Inj	Time w/Inj
16.9	21,108	6.4	0	16.9	27.2
6.4	7,941	2.4			
2.4	2,988	0.9			
0.9	1,124	0.3			
0.3	423	0.1			
0.1	159	0.0			
0.0	60	0.0			
0.0	23	0.0			
0.0	8	0.0			
0.0	3	0.0			

Table C-8. Action HOHS2: Time for RPV to Decline to -45" from Normal Operating Level During a General Transient, Given No Injection

RPV level calculations for 1,000 psia

Action HOHS2

```
        0 inches RPV start level (after shrinkage if applicable)
      122 inches start to       -122 inches
      200 Gal/in in RPV at normal level
   24,400 Gal in RPV from start to pt    -122 inches
  0.02159 ft3/lbm for sat liquid at 1,000 psia
      6.2 lb/gal at 1000 psia
  151,090 lbm available for boil down
  346,551 lbm/hr at       2 % power & 173,275 lbm/hr/%power
                                      based on Hfg of  650 Btu/lbm
                                      for pressure of 1,000 psia.
    5,776 lbm/min boil down rate
     4.66 in/min boil down rate
     26.2 min to       -122 " without injection
        0 HPCI flow gpm
        0 RCIC flow gpm
      150 CRD flow gpm
    1,246 Total flow lbm/min from CST water at 90 degrees F
     1134 Btu/lbm enthalpy change for CRD injected water
```

Pumping Time	Coolant Pumped	Additional Time	Power Level	Time wo/Inj	Time w/Inj
26.2	32,582	9.8	2	26.2	41.9
9.8	12,258	3.7			
3.7	4,612	1.4			
1.4	1,735	0.5			
0.5	653	0.2			
0.2	246	0.1			
0.1	92	0.0			
0.0	35	0.0			
0.0	13	0.0			
0.0	5	0.0			

Table C-9. Actions HOHS3 and HORP2: Time for RPV to Decline to -190" if RPV Injection Is Lost at Top of Active Fuel and Decay Heat is 2%

RPV level calculations in region of the active core at 1,000 psia
Actions: HOHS3, HORVD2, HORVD3

-162	Start level
28	in from start to -190 inches
95	Gal/in in RPV in the region of active fuel (including downcomer)
2,660	Gal in RPV from start to -190 inches
0.02159	ft3/lbm for sat liquid at 1,000 psia
6.2	lb/gal at 1000 psia
16,471	lbm available for boil down
346,551	lbm/hr at 2 % power & 173,275 lbm/hr/%power based on Hfg of 650 Btu/lbm at a pressure of 1,000 psia.
5,776	lbm/min boil down rate
2.9	min to -190 " without injection
0	HPCI flow gpm
0	RCIC flow gpm
200	CRD flow gpm (from CST at 90 deg F)
1,661	Total flow lbm/min (using 0.0161 ft3/lbm)
1134	Btu/lbm enthalpy change for CRD injected water.

Pumping Time	Coolant Pumped	Additional Time	Power Level	Time wo/Inj	Time w/Inj
2.9	4,736	1.4	2	2.9	5.7
1.4	2,376	0.7			
0.7	1,192	0.4			
0.4	598	0.2			
0.2	300	0.1			
0.1	150	0.0			
0.0	75	0.0			
0.0	38	0.0			
0.0	19	0.0			
0.0	10	0.0			

Table C-10. Action HOJC1: Time for RPV Level to Decline to -162" if RPV Injection Lost When Decay Heat is 1% or Less and RPV is 350 psia or Less

RPV level calculations for 350 psia
Action: HOJC1

35	inches RPV start level
197	inches normal to -162 inches
200	Gal/in in RPV at normal level
39,400	Gal in RPV from normal to -162 inches
0.019124	ft3/lbm for sat liquid at 350 psia
7.0	lb/gal at 350 psia
275,433	lbm available for boil down
141,672	lbm/hr at 1 % power & 141,672 lbm/hr/%power based on Hfg of 795 Btu/lbm for pressure of 350 psia.
2,361	lbm/min boil down rate
0.59	in/min boil down rate
116.6	min to -162 " without injection
0	HPCI flow gpm
0	RCIC flow gpm
200	CRD flow gpm
1,661	Total flow lbm/min from CST water at 90 degrees F
1134	Btu/lbm enthalpy change for CRD injected water

Pumping Time min	Coolant Pumped lbm	Additional Time min	% Power Level	Time wo/Inj min	Time w/Inj min
116.6	193,725	117.0	1	116.6	******
117.0	194,358	117.4			
117.4	194,993	117.8			
117.8	195,630	118.2			
118.2	196,270	118.6			
118.6	196,911	119.0			
119.0	197,554	119.3			
119.3	198,200	119.7			
119.7	198,847	120.1			
120.1	199,497	120.5			

Table C-11. Action HORF1: Time for RPV Level to Decline to -45" From High Level Trip at 2% Decay Heat

RPV level calculations for 1,000 psia

Action HORF1

```
     55 inches RPV start level (after shrinkage if applicable)
    177 inches normal to      -122 inches
    200 Gal/in in RPV at normal level
 35,400 Gal in RPV from normal to  -  -122 inches
0.02159 ft3/lbm for sat liquid at 1,000 psia
    6.2 lb/gal at 1000 psia
219,204 lbm available for boil down
346,551 lbm/hr at       2 % power & 173,275 lbm/hr/%power
                                    based on Hfg of  650 Btu/lbm
                                    for pressure of 1,000 psia.
  5,776 lbm/min boil down rate
   4.66 in/min boil down rate
   38.0 min to       -122 " without injection
      0 HPCI flow gpm
      0 RCIC flow gpm
    150 CRD flow gpm
  1,246 Total flow lbm/min from CST water at 90 degrees F
   1134 Btu/lbm enthalpy change for CRD injected water
```

Pumping Time	Coolant Pumped	Additional Time	Power Level	Time wo/Inj	Time w/Inj
38.0	47,271	14.3	2	38.0	60.8
14.3	17,785	5.4			
5.4	6,691	2.0			
2.0	2,517	0.8			
0.8	947	0.3			
0.3	356	0.1			
0.1	134	0.0			
0.0	50	0.0			
0.0	19	0.0			
0.0	7	0.0			

Table C-12. Action HORP2: Time Constraints for Initiating Low Pressure Injection Following Loss of High Pressure Injection Systems

RPV level calculations for 1,000 psia

Action HORP2

-45	inches RPV start level (after shrinkage if applicable)
117	inches normal to -162 inches
200	Gal/in in RPV at normal level
23,400	Gal in RPV from normal to -162 inches
0.02159	ft3/lbm for sat liquid at 1,000 psia
6.2	lb/gal at 1000 psia
144,898	lbm available for boil down
346,551	lbm/hr at 2 % power & 173,275 lbm/hr/%power based on Hfg of 650 Btu/lbm for pressure of 1,000 psia.
5,776	lbm/min boil down rate
4.66	in/min boil down rate
25.1	min to -162 " without injection
0	HPCI flow gpm
0	RCIC flow gpm
150	CRD flow gpm
1,246	Total flow lbm/min from CST water at 90 degrees F
1134	Btu/lbm enthalpy change for CRD injected water

Pumping Time	Coolant Pumped	Additional Time	Power Level	Time wo/Inj	Time w/Inj
25.1	31,247	9.4	2	25.1	40.2
9.4	11,756	3.6			
3.6	4,423	1.3			
1.3	1,664	0.5			
0.5	626	0.2			
0.2	236	0.1			
0.1	89	0.0			
0.0	33	0.0			
0.0	13	0.0			
0.0	5	0.0			

Table C-13. Action HOSP1: Time for Suppression Pool to Heat Up from 80°F to 140°F, Given It Absorbs 2% Decay Heat

```
Suppression pool heatup calculations
Action: HOSP1

Heatup rate of suppression pool during an ATWS
By thermal-hydraulics with 1 Btu/lbm/deg F

9.50E+05 gal in suppession pool
1.61E-02 ft3/lbm at 80 deg F
7.89E+06 lbm in suppession pool
7.89E+06 Btu/deg F of temperature rise.
    3293 MWt/Unit
1.87E+08 Btu/min if unit at full power
       2 % Percent power discharged to the suppression pool
     0.5 Degees/minute temperature rise

Given the heatup range,
     140 degrees F SP end temperature
      95 degrees F SP start temperature
it takes
    94.8 Minutes to heat over the range indicated.


Heatup rate of suppression pool during an ATWS
```

Table C-14. Actions HOSPRC and HOSPRO: Time for Suppression Pool to Heat Up from 95°F to 140°F, Given It Absorbs 1% Decay Heat

```
Suppression pool heatup calculations
Action: HOSPRC, HOSPRO

Heatup rate of suppression pool due to decay heat
By thermal-hydraulics with 1 Btu/lbm/deg F for suppression pool water

9.50E+05 gal in suppession pool
1.61E-02 ft3/lbm at 80 deg F
7.89E+06 lbm in suppession pool
7.89E+06 Btu/deg F of temperature rise.
    3293 MWt/Unit
1.87E+08 Btu/min if unit at full power
       1 % Percent power discharged to the suppression pool
     0.2 Degees/minute temperature rise

Given the heatup range,
     140 degrees F SP end temperature
      95 degrees F SP start temperature
it takes
   252.7 Minutes to heat over the range indicated.


Heatup rate of suppression pool during an ATWS
```

D. SEQUENCE QUANTIFICATION

This appendix contains the sequence quantification information used in the Level 1 analysis. The following items are included in this appendix:

The last item in this appendix is a listing of the dominant sequences in equation form. This equation is used to determine core damage frequency uncertainty.

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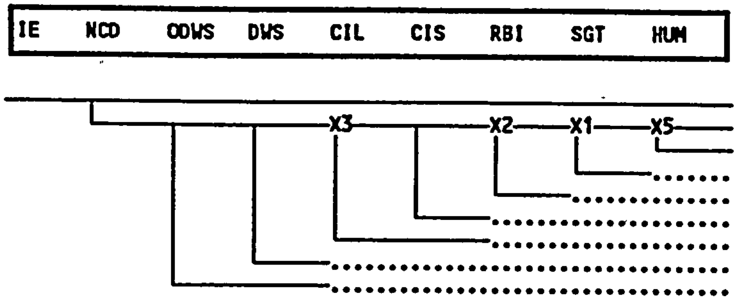
MODEL Name: BFNFINAL

Event Tree: CNTMT



1		1
2		2
3		3
4	X5	4-5
5	X1	6-9
6	X2	10-17
7	X2	18-25
8	X3	26-49
9	X3	50-73

MODEL Name: BFNFINAL

Top Event Legend for Tree: CNTMT

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Top Event Designator.....	Top Event Description..............................
IE	Initiating Event
NCD	CORE DAMAGE OCCURRED
ODWS	OPERATOR FAILS TO INITIATE DW SPRAY
DWS	DRYWELL SPRAY UNAVAILABLE
CIL	ISOLATION OF LARGE CONTAINMENT PENETRATIONS FAILED
CIS	ISOLATION OF SMALL CONTAINMENT PENETRATIONS FAILED
RBI	REACTOR BUILDING ISOLATION FAILURE
SGT	STANDBY GAS TREATMENT SYSTEM UNAVAILABLE
HUM	SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: CNTMT

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SF........	Split Fraction Logic..
	RR12:=RHR1*RHR3+RHR1*U3=S+RHR3*U3=S
	RR11:=RHR1+RHR3+U3=S
	RR22:=RHR2*RHR4+RHR2*U1=S+RHR4*U1=S
	RR21:=RHR2+RHR4+U1=S
	HEATL:=(RHR1+RHR2+RHR3+RHR4+U1=S+U3=S)*OSP=S*(SP=S+SPR=S)
	HEAT:=(RHR1+RHR2+RHR3+RHR4+U1=S+U3=S)*(OSP=S*(SP=S+SPR=S)+OSD=S*SDC=S*LPC=S)
	AHEAT:=RR12*RR21+RR11*RR22
	VENT:=OLP=S*VNT=S
	SIG:=LVP=S+DWP=S
NCDF	INIT=SLOCA*NA=F
NCDF	RPS=F*(RVO=F+OSL=F+SL=F+OAD=F)
NCD1	INIT=FLRB3S*DCA=S*(CD=S*HS=S+U1=S*LPC=S*RVD=DEP)
NCD1	DCA=S*(RVC=SORV1+RVC=SORV2+RVC=SORV3+RVD=DEP)*(RHR1+RHR2+RHR3+RHR4)*LPC=S
NCD1	FWA=S*RVL=S*(CRD=S+OLP=S*(CS=S+LPC=S))*HEAT
NCD1	NA=S*(RVC=SORV3+RVC=SORV2+RVC=SORV1+RVO=F+RVD=DEP+OBD=S)*(OJC=S+OLC=S)*HEATL
NCD1	NA=S*(RVC=SORV3+RVC=SORV2+RVC=SORV1+RVO=F+RVD=DEP+OBD=S)*OLP=S*HEATL
NCD1	NA=S*NRV=S*(OLC=S+(HRL=S+HR6=S)*HS=S*CDA=S+HRL=S*(HEAT+(VENT*OHR=S*HR=S+CRD=S))+OAI=S*AI=S)
NCD1	NA=S*NRV=S*HR6=S*(HEAT+VENT)*(CRD=S+(OLP=S*(CS=S+LPC=S))+OAI=S*AI=S)
NCD1	NA=S*NRV=S*HS=S*CDA=S
NCD1	NA=S*(OLC=S+(HR6=S*(CRD=S+CDA=S)))*(HEAT+VENT)
NCD1	-INIT=SLOCA*NA=F*NRV=S*OLC=S*(AHEAT+VENT)
NCD1	-INIT=SLOCA*NA=F*NRV=S*(HRL=S+HR6=S*CRD=S)*AHEAT
NCD1	NA=F*NRV=F*OLA=S*CRD=S*AHEAT
NCD1	(RCI=S+HPI=S)*HRC=S*(LPC=S+CS=S)*HEAT*OLP=S
NCD1	HPI=S*HRC=S*(OHC=S+HPL=S*OHL=S)*(RVD=DEP+RVC=SORV1)*CRD=S*(RR11+RR21)*(OSP=S*SP=S+LPC=S*SDC=S*OSD=S)
NCD1	HPI=S*HRC=S*(OHC=S*OBC=S+OHC=F*HPL=S*OHL=S*OBD=S)*HR6=S*HS=S*(CDA=S+CRD=S)
NCD1	HPI=S*HRC=S*(OHC=S+HPL=S*OHL=S)*(RVD=DEP+RVC=SORV1)*HS=S*CDA=S
NCD1	RCI=S*HRC=S*(OHC=S+RCL=S*OHL=S)*(RVD=DEP+RVC=SORV1)*CRD=S*(RR11+RR21)*(OSP=S*SP=S+LPC=S*SDC=S*OSD=S)

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: CNTMT

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SF........	Split Fraction Logic...
NCD1	RCI=S*HRC=S*(OHC=S*OBC=S+OHC=F*RCL=S*OHL=S*OBD=S) *HR6=S*HS=S*(CDA=S+CRD=S)
NCD1	RCI=S*HRC=S*(OHC=S+RCL=S*OHL=S)*(RVD=DEP+RVC=SORV1) *HS=S*CDA=S
NCD1	(RCL=S+HPL=S)*OHL=S*OSP=S*SP=S
NCD1	(-HPI=S*-RCI=S+-HRC=S+-OHC=S*(-L8H=S+-OHL=S+-HPL=S*-RCL=S)) *RVD=DEP*HEAT*CS=S*OLP=S
NCD1	RVC=SORV1*(RCI=S+HPI=S)*HRC=S*OHC=S*HEAT*CS=S*OLP=S
NCD1	RVC=SORV2*HPI=S*HEATL*(LPC=S+CS=S)*OLP=S
NCD1	-FWA=S*-HRL=S*-HR6=S*RVD=DEP*((CS=S+LPC=S) *OLP=S*HEAT+LC=S+JC=S+CRD=S)
NCD1	-FWA=S*-HRL=S*-HR6=S*RVC=SORV3*HEAT*((CS=S+LPC=S) *OLP=S+LC=S+JC=S+CRD=S)
NCD1	-FWA=S*-HRL=S*-HR6=S*RVD=NODEP*HEATL*CRD=S
NCD1	OF=S*OLC=F*CRD=S*RVL=S*HEAT
NCD1	((RPA=S+RPC=S+U3=S)*(RPB=S+RPD=S+U1=S)*LPC=S*SP=S*OLP=S +LC=S+JC=S+CRD=S)*(SORV+-RVC=SORV0+RVD=DEP+RVL=S+OIV=S*OBD=S)
NCD1	MCD=S*FWA=S*(LC=S+JC=S)
NCDF	1
CDWS1	RPS=S
CDWS2	RPS=F
CDWS2	1
DWSF	PX1=F*PX2=F+(-RR11+-RHOK+NOGB)*(-RR21+-RIOK+NOGD) +SP=F*SPR=F+TOR=F
DWS1	EPR6=S*RR11*RR21
DWS2	-RR11+-RHOK+-RR21+-RIOK+NOGB+NOGD
DWS1	(PX1=S+PX2=S)*RR11*RHOK*RR21*RIOK
DWSF	1
CILF	LVP=F*DWP=F
CIL2	PCA=F+DN=F
CIL1	1
CISF	LVP=F*DWP=F
CIS1	1
RBIF	LVP=F*DWP=F
RBI1	1
SGTF	RM=F*RN=F+RN=F*A3ED=F+RM=F*A3ED=F+DN=F*DO=F+AA=F*DM=F +RM=F*(DO=F+DM=F)+RN=F*(DN=F+AA=F)+-SIG+NOGA*NOGC*NOGG +NOGD*(NOGB*NOGF+NOGA+NOGH+NOGB*NOGC*NOGE)

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: CNTMT

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SF........	Split Fraction Logic..
SGT1	(RM=S*RN=S*A3ED=S*DN=S*AA=S*DO=S*DM=S+EPR6=S)*SIG
SGT9	RM=F+RN=F+NOGA+NOGD
SGT8	A3ED=F*((DN=F+DO=F)*(AA=F+DM=F))+NOGH*NOGE*NOGB*NOGC
SGT6	A3ED=F*(AA=F+DM=F+DN=F+DO=F)+NOGH*(NOGA+NOGB*NOGG)
SGT5	A3ED=F+NOGH
SGT4	(DN=F+DO=F)*(AA=F+DM=F)+NOGB*NOGC*NOGE
SGT2	AA=F+DM=F+DN=F+DO=F+NOGA+NOGB*NOGG
SGTF	1
HUMF	A3ED=F*(RM=F+RN=F)+RM=F*RN=F+NOGH*(NOGA+NOGD)+NOGA*NOGD
HUM1	RM=S*RN=S*A3ED=S+EPR6=S
HUM3	(RM=F+NOGA+RN=F+NOGD)*A3ED=S
HUM2	RM=S*RN=S*(A3ED=F+NOGH)
HUMF	1

MODEL Name: BFNFINAL

Binning Logic for Event Tree: CNTMT

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Page 1

Bin.......	Binning Rules..
SUCCESS	NCD=S
MELT	NCD=F

MODEL Name: BFNFINAL
Event Tree: ELECT12

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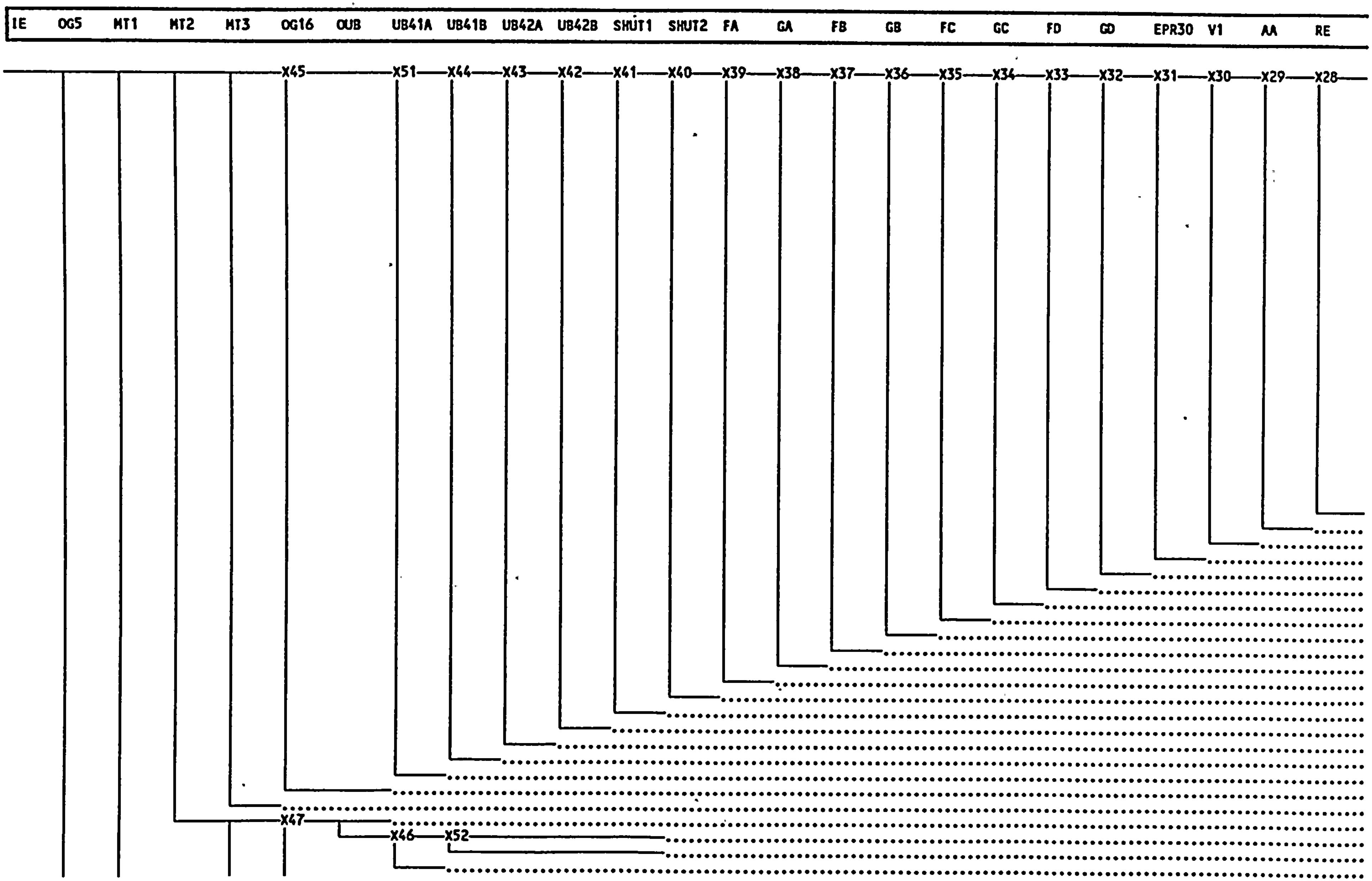
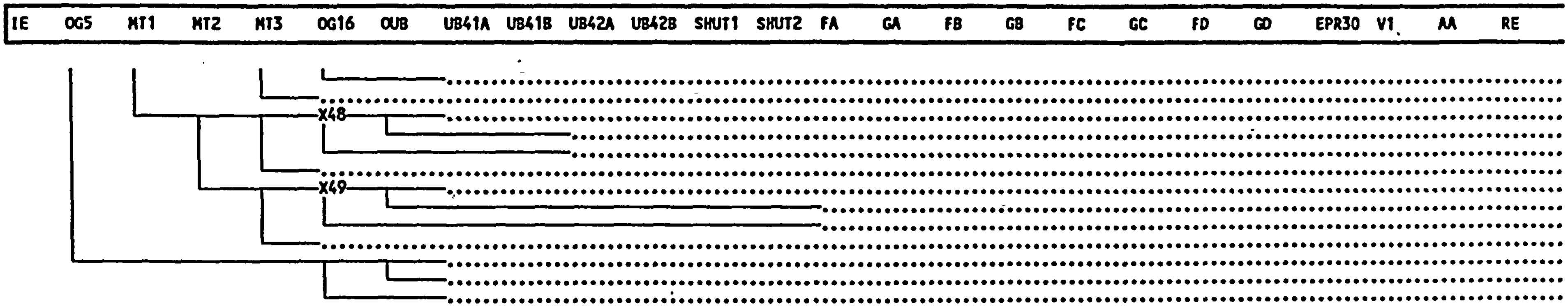
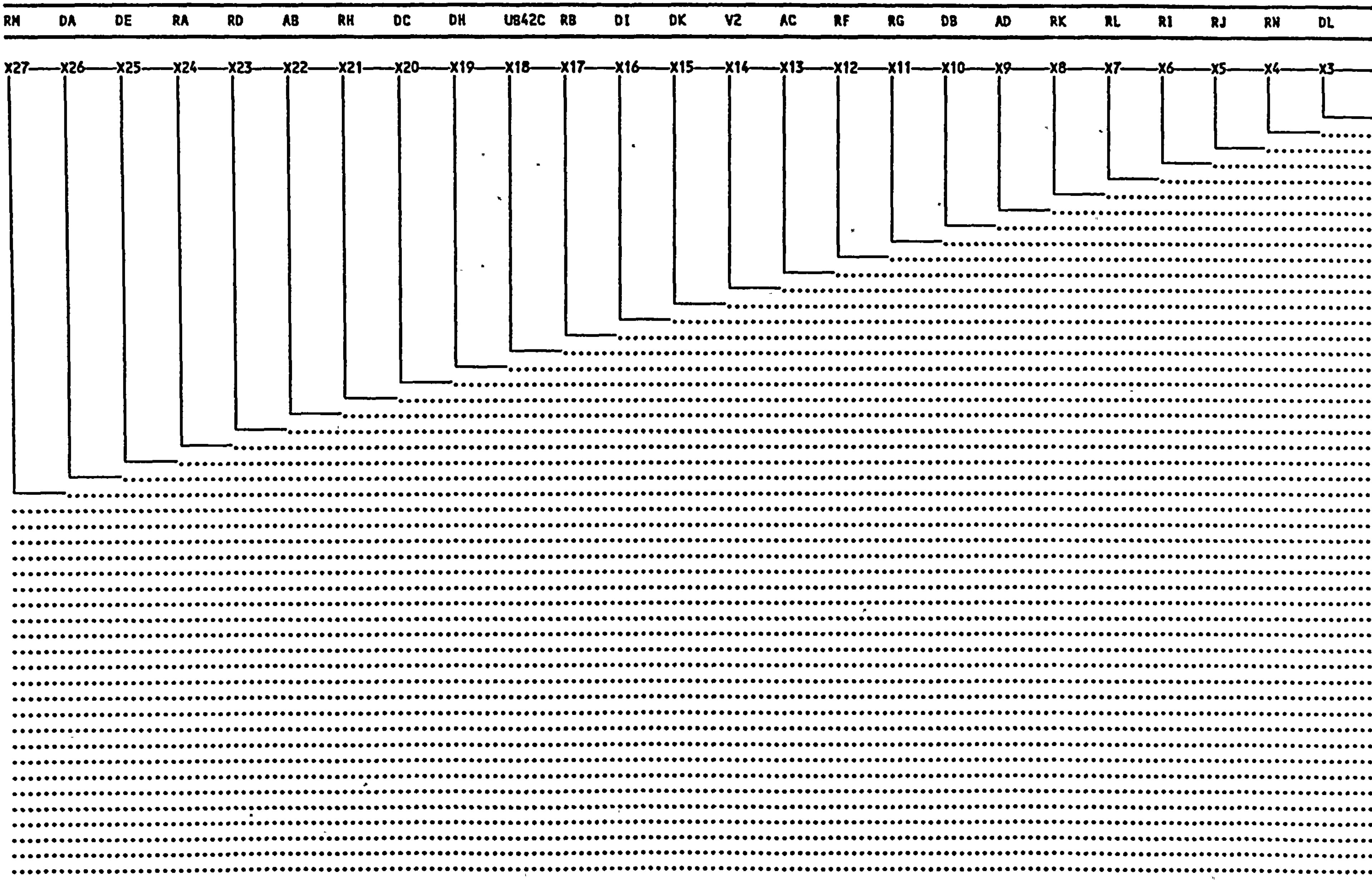



IE OG5 MT1 MT2 MT3 OG16 OUB UB41A UB41B UB42A UB42B SHUT1 SHUT2 FA GA FB GB FC GC FD GD EPR30 V1 AA RE
X48
X49


RM DA DE RA RD AB RH DC DH UB42C RB DI DK V2 AC RF RG DB AD RK RL RI RJ RN DL
X27 X26 X25 X24 X23 X22 X21 X20 X19 X18 X17 X16 X15 X14 X13 X12 X11 X10 X9 X8 X7 X6 X5 X4 X3

RM	DA	DE	RA	RD	AB	RH	DC	DH	UB42C	RB	DI	DK	V2	AC	RF	RG	DB	AD	RK	RL	RI	RJ	RN	DL

DD DO			
X2——X1——	1		1
└——	2		2
└——.......	3	X1	3-4
....	4	X2	5-8
....	5	X3	9-16
....	6	X4	17-32
....	7	X5	33-64
....	8	X6	65-128
....	9	X7	129-256
....	10	X8	257-512
....	11	X9	513-1024
....	12	X10	1025-2048
....	13	X11	2049-4096
....	14	X12	4097-8192
....	15	X13	8193-16384
....	16	X14	16385-32768
....	17	X15	32769-65536
....	18	X16	65537-131072
....	19	X17	131073-262144
....	20	X18	262145-524288
....	21	X19	524289-1048576
....	22	X20	1048577-2097152
....	23	X21	2097153-4194304
....	24	X22	4194305-8388608
....	25	X23	8388609-16777216
....	26	X24	16777217-33554432
....	27	X25	33554433-67108864
....	28	X26	67108865-134217728
....	29	X27	134217729-268435456
....	30	X28	268435457-536870912
....	31	X29	536870913-1073741824
....	32	X30	1073741825-2147483648
....	33	X31	2147483649-4294967296
....	34	X32	4294967297-8589934592
....	35	X33	8589934593-17179869184
....	36	X34	17179869185-34359738368
....	37	X35	34359738369-68719476736
....	38	X36	68719476737-137438953472
....	39	X37	137438953473-274877906944
....	40	X38	274877906945-549755813888
....	41	X39	549755813889-109951162777
....	42	X40	1099511627777-21990232555
....	43	X41	2199023255553-43980465111
....	44	X42	4398046511105-87960930222
....	45	X43	8796093022209-17592186044
....	46	X44	17592186044417-3518437208
....	47	X51	35184372088833-7036874417
....	48	X45	70368744177665-1407374883
....	49	X51	140737488355329-175921860
....	50	X40	175921860444161-177021372
....	51	X40	177021372071937-178120883
....	52	X52	178120883699713-180319906

DD	DO			
....		53	X46	180319906955265-184717953
....		54	X47	184717953466369-228698418
....		55	X51	228698418577409-263882790
....		56	X43	263882790666241-272678883
....		57	X43	272678883688449-281474976
....		58	X48	281474976710657-334251534
....		59	X51	334251534843905-369435906
....		60	X39	369435906932737-369985662
....		61	X39	369985662746625-370535418
....		62	X49	370535418560513-406819302
....		63	X51	406819302277121-442003674
....		64	X51	442003674365953-477188046
....		65	X51	477188046454785-512372418

MODEL Name: BFNFINAL

Top Event Legend for Tree: ELECT12

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Page 1

Top Event Designator.....	Top Event Description............................
IE	Initiating Event
OG5	500 KV OFFSITE GRID UNAVAILABLE
MT1	UNIT 1 MAIN TRANSFORMER & USST FAILURE
MT2	UNIT 2 MAIN TRANSFORMER & USSTS FAILURE
MT3	UNIT 3 MAIN TRANSFORMER & USST FAILURE
OG16	161 KV OFFSITE GRID UNAVAILABLE
OUB	OPERATOR FAILS TO RESTORE POWER TO UNIT BOARDS
UB41A	4KV UNIT BD 1A UNAVAILABLE
UB41B	4KV UNIT BD 1B UNAVAILABLE
UB42A	4KV UNIT BD 2A UNAVAILABLE
UB42B	4KV UNIT BD 2B UNAVAILABLE
SHUT1	SHUTDOWN BUS 1 UNAVAILABLE
SHUT2	SHUTDOWN BUS 2 UNAVAILABLE
FA	FUEL OIL SYSTEM FOR DIESEL A UNAVAILABLE
GA	DG A UNAVAILABLE
FB	FUEL OIL SYSTEM FOR DIESEL B UNAVAILABLE
GB	DG B UNAVAILABLE
FC	FUEL OIL SYSTEM FOR DIESEL C UNAVAILABLE
GC	DG C UNAVAILABLE
FD	FUEL OIL SYSTEM FOR DIESEL D UNAVAILABE
GD	DG D UNAVAILABLE
EPR30	FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES
V1	UNIT 1 VENTILATION
AA	4KV SD BD A AND 480V SD BD 1A POWER UNAVAILABLE
RE	480V RMOV BD 1A POWER UNAVAILABLE
RH	480V DIESEL AUX. BD A POWER UNAVAILABLE

MODEL Name: BFNFINAL

Top Event Legend for Tree: ELECT12

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Page 2

Top Event Designator.....	Top Event Description..............................
DA	250 V DC CONTROL POWER FOR 4KV SD BD A AND 480 SD BD 1A UNAVAILABLE
DE	250 V DC CONTROL POWER FOR 4KV SD BD 3EA AND 480 SD BD 3EA UNAVAILABLE
RA	250 V RMOV 1A UNAVAILABLE
RD	250 V RMOV 2C UNAVAILABLE
AB	4KV SD BD B AND 480V SD BD 2A UNAVAILABLE
RH	480V RMOV BD 2A POWER UNAVAILABLE
DC	250 V DC CONTROL POWER FOR 4KV SD BD B AND 480 V SD BD 2A UNAVAILABLE
DH	250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE
UB42C	4KV UNIT BD 2C POWER UNAVAILABLE
RB	250 RMOV BD 2A UNAVAILABLE
DI	120 V AC UNIT 1 PREFERRED POWER UNAVAILABLE
DK	120 V RPS BUS "A" UNAVAILABLE
V2	UNIT 2 VENTILATION
AC	4KV SD BD C AND 480V SD BD 1B UNAVAILABLE
RF	480V RMOV BD 1B POWER UNAVAILABLE
RG	480V RMOV BD 1E POWER UNAVAILABLE
DB	250 V CONTROL POWER FOR SD BD C AND 480 V SD BD 1B UNAVAILABLE
AD	4KV SD BD D AND 480V SD BD 2B UNAVAILABLE
RK	480V RMOV BD 2D POWER UNAVAILABLE
RL	480V RMOV BD 2E POWER UNAVAILABLE
RI	480V RMOV BD 2B POWER UNAVAILABLE
RJ	480V RMOV BD 2C POWER UNAVAILABLE
RN	480V DIESEL AUX BD B POWER UNAVAILABLE
DL	120 V RPS BUS "B" UNAVAILABLE
DD	250 V DC CONTROL POWER FOR SD BD D AND 480 V SD BD 2B UNAVAILABLE
DO	120 V I&C BUS "2B" UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT12

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Page 1

SF........	Split Fraction Logic..
	UB:=-UB41A=S*-UB41B=S*-UB42A=S*-UB42B=S
	FUEL:=FA=F*FB=F*FC=F*FD=F
	DIESEL:=GA=F*GB=F*GC=F*GD=F
	KV4:=AA=F*AB=F*AC=F*AD=F
OG5F	INIT=LOSP+INIT=L500
OG51	1
MT1F	OG5=F
MT11	1
MT2F	OG5=F
MT21	1
MT3F	OG5=F
MT31	1
OG16F	INIT=LOSP
OG161	1
EPR304	(INIT=LOSP+INIT=L500)*GA=F*GB=F*GC=F*GD=F
EPR303	(INIT=LOSP+INIT=L500)*(GA=F*GB=F*(GC=F+GD=F)+(GA=F+GB=F)*GC=F*GD=F)
EPR302	(INIT=LOSP+INIT=L500)*(GA=F*(GB=F+GC=F+GD=F)+GB=F*(GC=F+GD=F)+GC=F* GD=F)
EPR301	(INIT=LOSP+INIT=L500)*(GA=F+GB=F+GC=F+GD=F)
EPR30B	1
OUB2	OG5=F+MT1=F*MT2=F
OUB1	MT1=F+MT2=F
OUB2	1
UB41AF	OUB=F*-MT1=S+INIT=LOSP
UB41A2	OUB=S*-MT1=S
UB41A1	OUB=B+MT1=S
UB41AF	1
UB41BF	OUB=F*-MT1=S+INIT=LOSP
UB41B3	OUB=S*UB41A=S*-MT1=S
UB41B2	OUB=S*-UB41A=S*-MT1=S
UB41B1	OUB=B+MT1=S
UB41BF	1
UB42AF	OUB=F*-MT2=S+INIT=LOSP
UB42A5	OUB=S*UB41A=F*UB41B=F*-MT2=S

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT12

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Page 2

SF........	Split Fraction Logic..
UB42A4	OUB=S*(UB41A=F+UB41B=F)*-MT2=S
UB42A3	OUB=S*(UB41A=S*UB41B=S)*-MT2=S
UB42A1	OUB=B+MT2=S
UB42AF	1
UB42BF	OUB=F*-MT2=S+INIT=LOSP
UB42B7	OUB=S*UB41A=F*UB41B=F*UB42A=F*-MT2=S
UB42B6	OUB=S*-MT2=S*(UB41A=F*(UB41B=F+UB42A=F)+UB41B=F*UB42A=F)
UB42B5	OUB=S*(UB41A=F+UB41B=F+UB42A=F)*-MT2=S
UB42B4	OUB=S*UB41A=S*UB41B=S*UB42A=S*-MT2=S
UB42B1	OUB=B+MT2=S
UB42BF	1
SHUT1F	-UB41A=S*-UB42B=S
SHUT13	-UB42B=S
SHUT12	-UB41A=S
SHUT11	1
SHT2F	-UB42A=S*-UB41B=S
SHT217	-UB42B=S*-UB41B=S*-SHUT1=S
SHT216	-UB42A=S*-UB42B=S*-SHUT1=S
SHT215	-UB41A=S*-UB41B=S*-SHUT1=S
SHT214	-UB41A=S*-UB42A=S*-SHUT1=S
SHT213	-UB42B=S*-UB41B=S*SHUT1=S
SHT212	-UB42A=S*-UB42B=S*SHUT1=S
SHT211	-UB41A=S*-UB41B=S*SHUT1=S
SHT210	-UB41A=S*-UB42A=S*SHUT1=S
SHT26	-UB42B=S*-UB41A=S*-UB41B=S
SHT25	-UB42A=S*-UB41A=S*-UB42B=S
SHT24	-UB41A=S*-UB42B=S
SHT29	-UB42B=S*-SHUT1=S
SHT28	-UB41A=S*-SHUT1=S
SHT27	-SHUT1=S
SHT23	-UB42B=S
SHT22	-UB41A=S
SHT21	1

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT12

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Page 3

SF........	Split Fraction Logic..
FAB	SHUT1=S
FA1	1
GAB	SHUT1=S
GAF	-SHUT1=S*FA=F
GA1	1
V1S	1
AAF	V1=F + -INIT=LOSP*-SHUT1=S*GA=F+INIT=LOSP*-SHUT1=S*GA=F*EPR30=F
AA2	-SHUT1=S*GA=S
AA1	1
REF	AA=F
RE1	1
RMF	AA=F
RM1	1
DA2	RE=F
DA1	1
DE2	AA=F
DE1	1
RAF	DE=F
RA1	1
RDF	DE=F
RD1	1
FBB	SHUT1=S
FB2	FA=F*-SHUT1=S
FB1	-SHUT1=S
FB1	1
GBB	SHUT1=S
GBF	FB=F*-SHUT1=S
GB3	FA=F*-SHUT1=S
GB2	GA=F*-SHUT1=S
GB1	-SHUT1=S
GBF	1
ABF	V1=F+-INIT=LOSP*-SHUT1=S*GB=F+INIT=LOSP*-SHUT1=S*GB=F*EPR30=F
AB5	-SHUT1=S*GA=F

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT12

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Page 4

SF........	Split Fraction Logic..
AB4	GA=S*GB=S*AA=F*-SHUT1=S
AB3	AA=F*SHUT1=S
AB2	GA=S*GB=S*AA=S*-SHUT1=S
AB1	AA=S*SHUT1=S
ABF	1
RHF	AB=F
RH1	1
DC2	RH=F
DC1	1
DH2	AB=F
DH1	1
UB42CF	OG5=F*(EPR30=F+OG16=F)
UB42C2	OG16=F
UB42C1	1
RBF	DH=F
RB1	1
DKF	RH=F
DK1	1
DIF	AA=F*DE=F*AB=F*DH=F
DI2	AA=F*DE=F
DI3	AB=F*DH=F
DI1	1
FCB	SHUT2=S
FC3	FA=F*FB=F*-SHUT2=S
FC2	(FA=F + FB=F)*-SHUT2=S
FC1	-SHUT2=S
FC1	1
GCB	SHUT2=S
GCF	FC=F*-SHUT2=S
GC6	FA=F*FB=F*-SHUT2=S
GC4	GA=F*GB=F*-SHUT2=S
GC5	(FA=F*GB=F + FB=F*GA=F)*-SHUT2=S
GC3	(FA=F + FB=F)*-SHUT2=S

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT12

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Page 5

SF........	Split Fraction Logic..
GC2	(GA=F + GB=F)*-SHUT2=S
GC1	1
V2S	1
ACF	V2=F + -INIT=LOSP*-SHUT2=S*GC=F+INIT=LOSP*-SHUT2=S*GC=F*EPR30=F
AC18	-SHUT2=S*GC=S*-SHUT1=S*GA=F*GB=F
AC17	SHUT2=S*-SHUT1=S*GA=F*GB=F
AC16	-SHUT2=S*-SHUT1=S*GC=S*(GA=F*AB=F+GB=F*AA=F)
AC15	SHUT2=S*-SHUT1=S*(GA=F*AB=F+GB=F*AA=F)
AC14	-SHUT2=S*-SHUT1=S*GC=S*(GA=F*AB=S+GB=F*AA=S)
AC13	SHUT2=S*-SHUT1=S*(GA=F*AB=S+GB=F*AA=S)
AC12	-SHUT2=S*-SHUT1=S*GA=S*GB=S*GC=S*AA=F*AB=F
AC11	SHUT2=S*-SHUT1=S*GA=S*GB=S*AA=F*AB=F
AC10	-SHUT2=S*SHUT1=S*GC=S*AA=F*AB=F
AC9	SHUT2=S*SHUT1=S*AA=F*AB=F
AC8	-SHUT2=S*-SHUT1=S*GA=S*GB=S*GC=S*(AA=F + AB=F)
AC7	SHUT2=S*-SHUT1=S*GA=S*GB=S*(AA=F + AB=F)
AC6	-SHUT2=S*SHUT1=S*GC=S*(AA=F + AB=F)
AC5	SHUT2=S*SHUT1=S*(AA=F + AB=F)
AC4	-SHUT2=S*-SHUT1=S*GC=S*AA=S*AB=S
AC3	SHUT2=S*-SHUT1=S*AA=S*AB=S
AC2	-SHUT2=S*SHUT1=S*GC=S*AA=S*AB=S
AC1	SHUT2=S*SHUT1=S*AA=S*AB=S
ACF	1
RFF	AC=F
RF1	1
RGF	AC=F
RG1	1
DB2	RF=F
DB1	1
FDB	SHUT2=S
FD4	FA=F*FB=F*FC=F*-SHUT2=S
FD3	(FA=F*FB=F + FA=F*FC=F + FB=F*FC=F)*-SHUT2=S
FD2	(FA=F + FB=F + FC=F)*-SHUT2=S

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT12

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Page 6

SF........	Split Fraction Logic..
FD1	1
GDB	SHUT2=S
GDF	FD=F*-SHUT2=S
GD10	FA=F*FB=F*FC=F*-SHUT2=S
GD9	(FA=F*FB=F*GC=F + FA=F*FC=F*GB=F + FB=F*FC=F*GA=F)*-SHUT2=S
GD7	(FA=F*GB=F*GC=F + FC=F*GA=F*GB=F + FB=F*GA=F*GC=F)*-SHUT2=S
GD4	GA=F*GB=F*GC=F*-SHUT2=S
GD8	(FA=F*FB=F + FA=F*FC=F + FB=F*FC=F)*-SHUT2=S
GD6	(FA=F*(GB=F + GC=F) + FC=F*(GA=F + GB=F) + FB=F*(GA=F + GC=F))*-SHUT2=S
GD3	((GA=F*GB=F) + (GA=F*GC=F) + (GB=F*GC=F))*-SHUT2=S
GD5	(FA=F + FB=F + FC=F)*-SHUT2=S
GD2	(GA=F + GB=F + GC=F)*-SHUT2=S
GD1	1
ADF	V2=F + -INIT=LOSP*-SHUT2=S*GD=F+INIT=LOSP*-SHUT2=S*GD=F*EPR30=F
AD35	-SHUT1=S*-SHUT2=S*GA=F*GB=F*GC=F
AD34	-SHUT1=S*-SHUT2=S*(GA=F*(GB=F*GC=S*AC=F+GB=S*AB=F*GC=F) +GA=S*AA=F*GB=F*GC=F)
AD33	-SHUT1=S*SHUT2=S*GA=F*GB=F*AC=F
AD32	-SHUT1=S*-SHUT2=S*(GA=F*(GB=F*AC=S+AB=S*GC=F)+AA=S*GB=F*GC=F)
AD31	-SHUT1=S*SHUT2=S*GA=F*GB=F*AC=S
AD30	-SHUT1=S*-SHUT2=S*(GA=S*AA=F*(GB=S*AB=F*GC=F+GB=F*GC=S*AC=F) +GA=F*GB=S*AB=F*GC=S*AC=F)
AD29	-SHUT1=S*SHUT2=S*AC=F*(GA=F*GB=S*AB=F+GA=S*AA=F*GB=F)
AD28	SHUT1=S*-SHUT2=S*GC=F*AA=F*AB=F
AD27	-SHUT1=S*-SHUT2=S*(GA=F*(GB=S*AB=F*AC=S+AB=S*GC=S*AC=F) +GB=F*(GA=S*AA=F*AC=S+AA=S*GC=S*AC=F) +GC=F*(GA=S*AA=F*AB=S+AA=S*GB=S*AB=F))
AD26	-SHUT1=S*SHUT2=S*AC=S*(GA=S*AA=F*GB=F+GA=F*GB=S*AB=F)
AD25	-SHUT1=S*SHUT2=S*AC=F*(GA=F*AB=S+AA=S*GB=F)
AD24	SHUT1=S*-SHUT2=S*GC=F*(AA=F + AB=F)
AD23	-SHUT1=S*-SHUT2=S*(AA=S*(GB=F*AC=S+AB=S*GC=F)+GA=F*AB=S*AC=S)
AD22	-SHUT1=S*SHUT2=S*AC=S*(GB=F*AA=S+GA=F*AB=S)
AD21	SHUT1=S*-SHUT2=S*GC=F*AA=S*AB=S
AD20	-SHUT1=S*-SHUT2=S*GA=S*GB=S*GC=S*AA=F*AB=F*AC=F

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT12

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SF........	Split Fraction Logic..
AD19	-SHUT1=S*SHUT2=S*GA=S*GB=S*AA=F*AB=F*AC=F
AD18	SHUT1=S*-SHUT2=S*GC=S*AA=F*AB=F*AC=F
AD17	SHUT1=S*SHUT2=S*AA=F*AB=F*AC=F
AD16	-SHUT1=S*-SHUT2=S*GA=S*GB=S*GC=S*(AA=F*(AB=F + AC=F) + AB=F*AC=F)
AD15	-SHUT1=S*SHUT2=S*GA=S*GB=S*AC=F*(AA=F + AB=F)
AD14	-SHUT1=S*SHUT2=S*GA=S*GB=S*AA=F*AB=F
AD13	SHUT1=S*-SHUT2=S*GC=S*AC=F*(AA=F + AB=F)
AD12	SHUT1=S*-SHUT2=S*GC=S*AA=F*AB=F
AD11	SHUT1=S*SHUT2=S*(AA=F*(AB=F + AC=F) + AB=F*AC=F)
AD10	-SHUT1=S*-SHUT2=S*GA=S*GB=S*GC=S*GD=S*(AA=F + AB=F + AC=F)
AD9	-SHUT1=S*SHUT2=S*GA=S*GB=S*AC=F
AD8	-SHUT1=S*SHUT2=S*GA=S*GB=S*(AA=F + AB=F)
AD7	SHUT1=S*-SHUT2=S*GC=S*AC=F
AD6	SHUT1=S*-SHUT2=S*GC=S*(AA=F + AB=F)
AD5	SHUT1=S*SHUT2=S*(AA=F + AB=F + AC=F)
AD4	-SHUT1=S*-SHUT2=S*AA=S*AB=S*AC=S
AD3	-SHUT1=S*SHUT2=S*AA=S*AB=S*AC=S
AD2	SHUT1=S*-SHUT2=S*AA=S*AB=S*AC=S
AD1	SHUT1=S*SHUT2=S*AA=S*AB=S*AC=S
ADF	1
RKF	AB=F*AD=F
RK3	AB=F
RK2	AD=F
RK1	AB=S*AD=S
RKF	1
RLF	AD=F*AB=F
RL7	RK=F*AD=F
RL6	RK=S*AD=F
RL5	RK=F*AB=F
RL4	RK=S*AB=F
RL2	RK=F*AB=S*AD=S
RL1	RK=S*AB=S*AD=S
RLF	1

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT12

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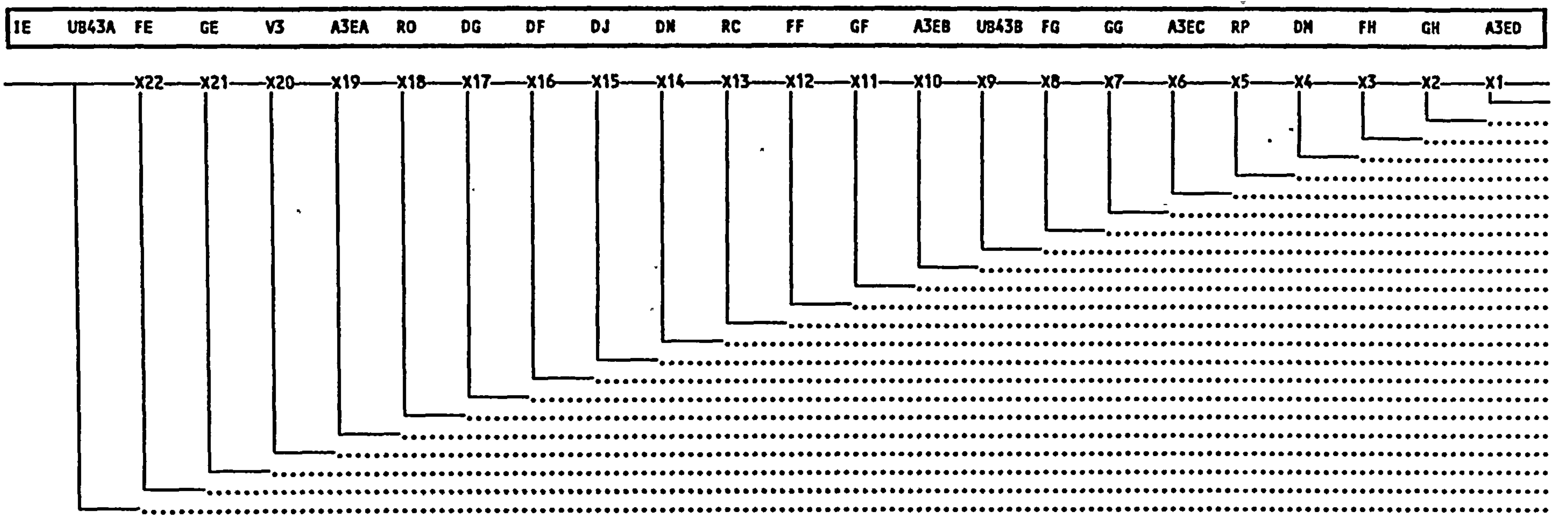
Page 8

SF........	Split Fraction Logic..
RIF	AD=F
RI1	1
RJF	AD=F
RJ1	1
RNF	AD=F
RN1	1
DLF	RI=F
DL3	RH=F
DL2	DK=F
DL1	1
DD2	RI=F
DD1	1
DOF	AD=F*AC=F+INIT=LICB
DO3	AD=F
DO2	AC=F
DO1	1


IE UB43A FE GE V3 A3EA RO DG DF DJ DN RC FF GF A3EB UB43B FG GG A3EC RP DM FH GH A3ED
X22 X21 X20 X19 X18 X17 X16 X15 X14 X13 X12 X11 X10 X9 X8 X7 X6 X5 X4 X3 X2 X1

1		1
2		2
3	X1	3-4
4	X2	5-8
5	X3	9-16
6	X4	17-32
7	X5	33-64
8	X6	65-128
9	X7	129-256
0	X8	257-512
1	X9	513-1024
2	X10	1025-2048
3	X11	2049-4096
4	X12	4097-8192
5	X13	8193-16384
6	X14	16385-32768
7	X15	32769-65536
8	X16	65537-131072
9	X17	131073-262144
0	X18	262145-524288
1	X19	524289-1048576
2	X20	1048577-2097152
3	X21	2097153-4194304
4	X22	4194305-8388608

MODEL Name: BFNFINAL

Top Event Legend for Tree: ELECT3

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Page 1

Top Event Designator.....	Top Event Description............................
IE	Initiating Event
UB43A	4KV UNIT BD 3A UNAVAILABLE
FE	FUEL OIL SYSTEM FOR DIESEL 3A UNAVAILABLE
GE	DG 3A UNAVAILABILITY
V3	UNIT 3 VENTILATION SYSTEM
A3EA	4KV SD BD 3EA AND 480V SD BD 3A POWER UNAVAILABLE
RO	480V DIESEL AUX BD 3EA POWER UNAVAILABLE
DG	250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILABLE
DF	250 V DC CONTROL POWER FOR 4KV SD BD 3EB UNAVAILABLE
DJ	120 V AC UNIT 2 PREFERRED POWER UNAVAILABLE
DN	120 V I&C BUS "2A" UNAVAILABLE
RC	250 V RMOV BD 2B UNAVAILABLE
FF	FUEL OIL SYSTEM FOR DIESEL 3B UNAVAILABLE
GF	DG 3B UNAVAILABLE
A3EB	4KV SD BD 3EB POWER UNAVAILABLE
UB43B	4KV UNIT BD 3B UNAVAILABLE
FG	FUEL OIL SYSTEM FOR DIESEL 3C UNAVAILABLE
GG	DG 3C UNAVAILABLE
A3EC	4KV SD BD 3EC AND 480V SD BD 3B UNAVAILABLE
RP	480V DIESEL AUX BD 3EB POWER UNAVAILABLE
DM	120 V I&C BUS "1B" UNAVAILABLE
FH	FUEL OIL FOR DIESEL 3D UNAVAILABLE
GH	DG 3D UNAVAILABLE
A3ED	4KV SD BD 3ED UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT3

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Page 1

SF........	Split Fraction Logic..
UB43AF	UB + MT3=F+OG5=F*EPR30=F
UB43A1	1
FEB	UB43A=S
FEF	FUEL*UB43A=F
FE1	1
GEB	UB43A=S
GEF	UB43A=F*(FE=F + DIESEL)
GE1	1
V3S	1
A3EAF	UB43A=F*(GE=F + DE=F) + KV4 + V3=F
A3EA2	UB43A=F
A3EA1	1
ROF	A3EA=F
RO1	1
DGB	A3EA=F
DGA	1
DF2	RO=F
DF1	1
DJF	A3EA=F*DG=F*AB=F*DH=F+INIT=LUPS
DJ11	AA=F*DE=F*AB=F*DH=F
DJ10	AA=F*DE=F*A3EA=F*DG=F*DI=F
DJ9	A3EA=F*DG=F*DI=F
DJ8	AB=F*DH=F*DI=F
DJ7	AA=F*DE=F*DI=F
DJ6	DI=F
DJ5	AA=F*DE=F*A3EA=F*DG=F*DI=S
DJ4	A3EA=F*DG=F*DI=S
DJ3	AB=F*DH=F*DI=S
DJ2	AA=F*DE=F*DI=S
DJ1	(AA=S+DE=S)*(AB=S+DH=S)*(A3EA=S+DG=S)*DI=S
DJF	1
DNF	AB=F*A3EA=F+INIT=LICA
DN3	A3EA=F

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT3

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Page 2

SF........	Split Fraction Logic..
DN2	AB=F
DN1	1
RCF	DG=F
RC1	1
FFB	UB43A=S
FFF	FUEL*UB43A=F
FF2	FE=F*UB43A=F
FF1	1
GFB	UB43A=S
GFF	UB43A=F*(DIESEL + FF=F)
GF3	FE=F*UB43A=F
GF2	GE=F*UB43A=F
GF1	1
A3EBF	V3=F + KV4 + UB43A=F*(DF=F + GF=F)
A3EB5	GF=S*DF=S*UB43A=F*(FE=F + DIESEL)
A3EB4	UB43A=F*GE=S*DE=S*GF=S*DF=S*A3EA=F
A3EB3	UB43A=S*A3EA=F
A3EB2	UB43A=F*GE=S*DE=S*GF=S*DF=S*A3EA=S
A3EB1	1
UB43BF	UB + MT3=F+OG5=F*EPR30=F
UB43B1	1
FGB	UB43B=S
FGF	FUEL*UB43B=F
FG3	FE=F*FF=F*UB43B=F
FG2	(FE=F + FF=F)*UB43B=F
FG1	1
GGB	UB43B=S
GGF	(DIESEL + FG=F)*UB43B=F
GG6	FE=F*FF=F*UB43B=F
GG5	(FE=F*GF=F + FF=F*GE=F)*UB43B=F
GG4	GE=F*GF=F*UB43B=F
GG3	(FE=F + FF=F)*UB43B=F
GG2	(GE=F + GF=F)*UB43B=F

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT3

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Page 3

SF........	Split Fraction Logic..
GG1	1
A3ECF	UB43B=F*(DG=F + GG=F) + V3=F + KV4
A3EC18	UB43B=F*UB43A=F*DG=S*GG=S*(GE=F+DE=F)*(GF=F+DF=F)
A3EC17	UB43B=S*UB43A=F*(GE=F + DE=F)*(GF=F + DF=F)
A3EC16	UB43B=F*UB43A=F*DG=S*GG=S*((GE=F+DE=F)*GF=S*DF=S*A3EB=F +(GF=F+DF=F)*GE=S*DE=S*A3EA=F)
A3EC15	UB43B=S*UB43A=F*((GE=F + DE=F)*GF=S*DF=S*A3EB=F + (GF=F + DF=F)*GE=S*DE=S*A3EA=F)
A3EC14	UB43B=F*UB43A=F*DG=S*GG=S*(GE=F + DE=F + GF=F + DF=F)
A3EC13	UB43B=S*UB43A=F*(GE=F + DE=F + GF=F + DF=F)
A3EC12	UB43B=F*UB43A=F*GE=S*DE=S*GF=S*DF=S*GG=S*DG=S*A3EA=F*A3EB=F
A3EC11	UB43B=S*UB43A=F*GE=S*DE=S*GF=S*DF=S*A3EA=F*A3EB=F
A3EC10	UB43B=F*UB43A=S*GG=S*DG=S*A3EA=F*A3EB=F
A3EC9	UB43B=S*UB43A=S*A3EA=F*A3EB=F
A3EC8	UB43B=F*UB43A=F*GE=S*DE=S*GF=S*DF=S*GG=S*DG=S*(A3EA=F + A3EB=F)
A3EC7	UB43B=S*UB43A=F*GE=S*DE=S*GF=S*DF=S*(A3EA=F+ A3EB=F)
A3EC6	UB43B=F*UB43A=S*GG=S*DG=S*(A3EA=F+A3EB=F)
A3EC5	UB43B=S*UB43A=S*(A3EA=F+A3EB=F)
A3EC4	UB43B=F*UB43A=F*GE=S*DE=S*GF=S*DF=S*GG=S*DG=S*A3EA=S*A3EB=S
A3EC3	UB43B=S*UB43A=F*GE=S*DE=S*GF=S*DF=S*A3EA=S*A3EB=S
A3EC2	UB43B=F*UB43A=S*GG=S*DG=S*A3EA=S*A3EB=S
A3EC1	UB43B=S*UB43A=S*A3EA=S*A3EB=S
A3ECF	1
RPF	A3EC=F
RP1	1
DMF	AC=F*A3EC=F
DM3	A3EC=F
DM2	AC=F
DM1	1
FHB	UB43B=S
FHF	FUEL*UB43B=F
FH4	FE=F*FF=F*FG=F*UB43B=F
FH3	(FE=F*FF=F + FE=F*FG=F + FF=F*FG=F)*UB43B=F

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT3

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SF........	Split Fraction Logic..
FH2	(FE=F + FF=F + FG=F)*UB43B=F
FH1	1
GHB	UB43B=S
GHF	(DIESEL + FH=F)*UB43B=F
GH10	FF=F*FG=F*FE=F*UB43B=F
GH9	(GF=F*FG=F*FE=F + FF=F*GG=F*FE=F + FF=F*FG=F*GE=F)*UB43B=F
GH8	(GF=F*GG=F*FE=F + FF=F*GG=F*GE=F + FG=F*GE=F*GF=F)*UB43B=F
GH7	GE=F*GF=F*GG=F*UB43B=F
GH6	(FG=F*FE=F + FF=F*FE=F + FF=F*FG=F)*UB43B=F
GH5	((FF=F + FE=F)*GG=F + (FF=F + FG=F)*GE=F + (FE=F + FG=F)*GF=F)*UB43B=F
GH4	(GF=F*GG=F + GF=F*GE=F + GG=F*GE=F)*UB43B=F
GH3	(FF=F + FG=F + FE=F)*UB43B=F
GH2	(GF=F + GG=F + GE=F)*UB43B=F
GH1	1
A3EDF	UB43B=F*(GH=F + DH=F) + V3=F + KV4
A3ED35	UB43B=F*UB43A=F*(GE=F + DE=F)*(GF=F + DF=F)*(GG=F + DG=F)
A3ED34	UB43B=F*UB43A=F*((GE=F + DE=F)*((GF=F + DF=F)*DG=S*GG=S* A3EC=F + (GG=F + DG=F)*GF=S*DF=S*A3EB=F) + GE=S*DE=S* A3EA=F*(GF=F + DF=F)*(GG=F + DG=F))
A3ED33	UB43B=S*UB43A=F*(GE=F+DE=F)*(GF=F+DF=F)*A3EC=F
A3ED32	UB43B=F*UB43A=F*((GE=F+DE=F)*((GF=F+DF=F)*A3EC=S +(GG=F+DG=F)*A3EB=S)+A3EA=S*(GF=F+DF=F)*(GG=F+DG=F))
A3ED31	UB43B=S*UB43A=F*(GE=F + DE=F)*(GF=F + DF=F)*A3EC=S
A3ED30	UB43B=F*UB43A=F*((GE=F+DE=F)*GF=S*DF=S*GG=S*DG=S*A3EB=F *A3EC=F+(GF=F+DF=F)*GE=S*DE=S*GG=S*DG=S*A3EA=F*A3EC=F +(GG=F+DG=F)*GE=S*DE=S*GG=S*DG=S*A3EA=F*A3EB=F)
A3ED29	UB43B=S*UB43A=F*A3EC=F*((GE=F+DE=F)*GF=S*DF=S*A3EB=F +(GF=F+DF=F)*GE=S*DE=S*A3EA=F)
A3ED28	UB43B=F*UB43A=S*A3EA=F*A3EB=F*(GG=F + DG=F)
A3ED27	UB43B=F*UB43A=F*((GE=F + DE=F)*GF=S*DF=S*GG=S*DG=S*(A3EB=F + A3EC=F) + (GF=F + DF=F)*GE=S*DE=S*GG=S*DG=S*(A3EA=F + A3EC=F) + (GG=F + DG=F) *GE=S*DE=S*GF=S*DF=S*(A3EA=F + A3EB=F))
A3ED26	UB43B=S*UB43A=F*A3EC=S*((GE=F + DE=F) * GF=S*DF=S*A3EB=F + GE=S*DE=S*A3EA=F*(GF=F + DF=F))
A3ED25	UB43B=S*UB43A=F*A3EC=F*((GE=F + DE=F)*A3EB=S + A3EA=S *(GF=F + DF=F))
A3ED24	UB43B=F*UB43A=S*(GG=F + DG=F)*(A3EA=F + A3EB=F)

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: ELECT3

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SF........	Split Fraction Logic..
A3ED23	UB43B=F*UB43A=F*((GE=F + DE=F)*A3EB=S*A3EC=S + (GF=F + DF=F)*A3EA=S*A3EC=S + (GG=F + DG=F)*A3EA=S*A3EB=S)
A3ED22	UB43B=S*UB43A=F*A3EC=S*((GE=F + DE=F)*A3EB=S + A3EA=S*(GF=F + DF=F))
A3ED21	UB43B=F*UB43A=S*A3EA=S*A3EB=S*(GG=F + DG=F)
A3ED20	UB43B=F*UB43A=F*GE=S*DE=S*GF=S*DF=S*GG=S*DG=S*A3EA=F*A3EB=F*A3EC=F
A3ED19	UB43B=S*UB43A=F*GE=S*DE=S*GF=S*DF=S*A3EA=F*A3EB=F*A3EC=F
A3ED18	UB43B=F*UB43A=S*GG=S*DG=S*A3EA=F*A3EB=F*A3EC=F
A3ED17	UB43B=S*UB43A=S*A3EA=F*A3EB=F*A3EC=F
A3ED16	UB43B=F*UB43A=F*GE=S*DE=S*GF=S*DF=S*GG=S*DG=S*(A3EA=F*(A3EB=F + A3EC=F) + A3EB=F*A3EC=F)
A3ED15	UB43B=S*UB43A=F*GE=S*DE=S*GF=S*DF=S*A3EC=F*(A3EA=F + A3EB=F)
A3ED14	UB43B=S*UB43A=F*GE=S*DE=S*GF=S*DF=S*A3EB=F*A3EA=S
A3ED13	UB43B=F*UB43A=S*GG=S*DG=S*A3EC=F*(A3EA=F + A3EB=F)
A3ED12	UB43B=F*UB43A=S*GG=S*DG=S*A3EA=F*A3EB=F
A3ED11	UB43B=S*UB43A=S*(A3EA=F*(A3EB=F + A3EC=F) + A3EB=F*A3EC=F)
A3ED10	UB43B=F*UB43A=F*GE=S*DE=S*GF=S*DF=S*GG=S*DG=S*(A3EA=F + A3EB = F + A3EC=F)
A3ED9	UB43B=S*UB43A=F*A3EA=S*A3EB=S*A3EC=F
A3ED8	UB43B=S*UB43A=F*GE=S*DE=S*GF=S*DF=S*(A3EA=F+A3EB=F)
A3ED7	UB43B=F*UB43A=S*GG=S*DG=S*A3EC=F
A3ED6	UB43B=F*UB43A=S*(A3EA=F+A3EB=F)
A3ED5	UB43B=S*UB43A=S*(A3EA=F + A3EB=F + A3EC=F)
A3ED4	UB43B=F*UB43A=F*A3EA=S*A3EB=S*A3EC=S
A3ED3	UB43B=S*UB43A=F*A3EA=S*A3EB=S*A3EC=S
A3ED2	UB43B=F*UB43A=S*A3EA=S*A3EB=S*A3EC=S
A3ED1	UB43B=S*UB43A=S*A3EA=S*A3EB=S*A3EC=S
A3EDF	1

MODEL Name: BFNFINAL
Event Tree: GTPDS

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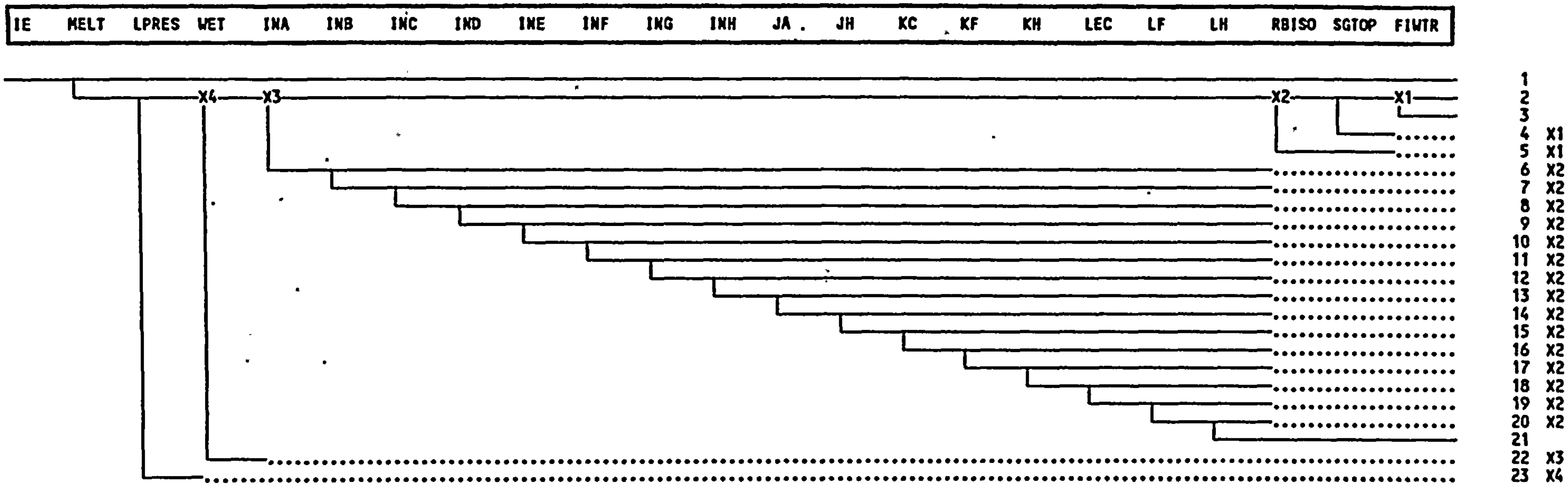

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MODEL Name: BFNFINAL

Top Event Legend for Tree: GTPDS

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Page 1

Top Event Designator.....	Top Event Description..............................
IE	Initiating Event
MELT	CORE DAMAGE HAS OCCURRED
LPRES	HIGH VESSEL PRESSURE AT MELT-THROUGH
WET	NO WATER ON DRYWELL FLOOR AT MELT-THROUGH
INA	NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
INB	NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
INC	NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
IND	NOT INTACT, WTR TO DEBRIS, NO DWS, SPC
INE	NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
INF	NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT
ING	NOT INTACT, NO WTR TO DEBRIS, VENT
INH	NOT INTACT, NO WTR TO DEBRIS, NO VENT
JA	NOT BYPASS, WTR TO DEBRIS
JH	NOT BYPASS, NO WTR TO DERBIS
KC	NOT EARLY, WTR TO DEBRIS, DWS
KF	NOT EARLY, WTR TO DEBRIS, NO DWS
KH	NOT EARLY, NO WTR TO DEBRIS, NO DWS
LEC	NOT LATE, WTR TO DEBRIS, DWS
LF	NOT LATE, WTR TO DEBRIS, NO DWS
LH	NOT LATE, NO WTR TO DEBRIS, NO DWS
RBISO	REACTOR BUILDING NOT ISOLATED
SGTOP	STANDBY GAS TREATMENT AND HUMIDIFIERS NOT OPERATING
FIWTR	FIRE WATER UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: GTPDS

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Page 1

SF........	Split Fraction Logic..
	UATWS:=RPS=F*(RPT=F+OSL=F+SL=F*OAL=F+OAD=F*OLA=F)
	LOPRESS:=-UATWS*(RVD=DEP+RVC=SORV1+RVC=SORV2+RVC=SORV3+FWA=S*RVL=S+ +INIT=IOTV+INIT=IOTM+INIT=BOC*ISO=F+TB=F*IVC=F
	NOTDRY:=INIT=SLOCA+DWS=S
	BYPASS:=INIT=BOC*ISO=F+INIT=ILOCA+TB=F*IVC=F+INIT=FLRB3S
	EARLY:=UATWS+CIL=F+CIS=F
	LATE:=(SP=F*SPR=F+OSP=F)*(FWA=S*RVL=S+LPC=S+CS=S)
	DBCAVAIL:=LPC=S+CS=S+CRD=S+CD=S+DWS=S
MELTS	NCD=S
MELTF	1
LPRESS	LOPRESS
LPRESF	1
WETS	NOTDRY
WETF	1
INAS	-(BYPASS+EARLY+LATE)*DBCAVAIL*DWS=S*(SP=S+SPR=S)
INAF	1
INBS	-(BYPASS+EARLY+LATE)*DBCAVAIL*DWS=S*(SP=F*SPR=F+OSP=F)*VNT=S
INBF	1
INCS	-(BYPASS+EARLY+LATE)*DBCAVAIL*DWS=S*(SP=F*SPR=F+OSP=F)*-VNT=S
INCF	1
INDS	-(BYPASS+EARLY+LATE)*DBCAVAIL*(ODWS=F+DWS=F)*(SP=S+SPR=S)
INDF	1
INES	-(BYPASS+EARLY+LATE)*DBCAVAIL*(ODWS=F+DWS=F)*(SP=F*SPR=F+OSP=F)*VNT =S
INEF	1
INFS	-(BYPASS+EARLY+LATE)*DBCAVAIL*(ODWS=F+DWS=F)*(SP=F*SPR=F+OSP=F)*-VN T=S
INFF	1
INGS	-(BYPASS+EARLY+LATE)*-DBCAVAIL*VNT=S*(ODWS=F+DWS=F)
INGF	1
INHS	-(BYPASS+EARLY+LATE)*-DBCAVAIL*-VNT=S*(ODWS=F+DWS=F)
INHF	1
JAS	BYPASS*DBCAVAIL
JAF	1
JHS	BYPASS*-DBCAVAIL

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: GTPDS

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Page 2

SF........	Split Fraction Logic..
JHF	1
KCS	EARLY*DBCAVAIL*DWS=S
KCF	1
KFS	EARLY*DBCAVAIL*(ODWS=F+DWS=F)
KFF	1
KHS	EARLY*-DBCAVAIL*(ODWS=F+DWS=F)
KHF	1
LECS	LATE*DBCAVAIL*DWS=S
LECF	1
LFS	LATE*DBCAVAIL*(ODWS=F+DWS=F)
LFF	1
LHS	LATE*-DBCAVAIL*(ODWS=F+DWS=F)
LHF	1
RBISOS	RBI=S
RBISOF	1
SGTOPS	SGT=S*HUM=S
SGTOPF	1
FIWTRS	AI=S
FIWTRF	1

MODEL Name: BFNFINAL

Binning Logic for Event Tree: GTPDS

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Page 1

Bin.......	Binning Rules...
SUCCESS	MELT=S
MIAU	LPRES=F*WET=S*INA=S*RBISO=S*SGTOP=S*FIWTR=S
MIAV	LPRES=F*WET=S*INA=S*RBISO=S*SGTOP=S*FIWTR=F
MIAW	LPRES=F*WET=S*INA=S*RBISO=S*SGTOP=F*FIWTR=S
MIAX	LPRES=F*WET=S*INA=S*RBISO=S*SGTOP=F*FIWTR=F
MIAY	LPRES=F*WET=S*INA=S*RBISO=F*FIWTR=S
MIAZ	LPRES=F*WET=S*INA=S*RBISO=F*FIWTR=F
MIBU	LPRES=F*WET=S*INB=S*RBISO=S*SGTOP=S*FIWTR=S
MIBV	LPRES=F*WET=S*INB=S*RBISO=S*SGTOP=S*FIWTR=F
MIBW	LPRES=F*WET=S*INB=S*RBISO=S*SGTOP=F*FIWTR=S
MIBX	LPRES=F*WET=S*INB=S*RBISO=S*SGTOP=F*FIWTR=F
MIBY	LPRES=F*WET=S*INB=S*RBISO=F*FIWTR=S
MIBZ	LPRES=F*WET=S*INB=S*RBISO=F*FIWTR=F
MICU	LPRES=F*WET=S*INC=S*RBISO=S*SGTOP=S*FIWTR=S
MICV	LPRES=F*WET=S*INC=S*RBISO=S*SGTOP=S*FIWTR=F
MICW	LPRES=F*WET=S*INC=S*RBISO=S*SGTOP=F*FIWTR=S
MICX	LPRES=F*WET=S*INC=S*RBISO=S*SGTOP=F*FIWTR=F
MICY	LPRES=F*WET=S*INC=S*RBISO=F*FIWTR=S
MICZ	LPRES=F*WET=S*INC=S*RBISO=F*FIWTR=F
MIDU	LPRES=F*WET=S*IND=S*RBISO=S*SGTOP=S*FIWTR=S
MIDV	LPRES=F*WET=S*IND=S*RBISO=S*SGTOP=S*FIWTR=F
MIDW	LPRES=F*WET=S*IND=S*RBISO=S*SGTOP=F*FIWTR=S
MIDX	LPRES=F*WET=S*IND=S*RBISO=S*SGTOP=F*FIWTR=F
MIDY	LPRES=F*WET=S*IND=S*RBISO=F*FIWTR=S
MIDZ	LPRES=F*WET=S*IND=S*RBISO=F*FIWTR=F
MIEU	LPRES=F*WET=S*INE=S*RBISO=S*SGTOP=S*FIWTR=S
MIEV	LPRES=F*WET=S*INE=S*RBISO=S*SGTOP=S*FIWTR=F
MIEW	LPRES=F*WET=S*INE=S*RBISO=S*SGTOP=F*FIWTR=S
MIEX	LPRES=F*WET=S*INE=S*RBISO=S*SGTOP=F*FIWTR=F
MIEY	LPRES=F*WET=S*INE=S*RBISO=F*FIWTR=S
MIEZ	LPRES=F*WET=S*INE=S*RBISO=F*FIWTR=F
MIFU	LPRES=F*WET=S*INF=S*RBISO=S*SGTOP=S*FIWTR=S
MIFV	LPRES=F*WET=S*INF=S*RBISO=S*SGTOP=S*FIWTR=F

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Bin.......	Binning Rules..
MIFW	LPRES=F*WET=S*INF=S*RBISO=S*SGTOP=F*FIWTR=S
MIFX	LPRES=F*WET=S*INF=S*RBISO=S*SGTOP=F*FIWTR=F
MIFY	LPRES=F*WET=S*INF=S*RBISO=F*FIWTR=S
MIFZ	LPRES=F*WET=S*INF=S*RBISO=F*FIWTR=F
MIGU	LPRES=F*WET=S*ING=S*RBISO=S*SGTOP=S*FIWTR=S
MIGV	LPRES=F*WET=S*ING=S*RBISO=S*SGTOP=S*FIWTR=F
MIGW	LPRES=F*WET=S*ING=S*RBISO=S*SGTOP=F*FIWTR=S
MIGX	LPRES=F*WET=S*ING=S*RBISO=S*SGTOP=F*FIWTR=F
MIGY	LPRES=F*WET=S*ING=S*RBISO=F*FIWTR=S
MIGZ	LPRES=F*WET=S*ING=S*RBISO=F*FIWTR=F
MIHU	LPRES=F*WET=S*INH=S*RBISO=S*SGTOP=S*FIWTR=S
MIHV	LPRES=F*WET=S*INH=S*RBISO=S*SGTOP=S*FIWTR=F
MIHW	LPRES=F*WET=S*INH=S*RBISO=S*SGTOP=F*FIWTR=S
MIHX	LPRES=F*WET=S*INH=S*RBISO=S*SGTOP=F*FIWTR=F
MIHY	LPRES=F*WET=S*INH=S*RBISO=F*FIWTR=S
MIHZ	LPRES=F*WET=S*INH=S*RBISO=F*FIWTR=F
MJAU	LPRES=F*WET=S*JA=S*RBISO=S*SGTOP=S*FIWTR=S
MJAV	LPRES=F*WET=S*JA=S*RBISO=S*SGTOP=S*FIWTR=F
MJAW	LPRES=F*WET=S*JA=S*RBISO=S*SGTOP=F*FIWTR=S
MJAX	LPRES=F*WET=S*JA=S*RBISO=S*SGTOP=F*FIWTR=F
MJAY	LPRES=F*WET=S*JA=S*RBISO=F*FIWTR=S
MJAZ	LPRES=F*WET=S*JA=S*RBISO=F*FIWTR=F
MJHU	LPRES=F*WET=S*JH=S*RBISO=S*SGTOP=S*FIWTR=S
MJHV	LPRES=F*WET=S*JH=S*RBISO=S*SGTOP=S*FIWTR=F
MJHW	LPRES=F*WET=S*JH=S*RBISO=S*SGTOP=F*FIWTR=S
MJHX	LPRES=F*WET=S*JH=S*RBISO=S*SGTOP=F*FIWTR=F
MJHY	LPRES=F*WET=S*JH=S*RBISO=F*FIWTR=S
MJHZ	LPRES=F*WET=S*JH=S*RBISO=F*FIWTR=F
MKCU	LPRES=F*WET=S*KC=S*RBISO=S*SGTOP=S*FIWTR=S
MKCV	LPRES=F*WET=S*KC=S*RBISO=S*SGTOP=S*FIWTR=F
MKCW	LPRES=F*WET=S*KC=S*RBISO=S*SGTOP=F*FIWTR=S
MKCX	LPRES=F*WET=S*KC=S*RBISO=S*SGTOP=F*FIWTR=F
MKCY	LPRES=F*WET=S*KC=S*RBISO=F*FIWTR=S

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Bin.......	Binning Rules..
MKCZ	LPRES=F*WET=S*KC=S*RBISO=F*FIWTR=F
MKFU	LPRES=F*WET=S*KF=S*RBISO=S*SGTOP=S*FIWTR=S
MKFV	LPRES=F*WET=S*KF=S*RBISO=S*SGTOP=S*FIWTR=F
MKFW	LPRES=F*WET=S*KF=S*RBISO=S*SGTOP=F*FIWTR=S
MKFX	LPRES=F*WET=S*KF=S*RBISO=S*SGTOP=F*FIWTR=F
MKFY	LPRES=F*WET=S*KF=S*RBISO=F*FIWTR=S
MKFZ	LPRES=F*WET=S*KF=S*RBISO=F*FIWTR=F
MKHU	LPRES=F*WET=S*KH=S*RBISO=S*SGTOP=S*FIWTR=S
MKHV	LPRES=F*WET=S*KH=S*RBISO=S*SGTOP=S*FIWTR=F
MKHW	LPRES=F*WET=S*KH=S*RBISO=S*SGTOP=F*FIWTR=S
MKHX	LPRES=F*WET=S*KH=S*RBISO=S*SGTOP=F*FIWTR=F
MKHY	LPRES=F*WET=S*KH=S*RBISO=F*FIWTR=S
MKHZ	LPRES=F*WET=S*KH=S*RBISO=F*FIWTR=F
MLCU	LPRES=F*WET=S*LEC=S*RBISO=S*SGTOP=S*FIWTR=S
MLCV	LPRES=F*WET=S*LEC=S*RBISO=S*SGTOP=S*FIWTR=F
MLCW	LPRES=F*WET=S*LEC=S*RBISO=S*SGTOP=F*FIWTR=S
MLCX	LPRES=F*WET=S*LEC=S*RBISO=S*SGTOP=F*FIWTR=F
MLCY	LPRES=F*WET=S*LEC=S*RBISO=F*FIWTR=S
MLCZ	LPRES=F*WET=S*LEC=S*RBISO=F*FIWTR=F
MLFU	LPRES=F*WET=S*LF=S*RBISO=S*SGTOP=S*FIWTR=S
MLFV	LPRES=F*WET=S*LF=S*RBISO=S*SGTOP=S*FIWTR=F
MLFW	LPRES=F*WET=S*LF=S*RBISO=S*SGTOP=F*FIWTR=S
MLFX	LPRES=F*WET=S*LF=S*RBISO=S*SGTOP=F*FIWTR=F
MLFY	LPRES=F*WET=S*LF=S*RBISO=F*FIWTR=S
MLFZ	LPRES=F*WET=S*LF=S*RBISO=F*FIWTR=F
MLHU	LPRES=F*WET=S*LH=S*RBISO=S*SGTOP=S*FIWTR=S
MLHV	LPRES=F*WET=S*LH=S*RBISO=S*SGTOP=S*FIWTR=F
MLHW	LPRES=F*WET=S*LH=S*RBISO=S*SGTOP=F*FIWTR=S
MLHX	LPRES=F*WET=S*LH=S*RBISO=S*SGTOP=F*FIWTR=F
MLHY	LPRES=F*WET=S*LH=S*RBISO=F*FIWTR=S
MLHZ	LPRES=F*WET=S*LH=S*RBISO=F*FIWTR=F
NIAU	LPRES=F*WET=F*INA=S*RBISO=S*SGTOP=S*FIWTR=S
NIAV	LPRES=F*WET=F*INA=S*RBISO=S*SGTOP=S*FIWTR=F

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Bin.......	Binning Rules..
NIAW	LPRES=F*WET=F*INA=S*RBISO=S*SGTOP=F*FIWTR=S
NIAX	LPRES=F*WET=F*INA=S*RBISO=S*SGTOP=F*FIWTR=F
NIAY	LPRES=F*WET=F*INA=S*RBISO=F*FIWTR=S
NIAZ	LPRES=F*WET=F*INA=S*RBISO=F*FIWTR=F
NIBU	LPRES=F*WET=F*INB=S*RBISO=S*SGTOP=S*FIWTR=S
NIBV	LPRES=F*WET=F*INB=S*RBISO=S*SGTOP=S*FIWTR=F
NIBW	LPRES=F*WET=F*INB=S*RBISO=S*SGTOP=F*FIWTR=S
NIBX	LPRES=F*WET=F*INB=S*RBISO=S*SGTOP=F*FIWTR=F
NIBY	LPRES=F*WET=F*INB=S*RBISO=F*FIWTR=S
NIBZ	LPRES=F*WET=F*INB=S*RBISO=F*FIWTR=F
NICU	LPRES=F*WET=F*INC=S*RBISO=S*SGTOP=S*FIWTR=S
NICV	LPRES=F*WET=F*INC=S*RBISO=S*SGTOP=S*FIWTR=F
NICW	LPRES=F*WET=F*INC=S*RBISO=S*SGTOP=F*FIWTR=S
NICX	LPRES=F*WET=F*INC=S*RBISO=S*SGTOP=F*FIWTR=F
NICY	LPRES=F*WET=F*INC=S*RBISO=F*FIWTR=S
NICZ	LPRES=F*WET=F*INC=S*RBISO=F*FIWTR=F
NIDU	LPRES=F*WET=F*IND=S*RBISO=S*SGTOP=S*FIWTR=S
NIDV	LPRES=F*WET=F*IND=S*RBISO=S*SGTOP=S*FIWTR=F
NIDW	LPRES=F*WET=F*IND=S*RBISO=S*SGTOP=F*FIWTR=S
NIDX	LPRES=F*WET=F*IND=S*RBISO=S*SGTOP=F*FIWTR=F
NIDY	LPRES=F*WET=F*IND=S*RBISO=F*FIWTR=S
NIDZ	LPRES=F*WET=F*IND=S*RBISO=F*FIWTR=F
NIEU	LPRES=F*WET=F*INE=S*RBISO=S*SGTOP=S*FIWTR=S
NIEV	LPRES=F*WET=F*INE=S*RBISO=S*SGTOP=S*FIWTR=F
NIEW	LPRES=F*WET=F*INE=S*RBISO=S*SGTOP=F*FIWTR=S
NIEX	LPRES=F*WET=F*INE=S*RBISO=S*SGTOP=F*FIWTR=F
NIEY	LPRES=F*WET=F*INE=S*RBISO=F*FIWTR=S
NIEZ	LPRES=F*WET=F*INE=S*RBISO=F*FIWTR=F
NIFU	LPRES=F*WET=F*INF=S*RBISO=S*SGTOP=S*FIWTR=S
NIFV	LPRES=F*WET=F*INF=S*RBISO=S*SGTOP=S*FIWTR=F
NIFW	LPRES=F*WET=F*INF=S*RBISO=S*SGTOP=F*FIWTR=S
NIFX	LPRES=F*WET=F*INF=S*RBISO=S*SGTOP=F*FIWTR=F
NIFY	LPRES=F*WET=F*INF=S*RBISO=F*FIWTR=S

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Bin.......	Binning Rules..
NIFZ	LPRES=F*WET=F*INF=S*RBISO=F*FIWTR=F
NIGU	LPRES=F*WET=F*ING=S*RBISO=S*SGTOP=S*FIWTR=S
NIGV	LPRES=F*WET=F*ING=S*RBISO=S*SGTOP=S*FIWTR=F
NIGW	LPRES=F*WET=F*ING=S*RBISO=S*SGTOP=F*FIWTR=S
NIGX	LPRES=F*WET=F*ING=S*RBISO=S*SGTOP=F*FIWTR=F
NIGY	LPRES=F*WET=F*ING=S*RBISO=F*FIWTR=S
NIGZ	LPRES=F*WET=F*ING=S*RBISO=F*FIWTR=F
NIHU	LPRES=F*WET=F*INH=S*RBISO=S*SGTOP=S*FIWTR=S
NIHV	LPRES=F*WET=F*INH=S*RBISO=S*SGTOP=S*FIWTR=F
NIHW	LPRES=F*WET=F*INH=S*RBISO=S*SGTOP=F*FIWTR=S
NIHX	LPRES=F*WET=F*INH=S*RBISO=S*SGTOP=F*FIWTR=F
NIHY	LPRES=F*WET=F*INH=S*RBISO=F*FIWTR=S
NIHZ	LPRES=F*WET=F*INH=S*RBISO=F*FIWTR=F
NJAU	LPRES=F*WET=F*JA=S*RBISO=S*SGTOP=S*FIWTR=S
NJAV	LPRES=F*WET=F*JA=S*RBISO=S*SGTOP=S*FIWTR=F
NJAW	LPRES=F*WET=F*JA=S*RBISO=S*SGTOP=F*FIWTR=S
NJAX	LPRES=F*WET=F*JA=S*RBISO=S*SGTOP=F*FIWTR=F
NJAY	LPRES=F*WET=F*JA=S*RBISO=F*FIWTR=S
NJAZ	LPRES=F*WET=F*JA=S*RBISO=F*FIWTR=F
NJHU	LPRES=F*WET=F*JH=S*RBISO=S*SGTOP=S*FIWTR=S
NJHV	LPRES=F*WET=F*JH=S*RBISO=S*SGTOP=S*FIWTR=F
NJHW	LPRES=F*WET=F*JH=S*RBISO=S*SGTOP=F*FIWTR=S
NJHX	LPRES=F*WET=F*JH=S*RBISO=S*SGTOP=F*FIWTR=F
NJHY	LPRES=F*WET=F*JH=S*RBISO=F*FIWTR=S
NJHZ	LPRES=F*WET=F*JH=S*RBISO=F*FIWTR=F
NKCU	LPRES=F*WET=F*KC=S*RBISO=S*SGTOP=S*FIWTR=S
NKCV	LPRES=F*WET=F*KC=S*RBISO=S*SGTOP=S*FIWTR=F
NKCW	LPRES=F*WET=F*KC=S*RBISO=S*SGTOP=F*FIWTR=S
NKCX	LPRES=F*WET=F*KC=S*RBISO=S*SGTOP=F*FIWTR=F
NKCY	LPRES=F*WET=F*KC=S*RBISO=F*FIWTR=S
NKCZ	LPRES=F*WET=F*KC=S*RBISO=F*FIWTR=F
NKFU	LPRES=F*WET=F*KF=S*RBISO=S*SGTOP=S*FIWTR=S
NKFV	LPRES=F*WET=F*KF=S*RBISO=S*SGTOP=S*FIWTR=F

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Bin.......	Binning Rules..
NKFW	LPRES=F*WET=F*KF=S*RBISO=S*SGTOP=F*FIWTR=S
NKFX	LPRES=F*WET=F*KF=S*RBISO=S*SGTOP=F*FIWTR=F
NKFY	LPRES=F*WET=F*KF=S*RBISO=F*FIWTR=S
NKFZ	LPRES=F*WET=F*KF=S*RBISO=F*FIWTR=F
NKHU	LPRES=F*WET=F*KH=S*RBISO=S*SGTOP=S*FIWTR=S
NKHV	LPRES=F*WET=F*KH=S*RBISO=S*SGTOP=S*FIWTR=F
NKHW	LPRES=F*WET=F*KH=S*RBISO=S*SGTOP=F*FIWTR=S
NKHX	LPRES=F*WET=F*KH=S*RBISO=S*SGTOP=F*FIWTR=F
NKHY	LPRES=F*WET=F*KH=S*RBISO=F*FIWTR=S
NKHZ	LPRES=F*WET=F*KH=S*RBISO=F*FIWTR=F
NLCU	LPRES=F*WET=F*LEC=S*RBISO=S*SGTOP=S*FIWTR=S
NLCV	LPRES=F*WET=F*LEC=S*RBISO=S*SGTOP=S*FIWTR=F
NLCW	LPRES=F*WET=F*LEC=S*RBISO=S*SGTOP=F*FIWTR=S
NLCX	LPRES=F*WET=F*LEC=S*RBISO=S*SGTOP=F*FIWTR=F
NLCY	LPRES=F*WET=F*LEC=S*RBISO=F*FIWTR=S
NLCZ	LPRES=F*WET=F*LEC=S*RBISO=F*FIWTR=F
NLFU	LPRES=F*WET=F*LF=S*RBISO=S*SGTOP=S*FIWTR=S
NLFV	LPRES=F*WET=F*LF=S*RBISO=S*SGTOP=S*FIWTR=F
NLFW	LPRES=F*WET=F*LF=S*RBISO=S*SGTOP=F*FIWTR=S
NLFX	LPRES=F*WET=F*LF=S*RBISO=S*SGTOP=F*FIWTR=F
NLFY	LPRES=F*WET=F*LF=S*RBISO=F*FIWTR=S
NLFZ	LPRES=F*WET=F*LF=S*RBISO=F*FIWTR=F
NLHU	LPRES=F*WET=F*LH=S*RBISO=S*SGTOP=S*FIWTR=S
NLHV	LPRES=F*WET=F*LH=S*RBISO=S*SGTOP=S*FIWTR=F
NLHW	LPRES=F*WET=F*LH=S*RBISO=S*SGTOP=F*FIWTR=S
NLHX	LPRES=F*WET=F*LH=S*RBISO=S*SGTOP=F*FIWTR=F
NLHY	LPRES=F*WET=F*LH=S*RBISO=F*FIWTR=S
NLHZ	LPRES=F*WET=F*LH=S*RBISO=F*FIWTR=F
OIAU	LPRES=S*WET=S*INA=S*RBISO=S*SGTOP=S*FIWTR=S
OIAV	LPRES=S*WET=S*INA=S*RBISO=S*SGTOP=S*FIWTR=F
OIAW	LPRES=S*WET=S*INA=S*RBISO=S*SGTOP=F*FIWTR=S
OIAX	LPRES=S*WET=S*INA=S*RBISO=S*SGTOP=F*FIWTR=F
OIAY	LPRES=S*WET=S*INA=S*RBISO=F*FIWTR=S

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Bin.......	Binning Rules..
OIAZ	LPRES=S*WET=S*INA=S*RBISO=F*FIWTR=F
OIBU	LPRES=S*WET=S*INB=S*RBISO=S*SGTOP=S*FIWTR=S
OIBV	LPRES=S*WET=S*INB=S*RBISO=S*SGTOP=S*FIWTR=F
OIBW	LPRES=S*WET=S*INB=S*RBISO=S*SGTOP=F*FIWTR=S
OIBX	LPRES=S*WET=S*INB=S*RBISO=S*SGTOP=F*FIWTR=F
OIBY	LPRES=S*WET=S*INB=S*RBISO=F*FIWTR=S
OIBZ	LPRES=S*WET=S*INB=S*RBISO=F*FIWTR=F
OICU	LPRES=S*WET=S*INC=S*RBISO=S*SGTOP=S*FIWTR=S
OICV	LPRES=S*WET=S*INC=S*RBISO=S*SGTOP=S*FIWTR=F
OICW	LPRES=S*WET=S*INC=S*RBISO=S*SGTOP=F*FIWTR=S
OICX	LPRES=S*WET=S*INC=S*RBISO=S*SGTOP=F*FIWTR=F
OICY	LPRES=S*WET=S*INC=S*RBISO=F*FIWTR=S
OICZ	LPRES=S*WET=S*INC=S*RBISO=F*FIWTR=F
OIDU	LPRES=S*WET=S*IND=S*RBISO=S*SGTOP=S*FIWTR=S
OIDV	LPRES=S*WET=S*IND=S*RBISO=S*SGTOP=S*FIWTR=F
OIDW	LPRES=S*WET=S*IND=S*RBISO=S*SGTOP=F*FIWTR=S
OIDX	LPRES=S*WET=S*IND=S*RBISO=S*SGTOP=F*FIWTR=F
OIDY	LPRES=S*WET=S*IND=S*RBISO=F*FIWTR=S
OIDZ	LPRES=S*WET=S*IND=S*RBISO=F*FIWTR=F
OIEU	LPRES=S*WET=S*INE=S*RBISO=S*SGTOP=S*FIWTR=S
OIEV	LPRES=S*WET=S*INE=S*RBISO=S*SGTOP=S*FIWTR=F
OIEW	LPRES=S*WET=S*INE=S*RBISO=S*SGTOP=F*FIWTR=S
OIEX	LPRES=S*WET=S*INE=S*RBISO=S*SGTOP=F*FIWTR=F
OIEY	LPRES=S*WET=S*INE=S*RBISO=F*FIWTR=S
OIEZ	LPRES=S*WET=S*INE=S*RBISO=F*FIWTR=F
OIFU	LPRES=S*WET=S*INF=S*RBISO=S*SGTOP=S*FIWTR=S
OIFV	LPRES=S*WET=S*INF=S*RBISO=S*SGTOP=S*FIWTR=F
OIFW	LPRES=S*WET=S*INF=S*RBISO=S*SGTOP=F*FIWTR=S
OIFX	LPRES=S*WET=S*INF=S*RBISO=S*SGTOP=F*FIWTR=F
OIFY	LPRES=S*WET=S*INF=S*RBISO=F*FIWTR=S
OIFZ	LPRES=S*WET=S*INF=S*RBISO=F*FIWTR=F
OIGU	LPRES=S*WET=S*ING=S*RBISO=S*SGTOP=S*FIWTR=S
OIGV	LPRES=S*WET=S*ING=S*RBISO=S*SGTOP=S*FIWTR=F

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Bin.......	Binning Rules..
OIGW	LPRES=S*WET=S*ING=S*RBISO=S*SGTOP=F*FIWTR=S
OIGX	LPRES=S*WET=S*ING=S*RBISO=S*SGTOP=F*FIWTR=F
OIGY	LPRES=S*WET=S*ING=S*RBISO=F*FIWTR=S
OIGZ	LPRES=S*WET=S*ING=S*RBISO=F*FIWTR=F
OIHU	LPRES=S*WET=S*INH=S*RBISO=S*SGTOP=S*FIWTR=S
OIHV	LPRES=S*WET=S*INH=S*RBISO=S*SGTOP=S*FIWTR=F
OIHW	LPRES=S*WET=S*INH=S*RBISO=S*SGTOP=F*FIWTR=S
OIHX	LPRES=S*WET=S*INH=S*RBISO=S*SGTOP=F*FIWTR=F
OIHY	LPRES=S*WET=S*INH=S*RBISO=F*FIWTR=S
OIHZ	LPRES=S*WET=S*INH=S*RBISO=F*FIWTR=F
OJAU	LPRES=S*WET=S*JA=S*RBISO=S*SGTOP=S*FIWTR=S
OJAV	LPRES=S*WET=S*JA=S*RBISO=S*SGTOP=S*FIWTR=F
OJAW	LPRES=S*WET=S*JA=S*RBISO=S*SGTOP=F*FIWTR=S
OJAX	LPRES=S*WET=S*JA=S*RBISO=S*SGTOP=F*FIWTR=F
OJAY	LPRES=S*WET=S*JA=S*RBISO=F*FIWTR=S
OJAZ	LPRES=S*WET=S*JA=S*RBISO=F*FIWTR=F
OJHU	LPRES=S*WET=S*JH=S*RBISO=S*SGTOP=S*FIWTR=S
OJHV	LPRES=S*WET=S*JH=S*RBISO=S*SGTOP=S*FIWTR=F
OJHW	LPRES=S*WET=S*JH=S*RBISO=S*SGTOP=F*FIWTR=S
OJHX	LPRES=S*WET=S*JH=S*RBISO=S*SGTOP=F*FIWTR=F
OJHY	LPRES=S*WET=S*JH=S*RBISO=F*FIWTR=S
OJHZ	LPRES=S*WET=S*JH=S*RBISO=F*FIWTR=F
OKCU	LPRES=S*WET=S*KC=S*RBISO=S*SGTOP=S*FIWTR=S
OKCV	LPRES=S*WET=S*KC=S*RBISO=S*SGTOP=S*FIWTR=F
OKCW	LPRES=S*WET=S*KC=S*RBISO=S*SGTOP=F*FIWTR=S
OKCX	LPRES=S*WET=S*KC=S*RBISO=S*SGTOP=F*FIWTR=F
OKCY	LPRES=S*WET=S*KC=S*RBISO=F*FIWTR=S
OKCZ	LPRES=S*WET=S*KC=S*RBISO=F*FIWTR=F
OKFU	LPRES=S*WET=S*KF=S*RBISO=S*SGTOP=S*FIWTR=S
OKFV	LPRES=S*WET=S*KF=S*RBISO=S*SGTOP=S*FIWTR=F
OKFW	LPRES=S*WET=S*KF=S*RBISO=S*SGTOP=F*FIWTR=S
OKFX	LPRES=S*WET=S*KF=S*RBISO=S*SGTOP=F*FIWTR=F
OKFY	LPRES=S*WET=S*KF=S*RBISO=F*FIWTR=S

MODEL Name: BFNFINAL

Binning Logic for Event Tree: GTPDS

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Bin.......	Binning Rules..
OKFZ	LPRES=S*WET=S*KF=S*RBISO=F*FIWTR=F
OKHU	LPRES=S*WET=S*KH=S*RBISO=S*SGTOP=S*FIWTR=S
OKHV	LPRES=S*WET=S*KH=S*RBISO=S*SGTOP=S*FIWTR=F
OKHW	LPRES=S*WET=S*KH=S*RBISO=S*SGTOP=F*FIWTR=S
OKHX	LPRES=S*WET=S*KH=S*RBISO=S*SGTOP=F*FIWTR=F
OKHY	LPRES=S*WET=S*KH=S*RBISO=F*FIWTR=S
OKHZ	LPRES=S*WET=S*KH=S*RBISO=F*FIWTR=F
OLCU	LPRES=S*WET=S*LEC=S*RBISO=S*SGTOP=S*FIWTR=S
OLCV	LPRES=S*WET=S*LEC=S*RBISO=S*SGTOP=S*FIWTR=F
OLCW	LPRES=S*WET=S*LEC=S*RBISO=S*SGTOP=F*FIWTR=S
OLCX	LPRES=S*WET=S*LEC=S*RBISO=S*SGTOP=F*FIWTR=F
OLCY	LPRES=S*WET=S*LEC=S*RBISO=F*FIWTR=S
OLCZ	LPRES=S*WET=S*LEC=S*RBISO=F*FIWTR=F
OLFU	LPRES=S*WET=S*LF=S*RBISO=S*SGTOP=S*FIWTR=S
OLFV	LPRES=S*WET=S*LF=S*RBISO=S*SGTOP=S*FIWTR=F
OLFW	LPRES=S*WET=S*LF=S*RBISO=S*SGTOP=F*FIWTR=S
OLFX	LPRES=S*WET=S*LF=S*RBISO=S*SGTOP=F*FIWTR=F
OLFY	LPRES=S*WET=S*LF=S*RBISO=F*FIWTR=S
OLFZ	LPRES=S*WET=S*LF=S*RBISO=F*FIWTR=F
OLHU	LPRES=S*WET=S*LH=S*RBISO=S*SGTOP=S*FIWTR=S
OLHV	LPRES=S*WET=S*LH=S*RBISO=S*SGTOP=S*FIWTR=F
OLHW	LPRES=S*WET=S*LH=S*RBISO=S*SGTOP=F*FIWTR=S
OLHX	LPRES=S*WET=S*LH=S*RBISO=S*SGTOP=F*FIWTR=F
OLHY	LPRES=S*WET=S*LH=S*RBISO=F*FIWTR=S
OLHZ	LPRES=S*WET=S*LH=S*RBISO=F*FIWTR=F
PIAU	LPRES=S*WET=F*INA=S*RBISO=S*SGTOP=S*FIWTR=S
PIAV	LPRES=S*WET=F*INA=S*RBISO=S*SGTOP=S*FIWTR=F
PIAW	LPRES=S*WET=F*INA=S*RBISO=S*SGTOP=F*FIWTR=S
PIAX	LPRES=S*WET=F*INA=S*RBISO=S*SGTOP=F*FIWTR=F
PIAY	LPRES=S*WET=F*INA=S*RBISO=F*FIWTR=S
PIAZ	LPRES=S*WET=F*INA=S*RBISO=F*FIWTR=F
PIBU	LPRES=S*WET=F*INB=S*RBISO=S*SGTOP=S*FIWTR=S
PIBV	LPRES=S*WET=F*INB=S*RBISO=S*SGTOP=S*FIWTR=F

MODEL Name: BFNFINAL

Binning Logic for Event Tree: GTPDS

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Bin.......	Binning Rules..
PIBW	LPRES=S*WET=F*INB=S*RBISO=S*SGTOP=F*FIWTR=S
PIBX	LPRES=S*WET=F*INB=S*RBISO=S*SGTOP=F*FIWTR=F
PIBY	LPRES=S*WET=F*INB=S*RBISO=F*FIWTR=S
PIBZ	LPRES=S*WET=F*INB=S*RBISO=F*FIWTR=F
PICU	LPRES=S*WET=F*INC=S*RBISO=S*SGTOP=S*FIWTR=S
PICV	LPRES=S*WET=F*INC=S*RBISO=S*SGTOP=S*FIWTR=F
PICW	LPRES=S*WET=F*INC=S*RBISO=S*SGTOP=F*FIWTR=S
PICX	LPRES=S*WET=F*INC=S*RBISO=S*SGTOP=F*FIWTR=F
PICY	LPRES=S*WET=F*INC=S*RBISO=F*FIWTR=S
PICZ	LPRES=S*WET=F*INC=S*RBISO=F*FIWTR=F
PIDU	LPRES=S*WET=F*IND=S*RBISO=S*SGTOP=S*FIWTR=S
PIDV	LPRES=S*WET=F*IND=S*RBISO=S*SGTOP=S*FIWTR=F
PIDW	LPRES=S*WET=F*IND=S*RBISO=S*SGTOP=F*FIWTR=S
PIDX	LPRES=S*WET=F*IND=S*RBISO=S*SGTOP=F*FIWTR=F
PIDY	LPRES=S*WET=F*IND=S*RBISO=F*FIWTR=S
PIDZ	LPRES=S*WET=F*IND=S*RBISO=F*FIWTR=F
PIEU	LPRES=S*WET=F*INE=S*RBISO=S*SGTOP=S*FIWTR=S
PIEV	LPRES=S*WET=F*INE=S*RBISO=S*SGTOP=S*FIWTR=F
PIEW	LPRES=S*WET=F*INE=S*RBISO=S*SGTOP=F*FIWTR=S
PIEX	LPRES=S*WET=F*INE=S*RBISO=S*SGTOP=F*FIWTR=F
PIEY	LPRES=S*WET=F*INE=S*RBISO=F*FIWTR=S
PIEZ	LPRES=S*WET=F*INE=S*RBISO=F*FIWTR=F
PIFU	LPRES=S*WET=F*INF=S*RBISO=S*SGTOP=S*FIWTR=S
PIFV	LPRES=S*WET=F*INF=S*RBISO=S*SGTOP=S*FIWTR=F
PIFW	LPRES=S*WET=F*INF=S*RBISO=S*SGTOP=F*FIWTR=S
PIFX	LPRES=S*WET=F*INF=S*RBISO=S*SGTOP=F*FIWTR=F
PIFY	LPRES=S*WET=F*INF=S*RBISO=F*FIWTR=S
PIFZ	LPRES=S*WET=F*INF=S*RBISO=F*FIWTR=F
PIGU	LPRES=S*WET=F*ING=S*RBISO=S*SGTOP=S*FIWTR=S
PIGV	LPRES=S*WET=F*ING=S*RBISO=S*SGTOP=S*FIWTR=F
PIGW	LPRES=S*WET=F*ING=S*RBISO=S*SGTOP=F*FIWTR=S
PIGX	LPRES=S*WET=F*ING=S*RBISO=S*SGTOP=F*FIWTR=F
PIGY	LPRES=S*WET=F*ING=S*RBISO=F*FIWTR=S

MODEL Name: BFNFINAL

Binning Logic for Event Tree: GTPDS

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Bin.......	Binning Rules..
PIGZ	LPRES=S*WET=F*ING=S*RBISO=F*FIWTR=F
PIHU	LPRES=S*WET=F*INH=S*RBISO=S*SGTOP=S*FIWTR=S
PIHV	LPRES=S*WET=F*INH=S*RBISO=S*SGTOP=S*FIWTR=F
PIHW	LPRES=S*WET=F*INH=S*RBISO=S*SGTOP=F*FIWTR=S
PIHX	LPRES=S*WET=F*INH=S*RBISO=S*SGTOP=F*FIWTR=F
PIHY	LPRES=S*WET=F*INH=S*RBISO=F*FIWTR=S
PIHZ	LPRES=S*WET=F*INH=S*RBISO=F*FIWTR=F
PJAU	LPRES=S*WET=F*JA=S*RBISO=S*SGTOP=S*FIWTR=S
PJAV	LPRES=S*WET=F*JA=S*RBISO=S*SGTOP=S*FIWTR=F
PJAW	LPRES=S*WET=F*JA=S*RBISO=S*SGTOP=F*FIWTR=S
PJAX	LPRES=S*WET=F*JA=S*RBISO=S*SGTOP=F*FIWTR=F
PJAY	LPRES=S*WET=F*JA=S*RBISO=F*FIWTR=S
PJAZ	LPRES=S*WET=F*JA=S*RBISO=F*FIWTR=F
PJHU	LPRES=S*WET=F*JH=S*RBISO=S*SGTOP=S*FIWTR=S
PJHV	LPRES=S*WET=F*JH=S*RBISO=S*SGTOP=S*FIWTR=F
PJHW	LPRES=S*WET=F*JH=S*RBISO=S*SGTOP=F*FIWTR=S
PJHX	LPRES=S*WET=F*JH=S*RBISO=S*SGTOP=F*FIWTR=F
PJHY	LPRES=S*WET=F*JH=S*RBISO=F*FIWTR=S
PJHZ	LPRES=S*WET=F*JH=S*RBISO=F*FIWTR=F
PKCU	LPRES=S*WET=F*KC=S*RBISO=S*SGTOP=S*FIWTR=S
PKCV	LPRES=S*WET=F*KC=S*RBISO=S*SGTOP=S*FIWTR=F
PKCW	LPRES=S*WET=F*KC=S*RBISO=S*SGTOP=F*FIWTR=S
PKCX	LPRES=S*WET=F*KC=S*RBISO=S*SGTOP=F*FIWTR=F
PKCY	LPRES=S*WET=F*KC=S*RBISO=F*FIWTR=S
PKCZ	LPRES=S*WET=F*KC=S*RBISO=F*FIWTR=F
PKFU	LPRES=S*WET=F*KF=S*RBISO=S*SGTOP=S*FIWTR=S
PKFV	LPRES=S*WET=F*KF=S*RBISO=S*SGTOP=S*FIWTR=F
PKFW	LPRES=S*WET=F*KF=S*RBISO=S*SGTOP=F*FIWTR=S
PKFX	LPRES=S*WET=F*KF=S*RBISO=S*SGTOP=F*FIWTR=F
PKFY	LPRES=S*WET=F*KF=S*RBISO=F*FIWTR=S
PKFZ	LPRES=S*WET=F*KF=S*RBISO=F*FIWTR=F
PKHU	LPRES=S*WET=F*KH=S*RBISO=S*SGTOP=S*FIWTR=S
PKHV	LPRES=S*WET=F*KH=S*RBISO=S*SGTOP=S*FIWTR=F

MODEL Name: BFNFINAL

Binning Logic for Event Tree: GTPDS

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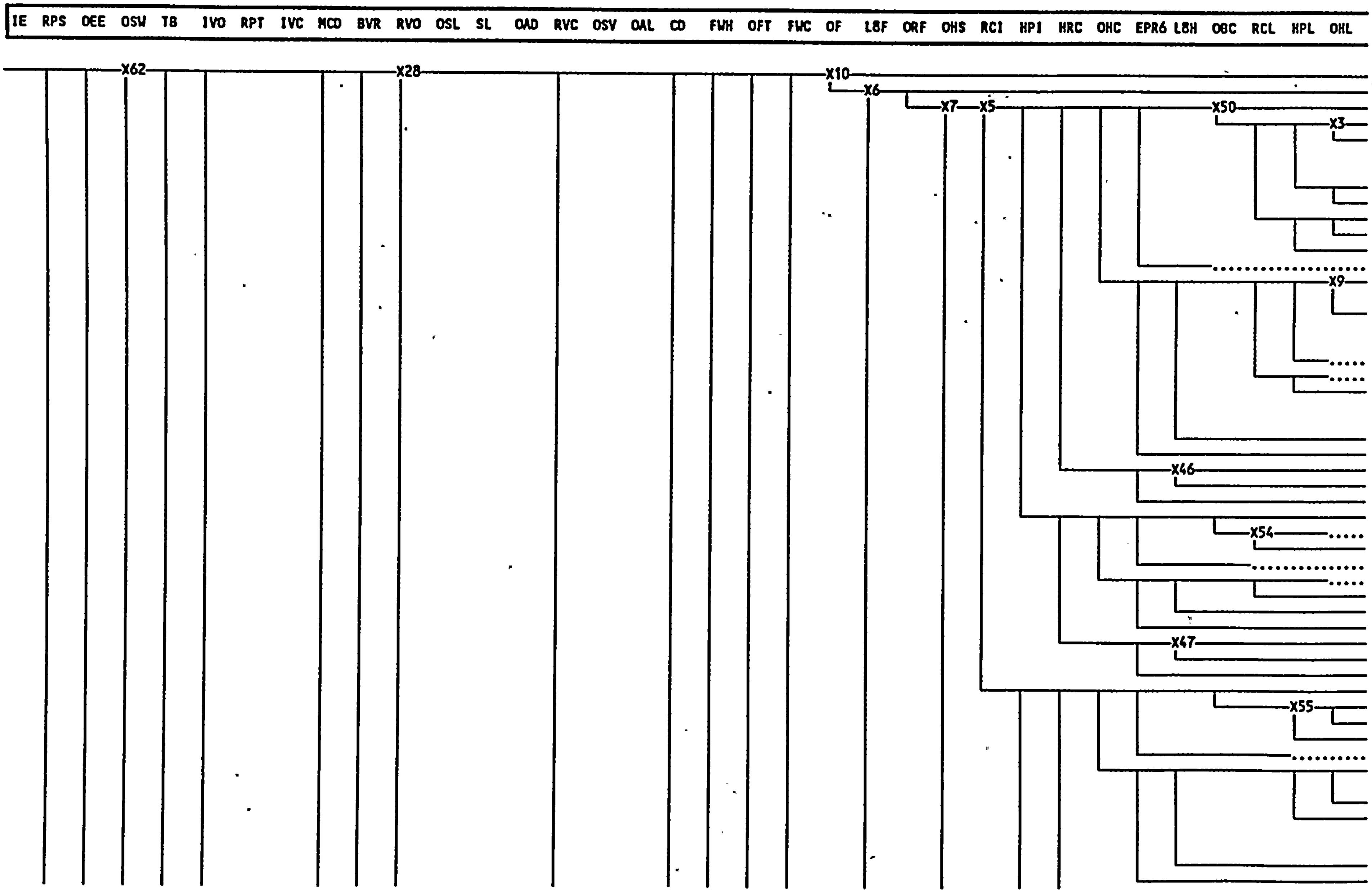
Bin.......	Binning Rules..
PKHW	LPRES=S*WET=F*KH=S*RBISO=S*SGTOP=F*FIWTR=S
PKHX	LPRES=S*WET=F*KH=S*RBISO=S*SGTOP=F*FIWTR=F
PKHY	LPRES=S*WET=F*KH=S*RBISO=F*FIWTR=S
PKHZ	LPRES=S*WET=F*KH=S*RBISO=F*FIWTR=F
PLCU	LPRES=S*WET=F*LEC=S*RBISO=S*SGTOP=S*FIWTR=S
PLCV	LPRES=S*WET=F*LEC=S*RBISO=S*SGTOP=S*FIWTR=F
PLCW	LPRES=S*WET=F*LEC=S*RBISO=S*SGTOP=F*FIWTR=S
PLCX	LPRES=S*WET=F*LEC=S*RBISO=S*SGTOP=F*FIWTR=F
PLCY	LPRES=S*WET=F*LEC=S*RBISO=F*FIWTR=S
PLCZ	LPRES=S*WET=F*LEC=S*RBISO=F*FIWTR=F
PLFU	LPRES=S*WET=F*LF=S*RBISO=S*SGTOP=S*FIWTR=S
PLFV	LPRES=S*WET=F*LF=S*RBISO=S*SGTOP=S*FIWTR=F
PLFW	LPRES=S*WET=F*LF=S*RBISO=S*SGTOP=F*FIWTR=S
PLFX	LPRES=S*WET=F*LF=S*RBISO=S*SGTOP=F*FIWTR=F
PLFY	LPRES=S*WET=F*LF=S*RBISO=F*FIWTR=S
PLFZ	LPRES=S*WET=F*LF=S*RBISO=F*FIWTR=F
PLHU	LPRES=S*WET=F*LH=S*RBISO=S*SGTOP=S*FIWTR=S
PLHV	LPRES=S*WET=F*LH=S*RBISO=S*SGTOP=S*FIWTR=F
PLHW	LPRES=S*WET=F*LH=S*RBISO=S*SGTOP=F*FIWTR=S
PLHX	LPRES=S*WET=F*LH=S*RBISO=S*SGTOP=F*FIWTR=F
PLHY	LPRES=S*WET=F*LH=S*RBISO=F*FIWTR=S
PLHZ	LPRES=S*WET=F*LH=S*RBISO=F*FIWTR=F
DUMMY	LH=F
MELT	1


IE RPS OEE OSW TB IVO RPT IVC MCD BVR RVO OSL SL OAD RVC OSV OAL CD FWH OFT FWC OF LBF ORF OHS RCI HPI HRC OHC EPR6 LBH OBC RCL HPL OHL
X62
X28
X10
X6
X7
X5
X50
X3
X9
X46
X54
X47
X55

MODEL Name: BFNHA
Event Tree: HPGTET

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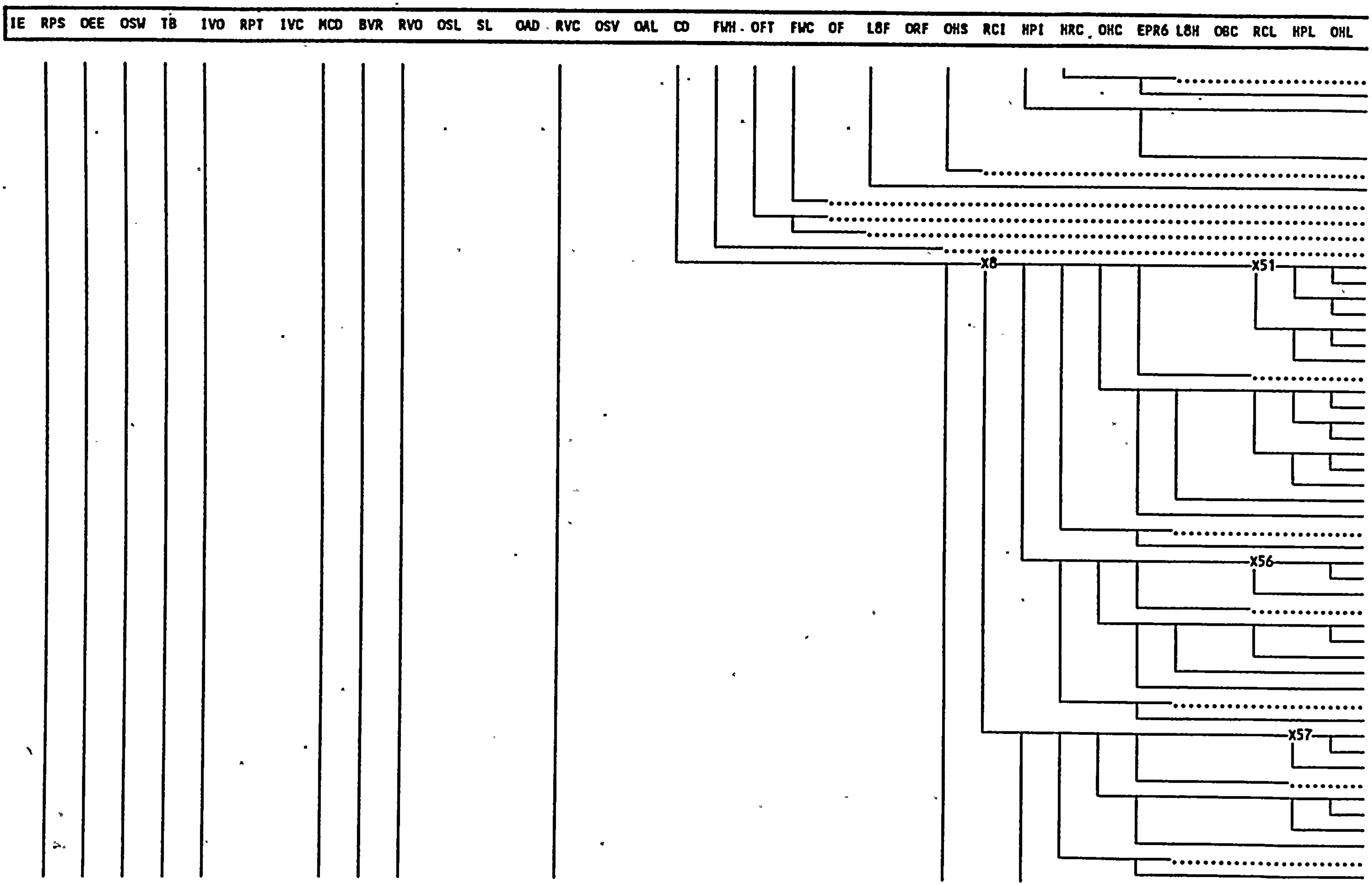
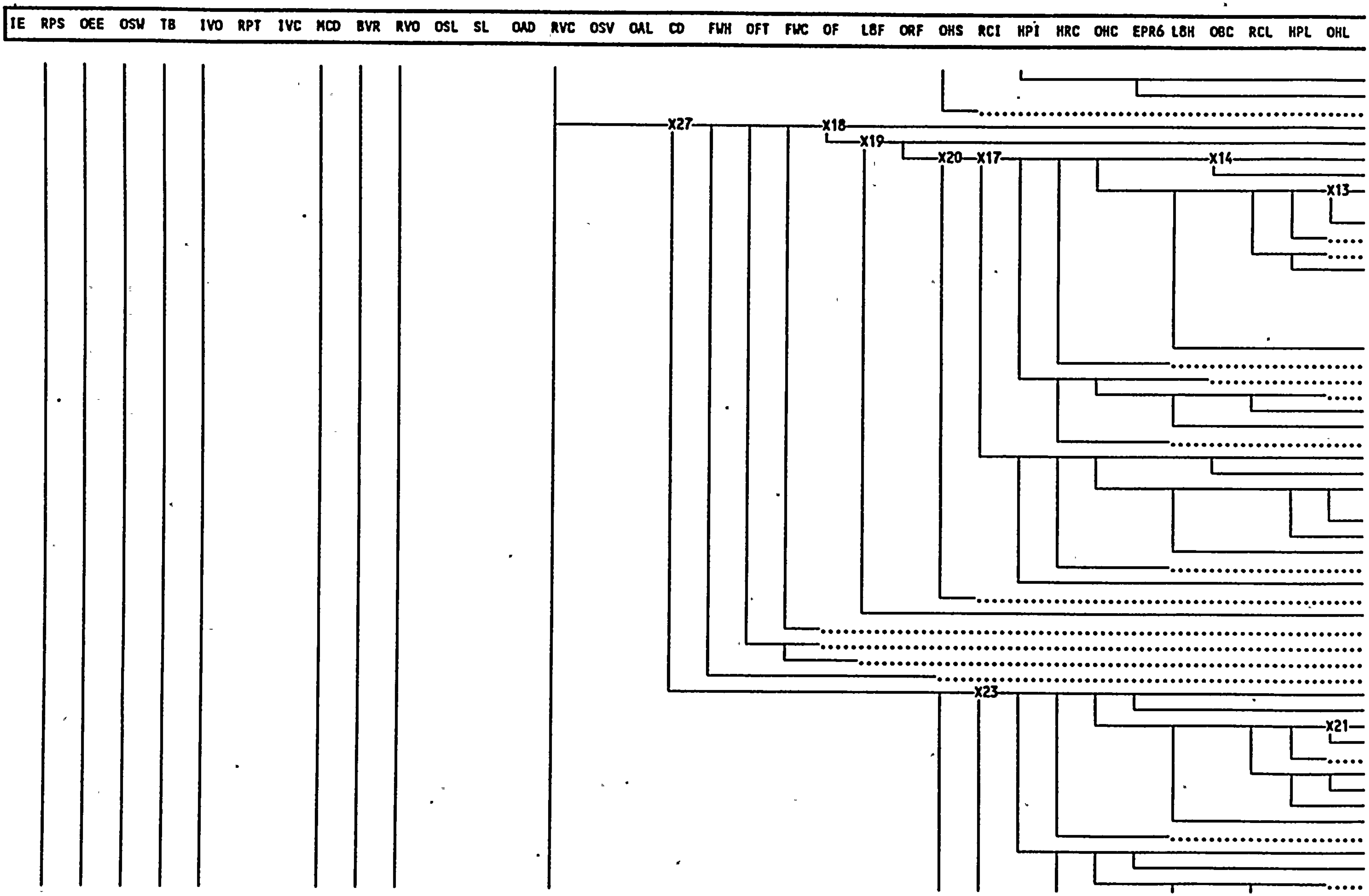


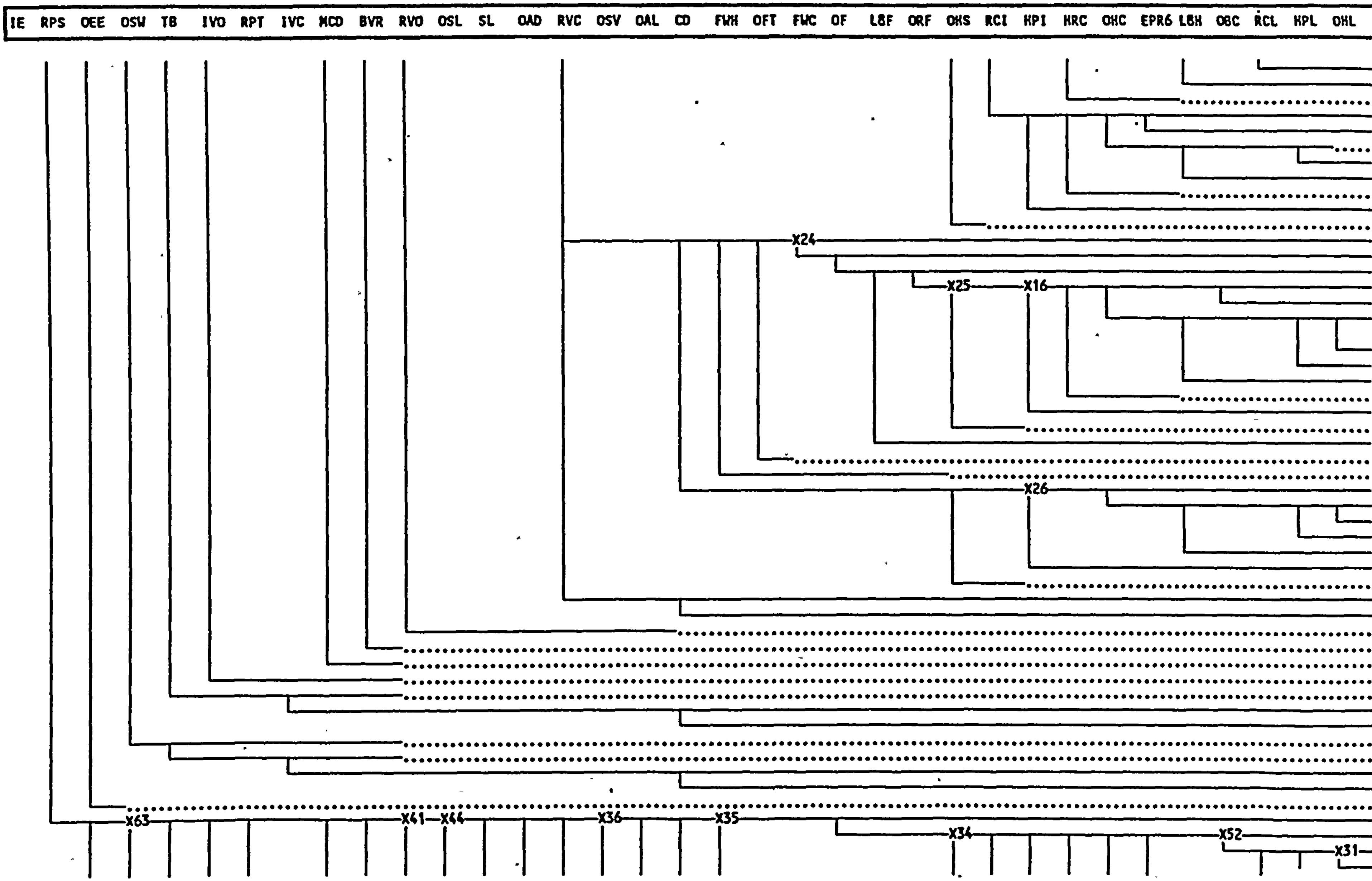
MODEL Name: BFNHA
Event Tree: HPGTET

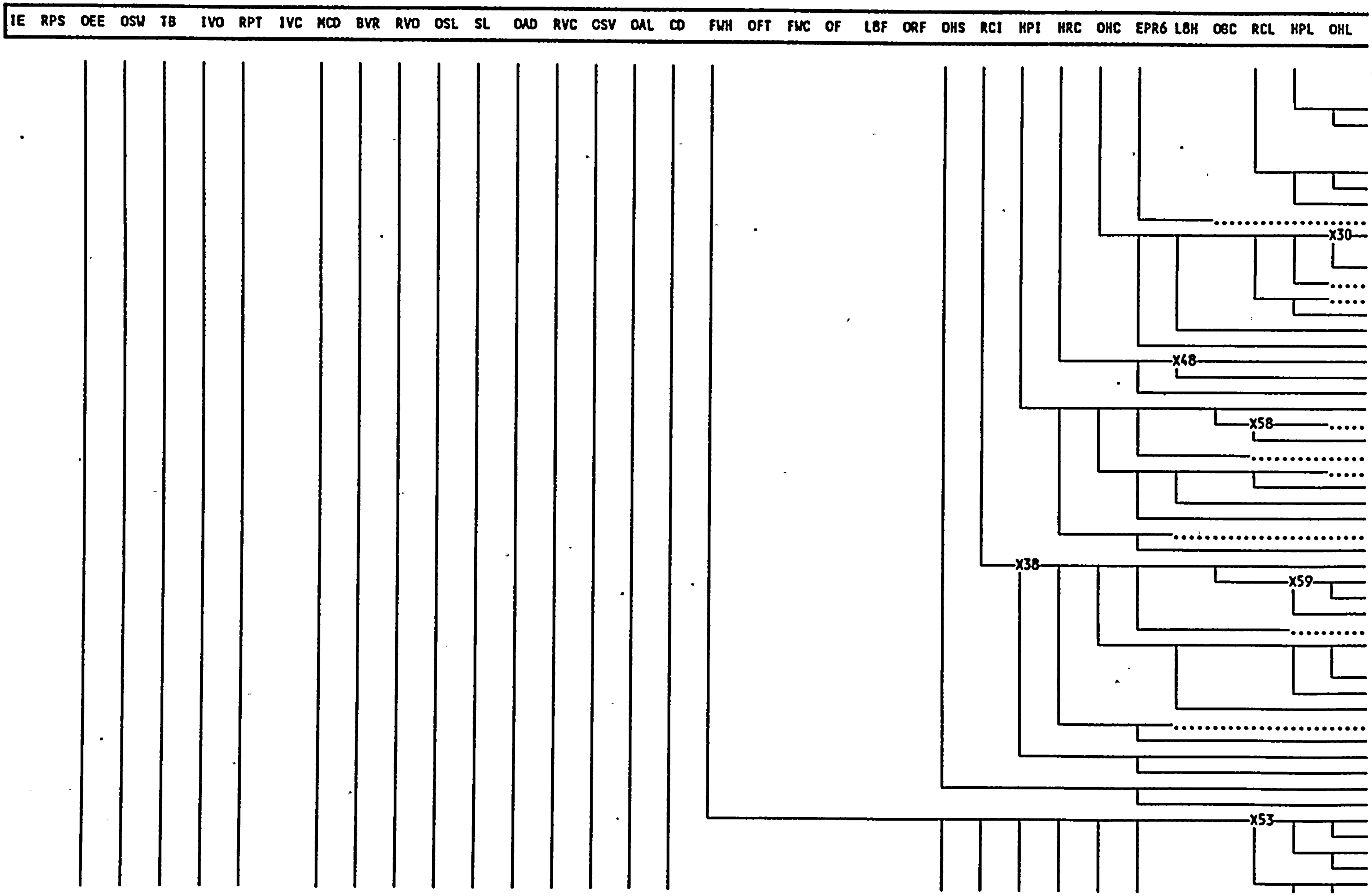
19:05:12 13 AUG 1992



MODEL Name: BFNHA
Event Tree: HPGTET

19:05:13 13 AUG 1992




IE RPS OEE OSW TB IVO RPT IVC MCD BVR RVO OSL SL OAD RVC CSV OAL CD FWH OFT FWC OF LBF ORF OHS RCI HPI HRC OHC EPR6 LBH OBC RCL HPL OHL
X30
X48
X58
X38
X59
X53

MODEL Name: BFNHA
Event Tree: HPGTET

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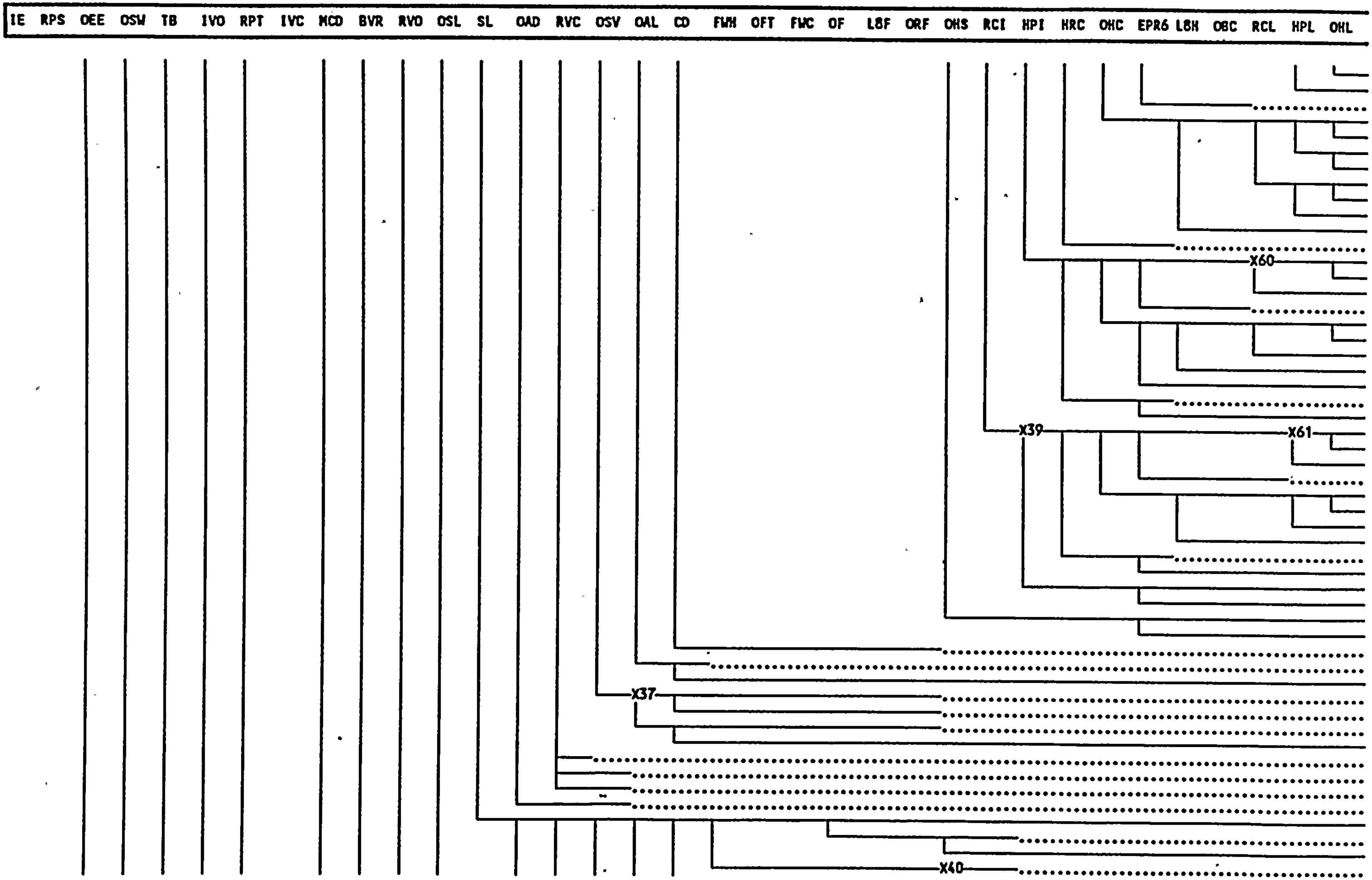
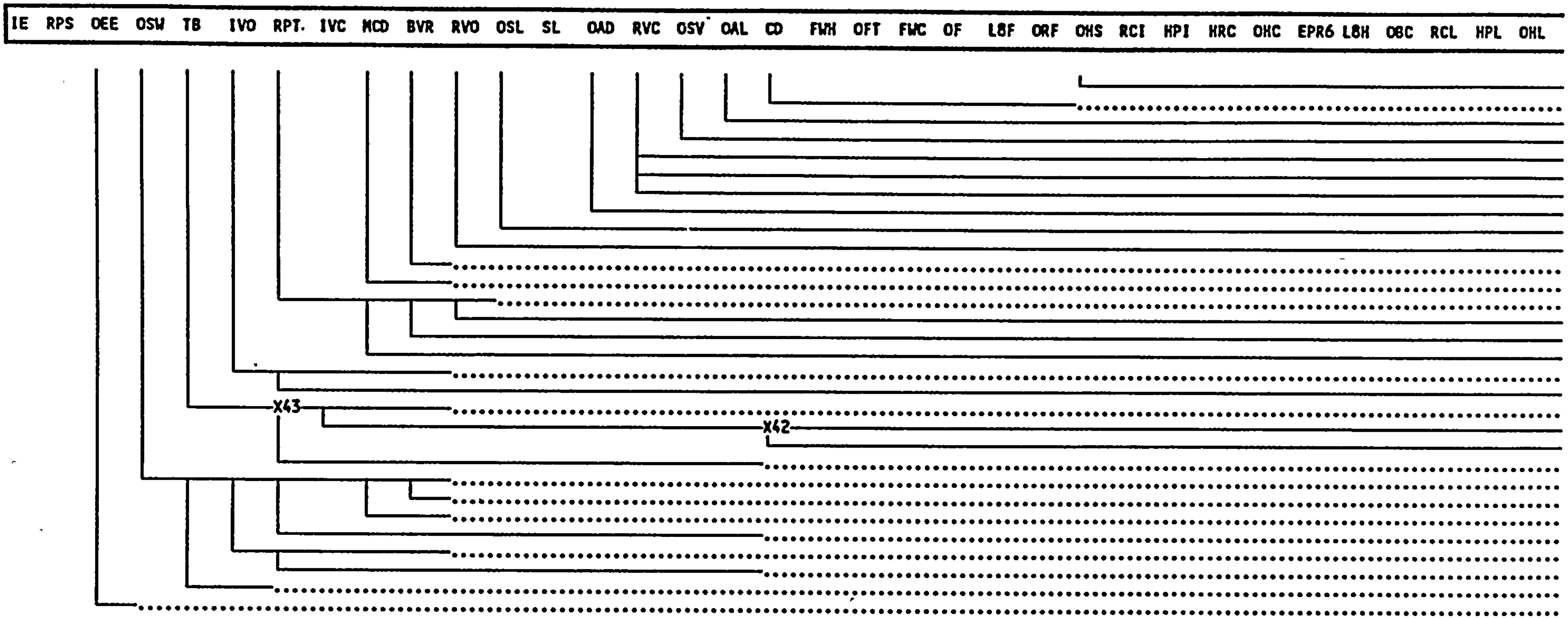


MODEL Name: BFNHA
Event Tree: HPGTET

19:05:18 13 AUG 1992



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MODEL Name: BFNHA
Event Tree: HPGTET

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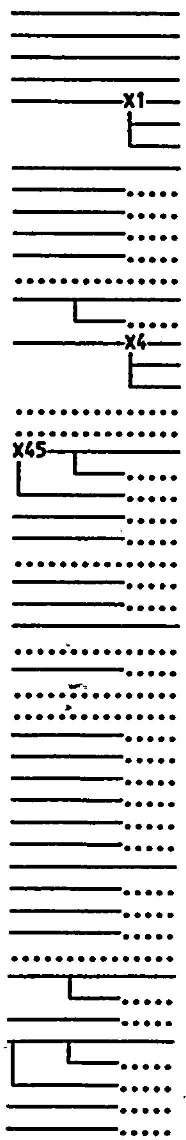
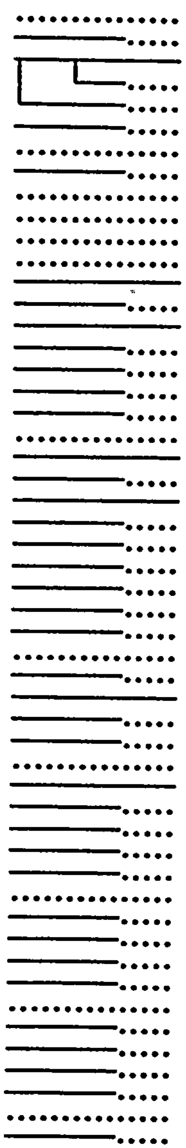
OIV OBD RVD



1		1
2		2
3		3
4		4
5		5
6		6
7		7
8		8
9	X1	9-11
10	X1	12-14
11	X1	15-17
12	X1	18-20
13	X50	21-38
14		39
15	X1	40-42
16		43
17		44
18		45
19	X9	46-52
20	X9	53-59
21		60
22	X4	61-63
23	X4	64-66
24	X4	67-69
25	X4	70-72
26	X45	73-79
27	X4	80-82
28	X4	83-85
29		86
30	X3	87-90
31	X1	91-93
32	X54	94-100
33	X3	101-104
34	X4	105-107
35	X4	108-110
36	X4	111-113
37	X1	114-116
38	X4	117-119
39	X4	120-122
40		123
41	X1	124-126
42	X1	127-129
43	X1	130-132
44	X55	133-141
45		142
46	X4	143-145
47	X4	146-148
48		149
49	X4	150-152
50	X4	153-155
51	X4	156-158
52	X4	159-161

OIV OBD RVD



53	X46	162-171
54	X4	172-174
55		175
56	X4	176-178
57	X4	179-181
58	X4	182-184
59	X5	185-366
60	X4	367-369
61	X10	370-738
62	X10	739-1107
63	X6	1108-1475
64	X7	1476-1839
65		1840
66	X1	1841-1843
67		1844
68	X1	1845-1847
69	X1	1848-1850
70	X1	1851-1853
71	X1	1854-1856
72	X51	1857-1873
73		1874
74	X4	1875-1877
75		1878
76	X4	1879-1881
77	X1	1882-1884
78	X4	1885-1887
79	X4	1888-1890
80	X4	1891-1893
81	X4	1894-1896
82	X47	1897-1902
83	X4	1903-1905
84		1906
85	X1	1907-1909
86	X1	1910-1912
87	X56	1913-1919
88		1920
89	X4	1921-1923
90	X4	1924-1926
91	X4	1927-1929
92	X4	1930-1932
93	X47	1933-1938
94	X4	1939-1941
95	X1	1942-1944
96	X1	1945-1947
97	X1	1948-1950
98	X57	1951-1959
99	X1	1960-1962
100	X4	1963-1965
101	X4	1966-1968
102	X4	1969-1971
103	X47	1972-1977
104	X4	1978-1980

MODEL Name: BFNHA
Event Tree: HPGTET

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OIV OBD RVD

OIV OBD RVD			
	105	X4	1981-1983
	106	X4	1984-1986
	107	X8	1987-2133
	108		2134
	109		2135
	110		2136
	111		2137
	112		2138
	113		2139
	114	X4	2140-2142
	115	X13	2143-2147
	116	X13	2148-2152
X2	117		2153
X12	118		2154
	119		2155
	120		2156
	121	X12	2157-2159
	122	X4	2160-2162
	123	X46	2163-2172
	124	X14	2173-2174
	125	X13	2175-2179
	126	X2	2180-2186
	127	X4	2187-2189
	128	X47	2190-2195
	129		2196
	130		2197
	131		2198
	132		2199
	133	X4	2200-2202
	134	X2	2203-2209
	135	X4	2210-2212
	136	X47	2213-2218
	137	X2	2219-2225
	138	X17	2226-2315
	139	X2	2316-2322
	140	X18	2323-2511
	141	X18	2512-2700
	142	X19	2701-2888
	143	X20	2889-3068
	144		3069
	145		3070
	146		3071
	147	X4	3072-3074
	148	X21	3075-3078
	149		3079
	150	X4	3080-3082
	151	X4	3083-3085
	152	X4	3086-3088
	153	X47	3089-3094
	154		3095
	155		3096
	156	X21	3097-3100

OIV OBD RVD			
————.....	157	X4	3101-3103
————.....	158	X4	3104-3106
....	159	X47	3107-3112
————————	160		3113
————————	161		3114
....	162	X21	3115-3118
————.....	163	X4	3119-3121
————.....	164	X4	3122-3124
....	165	X47	3125-3130
————.....	166	X4	3131-3133
....	167	X23	3134-3198
————————	168		3199
————————	169		3200
————————	170		3201
————————	171		3202
————————	172		3203
————————	173		3204
└———	174		3205
————.....	175	X4	3206-3208
....	176	X2	3209-3215
————.....	177	X4	3216-3218
....	178	X46	3219-3228
....	179	X2	3229-3235
....	180	X16	3236-3269
————.....	181	X4	3270-3272
....	182	X24	3273-3346
....	183	X25	3347-3414
————————	184		3415
————————	185		3416
————.....	186	X4	3417-3419
————.....	187	X4	3420-3422
————.....	188	X4	3423-3425
————.....	189	X4	3426-3428
....	190	X26	3429-3442
————————	191		3443
————————	192		3444
....	193	X27	3445-4509
....	194	X28	4510-9018
....	195	X28	9019-13527
....	196	X28	13528-18036
....	197	X28	18037-22545
————————	198		22546
————————	199		22547
....	200	X28	22548-27056
....	201	X28	27057-31565
————————	202		31566
————————	203		31567
....	204	X62	31568-63134
————————	205		63135
————————	206		63136
————————	207		63137
————X29—	208		63138

OIV OBD RVD

	209		63139
	210		63140
	211		63141
X33	212		63142
	213		63143
	214		63144
	215	X29	63145-63147
	216	X33	63148-63150
	217	X33	63151-63153
	218	X52	63154-63171
	219		63172
	220	X29	63173-63175
	221	X33	63176-63178
	222	X30	63179-63185
	223	X30	63186-63192
	224	X33	63193-63195
	225	X33	63196-63198
	226	X33	63199-63201
	227	X29	63202-63204
	228	X33	63205-63207
	229	X33	63208-63210
	230		63211
	231	X31	63212-63215
	232	X33	63216-63218
	233	X58	63219-63225
	234	X30	63226-63232
	235	X33	63233-63235
	236	X33	63236-63238
	237	X33	63239-63241
	238	X48	63242-63247
	239	X33	63248-63250
	240		63251
	241	X29	63252-63254
	242	X33	63255-63257
	243	X33	63258-63260
	244	X59	63261-63269
	245		63270
	246	X29	63271-63273
	247	X33	63274-63276
	248	X33	63277-63279
	249	X33	63280-63282
	250	X48	63283-63288
	251	X33	63289-63291
	252	X33	63292-63294
	253	X33	63295-63297
	254	X33	63298-63300
	255	X33	63301-63303
	256		63304
	257	X29	63305-63307
	258	X29	63308-63310
	259	X33	63311-63313
	260	X29	63314-63316

OIV OBD RVD			
————.....	261	X33	63317-63319
————.....	262	X33	63320-63322
....	263	X53	63323-63341
——————	264		63342
————.....	265	X33	63343-63345
————.....	266	X33	63346-63348
————.....	267	X33	63349-63351
————.....	268	X29	63352-63354
————.....	269	X33	63355-63357
————.....	270	X33	63358-63360
————.....	271	X33	63361-63363
....	272	X48	63364-63369
——————	273		63370
————.....	274	X33	63371-63373
————.....	275	X33	63374-63376
....	276	X60	63377-63383
——————	277		63384
————.....	278	X33	63385-63387
————.....	279	X33	63388-63390
————.....	280	X33	63391-63393
————.....	281	X33	63394-63396
....	282	X48	63397-63402
————.....	283	X33	63403-63405
————.....	284	X29	63406-63408
————.....	285	X29	63409-63411
————.....	286	X29	63412-63414
....	287	X61	63415-63423
——————	288		63424
————.....	289	X33	63425-63427
————.....	290	X33	63428-63430
————.....	291	X33	63431-63433
....	292	X48	63434-63439
————.....	293	X33	63440-63442
————.....	294	X33	63443-63445
————.....	295	X33	63446-63448
————.....	296	X33	63449-63451
————.....	297	X33	63452-63454
....	298	X34	63455-63622
....	299	X35	63623-63942
————.....	300	X29	63943-63945
....	301	X34	63946-64113
....	302	X34	64114-64281
....	303	X34	64282-64449
————.....	304	X29	64450-64452
....	305	X36	64453-65770
....	306	X37	65771-66277
....	307	X37	66278-66784
....	308	X37	66785-67291
——————	309		67292
....	310	X38	67293-67339
————.....	311	X29	67340-67342
....	312	X39	67343-67385

OIV OBD RVD			
————.....	313	X33	67386-67388
....	314	X40	67389-67434
————.....	315	X33	67435-67437
————.....	316	X33	67438-67440
————.....	317	X33	67441-67443
————.....	318	X33	67444-67446
————.....	319	X33	67447-67449
————.....	320	X33	67450-67452
————.....	321	X33	67453-67455
————.....	322	X33	67456-67458
....	323	X41	67459-71782
....	324	X41	71783-76106
....	325	X44	76107-80427
————.....	326	X33	80428-80430
————.....	327	X33	80431-80433
————.....	328	X33	80434-80436
....	329	X41	80437-84760
————.....	330	X33	84761-84763
....	331	X41	84764-89087
————.....	332	X33	89088-89090
————.....	333	X33	89091-89093
....	334	X42	89094-89099
....	335	X41	89100-93423
....	336	X41	93424-97747
....	337	X41	97748-102071
....	338	X42	102072-102077
....	339	X41	102078-106401
....	340	X42	106402-106407
....	341	X43	106408-110743
....	342	X63	110744-158352

MODEL Name: BFNHA

Top Event Legend for Tree: HPGTET

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Page 1

Top Event Designator.....	Top Event Description............................
IE	Initiating Event
RPS	AUTOMATIC/MANUAL REACTOR SCRAM FAILURE
OEE	OPERATOR FAILS TO RECOVER EECW (START SWING PUMP)
OSW	OPERATOR FAILA TO PLACE MODE SWITCH IN REFUEL THEN SHUTDOWN
TB	TURBINE TRIP FAILURE
IVO	MSIVS FAIL TO REMAIN OPEN
RPT	RECIRCULATION PUMP TRIP FAILURE
IVC	MSIVS FAIL TO CLOSE ON DEMAND
MCD	MAIN CONDENSER UNAVAILABLE
BVR	TBVS FAIL TO RELIEVE\MAINTAIN RX PRESSURE
RVO	SUFFICIENT SRV FAIL TO LIFT TO LIMIT RX PRESSURE
OSL	OPERATOR FAILS TO START SLC
SL	STANDBY LIQUID CONTROL SYSTEM UNAVAILABLE
OAD	OPERATOR FAILS TO INHIBIT ADS
RVC	CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
OSV	OPERATOR FAILS TO INHIBIT MSIV CLOSURE ON LEVEL1 (ATWS)
OAL	OPERATOR FAILS TO ALLOW LEVEL TO FALL PER PROC
CD	1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABLE
FWH	RFW HARDWARE UNAVAILABLE
OFT	OPERATOR FAILS TO TRIP ALL BUT ONE RUNNING FW PUMP
FWC	AUTOMATIV/MANUAL ACTION TO PREVENT HI LVL TRIP FAILS
OF	OPERATOR FAILS TO CONTROL RFW LONG TERM
L8F	FAILURE OF LEVEL 8 TRIP OF RFW
ORF	OPERATOR FAILS TO RESTART RFW AFTER L8 TRIP

MODEL Name: BFNHA

Top Event Legend for Tree: HPGTET

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Top Event Designator.....	Top Event Description.............................
OHS	OPERATOR FAILS TO START HPCI AND/OR RCIC
RCI	RCIC UNAVAILABLE (6 HOURS)
HPI	HPCI UNAVAILABLE (6 HOURS)
HRC	HPCI/RCIC CONTROL HARDWARE UNAVAILABLE
OHC	OPERATOR FAILS TO MAINTAIN HP LVL CNTL (RCIC,HPCI)
EPR6	FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS
L8H	FAILURE OF HPCI/RCIC LEVEL 8 TRIP
OBC	OPERATOR FAILS TO COOLDOWN USING THE TBVS
RCL	RCIC UNAVAILABLE LONG TERM
HPL	HPCI UNAVAILABLE LONG TERM
OHL	OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM
OIV	OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL
OBD	OPERATOR FAILS TO DEPRESSURIZE USING TBV'S
RVD	CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRESS, NO SRV OPERATE)

MODEL

T Event

Name: BFNFINAL

Legend for Tree: HPGTET

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Page 1

Top Event Designator.....	Top Event Description..........................
IE	Initiating Event
RPS	AUTOMATIC/MANUAL REACTOR SCRAM FAILURE
OEE	OPERATOR FAILS TO RECOVER EECW (START SWING PUMP)
OSW	OPERATOR FAILA TO PLACE MODE SWITCH IN REFUEL THEN SHUTDOWN
TB	TURBINE TRIP FAILURE
IVO	MSIVS FAIL TO REMAIN OPEN
RPT	RECIRCULATION PUMP TRIP FAILURE
IVC	MSIVS FAIL TO CLOSE ON DEMAND
MCD	MAIN CONDENSER UNAVAILABLE
BVR	TBVS FAIL TO RELIEVE\MAINTAIN RX PRESSURE
RVO	SUFFICIENT SRV FAIL TO LIFT TO LIMIT RX PRESSURE
OSL	OPERATOR FAILS TO START SLC
SL	STANDBY LIQUID CONTROL SYSTEM UNAVAILABLE
OAD	OPERATOR FAILS TO INHIBIT ADS
RVC	CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
OSV	OPERATOR FAILS TO INHIBIT MSIV CLOSURE ON LEVEL1 (ATWS)
OAL	OPERATOR FAILS TO ALLOW LEVEL TO FALL PER PROC
CD	1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABLE
FWH	RFW HARDWARE UNAVAILABLE
OFT	OPERATOR FAILS TO TRIP ALL BUT ONE RUNNING FW PUMP
FWC	AUTOMATIV/MANUAL ACTION TO PREVENT HI LVL TRIP FAILS
OF	OPERATOR FAILS TO CONTROL RFW LONG TERM
L8F	FAILURE OF LEVEL 8 TRIP OF RFW
ORF	OPERATOR FAILS TO RESTART RFW AFTER L8 TRIP

MODEL

T Event

Name: BFNFINAL

Legend for Tree: HPGTET

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Top Event Designator.....	Top Event Description...........................
OHS	OPERATOR FAILS TO START HPCI AND/OR RCIC
RCI	RCIC UNAVAILABLE (6 HOURS)
HPI	HPCI UNAVAILABLE (6 HOURS)
HRC	HPCI/RCIC CONTROL HARDWARE UNAVAILABLE
OHC	OPERATOR FAILS TO MAINTAIN HP LVL CNTL (RCIC,HPCI)
EPR6	FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS
L8H	FAILURE OF HPCI/RCIC LEVEL 8 TRIP
OBC	OPERATOR FAILS TO COOLDOWN USING THE TBVS
RCL	RCIC UNAVAILABLE LONG TERM
HPL	HPCI UNAVAILABLE LONG TERM
OHL	OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM
OIV	OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL
OBD	OPERATOR FAILS TO DEPRESSURIZE USING TBV'S
RVD	CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRESS, NO SRV OPERATE)

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: HPGTET

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```
SF........ Split Fraction Logic.........................................

          MCDSUP:=OG5=S*OG16=S

          L8FSUP:=DH=S

          HPISUP:=RB=S*PX2=S

          RCISUP:=RD=S*DJ=S*RC=S

          L8HSUP:=RB=S*PX2=S

          L8RSUP:=RC=S*RD=S*PX1=S

          NOGA:=GA=S*OEE=F

          NOGB:=GB=S*OEE=F

          NOGC:=GC=S*OEE=F

          NOGD:=GD=S*OEE=F

          NOGE:=GE=S*OEE=F

          NOGF:=GF=S*OEE=F

          NOGG:=GG=S*OEE=F

          NOGH:=GH=S*OEE=F

          SRV1B:=RVC=SORV0*-INIT=SLOCA*(HPI=S+RCI=S)*HRC=S
          *(OHC=S+-OHC=S*L8H=S*(HPL=S+RCL=S)*OHL=S)

          SRV2:=RVC=SORV1*-INIT=SLOCA*(-HPI=S*-RCI=S+-HRC=S)

          SRV2A:=RVC=SORV1*-INIT=SLOCA*HRC=S
          *-OHC=S*(-L8H=S+-OHL=S+-RCL=S*-HPL=S)

          SRV3:=RVC=SORV0*-INIT=SLOCA*(-HPI=S*-RCI=S+-HRC=S+-L8H=S)

          SRV3A:=RVC=SORV0*-INIT=SLOCA*HRC=S*-OHC=S*(-L8H=S+-OHL=S)
          +EPR6=F

          SRV1:=RVC=SORV1*INIT=SLOCA*(-HPI=S*-RCI=S+-HRC=S)
          +RVC=SORV2*-INIT=SLOCA*-HPI=S

          SRV1A:=-OHC=S*(-L8H=S+-OHL=S)*(RVC=SORV1*INIT=SLOCA
          +RVC=SORV2*-INIT=SLOCA)

          SRV2B:=RVC=SORV0*INIT=SLOCA*(-HPI=S*-RCI=S+-HRC=S)

          SRV2C:=RVC=SORV0*INIT=SLOCA*HRC=S*-OHC=S*(-L8H=S+-OHL=S+-RCL=S*-HPL
          =S)

          POWER:=RH=S+RI=S

          PWR4:=RB=F*(RC=F+RD=F)+RC=F*RD=F

          PWR6:=RB=F+RC=F+RD=F+-DCA=S+RB=S*RC=S*RD=S*DCA=S

          PWRALL:=RB=S*RC=S*RD=S*DCA=S

          LOF:=INIT=LOFW+INIT=PLFW+INIT=LOAC+INIT=PLOC

          LOC:=INIT=LOAC+INIT=PLOC

          FLOOD:=INIT=FLTB+INIT=FLPH1+INIT=FLRB1+INIT=FLRB2+
          INIT=FLRB3C+INIT=FLRB3S
```

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: HPGTET

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SF........	Split Fraction Logic..
	SORV:=(INIT=IOOV+INIT=IOTV+INIT=IOTM)
RPS0	INIT=ISCRAM
RPS11	LOF*LVP=F*PCA=S
RPS10	-POWER+PCA=F
RPS9	POWER*RB=F*RC=F*DB=F*DD=F
RPS8	POWER*RB=F*RC=F*(DB=F+DD=F)
RPS7	POWER*RB=F*RC=F
RPS6	POWER*(RB=F+RC=F)*DB=F*DD=F
RPS5	POWER*(RB=F+RC=F)*(DB=F+DD=F)
RPS4	POWER*(RB=F+RC=F)
RPS3	POWER*DB=F*DD=F
RPS2	POWER*(DB=F+DD=F)
RPS1	PCA=S*POWER*RB=S*RC=S*DB=S*DD=S
RPS11	1
OEEB	EECW
OEE1	-EECW*RPS=S*(SW1A=S+SW1B=S+SW1C=S+SW1D=S)
OEE2	-EECW*RPS=F*(SW1A=S+SW1B=S+SW1C=S+SW1D=S)
OEEF	1
OSW1	1
RPTF	(TB=F+RB=F*RC=F)*(DB=F*DD=F+NH1=F*NH2=F)
RPT9	(TB=F+RB=F*RC=F)*(DB=F+DD=F+NH1=F+NH2=F)
RPT8	(TB=F+RB=F*RC=F)
RPT7	(RB=F+RC=F)*(DB=F+NH1=F)*(DD=F+NH2=F)
RPT6	RC=F*(DD=F+NH2=F)+RB=F*(DB=F+NH1=F)
RPT5	RC=F*(DB=F+NH1=F)+RB=F*(DD=F+NH2=F)
RPT4	RB=F+RC=F
RPT3	(DB=F+NH1=F)*(DD=F+NH2=F)
RPT2	DB=F+DD=F+NH1=F+NH2=F
RPT1	TB=S*RB=S*RC=S*DB=S*DD=S*NH1=S*NH2=S
RPTF	1
OAL2	IVO=F+IVC=S+INIT=CIV+INIT=TTWB
OAL1	IVO=S*-IVC=S*-INIT=CIV*-INIT=TTWB
OAL2	1

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: HPGTET

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SF........	Split Fraction Logic..
TBB	INIT=CIV+INIT=LOSP+MSVC=S
TBO	INIT=TT+INIT=TTWB
TBF	AB=F+UB42A=F*(UB42B=F+DH=F)+NOGB
TB3	AB=S*UB42A=F*UB42B=S*DH=S
TB2	AB=S*UB42A=S*(UB42B=F+DH=F)
TB1	AB=S*UB42A=S*UB42B=S
TBF	1
BVRF	INIT=LOCV+INIT=LOC+INIT=TTWB+INIT=LICA+INIT=LUPS
BVR1	1
OBCF	-BVR=S+IVC=S+IVO=F+INIT=CIV
OBC1	1
OBDF	-BVR=S+IVC=S+IVO=F+INIT=CIV
OBD2	BVR=S*(HPI=S+RCI=S)*HRC=S*(RCL=S+HPL=S)
OBD1	BVR=S*(-HPI=S*-RCI=S+HRC=F)+(RCI=S+HPI=S)*-RCL=S*-HPL=S
OBDF	1
IVOF	-DCA=S+PCA=F+(RH=F+NOGB)*RC=F+(RI=F+NOGD)*RB=F +INIT=CIV+INIT=BOC+INIT=PRFO*MSVC=S+INIT=LOSP
IVO1	DCA=S*PCA=S*(RH=S+RC=S)*(RI=S+RB=S)
IVOB	INIT=PRFO*MSVC=F
IVOF	1
IVCF	NOSIG*PCA=S*DCA=S*(RH=S+RC=S)*(RI=S+RB=S)+MSVC=F
IVCO	INIT=CIV+INIT=BOC+MSVC=S
IVC3	(-DCA=S+(RH=F+NOGB)*RC=F)*(PCA=F+(RI=F+NOGD)*RB=F)
IVC2	(-DCA=S+(RH=F+NOGB)*RC=F+PCA=F+(RI=F+NOGD)*RB=F)
IVC1	(RH=F+NOGB)*(RI=F+NOGD)*-NOSIG
IVC1	(RH=F+NOGB)*RB=F*-NOSIG
IVC1	RC=F*(RI=F+NOGD)*-NOSIG
IVC1	RC=F*RB=F*-NOSIG
IVC1	(RI=F+NOGB+RH=F+NOGD)*-NOSIG
IVC1	(RB=F+RC=F)*-NOSIG
IVC1	-NOSIG*DCA=S*PCA=S*RH=S*RC=S*RI=S*RB=S
IVCF	1
OIVF	IVO=F

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: HPGTET

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SF........	Split Fraction Logic..
OIV1	1
OSVF	INIT=CIV+INIT=TTWB+INIT=BOC+IVO=F+IVC=S
OSV1	IVO=S*-IVC=S*-INIT=CIV*-INIT=TTWB*-INIT=BOC
OSVF	1
SLF	RC=F+(AB=F+NOGB+DC=F)*(AD=F+NOGD+DD=F)
SL3	(AB=F+NOGB+AD=F+NOGD+DC=F+DD=F)*(RC=F*(RH=F+RI=F)+RH=F*RI=F)
SL2	(DD=F+DC=F+AD=F+NOGD+AB=F+NOGB)*(RC=F+RH=F+RI=F)
SL2	(DD=F+DC=F+AD=F+NOGD+AB=F+NOGB)*RC=S*RH=S*RI=S
SL1	AB=S*DC=S*AD=S*DD=S*RC=S*RH=S*RI=S
SLF	1
OSL2	INIT=CIV+INIT=TTWB+IVO=F+IVC=S
OSL1	IVO=S*-INIT=CIV*-INIT=TTWB
OSL2	1
OAD2	INIT=CIV+INIT=TTWB+IVO=F+IVC=S
OAD1	IVO=S*-IVC=S*-INIT=CIV*-INIT=TTWB
OAD2	1
MCDF	OG5=F+INIT=LOCV+INIT=LOAC+INIT=FLTB+INIT=LICA+INIT=LUPS
MCD1	OG5=S
MCDF	1
RVO8	BVR=S*RPS=S*MCD=S*OSW=S
RVO1	RPS=S*(BVR=F+MCD=F+IVO=F+IVC=S+OSW=F)
RVO2	RPS=F
RVO2	1
RVC8	INIT=IOOV*(RVC=SORV0+RVC=SORV2+RVC=SORV3)+INIT=IOTV*(RVC=SORV0+RVC= +INIT=SLOCA*(RVC=SORV0+RVC=SORV2+RVC=SORV3) +FLOOD*(RVC=SORV1+RVC=SORV2+RVC=SORV3)
RVC9	INIT=IOOV*RVC=SORV1+INIT=IOTV*RVC=SORV2+INIT=IOTM*RVC=SORV3 +INIT=SLOCA*RVC=SORV1+FLOOD*RVC=SORV0
RVC0	RVC=SORV0*RPS=S*-SORV
RVC1	RVC=SORV1*RPS=S*-SORV
RVC2	RVC=SORV2*RPS=S*-SORV
RVC3	RVC=SORV3*RPS=S*-SORV
RVC4	RVC=SORV0*RPS=F*-SORV
RVC5	RVC=SORV1*RPS=F*-SORV
RVC6	RVC=SORV2*RPS=F*-SORV

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: HPGTET

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SF........	Split Fraction Logic..
RVC7	RVC=SORV3*RPS=F*-SORV
CDF	RCW=F+UB42A=F*UB42B=F*UB42C=F+INIT=LICA +INIT=LOSP+INIT=LOAC+INIT=FLTB
CD3	RCW=S*(UB42A=F*(UB42B=F+UB42C=F)+UB42B=F*UB42C=F)+INIT=PLOC
CD2	RCW=S*(UB42A=F+UB42B=F+UB42C=F)
CD1	RCW=S*UB42A=S*UB42B=S*UB42C=S
CDF	1
FWHF	RCW=F+INIT=LOFW+INIT=FWRU+INIT=CIV+INIT=LOCV+IVC=S+IVO=F+-BVR=S+INI T=LUPS+PX1=F*(DJ=F+DN=F)+DJ=F*DN=F
FWH2	INIT=PLFW
FWH1	RCW=S*-IVC=S*IVO=S*-INIT=LOFW*-INIT=FWRU*-INIT=CIV*-INIT=LOCV*BVR=S
FWHF	1
OFTF	OPTR=F
OFTS	OPTR=S
OFT1	1
FWCF	PX1=F+DJ=F+DN=F
FWC2	OFT=F
FWC1	OFT=S
FWCF	1
OFF	-OFT=S*-FWC=S*RPS=S
OF4	RPS=F
OF3	-OFT=S*FWC=S*RPS=S
OF2	OFT=S*-FWC=S*RPS=S
OF1	OFT=S*FWC=S*RPS=S
OFF	1
L8FF	VT1=L1B+-L8FSUP+L8TR=F+NOGB*NOGD
L8F0	L8TR=S
L8F1	L8FSUP*-VT1=L1B*-VT2=L2B
L8F2	L8FSUP*-VT1=L1B*VT2=L2B
L8FF	1
ORF1	UB42A=S*UB42B=S
ORFF	1
OHS3	RPS=F
OHS1	RPS=S*RVC=SORV2

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: HPGTET

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SF........	Split Fraction Logic..
OHS2	RPS=S
OHS3	1
HPIF	-HPISUP+TOR=F+OHS=F*LV=F*DW=F+INIT=FWRU*OPTR=F*L8TR=F +INIT=BOC*ISO=F+INIT=FLRB2+INIT=FLRB3S
HPI6	HPISUP*-INIT=MLOCA*OHS=S*TOR=S*(RCI=B+-RCISUP+OHS=F*LV=F+CST=F)
HPI5	HPISUP*(INIT=MLOCA+OHS=F)*TOR=S*(LV=S+DW=S)*(RCI=B+-RCISUP+OHS=F*LV =F+CST=F)
HPI4	HPISUP*-INIT=MLOCA*OHS=S*TOR=S*RCI=F
HPI3	HPISUP*(INIT=MLOCA+OHS=F)*TOR=S*(LV=S+DW=S)*RCI=F
HPI2	HPISUP*-INIT=MLOCA*OHS=S*TOR=S*RCI=S
HPI1	HPISUP*(INIT=MLOCA+OHS=F)*TOR=S*(LV=S+DW=S)*RCI=S
HPIF	1
RCIF	-RCISUP+OHS=F*LV=F+CST=F+INIT=BOC+(INIT=FWRU*OPTR=F*L8TR=F) +INIT=FLRB2+INIT=FLRB3S
RCI2	RCISUP*OHS=F*CST=S*LV=S
RCI1	RCISUP*OHS=S*CST=S
RCIF	1
HRCF	RC=F*RB=F+RC=F*RCI=S+RB=F*HPI=S+RB=F*-RCI=S+RC=F*-HPI=S
HRC1	RC=S*HPI=S*RCI=S*RD=S*RB=S
HRC2	RC=S*HPI=S*RB=S*RCI=S
HRC3	RC=S*-HPI=S*RCI=S*RD=S
HRC4	RC=S*-HPI=S*RCI=S
HRC5	RC=S*HPI=S*RB=S*-RCI=S
HRC6	HPI=S*RB=S*-RCI=S
HRCF	1
OHC4	RPS=F*(HPI=S+RCI=S)
OHC3	RPS=S*-HPI=S*RCI=S
OHC2	RPS=S*HPI=S*-RCI=S
OHC1	RPS=S*HPI=S*RCI=S
OHC4	1
EPR64	(INIT=LOSP+INIT=L500)*EPR30=F*GA=F*GB=F*GC=F*GD=F
EPR63	(INIT=LOSP+INIT=L500)*EPR30=F*(GA=F*GB=F*(GC=F+GD=F)+(GA=F+GB=F)*GC =F*GD=F)
EPR62	(INIT=LOSP+INIT=L500)*EPR30=F*(GA=F*(GB=F+GC=F+GD=F)+GB=F*(GC=F+GD= F)+GC=F*GD=F)

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: HPGTET

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SF........	Split Fraction Logic..
EPR61	(INIT=LOSP+INIT=L500)*EPR30=F*(GA=F+GB=F+GC=F+GD=F)
EPR6B	1
L8HF	-L8HSUP*HPI=S+RCI=S*-L8RSUP
L8H3	-HPI=S*RCI=S*L8RSUP
L8H2	HPI=S*L8HSUP*-RCI=S
L8H1	HPI=S*L8HSUP*RCI=S*L8RSUP
L8HF	1
HPLF	OHC=F*LV=F+INIT=LOSP*(EPR6=F*(-EECW*OEE=F+GE=F+GB=F)) +INIT=FLRB2+INIT=FLRB3S
HPL6	OHC=F*LV=S*(RCL=B+OHC=F*LV=F+TOR=F)
HPL5	OHC=S*(RCL=B+TOR=F)
HPL4	OHC=F*LV=S*RCL=F
HPL3	OHC=S*RCL=F
HPL2	OHC=F*LV=S*RCL=S
HPL1	OHC=S*RCL=S
HPLF	1
RCLF	OHC=F*LV=F+TOR=F+INIT=LOSP*(EPR6=F*(-EECW*OEE=F+GA=F)) +INIT=FLRB2+INIT=FLRB3S
RCL2	OHC=F*LV=S*TOR=S
RCL1	OHC=S*TOR=S
RCLF	1
OHL2	OHC=F*(HPL=S+RCL=S)
OHL1	OHC=S*(HPL=S+RCL=S)
OHL2	1
RVD0	RVD=NOSRV*(SRV1+SRV1A+SRV2+SRV2A)
RVD1	RVD=DEP*(SRV1+SRV1B)*PWR4
RVD2	RVD=DEP*(SRV1+SRV1B)*PWR6
RVD3	RVD=DEP*SRV1A*PWR4
RVD4	RVD=DEP*SRV1A*PWR6
RVD5	RVD=DEP*(SRV2+SRV2B)*PWR4
RVD6	RVD=DEP*(SRV2+SRV2B)*PWR6
RVD7	RVD=DEP*(SRV2A+SRV2C)*PWR4
RVD8	RVD=DEP*(SRV2A+SRV2C)*PWR6
RVD9	RVD=DEP*SRV3*PWR4

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: HPGTET

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SF........	Split Fraction Logic..
RVD10	RVD=DEP*SRV3*PWR6
RVD11	RVD=DEP*SRV3A*PWR4
RVD12	RVD=DEP*SRV3A*PWR6
RVD13	RVD=NODEP*SRV1*PWR4
RVD14	RVD=NODEP*SRV1*PWR6
RVD15	RVD=NODEP*SRV1A*PWR4
RVD16	RVD=NODEP*SRV1A*PWR6
RVD17	RVD=NODEP*SRV2*PWR4
RVD18	RVD=NODEP*SRV2*PWR6
RVD19	RVD=NODEP*SRV2A*PWR4
RVD20	RVD=NODEP*SRV2A*PWR6
RVD21	RVD=NODEP*SRV3*PWR4
RVD22	RVD=NODEP*SRV3*PWR6
RVD23	RVD=NODEP*SRV3A*PWR4
RVD24	RVD=NODEP*SRV3A*PWR6
RVD25	RVD=NOSRV*SRV1B*PWR4
RVD26	RVD=NOSRV*SRV1B*PWR6
RVD29	RVD=NOSRV*SRV2B*PWR4
RVD30	RVD=NOSRV*SRV2B*PWR6
RVD31	RVD=NOSRV*SRV2C*PWR4
RVD32	RVD=NOSRV*SRV2C*PWR6
RVD33	RVD=NOSRV*SRV3*PWR4
RVD34	RVD=NOSRV*SRV3*PWR6
RVD35	RVD=NOSRV*SRV3A*PWR4
RVD36	RVD=NOSRV*SRV3A*PWR6
RVD37	RVD=NODEP*SRV1B*PWR4
RVD38	RVD=NODEP*SRV1B*PWR6
RVD39	RVD=NODEP*SRV2B*PWR4
RVD40	RVD=NODEP*SRV2B*PWR6
RVD41	RVD=NODEP*SRV2C*PWR4
RVD42	RVD=NODEP*SRV2C*PWR6
RVD43	RVD=DEP*RVO=F+RVD=NOSRV*-OAD=S
RVD44	RVD=NODEP*(RVO=F+-OAD=S)

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: HPGTET

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SF........	Split Fraction Logic..
RVD45	RVD=NOSRV*RVO=F+RVD=DEP*-OAD=S
RVD43	RVD=NOSRV
RVD44	RVD=NODEP
RVD45	RVD=DEP

MODEL Name: BFNFINAL
Event Tree: LLOCA1

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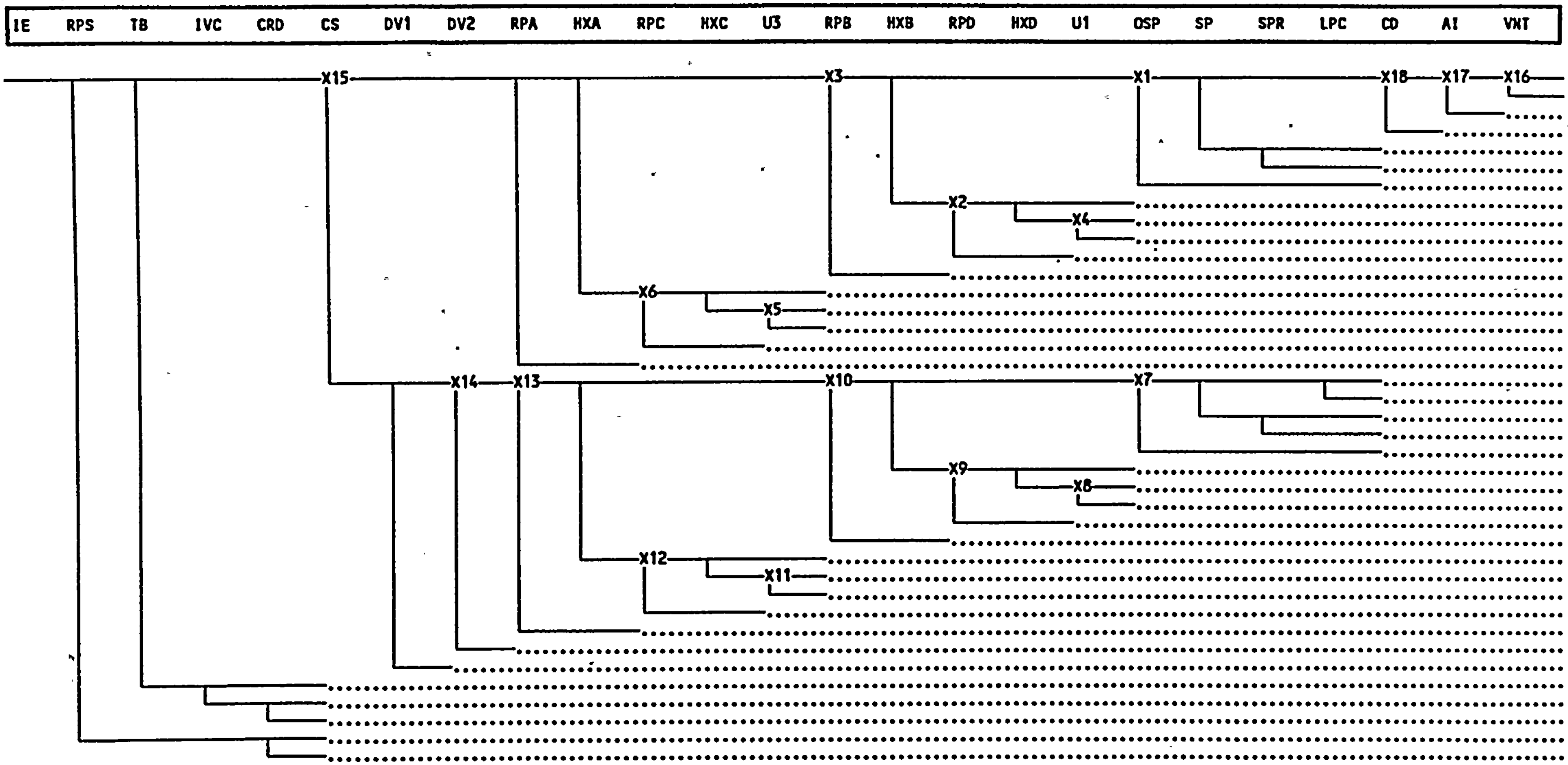

1		1
2		2
3	X16	3-4
4	X17	5-8
5	X18	9-16
6	X18	17-24
7	X18	25-32
8	X1	33-64
9	X1	65-96
10	X1	97-128
11	X4	129-192
12	X2	193-352
13	X3	353-704
14	X3	705-1056
15	X3	1057-1408
16	X5	1409-2112
17	X6	2113-3872
18	X18	3873-3880
19	X18	3881-3888
20	X18	3889-3896
21	X18	3897-3904
22	X18	3905-3912
23	X7	3913-3952
24	X7	3953-3992
25	X7	3993-4032
26	X8	4033-4112
27	X9	4113-4312
28	X10	4313-4752
29	X10	4753-5192
30	X10	5193-5632
31	X11	5633-6512
32	X12	6513-8712
33	X13	8713-13552
34	X14	13553-23232
35	X15	23233-46464
36	X15	46465-69696
37	X15	69697-92928
38	X15	92929-116160
39	X15	116161-139392

MODEL Name: BFNFINAL

Top Event Legend for Tree: LLOCA1

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Page 1

Top Event Designator.....	Top Event Description..............................
IE	Initiating Event
RPS	AUTOMATIC (OR MANUAL) REACTOR SCRAM FAILURE
TB	AUTOMATIC (OR MANUAL) TURBINE TRIP FAILURE
IVC	FAILURE TO CLOSE AT LEAST ONE MSIV IN EACH LINE
CRD	CONTROL ROD DRIVE HYDRAULIC UNAVAILABLE FOR DEBRIS BED COOLING
CS	ONE CORE SPRAY LOOP FAILS TO INJECT
DV1	LOOP I RDV FAILS TO CLOSE ON DEMAND
DV2	LOOP II RDV FAILS TO CLOSE ON DEMAND
RPA	RHR PUMP A UNAVAILABLE
HXA	RHR HEAT EXCHANGER A UNAVAILABLE
RPC	RHR PUMP C UNAVAILABLE
HXC	RHR HEAT EXCHANGER C UNAVAILABLE
U3	CROSS CONNECT TO UNIT 3 RHR SYSTEM UNAVAILABLE
RPB	RHR PUMP B UNAVAILABLE
HXB	RHR HEAT EXCHANGER B UNAVAILABLE
RPD	RHR PUMP D UNAVAILABLE
HXD	RHR HEAT EXCHANGER D UNAVAILABLE
U1	CROSS CONNECT TO UNIT 1 RHR SYSTEM UNAVAILABLE
OSP	OPERATOR FAILS TO INITIATE SP COOLING
SP	SUPPRESSION POOL COOLING HARDWARE UNAVAILABLE
SPR	FAILURE TO RECOVER TORUS COOLING
LPC	RHR LPCI. INJECTION PATH UNAVAILABLE
CD	CONDENSATE UNAVAILABLE FOR DEBRIS BED COOLING
AI	ALTERNATE INJECTION UNAVAILABLE FOR DEBRIS BED COOLING
VNT	CONTAINMENT VENT UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LLOCA1

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SF........Split Fraction Logic..........................................

        NOGA:=GA=S*-EECW
        NOGB:=GB=S*-EECW
        NOGC:=GC=S*-EECW
        NOGD:=GD=S*-EECW
        NOGE:=GE=S*-EECW
        NOGF:=GF=S*-EECW
        NOGG:=GG=S*-EECW
        NOGH:=GH=S*-EECW
        Y1:=(DA=F+AA=F+DB=F+AC=F)
        Y2:=(DC=F+AB=F+DD=F+AD=F)
        Y3:=(TOR=F+-EECW)
        RHR1:=RPA=S*HXA=S
        RHR2:=RPB=S*HXB=S
        RHR3:=RPC=S*HXC=S
        RHR4:=RPD=S*HXD=S
        RPDSUP:=AD=S*DD=S*(EECW+RCW=S)*TOR=S
        RPBSUP:=AC=S*DB=S*(EECW+RCW=S)*TOR=S
        RPCSUP:=AB=S*DC=S*(EECW+RCW=S)*TOR=S
        RPASUP:=AA=S*DA=S*(EECW+RCW=S)*TOR=S
        NOSIG:=LM1=F*LM3=F+LM2=F*LM4=F
        SIG1:=LV=S+DW=S*(NPI=S+NPII=S)
        SIG3:=(LV=S+DW=S)
        POWER:=RH=S+RH=S
        RHRSW1:=SW2B=S+SW1B=S+SW2D=S+SW1D=S
        LPCI:=INIT=LLD*(RPB=S+RPD=S)*RL=S
        +-INIT=LLD*((OSP=F+SP=F*SPR=F)*((RPA=S+RPC=S)*RK=S+(RPB=S+RPD=S)*RL
        +(SP=S+SPR=S)*((RPA=S+RPC=S)*RK=S*(RPB=S+RPD=S)*RL=S))
        RHRPMP:=-RHR1*-RHR3
        HXAB:=RH=F+SW2A=F*SW1A=F+NOGB+HXA=B
        HXBB:=RI=F+SW2B=F*SW1B=F+NOGD+HXB=B
        HXCB:=RH=F+SW2C=F*SW1C=F+NOGB+HXC=B
        DV2SUP:=DD=S*DB=S*NH1=S*NH2=S
        DV2MIN:=DD=S*NH2=S+DB=S*NH1=S

RPS10   -POWER+PCA=F
```

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LLOCA1

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SF........	Split Fraction Logic..
RPS9	POWER*RB=F*RC=F*DB=F*DD=F
RPS8	POWER*RB=F*RC=F*(DB=F+DD=F)
RPS7	POWER*RB=F*RC=F
RPS6	POWER*(RB=F+RC=F)*DB=F*DD=F
RPS5	POWER*(RB=F+RC=F)*(DB=F+DD=F)
RPS4	POWER*(RB=F+RC=F)
RPS3	POWER*DB=F*DD=F
RPS2	POWER*(DB=F+DD=F)
RPS1	PCA=S*POWER*RB=S*RC=S*DB=S*DD=S
RPS11	1
TBF	AB=F+UB42A=F*UB42B=F+NOGB
TB3	AB=S*UB42A=F*UB42B=S
TB2	AB=S*UB42A=S*UB42B=F
TB1	AB=S*UB42A=S*UB42B=S
TBF	1
IVCF	NOSIG*PCA=S*DCA=S*(RH=S+RC=S)*(RI=S+RB=S)
IVC3	(-DCA=S+(RH=F+NOGB)*RC=F)*(PCA=F+(RI=F+NOGD)*RB=F)
IVC2	(-DCA=S+(RH=F+NOGB)*RC=F+PCA=F+(RI=F+NOGD)*RB=F)
IVC1	(RC=F*(RI=F+NOGD+RB=F)+(RH=F+NOGB)*(RI=F+NOGD+RB=F))*-NOSIG
IVC1	(RI=F+NOGD+RH=F+NOGB+RB=F+RC=F)*DCA=S*PCA=S*-NOSIG
IVC1	-NOSIG*RH=S*RI=S*RB=S*RC=S*DCA=S*PCA=S
IVCF	1
DV1B	-INIT=LLS
DV1F	RB=F*RC=F+RK=F+-SIG1+NOGB*NOGD
DV12	(RB=F+RC=F)*RK=S*INIT=LLS*SIG1
DV11	RB=S*RC=S*RK=S*INIT=LLS*SIG1
DV1F	1
DV2B	-(INIT=LLS+INIT=LLD)
DV2F	RB=F*RC=F+RK=F+-SIG1+NOGB*NOGD+-DV2MIN
DV26	RL=S*(RB=F+RC=F)*(DV1=B+RB=F*RC=F+RK=F)*SIG1*(INIT=LLS+INIT=LLD)*DV2SUP
DV25	RL=S*RB=S*RC=S*(DV1=B+RB=F*RC=F+RK=F)*SIG1*(INIT=LLS+INIT=LLD)*DV2SUP
DV24	RL=S*(RB=F+RC=F)*DV1=F*SIG1*(INIT=LLS+INIT=LLD)*DV2SUP

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LLOCA1

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SF........	Split Fraction Logic..
DV23	RL=S*(RB=F+RC=F)*SIG1*(INIT=LLS+INIT=LLD)*DV1=S*DV2SUP
DV22	RL=S*RB=S*RC=S*SIG1*(INIT=LLS+INIT=LLD)*DV1=F*DV2SUP
DV21	RL=S*RB=S*RC=S*SIG1*(INIT=LLS+INIT=LLD)*DV1=S*DV2SUP
DV212	RL=S*(RB=F+RC=F)*(DV1=B+RB=F*RC=F+RK=F)*SIG1*(INIT=LLS+INIT=LLD)*DV2MIN
DV211	RL=S*RB=S*RC=S*(DV1=B+RB=F*RC=F+RK=F)*SIG1*(INIT=LLS+INIT=LLD)*DV2MIN
DV210	RL=S*(RB=F+RC=F)*DV1=F*SIG1*(INIT=LLS+INIT=LLD)*DV2MIN
DV29	RL=S*(RB=F+RC=F)*SIG1*(INIT=LLS+INIT=LLD)*DV1=S*DV2MIN
DV28	RL=S*RB=S*RC=S*SIG1*(INIT=LLS+INIT=LLD)*DV1=F*DV2MIN
DV27	RL=S*RB=S*RC=S*SIG1*(INIT=LLS+INIT=LLD)*DV1=S*DV2MIN
DV2F	1
CRDF	RCW=F+UB42C=F+CST=F
CRD1	RCW=S*UB42C=S*CST=S
CRDF	1
RPAF	-RPASUP+RH=F+RC=F+-SIG1+NOGA+NOGB
RPA1	RPASUP*RH=S*RC=S*SIG1
RPAF	1
RPCF	-RPCSUP+RH=F+RB=F*RC=F+-SIG1+NOGB
RPC1	RPCSUP*RH=S*(RB=S+RC=S)*RPA=S*SIG1
RPC3	RPCSUP*RH=S*(RB=S+RC=S)*(-RPASUP+RC=F)*SIG1
RPC2	RPCSUP*RH=S*(RB=S+RC=S)*RPASUP*RC=S*RPA=F*SIG1
RPCF	1
RPBF	-RPBSUP+RI=F+RB=F+-SIG1+NOGC+NOGD
RPB6	RPBSUP*RI=S*RB=S*(-(RPASUP*RH=S)*RPC=F+RPA=F*(RPC=B+-(RPCSUP*RH=S*RB=S)))*SIG1
RPB5	RPBSUP*RI=S*RB=S*(-(RPASUP*RH=S)*RPC=S+RPA=S*(RPC=B+-(RPCSUP*RH=S*RB=S)))*SIG1
RPB4	RPBSUP*RI=S*RB=S*-(RPASUP*RH=S)*(RPC=B+-(RPCSUP*RH=S*RB=S))*SIG1
RPB3	RPBSUP*RI=S*RB=S*RPA=F*RPC=F*SIG1
RPB2	RPBSUP*RI=S*RB=S*(RPA=S*RPC=F+RPA=F*RPC=S)*SIG1
RPB1	RPBSUP*RI=S*RB=S*RPA=S*RPC=S*SIG1
RPBF	1
RPDF	-RPDSUP+RI=F+RB=F*RC=F+-SIG1+NOGD
RPD10	RPDSUP*RI=S*(RB=S+RC=S)*(RPA=F*(RPC=F*-(RPBSUP*RC=S)+(RPC=B+-(RPCSU +-(RPASUP*RH=S*RC=S)*RPC=F*RPB=F)*SIG1

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LLOCA1

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SF........	Split Fraction Logic..
RPD9	RPDSUP*RI=S*(RB=S+RC=S)*(RPA=S*(RPC=F*-(RPBSUP*RC=S)+(RPC=B+-(RPCSU +RPC=S*(RPA=F*-(RPBSUP*RC=S)+-(RPASUP*RH=S*RC=S)*RPB=F) +RPB=S*(RPA=F*(RPC=B+-(RPCSUP*RH=S)+-(RPASUP*RH=S*RC=S)*RPC=F)))*SI
RPD8	RPDSUP*RI=S*(RB=S+RC=S)*(RPA=S*(RPC=S*-(RPBSUP*RC=S)+(RPC=B+-(RPCSU +-(RPASUP*RH=S*RC=S)*RPC=S*RPB=S)*SIG1
RPD7	RPDSUP*RI=S*(RB=S+RC=S)*(-(RPASUP*RH=S*RC=S)*(RPC=F*-(RPBSUP*RC=S)+ +RPA=F*(RPC=B+-(RPCSUP*RH=S))*-(RPBSUP*RC=S))*SIG1
RPD6	RPDSUP*RI=S*(RB=S+RC=S)*(-(RPASUP*RH=S*RC=S)*(RPC=S*-(RPBSUP*RC=S)+ +RPA=S*(RPC=B+-(RPCSUP*RH=S))*-(RPBSUP*RC=S))*SIG1
RPD5	RPDSUP*RI=S*(RB=S+RC=S)*-(RPASUP*RH=S*RC=S)*(RPC=B+-(RPCSUP*RH=S))* -(RPBSUP*RC=S)*SIG1
RPD4	RPDSUP*RI=S*(RB=S+RC=S)*RPA=F*RPC=F*RPB=F*SIG1
RPD3	RPDSUP*RI=S*(RB=S+RC=S)*(RPA=F*(RPC=F*RPB=S+RPC=S*RPB=F) +RPA=S*RPC=F*RPB=F)*SIG1
RPD2	RPDSUP*RI=S*(RB=S+RC=S)*(RPA=F*RPC=S*RPB=S +RPA=S*RPC=F*RPB=S+RPA=S*RPC=S*RPB=F)*SIG1
RPD1	RPDSUP*RI=S*(RB=S+RC=S)*RPA=S*RPC=S*RPB=S*SIG1
RPDF	1
HXAF	RH=F+SW2A=F*SW1A=F+NOGB
HXA1	RH=S*(SW2A=S+SW1A=S)
HXAF	1
HXCF	RH=F+SW2C=F*SW1C=F+NOGB
HXC1	RH=S*HXA=S*(SW2C=S+SW1C=S)
HXC2	RH=S*HXA=F*(SW2C=S+SW1C=S)
HXC3	RH=S*HXAB*(SW2C=S+SW1C=S)
HXCF	1
HXBF	RI=F+SW2B=F*SW1B=F+NOGD
HXB1	RI=S*HXA=S*HXC=S*(SW2B=S+SW1B=S)
HXB6	RI=S*HXAB*HXCB*(SW2B=S+SW1B=S)
HXB4	RI=S*(HXA=F*HXCB+HXAB*HXC=F)*(SW2B=S+SW1B=S)
HXB3	RI=S*(HXA=S*HXCB+HXAB*HXC=S)*(SW2B=S+SW1B=S)
HXB5	RI=S*HXA=F*HXC=F*(SW2B=S+SW1B=S)
HXB2	RI=S*(HXA=S*HXC=F+HXA=F*HXC=S)*(SW2B=S+SW1B=S)
HXBF	1
HXDF	RI=F+SW2D=F*SW1D=F+NOGD
HXD10	HXAB*HXCB*HXBB*(SW2D=S+SW1D=S)
HXD9	(HXA=B*(HXCB*HXB=F+HXC=F*HXBB)+HXA=F*HXCB*HXBB)*(SW2D=S+SW1D=S)

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LLOCA1

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SF........	Split Fraction Logic..
HXD8	(HXAB*(HXCB+HXBB)+HXCB*HXBB)*(SW2D=S+SW1D=S)
HXD7	HXA=F*HXC=F*HXB=F*(SW2D=S+SW1D=S)
HXD6	(HXA=F*(HXC=F*HXBB+HXCB*HXB=F)+HXAB*HXC=F*HXB=F)*(SW2D=S+SW1D=S)
HXD5	(HXA=F*(HXC=F+HXB=F)+HXC=F*HXB=F)*(SW2D=S+SW1D=S)
HXD4	(HXAB*(HXC=F+HXB=F)+HXCB*(HXA=F+HXB=F)+HXBB*(HXA=F+HXC=F))*(SW2D=S+ SW1D=S)
HXD3	(HXA=F+HXC=F+HXB=F)*(SW2D=S+SW1D=S)
HXD2	(HXAB+HXCB+HXBB)*(SW2D=S+SW1D=S)
HXD1	RI=S*HXA=S*HXC=S*HXB=S*(SW2D=S+SW1D=S)
HXDF	1
U3F	1
U11	RHRSW1*RF=F*RHRPMP
U1F	1
OSPF	RPS=S*-(RHR1+RHR3)*-(RHR2+RHR4)*U1=F+RPS=F*-(RHR1*RHR2*RHR3*RHR4)
OSP3	RPS=S*(-(RHR1+RHR3)+-(RHR2+RHR4)+U1=S)
OSP2	RPS=F*RHR1*RHR2*RHR3*RHR4
OSP1	RPS=S*(RHR1+RHR3)*(RHR2+RHR4)
OSPF	1
SPF	INIT=LLD*CS=F*(-(RHR1+RHR3)+RK=F)*U1=F +(-(RHR1+RHR3)+RK=F)*(-(RHR2+RHR4)+RL=F)*U1=F
SP3	INIT=LLD*CS=F*((RHR1+RHR3)*RK=S+U1=S) +-(RHR1+RHR3)+RK=F+-(RHR2+RHR4)+RL=F+U1=S
SP1	(RHR1+RHR3)*RK=S*(RHR2+RHR4)*RL=S
SPF	1
SPR1	RPS=S*TB=S
SPRF	1
LPCF	(NPI=F*NPII=F)+-LPCI+NOGB*NOGD +INIT=LLD*(DV2=F+RL=F+-(RHR2+RHR4)) +INIT=LLS*(DV1=F*DV2=F+DV1=F*(-(RHR2*RHR4)+RL=F) +DV2=F*(-(RHR1+RHR2)+RK=F))
LPC5	-(INIT=LLS+INIT=LLD)*(NPI=S+NPII=S)*(RK=F+RL=F+RPA=F*RPC=F+RPB=F*RP D=F)
LPC4	(NPI=S+NPII=S)*(-(INIT=LLS+INIT=LLD)*RK=S*RL=S*(RPA=S+RPC=S) *(RPB=S+RPD=S))
LPC5	INIT=LLD*DV2=S*(NPI=S+NPII=S)*RL=S*(RPB=S+RPD=S)
LPC5	INIT=LLS*(NPI=S+NPII=S)*(DV1=F*RL=S*(RPB=S+RPD=S)+DV2=F*RK=S*(RPA=S +RPC=S))

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LLOCA1

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SF........	Split Fraction Logic..
LPC5	INIT=LLS*(NPI=S+NPII=S)*(DV2=S*RK=F*(RPB=S+RPD=S)+DV1=S*RL=F*(RPA=S +RPC=S))
LPC5	INIT=LLS*(NPI=S+NPII=S)*((RPA=F+RPC=F)*DV2=S*RL=S +(RPB=F+RPD=F)*DV1=S*RK=S)
LPC4	INIT=LLS*(NPI=S+NPII=S)*DV1=S*RK=S*(RPA=S+RPC=S)*DV2=S*RL=S*(RPB=S+ RPD=S)
LPCF	1
CSF	Y3+-SIG3+RH=F*RI=F+Y1*Y2+NPI=F*NPII=F
CS2	-Y3*(Y1+RH=F+NPI=F+Y2+RI=F+NPII=F)*SIG3+INIT=LLC
CS1	-Y3*-Y1*RH=S*NPI=S*-Y2*RI=S*NPII=S*SIG3
CSF	1
CDF	PCA=F+RCW=F+UB42A=F*UB42B=F*UB42C=F+DJ=F
CD1	1
AIF	1
VNTF	1

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LOCACNTMT

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Page 1

```
SF........ Split Fraction Logic...........................................

           NOTAP:=-(INIT=DWT1+INIT=DWT2)

           RR12:=RHR1*RHR3+RHR1*U3=S+RHR3*U3=S

           RR11:=RHR1+RHR3+U3=S

           RR22:=RHR2*RHR4+RHR2*U1=S+RHR4*U1=S

           RR21:=RHR2+RHR4+U1=S

           HEATL:=(RHR1+RHR2+RHR3+RHR4+U1=S+U3=S)*OSP=S*(SP=S+SPR=S)

           HEAT:=(RHR1+RHR2+RHR3+RHR4+U1=S+U3=S)*(OSP=S*(SP=S+SPR=S)+OSD=S*SDC
           =S)

           AHEAT:=RR12*RR21+RR11*RR22

           NOLOCA:=-(INIT=LLS+INIT=LLD+INIT=LLC+INIT=LLO+INIT=ELOCA)

           VENT:=OLP=S*VNT=S

           SIG:=LVP=S+DWP=S

NCDF       INIT=ELOCA

NCD1       (INIT=LLS+INIT=LLD+INIT=LLC+INIT=LLO)*RPS=S*(TB=S+IVC=S)*(CS=S+LPC=
           S)*HEATL

NCDF       1

ODWS1      RPS=S

ODWS2      RPS=F

ODWS2      1

DWSF       PX1=F*PX2=F+(-RR11+RH=F+NOGB)*(-RR21+RI=F+NOGD)+SP=F*SPR=F

DWS2       -RR11+RH=F+-RR21+RI=F

DWS1       PX1=S*PX2=S*RR11*RH=S*RR21*RI=S

DWSF       1

CILF       LVP=F*DWP=F

CIL2       PCA=F+DN=F

CIL1       1

CISF       LVP=F*DWP=F

CIS1       1

RBIF       LVP=F*DWP=F

RBI1       1

SGTF       RM=F*RN=F+RN=F*A3ED=F+RM=F*A3ED=F+DN=F*DO=F+AA=F*DM=F
           +RM=F*(DO=F+DM=F)+RN=F*(DN=F+AA=F)+-SIG
           +NOGD*(NOGA+NOGH+NOGB*NOGF+NOGB+NOGC+NOGE)
           +NOGA*NOGC*NOGG

SGT9       RM=F+RN=F+NOGA+NOGD

SGT8       A3ED=F*((DN=F+DO=F)*(AA=F+DM=F))+NOGB*NOGC*NOGE*NOGH
```

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LOCACNTMT

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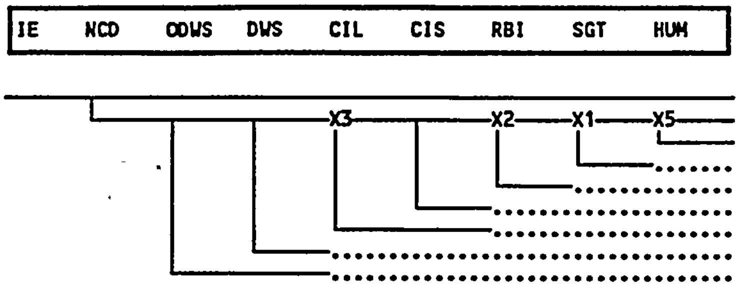
Page 2

SF........	Split Fraction Logic..
SGT6	A3ED=F*(AA=F+DM=F+DN=F+DO=F)+NOGH*(NOGA+NOGB*NOGG)
SGT5	A3ED=F+NOGH
SGT4	(DN=F+DO=F)*(AA=F+DM=F)+NOGB*NOGC*NOGE
SGT2	AA=F+DM=F+DN=F+DO=F+NOGA+NOGB*NOGG
SGT1	RM=S*RN=S*A3ED=S*DN=S*AA=S*DO=S*DM=S*SIG
SGTF	1
HUMF	A3ED=F*(RM=F+RN=F)+RM=F*RN=F+NOGH*(NOGA+NOGD)+NOGA*NOGD
HUM3	(RM=S+NOGA+RN=S+NOGD)*A3ED=S
HUM2	RM=S*RN=S*(A3ED=F+NOGH)
HUM1	RM=S*RN=S*A3ED=S
HUMF	1



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2		2
3		3
4	X5	4-5
5	X1	6-9
6	X2	10-17
7	X2	18-25
8	X3	26-49
9	X3	50-73

MODEL Name: BFNFINAL

Top Event Legend for Tree: LOCACNTMT

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Page 1

Top Event Designator.....	Top Event Description..............................
IE	Initiating Event
NCD	CORE DAMAGE OCCURRED
ODWS	OPERATOR FAILS TO INITIATE DW SPRAY
DWS	DRYWELL SPRAY UNAVAILABLE
CIL	ISOLATION OF LARGE CONTAINMENT PENETRATIONS FAILED
CIS	ISOLATION OF SMALL CONTAINMENT PENETRATIONS FAILED
RBI	REACTOR BUILDING ISOLATION FAILURE
SGT	STANDBY GAS TREATMENT SYSTEM UNAVAILABLE
HUM	SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LOCACNTMT

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Page 1

SF........	Split Fraction Logic..
	NOTAP:=-(INIT=DWT1+INIT=DWT2)
	RR12:=RHR1*RHR3+RHR1*U3=S+RHR3*U3=S
	RR11:=RHR1+RHR3+U3=S
	RR22:=RHR2*RHR4+RHR2*U1=S+RHR4*U1=S
	RR21:=RHR2+RHR4+U1=S
	HEATL:=(RHR1+RHR2+RHR3+RHR4+U1=S+U3=S)*OSP=S*(SP=S+SPR=S)
	HEAT:=(RHR1+RHR2+RHR3+RHR4+U1=S+U3=S)*(OSP=S*(SP=S+SPR=S)+OSD=S*SDC =S)
	AHEAT:=RR12*RR21+RR11*RR22
	NOLOCA:=-(INIT=LLS+INIT=LLD+INIT=LLC+INIT=LLO+INIT=ELOCA)
	VENT:=OLP=S*VNT=S
	SIG:=LVP=S+DWP=S
NCDF	INIT=ELOCA
NCD1	(INIT=LLS+INIT=LLD+INIT=LLC+INIT=LLO)*RPS=S*(TB=S+IVC=S)*(CS=S+LPC= S)*HEATL
NCDF	1
ODWS1	RPS=S
ODWS2	RPS=F
ODWS2	1
DWSF	PX1=F*PX2=F+(-RR11+RH=F+NOGB)*(-RR21+RI=F+NOGD)+SP=F*SPR=F
DWS2	-RR11+RH=F+-RR21+RI=F
DWS1	PX1=S*PX2=S*RR11*RH=S*RR21*RI=S
DWSF	1
CILF	LVP=F*DWP=F
CIL2	PCA=F+DN=F
CIL1	1
CISF	LVP=F*DWP=F

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LOCACNTMT

11:21:18 13 AUG 1992
Page 2

SF........	Split Fraction Logic..
CIS1	1
RBIF	LVP=F*DWP=F
RBI1	1
SGTF	RM=F*RN=F+RN=F*A3ED=F+RM=F*A3ED=F+DN=F*DO=F+AA=F*DM=F +RM=F*(DO=F+DM=F)+RN=F*(DN=F+AA=F)+-SIG +NOGD*(NOGA+NOGH+NOGB*NOGF+NOGB+NOGC+NOGE) +NOGA*NOGC*NOGG
SGT9	RM=F+RN=F+NOGA+NOGD
SGT8	A3ED=F*((DN=F+DO=F)*(AA=F+DM=F))+NOGB*NOGC*NOGE*NOGH
SGT6	A3ED=F*(AA=F+DM=F+DN=F+DO=F)+NOGH*(NOGA+NOGB*NOGG)
SGT5	A3ED=F+NOGH
SGT4	(DN=F+DO=F)*(AA=F+DM=F)+NOGB*NOGC*NOGE
SGT2	AA=F+DM=F+DN=F+DO=F+NOGA+NOGB*NOGG
SGT1	RM=S*RN=S*A3ED=S*DN=S*AA=S*DO=S*DM=S*SIG
SGTF	1
HUMF	A3ED=F*(RM=F+RN=F)+RM=F*RN=F+NOGH*(NOGA+NOGD)+NOGA*NOGD
HUM3	(RM=S+NOGA+RN=S+NOGD)*A3ED=S
HUM2	RM=S*RN=S*(A3ED=F+NOGH)
HUM1	RM=S*RN=S*A3ED=S
HUMF	1

MODEL Name: BFNFINAL

Binning Logic for Event Tree: LOCACNTMT

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Page 1

Bin.......	Binning Rules...
SUCCESS	NCD=S
MELT	NCD=F

MODEL N: 3FNFINAL
Event 1 LOCAPDS

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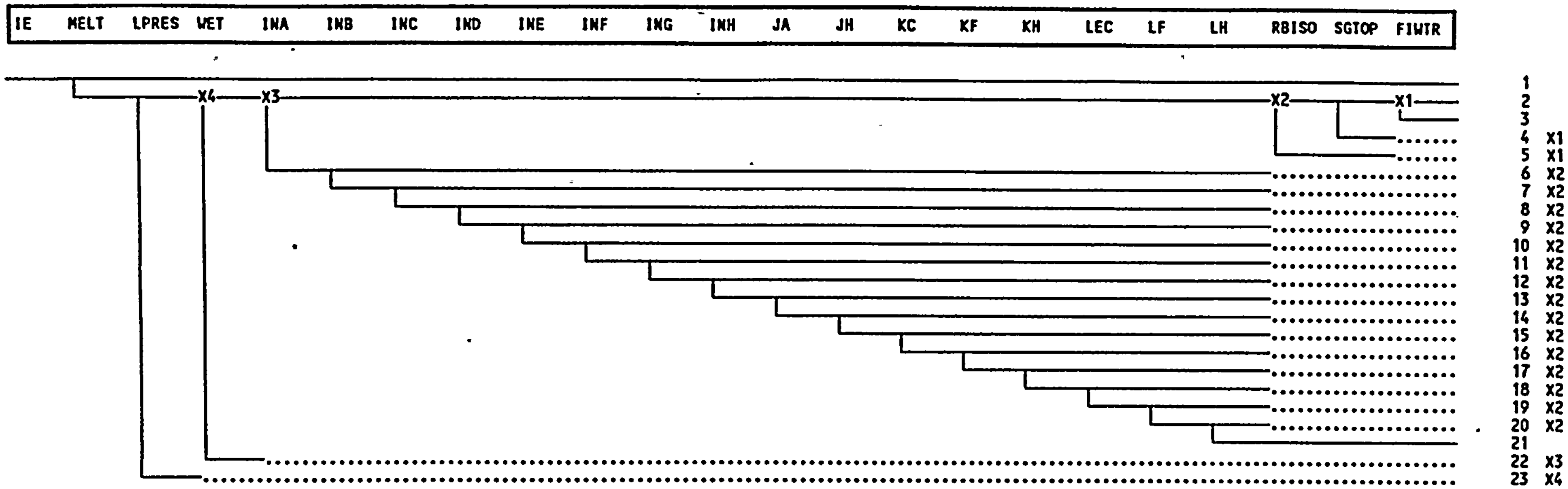

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26-31
32-37
38-43
44-49
50-55
56-61
62-67
68-73
74-79
80-85
86-91
92-97
98
99-195
196-389

MODEL Name: BFNFINAL

Top Event Legend for Tree: LOCAPDS

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Page 1

Top Event Designator.....	Top Event Description..............................
IE	Initiating Event
MELT	CORE DAMAGE HAS OCCURRED
LPRES	HIGH VESSEL PRESSURE AT MELT-THROUGH
WET	NO WATER ON DRYWELL FLOOR AT MELT-THROUGH
INA	NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
INB	NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
INC	NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
IND	NOT INTACT, WTR TO DEBRIS, NO DWS, SPC
INE	NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
INF	NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT
ING	NPT INTACT, NO WTR TO DEBRIS, VENT
INH	NOT INTACT, NO WTR TO DEBRIS, NO VENT
JA	NOT BYPASS, WTR TO DEBRIS
JH	NOT BYPASS, NO WTR TO DERBIS
KC	NOT EARLY, WTR TO DEBRIS, DWS
KF	NOT EARLY, WTR TO DEBRIS, NO DWS
KH	NOT EARLY, NO WTR TO DEBRIS, NO DWS
LEC	NOT LATE, WTR TO DEBRIS, DWS
LF	NOT LATE, WTR TO DEBRIS, NO DWS
LH	NOT LATE, NO WTR TO DEBRIS, NO DWS
RBISO	REACTOR BUILDING NOT ISOLATED
SGTOP	STANDBY GAS TREATMENT AND HUMIDIFIERS NOT OPERATING
FIWTR	FIRE WATER UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LOCAPDS

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Page 1

SF........	Split Fraction Logic...
	UATWS:=RPS=F
	LOPRESS:=-NOLOCA+INIT=NLOCA
	NOTDRY:=-NOLOCA+INIT=NLOCA+DWS=S
	BYPASS:=INIT=ILOCA
	EARLY:=UATWS+TOR=F*(-NOLOCA+INIT=NLOCA)+CIL=F+CIS=F
	LATE:=(SP=F*SPR=F+OSP=F)*(LPC=S+CS=S)
	DBCAVAIL:=LPC=S+CS=S+CRD=S+CD=S+DWS=S
MELTS	NCD=S
MELTF	1
LPRESS	LOPRESS
LPRESF	1
WETS	NOTDRY
WETF	1
INAS	-(BYPASS+EARLY+LATE)*DBCAVAIL*DWS=S*(SP=S+SPR=S)
INAF	1
INBS	-(BYPASS+EARLY+LATE)*DBCAVAIL*DWS=S*(SP=F*SPR=F+OSP=F)*VNT=S
INBF	1
INCS	-(BYPASS+EARLY+LATE)*DBCAVAIL*DWS=S*(SP=F*SPR=F+OSP=F)*VNT=F
INCF	1
INDS	-(BYPASS+EARLY+LATE)*DBCAVAIL*(CDWS=F+DWS=F)*(SP=S+SPR=S)
INDF	1
INES	-(BYPASS+EARLY+LATE)*DBCAVAIL*(CDWS=F+DWS=F)*(SP=F*SPR=F+OSP=F)*VNT=S
INEF	1
INFS	-(BYPASS+EARLY+LATE)*DBCAVAIL*(CDWS=F+DWS=F)*(SP=F*SPR=F+OSP=F)*VNT=F
INFF	1
INGS	-(BYPASS+EARLY+LATE)*-DBCAVAIL*VNT=S*(CDWS=F+DWS=F)
INGF	1
INHS	-(BYPASS+EARLY+LATE)*-DBCAVAIL*VNT=F*(CDWS=F+DWS=F)
INHF	1
JAS	BYPASS*DBCAVAIL
JAF	1
JHS	BYPASS*-DBCAVAIL

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LOCAPDS

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Page 2

SF........	Split Fraction Logic..
JHF	1
KCS	EARLY*DBCAVAIL*DWS=S
KCF	1
KFS	EARLY*DBCAVAIL*(COWS=F+DWS=F)
KFF	1
KHS	EARLY*-DBCAVAIL*(COWS=F+DWS=F)
KHF	1
LECS	LATE*DBCAVAIL*DWS=S
LECF	1
LFS	LATE*DBCAVAIL*(COWS=F+DWS=F)
LFF	1
LHS	LATE*-DBCAVAIL+(COWS=F+DWS=F)
LHF	1
RBISOS	RBI=S
RBISOF	1
SGTOPS	SGT=S*HUM=S
SGTOPF	1
FIWTRS	AI=S
FIWTRF	1

MODEL Name: BFNFINAL

Binning Logic for Event Tree: LOCAPDS

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Page 1

Bin.......	Binning Rules..
SUCCESS	MELT=S
MIAU	LPRES=F*WET=S*INA=S*RBISO=S*SGTOP=S*FIWTR=S
MIAV	LPRES=F*WET=S*INA=S*RBISO=S*SGTOP=S*FIWTR=F
MIAW	LPRES=F*WET=S*INA=S*RBISO=S*SGTOP=F*FIWTR=S
MIAX	LPRES=F*WET=S*INA=S*RBISO=S*SGTOP=F*FIWTR=F
MIAY	LPRES=F*WET=S*INA=S*RBISO=F*FIWTR=S
MIAZ	LPRES=F*WET=S*INA=S*RBISO=F*FIWTR=F
MIBU	LPRES=F*WET=S*INB=S*RBISO=S*SGTOP=S*FIWTR=S
MIBV	LPRES=F*WET=S*INB=S*RBISO=S*SGTOP=S*FIWTR=F
MIBW	LPRES=F*WET=S*INB=S*RBISO=S*SGTOP=F*FIWTR=S
MIBX	LPRES=F*WET=S*INB=S*RBISO=S*SGTOP=F*FIWTR=F
MIBY	LPRES=F*WET=S*INB=S*RBISO=F*FIWTR=S
MIBZ	LPRES=F*WET=S*INB=S*RBISO=F*FIWTR=F
MICU	LPRES=F*WET=S*INC=S*RBISO=S*SGTOP=S*FIWTR=S
MICV	LPRES=F*WET=S*INC=S*RBISO=S*SGTOP=S*FIWTR=F
MICW	LPRES=F*WET=S*INC=S*RBISO=S*SGTOP=F*FIWTR=S
MICX	LPRES=F*WET=S*INC=S*RBISO=S*SGTOP=F*FIWTR=F
MICY	LPRES=F*WET=S*INC=S*RBISO=F*FIWTR=S
MICZ	LPRES=F*WET=S*INC=S*RBISO=F*FIWTR=F
MIDU	LPRES=F*WET=S*IND=S*RBISO=S*SGTOP=S*FIWTR=S
MIDV	LPRES=F*WET=S*IND=S*RBISO=S*SGTOP=S*FIWTR=F
MIDW	LPRES=F*WET=S*IND=S*RBISO=S*SGTOP=F*FIWTR=S
MIDX	LPRES=F*WET=S*IND=S*RBISO=S*SGTOP=F*FIWTR=F
MIDY	LPRES=F*WET=S*IND=S*RBISO=F*FIWTR=S
MIDZ	LPRES=F*WET=S*IND=S*RBISO=F*FIWTR=F
MIEU	LPRES=F*WET=S*INE=S*RBISO=S*SGTOP=S*FIWTR=S
MIEV	LPRES=F*WET=S*INE=S*RBISO=S*SGTOP=S*FIWTR=F
MIEW	LPRES=F*WET=S*INE=S*RBISO=S*SGTOP=F*FIWTR=S
MIEX	LPRES=F*WET=S*INE=S*RBISO=S*SGTOP=F*FIWTR=F
MIEY	LPRES=F*WET=S*INE=S*RBISO=F*FIWTR=S
MIEZ	LPRES=F*WET=S*INE=S*RBISO=F*FIWTR=F
MIFU	LPRES=F*WET=S*INF=S*RBISO=S*SGTOP=S*FIWTR=S
MIFV	LPRES=F*WET=S*INF=S*RBISO=S*SGTOP=S*FIWTR=F

MODEL Name: BFNFINAL

Binning Logic for Event Tree: LOCAPDS

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Page 2

Bin.......	Binning Rules..
MIFW	LPRES=F*WET=S*INF=S*RBISO=S*SGTOP=F*FIWTR=S
MIFX	LPRES=F*WET=S*INF=S*RBISO=S*SGTOP=F*FIWTR=F
MIFY	LPRES=F*WET=S*INF=S*RBISO=F*FIWTR=S
MIFZ	LPRES=F*WET=S*INF=S*RBISO=F*FIWTR=F
MIGU	LPRES=F*WET=S*ING=S*RBISO=S*SGTOP=S*FIWTR=S
MIGV	LPRES=F*WET=S*ING=S*RBISO=S*SGTOP=S*FIWTR=F
MIGW	LPRES=F*WET=S*ING=S*RBISO=S*SGTOP=F*FIWTR=S
MIGX	LPRES=F*WET=S*ING=S*RBISO=S*SGTOP=F*FIWTR=F
MIGY	LPRES=F*WET=S*ING=S*RBISO=F*FIWTR=S
MIGZ	LPRES=F*WET=S*ING=S*RBISO=F*FIWTR=F
MIHU	LPRES=F*WET=S*INH=S*RBISO=S*SGTOP=S*FIWTR=S
MIHV	LPRES=F*WET=S*INH=S*RBISO=S*SGTOP=S*FIWTR=F
MIHW	LPRES=F*WET=S*INH=S*RBISO=S*SGTOP=F*FIWTR=S
MIHX	LPRES=F*WET=S*INH=S*RBISO=S*SGTOP=F*FIWTR=F
MIHY	LPRES=F*WET=S*INH=S*RBISO=F*FIWTR=S
MIHZ	LPRES=F*WET=S*INH=S*RBISO=F*FIWTR=F
MJAU	LPRES=F*WET=S*JA=S*RBISO=S*SGTOP=S*FIWTR=S
MJAV	LPRES=F*WET=S*JA=S*RBISO=S*SGTOP=S*FIWTR=F
MJAW	LPRES=F*WET=S*JA=S*RBISO=S*SGTOP=F*FIWTR=S
MJAX	LPRES=F*WET=S*JA=S*RBISO=S*SGTOP=F*FIWTR=F
MJAY	LPRES=F*WET=S*JA=S*RBISO=F*FIWTR=S
MJAZ	LPRES=F*WET=S*JA=S*RBISO=F*FIWTR=F
MJHU	LPRES=F*WET=S*JH=S*RBISO=S*SGTOP=S*FIWTR=S
MJHV	LPRES=F*WET=S*JH=S*RBISO=S*SGTOP=S*FIWTR=F
MJHW	LPRES=F*WET=S*JH=S*RBISO=S*SGTOP=F*FIWTR=S
MJHX	LPRES=F*WET=S*JH=S*RBISO=S*SGTOP=F*FIWTR=F
MJHY	LPRES=F*WET=S*JH=S*RBISO=F*FIWTR=S
MJHZ	LPRES=F*WET=S*JH=S*RBISO=F*FIWTR=F
MKCU	LPRES=F*WET=S*KC=S*RBISO=S*SGTOP=S*FIWTR=S
MKCV	LPRES=F*WET=S*KC=S*RBISO=S*SGTOP=S*FIWTR=F
MKCW	LPRES=F*WET=S*KC=S*RBISO=S*SGTOP=F*FIWTR=S
MKCX	LPRES=F*WET=S*KC=S*RBISO=S*SGTOP=F*FIWTR=F
MKCY	LPRES=F*WET=S*KC=S*RBISO=F*FIWTR=S

MODEL Name: BFNFINAL

Binning Logic for Event Tree: LOCAPDS

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Page 3

Bin.......	Binning Rules..
MKCZ	LPRES=F*WET=S*KC=S*RBISO=F*FIWTR=F
MKFU	LPRES=F*WET=S*KF=S*RBISO=S*SGTOP=S*FIWTR=S
MKFV	LPRES=F*WET=S*KF=S*RBISO=S*SGTOP=S*FIWTR=F
MKFW	LPRES=F*WET=S*KF=S*RBISO=S*SGTOP=F*FIWTR=S
MKFX	LPRES=F*WET=S*KF=S*RBISO=S*SGTOP=F*FIWTR=F
MKFY	LPRES=F*WET=S*KF=S*RBISO=F*FIWTR=S
MKFZ	LPRES=F*WET=S*KF=S*RBISO=F*FIWTR=F
MKHU	LPRES=F*WET=S*KH=S*RBISO=S*SGTOP=S*FIWTR=S
MKHV	LPRES=F*WET=S*KH=S*RBISO=S*SGTOP=S*FIWTR=F
MKHW	LPRES=F*WET=S*KH=S*RBISO=S*SGTOP=F*FIWTR=S
MKHX	LPRES=F*WET=S*KH=S*RBISO=S*SGTOP=F*FIWTR=F
MKHY	LPRES=F*WET=S*KH=S*RBISO=F*FIWTR=S
MKHZ	LPRES=F*WET=S*KH=S*RBISO=F*FIWTR=F
MLCU	LPRES=F*WET=S*LEC=S*RBISO=S*SGTOP=S*FIWTR=S
MLCV	LPRES=F*WET=S*LEC=S*RBISO=S*SGTOP=S*FIWTR=F
MLCW	LPRES=F*WET=S*LEC=S*RBISO=S*SGTOP=F*FIWTR=S
MLCX	LPRES=F*WET=S*LEC=S*RBISO=S*SGTOP=F*FIWTR=F
MLCY	LPRES=F*WET=S*LEC=S*RBISO=F*FIWTR=S
MLCZ	LPRES=F*WET=S*LEC=S*RBISO=F*FIWTR=F
MLFU	LPRES=F*WET=S*LF=S*RBISO=S*SGTOP=S*FIWTR=S
MLFV	LPRES=F*WET=S*LF=S*RBISO=S*SGTOP=S*FIWTR=F
MLFW	LPRES=F*WET=S*LF=S*RBISO=S*SGTOP=F*FIWTR=S
MLFX	LPRES=F*WET=S*LF=S*RBISO=S*SGTOP=F*FIWTR=F
MLFY	LPRES=F*WET=S*LF=S*RBISO=F*FIWTR=S
MLFZ	LPRES=F*WET=S*LF=S*RBISO=F*FIWTR=F
MLHU	LPRES=F*WET=S*LH=S*RBISO=S*SGTOP=S*FIWTR=S
MLHV	LPRES=F*WET=S*LH=S*RBISO=S*SGTOP=S*FIWTR=F
MLHW	LPRES=F*WET=S*LH=S*RBISO=S*SGTOP=F*FIWTR=S
MLHX	LPRES=F*WET=S*LH=S*RBISO=S*SGTOP=F*FIWTR=F
MLHY	LPRES=F*WET=S*LH=S*RBISO=F*FIWTR=S
MLHZ	LPRES=F*WET=S*LH=S*RBISO=F*FIWTR=F
NIAU	LPRES=F*WET=F*INA=S*RBISO=S*SGTOP=S*FIWTR=S
NIAV	LPRES=F*WET=F*INA=S*RBISO=S*SGTOP=S*FIWTR=F

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Bin.......	Binning Rules..
NIAW	LPRES=F*WET=F*INA=S*RBISO=S*SGTOP=F*FIWTR=S
NIAX	LPRES=F*WET=F*INA=S*RBISO=S*SGTOP=F*FIWTR=F
NIAY	LPRES=F*WET=F*INA=S*RBISO=F*FIWTR=S
NIAZ	LPRES=F*WET=F*INA=S*RBISO=F*FIWTR=F
NIBU	LPRES=F*WET=F*INB=S*RBISO=S*SGTOP=S*FIWTR=S
NIBV	LPRES=F*WET=F*INB=S*RBISO=S*SGTOP=S*FIWTR=F
NIBW	LPRES=F*WET=F*INB=S*RBISO=S*SGTOP=F*FIWTR=S
NIBX	LPRES=F*WET=F*INB=S*RBISO=S*SGTOP=F*FIWTR=F
NIBY	LPRES=F*WET=F*INB=S*RBISO=F*FIWTR=S
NIBZ	LPRES=F*WET=F*INB=S*RBISO=F*FIWTR=F
NICU	LPRES=F*WET=F*INC=S*RBISO=S*SGTOP=S*FIWTR=S
NICV	LPRES=F*WET=F*INC=S*RBISO=S*SGTOP=S*FIWTR=F
NICW	LPRES=F*WET=F*INC=S*RBISO=S*SGTOP=F*FIWTR=S
NICX	LPRES=F*WET=F*INC=S*RBISO=S*SGTOP=F*FIWTR=F
NICY	LPRES=F*WET=F*INC=S*RBISO=F*FIWTR=S
NICZ	LPRES=F*WET=F*INC=S*RBISO=F*FIWTR=F
NIDU	LPRES=F*WET=F*IND=S*RBISO=S*SGTOP=S*FIWTR=S
NIDV	LPRES=F*WET=F*IND=S*RBISO=S*SGTOP=S*FIWTR=F
NIDW	LPRES=F*WET=F*IND=S*RBISO=S*SGTOP=F*FIWTR=S
NIDX	LPRES=F*WET=F*IND=S*RBISO=S*SGTOP=F*FIWTR=F
NIDY	LPRES=F*WET=F*IND=S*RBISO=F*FIWTR=S
NIDZ	LPRES=F*WET=F*IND=S*RBISO=F*FIWTR=F
NIEU	LPRES=F*WET=F*INE=S*RBISO=S*SGTOP=S*FIWTR=S
NIEV	LPRES=F*WET=F*INE=S*RBISO=S*SGTOP=S*FIWTR=F
NIEW	LPRES=F*WET=F*INE=S*RBISO=S*SGTOP=F*FIWTR=S
NIEX	LPRES=F*WET=F*INE=S*RBISO=S*SGTOP=F*FIWTR=F
NIEY	LPRES=F*WET=F*INE=S*RBISO=F*FIWTR=S
NIEZ	LPRES=F*WET=F*INE=S*RBISO=F*FIWTR=F
NIFU	LPRES=F*WET=F*INF=S*RBISO=S*SGTOP=S*FIWTR=S
NIFV	LPRES=F*WET=F*INF=S*RBISO=S*SGTOP=S*FIWTR=F
NIFW	LPRES=F*WET=F*INF=S*RBISO=S*SGTOP=F*FIWTR=S
NIFX	LPRES=F*WET=F*INF=S*RBISO=S*SGTOP=F*FIWTR=F
NIFY	LPRES=F*WET=F*INF=S*RBISO=F*FIWTR=S

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Bin.......	Binning Rules..
NIFZ	LPRES=F*WET=F*INF=S*RBISO=F*FIWTR=F
NIGU	LPRES=F*WET=F*ING=S*RBISO=S*SGTOP=S*FIWTR=S
NIGV	LPRES=F*WET=F*ING=S*RBISO=S*SGTOP=S*FIWTR=F
NIGW	LPRES=F*WET=F*ING=S*RBISO=S*SGTOP=F*FIWTR=S
NIGX	LPRES=F*WET=F*ING=S*RBISO=S*SGTOP=F*FIWTR=F
NIGY	LPRES=F*WET=F*ING=S*RBISO=F*FIWTR=S
NIGZ	LPRES=F*WET=F*ING=S*RBISO=F*FIWTR=F
NIHU	LPRES=F*WET=F*INH=S*RBISO=S*SGTOP=S*FIWTR=S
NIHV	LPRES=F*WET=F*INH=S*RBISO=S*SGTOP=S*FIWTR=F
NIHW	LPRES=F*WET=F*INH=S*RBISO=S*SGTOP=F*FIWTR=S
NIHX	LPRES=F*WET=F*INH=S*RBISO=S*SGTOP=F*FIWTR=F
NIHY	LPRES=F*WET=F*INH=S*RBISO=F*FIWTR=S
NIHZ	LPRES=F*WET=F*INH=S*RBISO=F*FIWTR=F
NJAU	LPRES=F*WET=F*JA=S*RBISO=S*SGTOP=S*FIWTR=S
NJAV	LPRES=F*WET=F*JA=S*RBISO=S*SGTOP=S*FIWTR=F
NJAW	LPRES=F*WET=F*JA=S*RBISO=S*SGTOP=F*FIWTR=S
NJAX	LPRES=F*WET=F*JA=S*RBISO=S*SGTOP=F*FIWTR=F
NJAY	LPRES=F*WET=F*JA=S*RBISO=F*FIWTR=S
NJAZ	LPRES=F*WET=F*JA=S*RBISO=F*FIWTR=F
NJHU	LPRES=F*WET=F*JH=S*RBISO=S*SGTOP=S*FIWTR=S
NJHV	LPRES=F*WET=F*JH=S*RBISO=S*SGTOP=S*FIWTR=F
NJHW	LPRES=F*WET=F*JH=S*RBISO=S*SGTOP=F*FIWTR=S
NJHX	LPRES=F*WET=F*JH=S*RBISO=S*SGTOP=F*FIWTR=F
NJHY	LPRES=F*WET=F*JH=S*RBISO=F*FIWTR=S
NJHZ	LPRES=F*WET=F*JH=S*RBISO=F*FIWTR=F
NKCU	LPRES=F*WET=F*KC=S*RBISO=S*SGTOP=S*FIWTR=S
NKCV	LPRES=F*WET=F*KC=S*RBISO=S*SGTOP=S*FIWTR=F
NKCW	LPRES=F*WET=F*KC=S*RBISO=S*SGTOP=F*FIWTR=S
NKCX	LPRES=F*WET=F*KC=S*RBISO=S*SGTOP=F*FIWTR=F
NKCY	LPRES=F*WET=F*KC=S*RBISO=F*FIWTR=S
NKCZ	LPRES=F*WET=F*KC=S*RBISO=F*FIWTR=F
NKFU	LPRES=F*WET=F*KF=S*RBISO=S*SGTOP=S*FIWTR=S
NKFV	LPRES=F*WET=F*KF=S*RBISO=S*SGTOP=S*FIWTR=F

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Bin.......	Binning Rules..
NKFW	LPRES=F*WET=F*KF=S*RBISO=S*SGTOP=F*FIWTR=S
NKFX	LPRES=F*WET=F*KF=S*RBISO=S*SGTOP=F*FIWTR=F
NKFY	LPRES=F*WET=F*KF=S*RBISO=F*FIWTR=S
NKFZ	LPRES=F*WET=F*KF=S*RBISO=F*FIWTR=F
NKHU	LPRES=F*WET=F*KH=S*RBISO=S*SGTOP=S*FIWTR=S
NKHV	LPRES=F*WET=F*KH=S*RBISO=S*SGTOP=S*FIWTR=F
NKHW	LPRES=F*WET=F*KH=S*RBISO=S*SGTOP=F*FIWTR=S
NKHX	LPRES=F*WET=F*KH=S*RBISO=S*SGTOP=F*FIWTR=F
NKHY	LPRES=F*WET=F*KH=S*RBISO=F*FIWTR=S
NKHZ	LPRES=F*WET=F*KH=S*RBISO=F*FIWTR=F
NLCU	LPRES=F*WET=F*LEC=S*RBISO=S*SGTOP=S*FIWTR=S
NLCV	LPRES=F*WET=F*LEC=S*RBISO=S*SGTOP=S*FIWTR=F
NLCW	LPRES=F*WET=F*LEC=S*RBISO=S*SGTOP=F*FIWTR=S
NLCX	LPRES=F*WET=F*LEC=S*RBISO=S*SGTOP=F*FIWTR=F
NLCY	LPRES=F*WET=F*LEC=S*RBISO=F*FIWTR=S
NLCZ	LPRES=F*WET=F*LEC=S*RBISO=F*FIWTR=F
NLFU	LPRES=F*WET=F*LF=S*RBISO=S*SGTOP=S*FIWTR=S
NLFV	LPRES=F*WET=F*LF=S*RBISO=S*SGTOP=S*FIWTR=F
NLFW	LPRES=F*WET=F*LF=S*RBISO=S*SGTOP=F*FIWTR=S
NLFX	LPRES=F*WET=F*LF=S*RBISO=S*SGTOP=F*FIWTR=F
NLFY	LPRES=F*WET=F*LF=S*RBISO=F*FIWTR=S
NLFZ	LPRES=F*WET=F*LF=S*RBISO=F*FIWTR=F
NLHU	LPRES=F*WET=F*LH=S*RBISO=S*SGTOP=S*FIWTR=S
NLHV	LPRES=F*WET=F*LH=S*RBISO=S*SGTOP=S*FIWTR=F
NLHW	LPRES=F*WET=F*LH=S*RBISO=S*SGTOP=F*FIWTR=S
NLHX	LPRES=F*WET=F*LH=S*RBISO=S*SGTOP=F*FIWTR=F
NLHY	LPRES=F*WET=F*LH=S*RBISO=F*FIWTR=S
NLHZ	LPRES=F*WET=F*LH=S*RBISO=F*FIWTR=F
OIAU	LPRES=S*WET=S*INA=S*RBISO=S*SGTOP=S*FIWTR=S
OIAV	LPRES=S*WET=S*INA=S*RBISO=S*SGTOP=S*FIWTR=F
OIAW	LPRES=S*WET=S*INA=S*RBISO=S*SGTOP=F*FIWTR=S
OIAX	LPRES=S*WET=S*INA=S*RBISO=S*SGTOP=F*FIWTR=F
OIAY	LPRES=S*WET=S*INA=S*RBISO=F*FIWTR=S

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Bin.......	Binning Rules..
OIAZ	LPRES=S*WET=S*INA=S*RBISO=F*FIWTR=F
OIBU	LPRES=S*WET=S*INB=S*RBISO=S*SGTOP=S*FIWTR=S
OIBV	LPRES=S*WET=S*INB=S*RBISO=S*SGTOP=S*FIWTR=F
OIBW	LPRES=S*WET=S*INB=S*RBISO=S*SGTOP=F*FIWTR=S
OIBX	LPRES=S*WET=S*INB=S*RBISO=S*SGTOP=F*FIWTR=F
OIBY	LPRES=S*WET=S*INB=S*RBISO=F*FIWTR=S
OIBZ	LPRES=S*WET=S*INB=S*RBISO=F*FIWTR=F
OICU	LPRES=S*WET=S*INC=S*RBISO=S*SGTOP=S*FIWTR=S
OICV	LPRES=S*WET=S*INC=S*RBISO=S*SGTOP=S*FIWTR=F
OICW	LPRES=S*WET=S*INC=S*RBISO=S*SGTOP=F*FIWTR=S
OICX	LPRES=S*WET=S*INC=S*RBISO=S*SGTOP=F*FIWTR=F
OICY	LPRES=S*WET=S*INC=S*RBISO=F*FIWTR=S
OICZ	LPRES=S*WET=S*INC=S*RBISO=F*FIWTR=F
OIDU	LPRES=S*WET=S*IND=S*RBISO=S*SGTOP=S*FIWTR=S
OIDV	LPRES=S*WET=S*IND=S*RBISO=S*SGTOP=S*FIWTR=F
OIDW	LPRES=S*WET=S*IND=S*RBISO=S*SGTOP=F*FIWTR=S
OIDX	LPRES=S*WET=S*IND=S*RBISO=S*SGTOP=F*FIWTR=F
OIDY	LPRES=S*WET=S*IND=S*RBISO=F*FIWTR=S
OIDZ	LPRES=S*WET=S*IND=S*RBISO=F*FIWTR=F
OIEU	LPRES=S*WET=S*INE=S*RBISO=S*SGTOP=S*FIWTR=S
OIEV	LPRES=S*WET=S*INE=S*RBISO=S*SGTOP=S*FIWTR=F
OIEW	LPRES=S*WET=S*INE=S*RBISO=S*SGTOP=F*FIWTR=S
OIEX	LPRES=S*WET=S*INE=S*RBISO=S*SGTOP=F*FIWTR=F
OIEY	LPRES=S*WET=S*INE=S*RBISO=F*FIWTR=S
OIEZ	LPRES=S*WET=S*INE=S*RBISO=F*FIWTR=F
OIFU	LPRES=S*WET=S*INF=S*RBISO=S*SGTOP=S*FIWTR=S
OIFV	LPRES=S*WET=S*INF=S*RBISO=S*SGTOP=S*FIWTR=F
OIFW	LPRES=S*WET=S*INF=S*RBISO=S*SGTOP=F*FIWTR=S
OIFX	LPRES=S*WET=S*INF=S*RBISO=S*SGTOP=F*FIWTR=F
OIFY	LPRES=S*WET=S*INF=S*RBISO=F*FIWTR=S
OIFZ	LPRES=S*WET=S*INF=S*RBISO=F*FIWTR=F
OIGU	LPRES=S*WET=S*ING=S*RBISO=S*SGTOP=S*FIWTR=S
OIGV	LPRES=S*WET=S*ING=S*RBISO=S*SGTOP=S*FIWTR=F

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Bin.......	Binning Rules..
OIGW	LPRES=S*WET=S*ING=S*RBISO=S*SGTOP=F*FIWTR=S
OIGX	LPRES=S*WET=S*ING=S*RBISO=S*SGTOP=F*FIWTR=F
OIGY	LPRES=S*WET=S*ING=S*RBISO=F*FIWTR=S
OIGZ	LPRES=S*WET=S*ING=S*RBISO=F*FIWTR=F
OIHU	LPRES=S*WET=S*INH=S*RBISO=S*SGTOP=S*FIWTR=S
OIHV	LPRES=S*WET=S*INH=S*RBISO=S*SGTOP=S*FIWTR=F
OIHW	LPRES=S*WET=S*INH=S*RBISO=S*SGTOP=F*FIWTR=S
OIHX	LPRES=S*WET=S*INH=S*RBISO=S*SGTOP=F*FIWTR=F
OIHY	LPRES=S*WET=S*INH=S*RBISO=F*FIWTR=S
OIHZ	LPRES=S*WET=S*INH=S*RBISO=F*FIWTR=F
OJAU	LPRES=S*WET=S*JA=S*RBISO=S*SGTOP=S*FIWTR=S
OJAV	LPRES=S*WET=S*JA=S*RBISO=S*SGTOP=S*FIWTR=F
OJAW	LPRES=S*WET=S*JA=S*RBISO=S*SGTOP=F*FIWTR=S
OJAX	LPRES=S*WET=S*JA=S*RBISO=S*SGTOP=F*FIWTR=F
OJAY	LPRES=S*WET=S*JA=S*RBISO=F*FIWTR=S
OJAZ	LPRES=S*WET=S*JA=S*RBISO=F*FIWTR=F
OJHU	LPRES=S*WET=S*JH=S*RBISO=S*SGTOP=S*FIWTR=S
OJHV	LPRES=S*WET=S*JH=S*RBISO=S*SGTOP=S*FIWTR=F
OJHW	LPRES=S*WET=S*JH=S*RBISO=S*SGTOP=F*FIWTR=S
OJHX	LPRES=S*WET=S*JH=S*RBISO=S*SGTOP=F*FIWTR=F
OJHY	LPRES=S*WET=S*JH=S*RBISO=F*FIWTR=S
OJHZ	LPRES=S*WET=S*JH=S*RBISO=F*FIWTR=F
OKCU	LPRES=S*WET=S*KC=S*RBISO=S*SGTOP=S*FIWTR=S
OKCV	LPRES=S*WET=S*KC=S*RBISO=S*SGTOP=S*FIWTR=F
OKCW	LPRES=S*WET=S*KC=S*RBISO=S*SGTOP=F*FIWTR=S
OKCX	LPRES=S*WET=S*KC=S*RBISO=S*SGTOP=F*FIWTR=F
OKCY	LPRES=S*WET=S*KC=S*RBISO=F*FIWTR=S
OKCZ	LPRES=S*WET=S*KC=S*RBISO=F*FIWTR=F
OKFU	LPRES=S*WET=S*KF=S*RBISO=S*SGTOP=S*FIWTR=S
OKFV	LPRES=S*WET=S*KF=S*RBISO=S*SGTOP=S*FIWTR=F
OKFW	LPRES=S*WET=S*KF=S*RBISO=S*SGTOP=F*FIWTR=S
OKFX	LPRES=S*WET=S*KF=S*RBISO=S*SGTOP=F*FIWTR=F
OKFY	LPRES=S*WET=S*KF=S*RBISO=F*FIWTR=S

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Bin.......	Binning Rules..
OKFZ	LPRES=S*WET=S*KF=S*RBISO=F*FIWTR=F
OKHU	LPRES=S*WET=S*KH=S*RBISO=S*SGTOP=S*FIWTR=S
OKHV	LPRES=S*WET=S*KH=S*RBISO=S*SGTOP=S*FIWTR=F
OKHW	LPRES=S*WET=S*KH=S*RBISO=S*SGTOP=F*FIWTR=S
OKHX	LPRES=S*WET=S*KH=S*RBISO=S*SGTOP=F*FIWTR=F
OKHY	LPRES=S*WET=S*KH=S*RBISO=F*FIWTR=S
OKHZ	LPRES=S*WET=S*KH=S*RBISO=F*FIWTR=F
OLCU	LPRES=S*WET=S*LEC=S*RBISO=S*SGTOP=S*FIWTR=S
OLCV	LPRES=S*WET=S*LEC=S*RBISO=S*SGTOP=S*FIWTR=F
OLCW	LPRES=S*WET=S*LEC=S*RBISO=S*SGTOP=F*FIWTR=S
OLCX	LPRES=S*WET=S*LEC=S*RBISO=S*SGTOP=F*FIWTR=F
OLCY	LPRES=S*WET=S*LEC=S*RBISO=F*FIWTR=S
OLCZ	LPRES=S*WET=S*LEC=S*RBISO=F*FIWTR=F
OLFU	LPRES=S*WET=S*LF=S*RBISO=S*SGTOP=S*FIWTR=S
OLFV	LPRES=S*WET=S*LF=S*RBISO=S*SGTOP=S*FIWTR=F
OLFW	LPRES=S*WET=S*LF=S*RBISO=S*SGTOP=F*FIWTR=S
OLFX	LPRES=S*WET=S*LF=S*RBISO=S*SGTOP=F*FIWTR=F
OLFY	LPRES=S*WET=S*LF=S*RBISO=F*FIWTR=S
OLFZ	LPRES=S*WET=S*LF=S*RBISO=F*FIWTR=F
OLHU	LPRES=S*WET=S*LH=S*RBISO=S*SGTOP=S*FIWTR=S
OLHV	LPRES=S*WET=S*LH=S*RBISO=S*SGTOP=S*FIWTR=F
OLHW	LPRES=S*WET=S*LH=S*RBISO=S*SGTOP=F*FIWTR=S
OLHX	LPRES=S*WET=S*LH=S*RBISO=S*SGTOP=F*FIWTR=F
OLHY	LPRES=S*WET=S*LH=S*RBISO=F*FIWTR=S
OLHZ	LPRES=S*WET=S*LH=S*RBISO=F*FIWTR=F
PIAU	LPRES=S*WET=F*INA=S*RBISO=S*SGTOP=S*FIWTR=S
PIAV	LPRES=S*WET=F*INA=S*RBISO=S*SGTOP=S*FIWTR=F
PIAW	LPRES=S*WET=F*INA=S*RBISO=S*SGTOP=F*FIWTR=S
PIAX	LPRES=S*WET=F*INA=S*RBISO=S*SGTOP=F*FIWTR=F
PIAY	LPRES=S*WET=F*INA=S*RBISO=F*FIWTR=S
PIAZ	LPRES=S*WET=F*INA=S*RBISO=F*FIWTR=F
PIBU	LPRES=S*WET=F*INB=S*RBISO=S*SGTOP=S*FIWTR=S
PIBV	LPRES=S*WET=F*INB=S*RBISO=S*SGTOP=S*FIWTR=F

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Bin.......	Binning Rules...
PIBW	LPRES=S*WET=F*INB=S*RBISO=S*SGTOP=F*FIWTR=S
PIBX	LPRES=S*WET=F*INB=S*RBISO=S*SGTOP=F*FIWTR=F
PIBY	LPRES=S*WET=F*INB=S*RBISO=F*FIWTR=S
PIBZ	LPRES=S*WET=F*INB=S*RBISO=F*FIWTR=F
PICU	LPRES=S*WET=F*INC=S*RBISO=S*SGTOP=S*FIWTR=S
PICV	LPRES=S*WET=F*INC=S*RBISO=S*SGTOP=S*FIWTR=F
PICW	LPRES=S*WET=F*INC=S*RBISO=S*SGTOP=F*FIWTR=S
PICX	LPRES=S*WET=F*INC=S*RBISO=S*SGTOP=F*FIWTR=F
PICY	LPRES=S*WET=F*INC=S*RBISO=F*FIWTR=S
PICZ	LPRES=S*WET=F*INC=S*RBISO=F*FIWTR=F
PIDU	LPRES=S*WET=F*IND=S*RBISO=S*SGTOP=S*FIWTR=S
PIDV	LPRES=S*WET=F*IND=S*RBISO=S*SGTOP=S*FIWTR=F
PIDW	LPRES=S*WET=F*IND=S*RBISO=S*SGTOP=F*FIWTR=S
PIDX	LPRES=S*WET=F*IND=S*RBISO=S*SGTOP=F*FIWTR=F
PIDY	LPRES=S*WET=F*IND=S*RBISO=F*FIWTR=S
PIDZ	LPRES=S*WET=F*IND=S*RBISO=F*FIWTR=F
PIEU	LPRES=S*WET=F*INE=S*RBISO=S*SGTOP=S*FIWTR=S
PIEV	LPRES=S*WET=F*INE=S*RBISO=S*SGTOP=S*FIWTR=F
PIEW	LPRES=S*WET=F*INE=S*RBISO=S*SGTOP=F*FIWTR=S
PIEX	LPRES=S*WET=F*INE=S*RBISO=S*SGTOP=F*FIWTR=F
PIEY	LPRES=S*WET=F*INE=S*RBISO=F*FIWTR=S
PIEZ	LPRES=S*WET=F*INE=S*RBISO=F*FIWTR=F
PIFU	LPRES=S*WET=F*INF=S*RBISO=S*SGTOP=S*FIWTR=S
PIFV	LPRES=S*WET=F*INF=S*RBISO=S*SGTOP=S*FIWTR=F
PIFW	LPRES=S*WET=F*INF=S*RBISO=S*SGTOP=F*FIWTR=S
PIFX	LPRES=S*WET=F*INF=S*RBISO=S*SGTOP=F*FIWTR=F
PIFY	LPRES=S*WET=F*INF=S*RBISO=F*FIWTR=S
PIFZ	LPRES=S*WET=F*INF=S*RBISO=F*FIWTR=F
PIGU	LPRES=S*WET=F*ING=S*RBISO=S*SGTOP=S*FIWTR=S
PIGV	LPRES=S*WET=F*ING=S*RBISO=S*SGTOP=S*FIWTR=F
PIGW	LPRES=S*WET=F*ING=S*RBISO=S*SGTOP=F*FIWTR=S
PIGX	LPRES=S*WET=F*ING=S*RBISO=S*SGTOP=F*FIWTR=F
PIGY	LPRES=S*WET=F*ING=S*RBISO=F*FIWTR=S

MODEL Name: BFNFINAL

Binning Logic for Event Tree: LOCAPDS

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Bin.......	Binning Rules..
PIGZ	LPRES=S*WET=F*ING=S*RBISO=F*FIWTR=F
PIHU	LPRES=S*WET=F*INH=S*RBISO=S*SGTOP=S*FIWTR=S
PIHV	LPRES=S*WET=F*INH=S*RBISO=S*SGTOP=S*FIWTR=F
PIHW	LPRES=S*WET=F*INH=S*RBISO=S*SGTOP=F*FIWTR=S
PIHX	LPRES=S*WET=F*INH=S*RBISO=S*SGTOP=F*FIWTR=F
PIHY	LPRES=S*WET=F*INH=S*RBISO=F*FIWTR=S
PIHZ	LPRES=S*WET=F*INH=S*RBISO=F*FIWTR=F
PJAU	LPRES=S*WET=F*JA=S*RBISO=S*SGTOP=S*FIWTR=S
PJAV	LPRES=S*WET=F*JA=S*RBISO=S*SGTOP=S*FIWTR=F
PJAW	LPRES=S*WET=F*JA=S*RBISO=S*SGTOP=F*FIWTR=S
PJAX	LPRES=S*WET=F*JA=S*RBISO=S*SGTOP=F*FIWTR=F
PJAY	LPRES=S*WET=F*JA=S*RBISO=F*FIWTR=S
PJAZ	LPRES=S*WET=F*JA=S*RBISO=F*FIWTR=F
PJHU	LPRES=S*WET=F*JH=S*RBISO=S*SGTOP=S*FIWTR=S
PJHV	LPRES=S*WET=F*JH=S*RBISO=S*SGTOP=S*FIWTR=F
PJHW	LPRES=S*WET=F*JH=S*RBISO=S*SGTOP=F*FIWTR=S
PJHX	LPRES=S*WET=F*JH=S*RBISO=S*SGTOP=F*FIWTR=F
PJHY	LPRES=S*WET=F*JH=S*RBISO=F*FIWTR=S
PJHZ	LPRES=S*WET=F*JH=S*RBISO=F*FIWTR=F
PKCU	LPRES=S*WET=F*KC=S*RBISO=S*SGTOP=S*FIWTR=S
PKCV	LPRES=S*WET=F*KC=S*RBISO=S*SGTOP=S*FIWTR=F
PKCW	LPRES=S*WET=F*KC=S*RBISO=S*SGTOP=F*FIWTR=S
PKCX	LPRES=S*WET=F*KC=S*RBISO=S*SGTOP=F*FIWTR=F
PKCY	LPRES=S*WET=F*KC=S*RBISO=F*FIWTR=S
PKCZ	LPRES=S*WET=F*KC=S*RBISO=F*FIWTR=F
PKFU	LPRES=S*WET=F*KF=S*RBISO=S*SGTOP=S*FIWTR=S
PKFV	LPRES=S*WET=F*KF=S*RBISO=S*SGTOP=S*FIWTR=F
PKFW	LPRES=S*WET=F*KF=S*RBISO=S*SGTOP=F*FIWTR=S
PKFX	LPRES=S*WET=F*KF=S*RBISO=S*SGTOP=F*FIWTR=F
PKFY	LPRES=S*WET=F*KF=S*RBISO=F*FIWTR=S
PKFZ	LPRES=S*WET=F*KF=S*RBISO=F*FIWTR=F
PKHU	LPRES=S*WET=F*KH=S*RBISO=S*SGTOP=S*FIWTR=S
PKHV	LPRES=S*WET=F*KH=S*RBISO=S*SGTOP=S*FIWTR=F

MODEL Name: BFNFINAL

Binning Logic for Event Tree: LOCAPDS

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Bin.......	Binning Rules..
PKHW	LPRES=S*WET=F*KH=S*RBISO=S*SGTOP=F*FIWTR=S
PKHX	LPRES=S*WET=F*KH=S*RBISO=S*SGTOP=F*FIWTR=F
PKHY	LPRES=S*WET=F*KH=S*RBISO=F*FIWTR=S
PKHZ	LPRES=S*WET=F*KH=S*RBISO=F*FIWTR=F
PLCU	LPRES=S*WET=F*LEC=S*RBISO=S*SGTOP=S*FIWTR=S
PLCV	LPRES=S*WET=F*LEC=S*RBISO=S*SGTOP=S*FIWTR=F
PLCW	LPRES=S*WET=F*LEC=S*RBISO=S*SGTOP=F*FIWTR=S
PLCX	LPRES=S*WET=F*LEC=S*RBISO=S*SGTOP=F*FIWTR=F
PLCY	LPRES=S*WET=F*LEC=S*RBISO=F*FIWTR=S
PLCZ	LPRES=S*WET=F*LEC=S*RBISO=F*FIWTR=F
PLFU	LPRES=S*WET=F*LF=S*RBISO=S*SGTOP=S*FIWTR=S
PLFV	LPRES=S*WET=F*LF=S*RBISO=S*SGTOP=S*FIWTR=F
PLFW	LPRES=S*WET=F*LF=S*RBISO=S*SGTOP=F*FIWTR=S
PLFX	LPRES=S*WET=F*LF=S*RBISO=S*SGTOP=F*FIWTR=F
PLFY	LPRES=S*WET=F*LF=S*RBISO=F*FIWTR=S
PLFZ	LPRES=S*WET=F*LF=S*RBISO=F*FIWTR=F
PLHU	LPRES=S*WET=F*LH=S*RBISO=S*SGTOP=S*FIWTR=S
PLHV	LPRES=S*WET=F*LH=S*RBISO=S*SGTOP=S*FIWTR=F
PLHW	LPRES=S*WET=F*LH=S*RBISO=S*SGTOP=F*FIWTR=S
PLHX	LPRES=S*WET=F*LH=S*RBISO=S*SGTOP=F*FIWTR=F
PLHY	LPRES=S*WET=F*LH=S*RBISO=F*FIWTR=S
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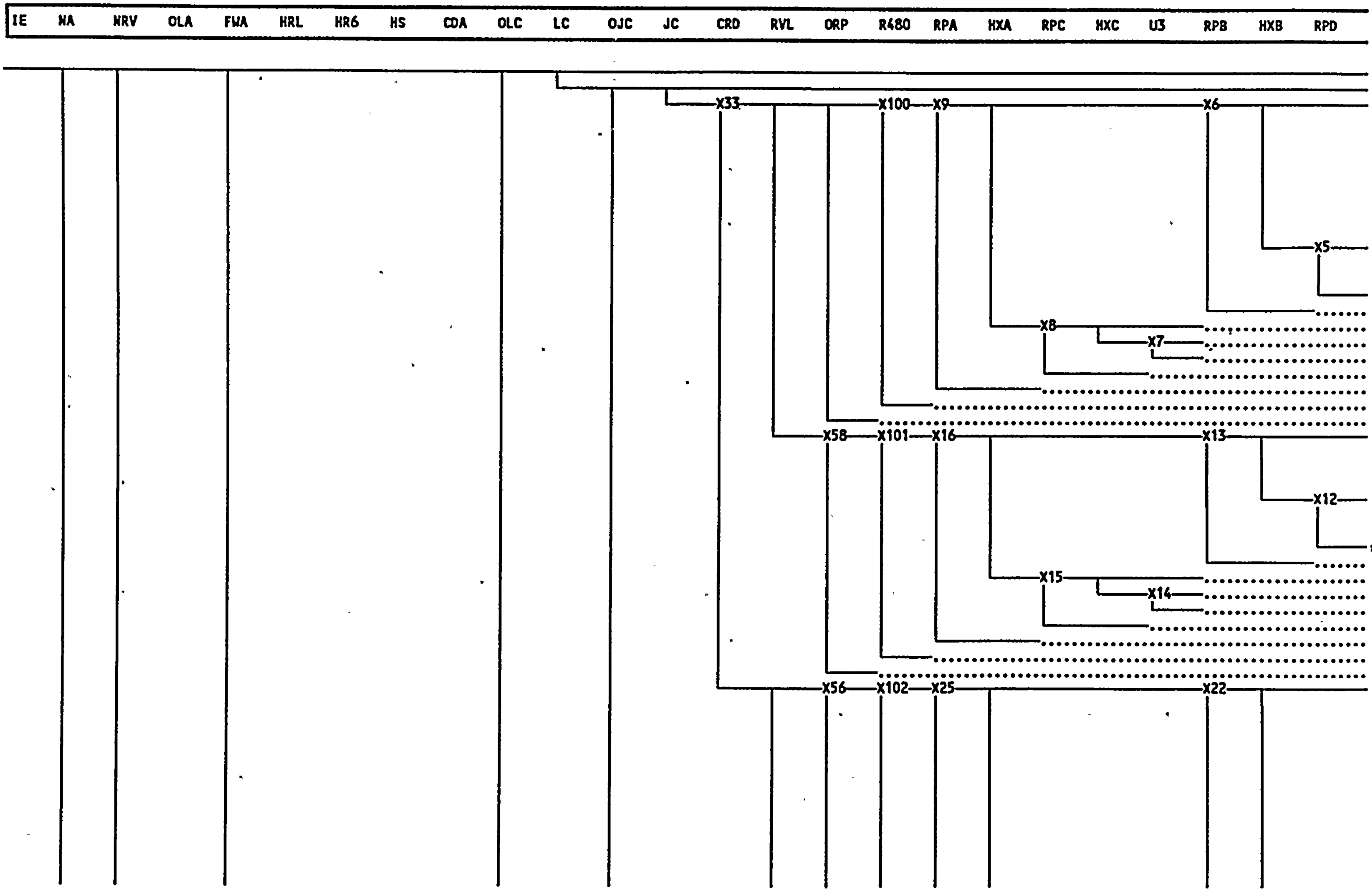
DUMMY	LH=F
MELT	1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HR6
HS
CDA
OLC
LC
OJC
JC
CRD
RVL
ORP
R480
RPA
HXA
RPC
HXC
U3
RPB
HXB
RPD
X33
X100
X9
X6
X5
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X7
X58
X101
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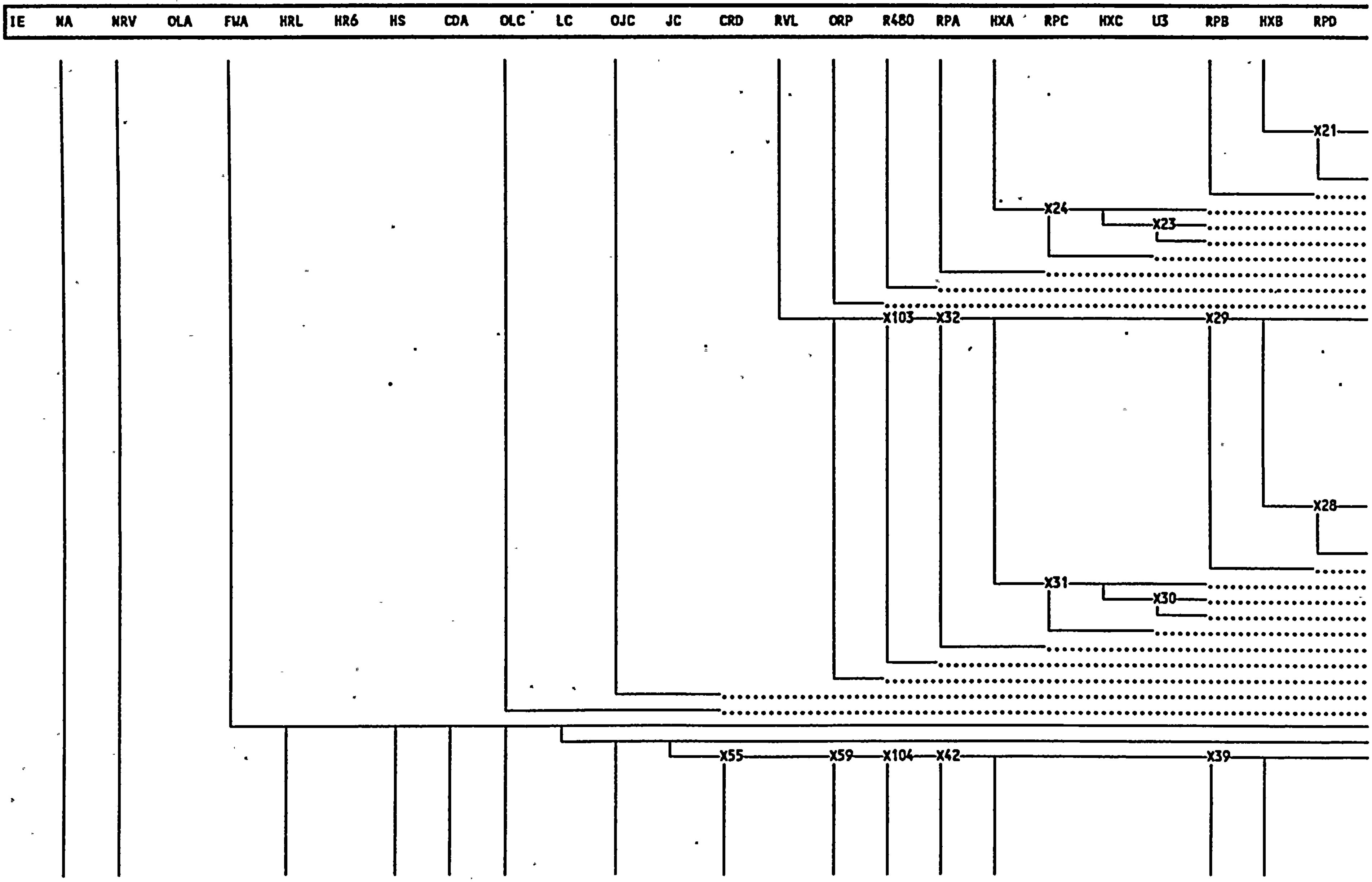
X13
X12
X15
X14
X56
X102
X25
X22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HXA
RPC
HXC
U3
RPB
HXB
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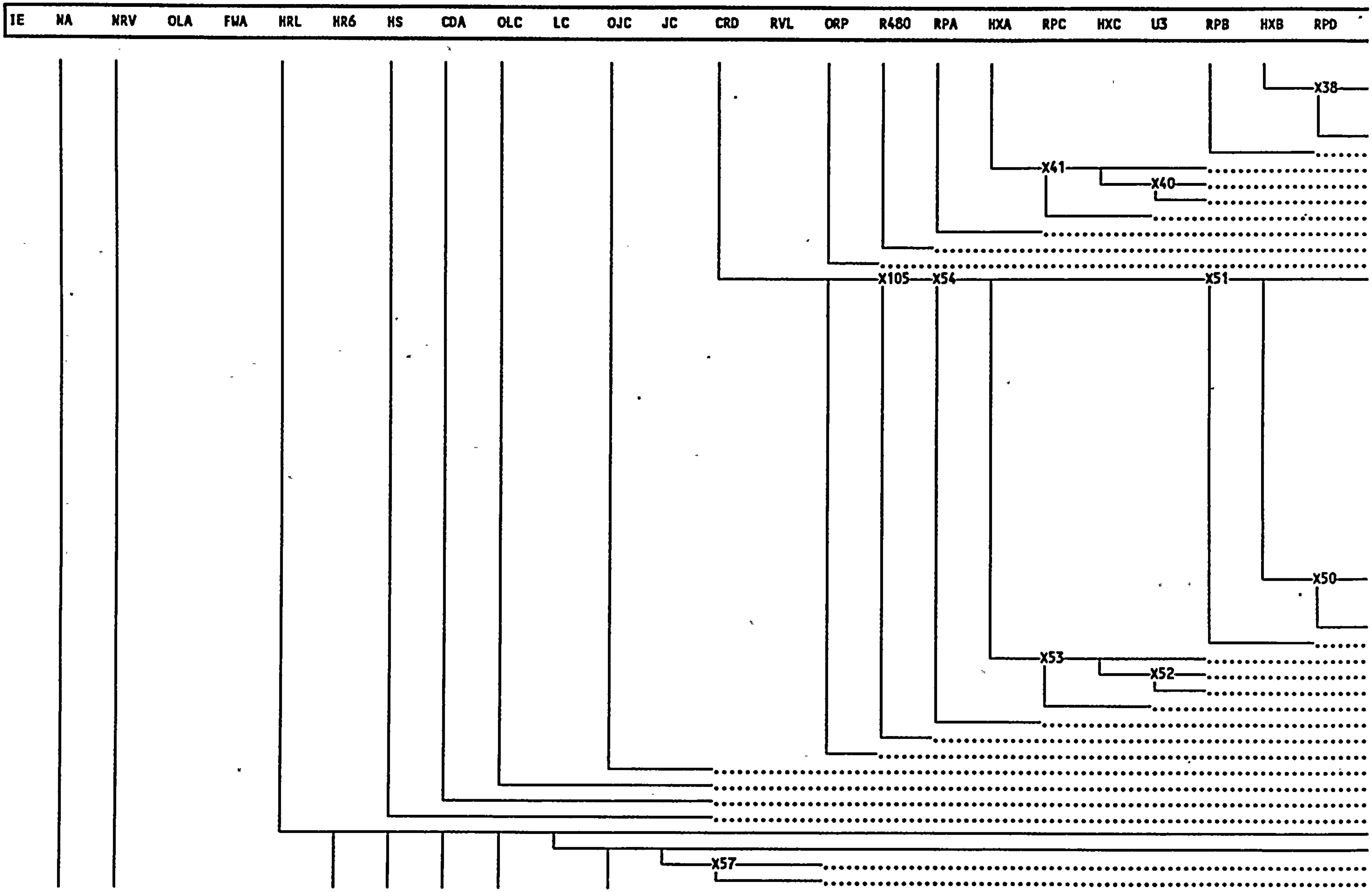
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RPA
HXA
RPC
HXC
U3
RPB
HXB
RPD
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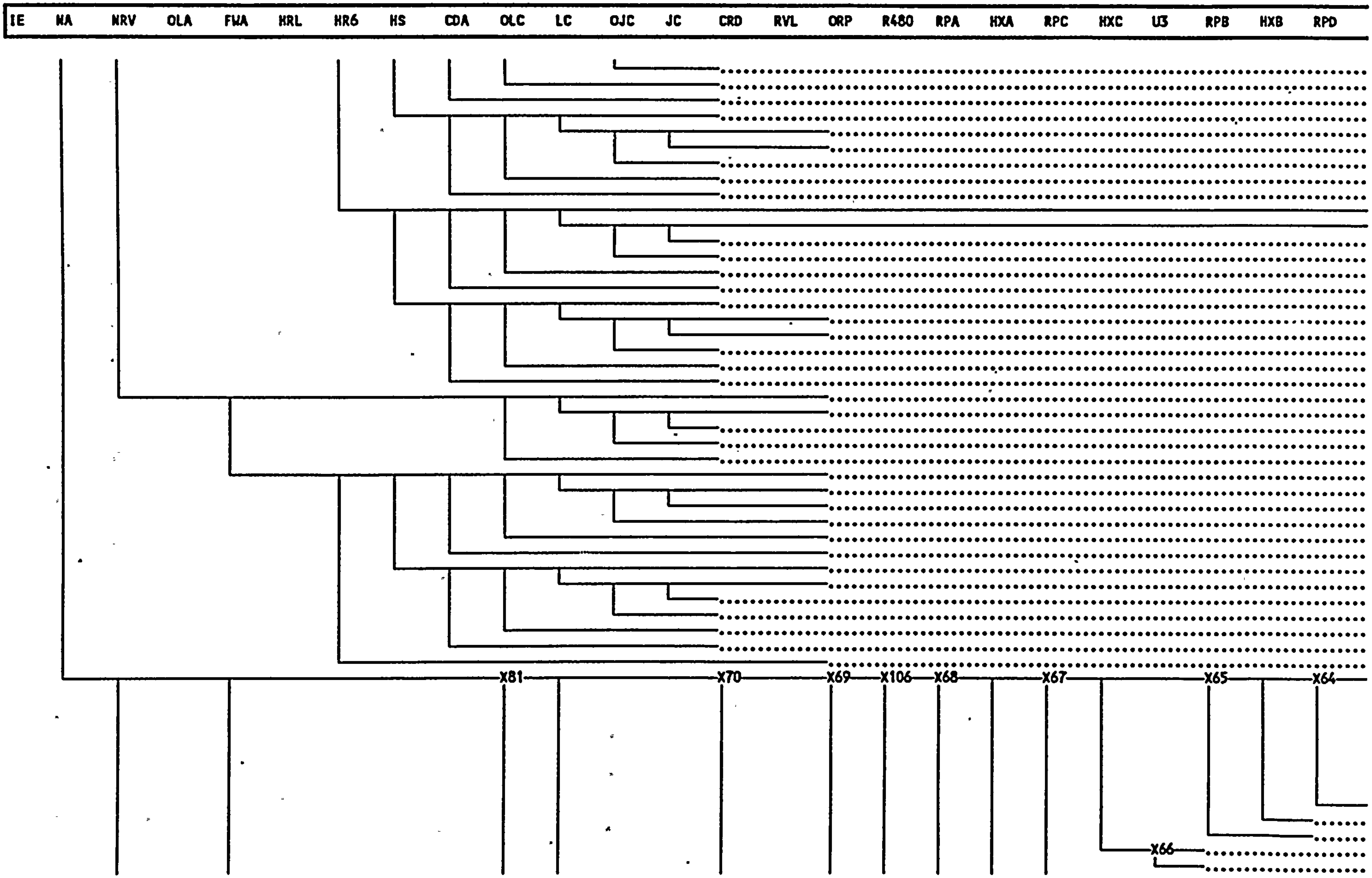
X41
X40
X105
X54
X51
X50
X53
X52
X57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NRV
OLA
FWA
HRL
HR6
HS
CDA
OLC
LC
OJC
JC
CRD
RVL
ORP
R480
RPA
HXA
RPC
HXC
U3
RPB
HXB
RPD
X81
X70
X69
X106
X68
X67
X65
X64
X66

MODEL Name: BFNFINAL
Event Tree: LPGTET

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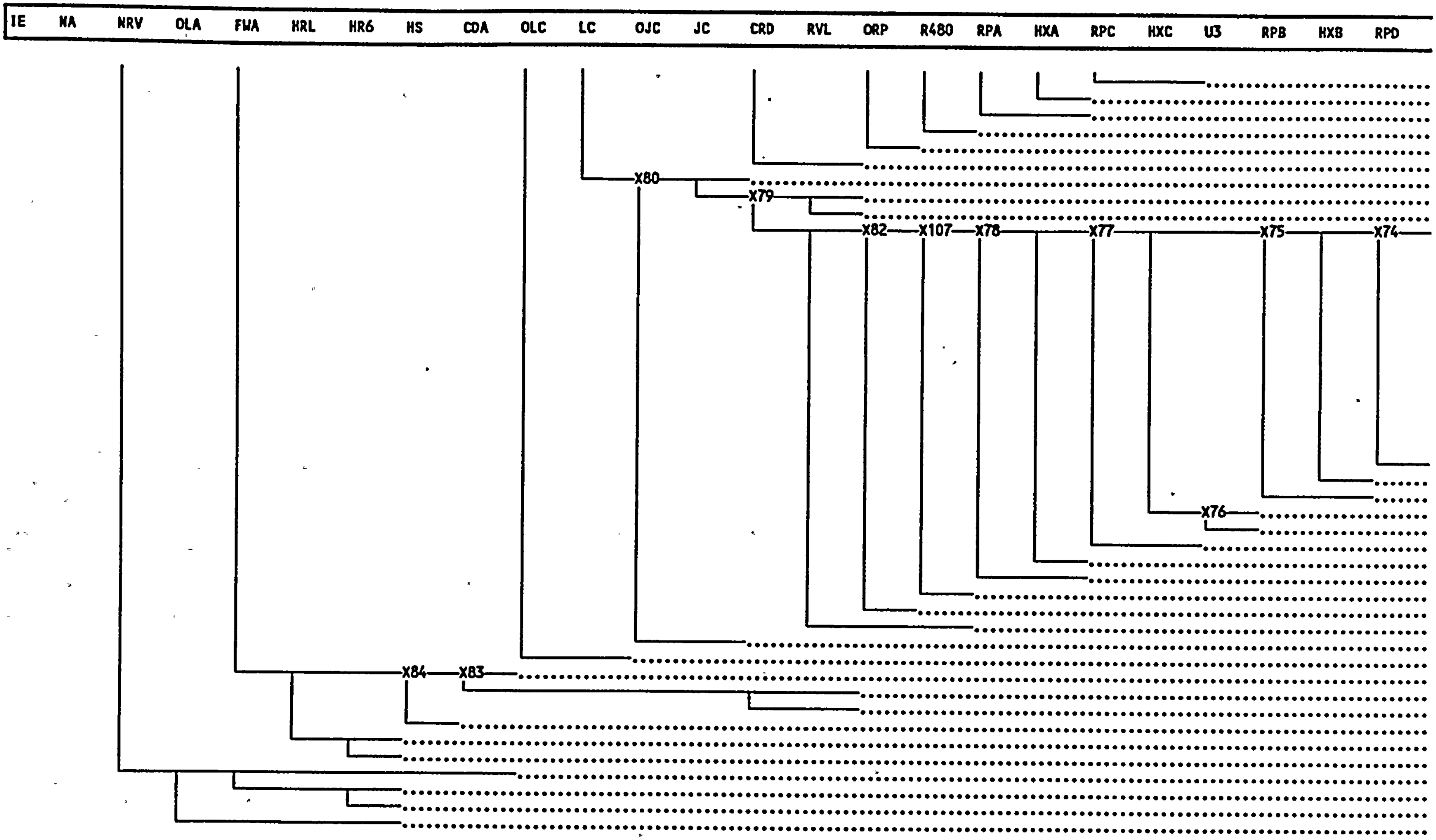

MODEL Name: BFNFINAL
Event Tree: LPGTET

1		1
2		2
3		3
4		4
5		5
6		6
7		7
8		8
9	X1	9-11
10	X1	12-14
11	X2	15-24
12	X3	25-46
13	X3	47-68
14	X3	69-90
15	X4	91-134
16	X5	135-244
17	X6	245-486
18	X6	487-728
19	X6	729-970
20	X7	971-1454
21	X8	1455-2664
22	X9	2665-5326
23	X100	5327-10650
24		10651
25		10652
26		10653
27		10654
28	X10	10655-10658
29	X10	10659-10662
30	X10	10663-10666
31	X11	10667-10674
32	X12	10675-10694
33	X13	10695-10738
34	X13	10739-10782
35	X13	10783-10826
36	X14	10827-10914
37	X15	10915-11134
38	X16	11135-11618
39	X101	11619-12586
40		12587
41		12588
42		12589
43		12590
44		12591
45		12592
46		12593
47	X91	12594-12600
48		12601
49		12602
50		12603
51		12604
52		12605

MODEL Name: BFNFINAL
Event Tree: LPGTET

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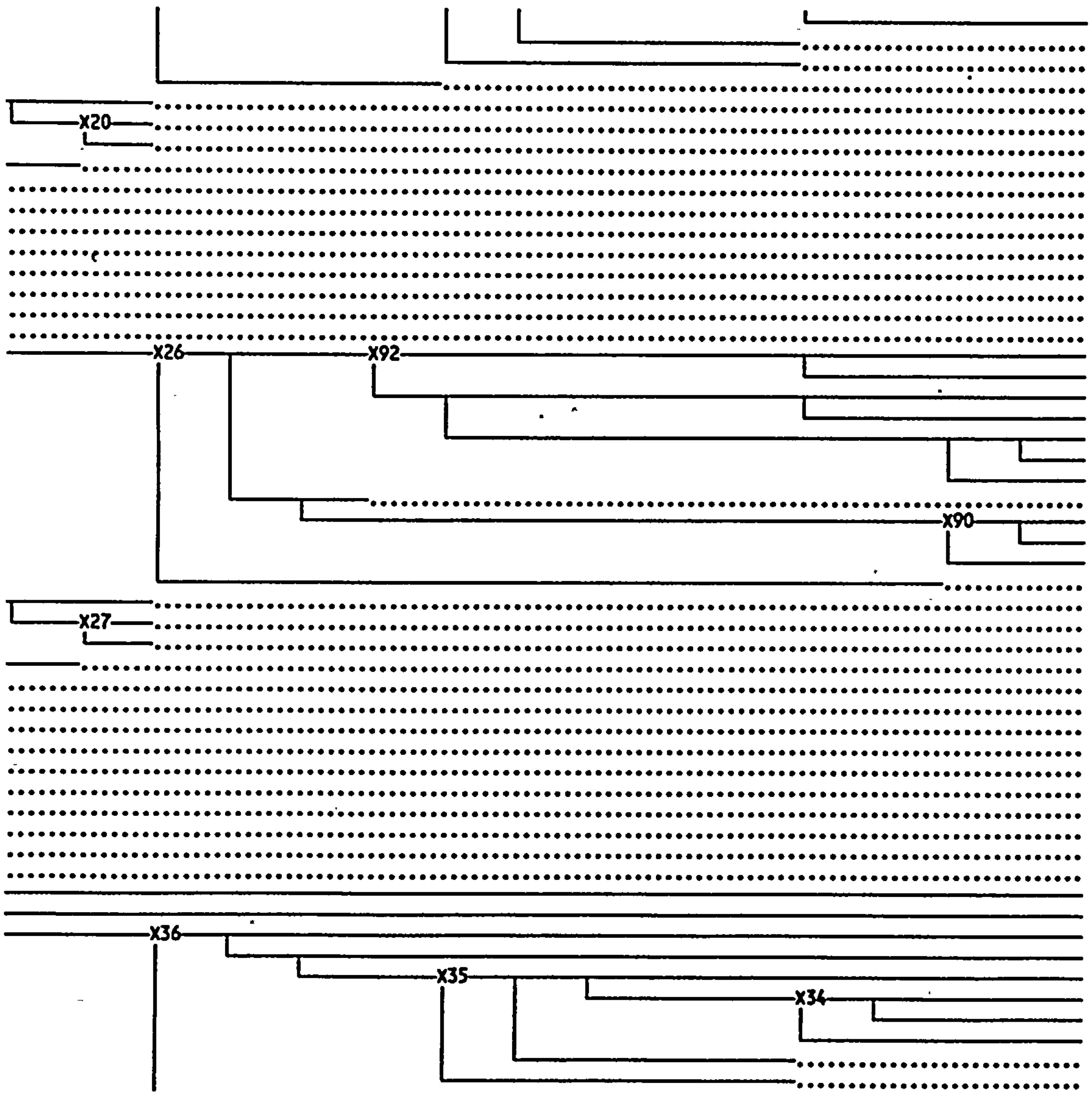
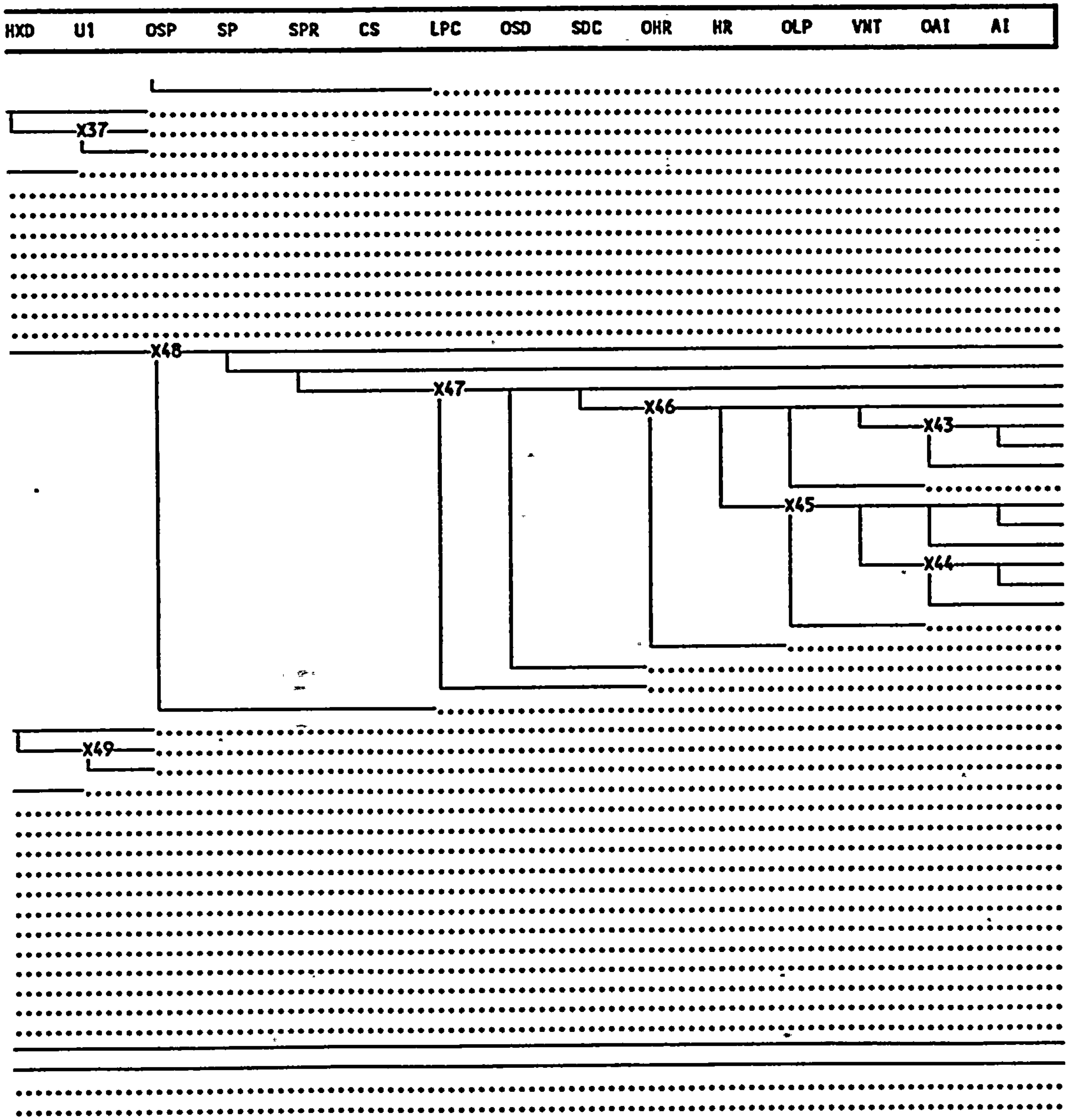
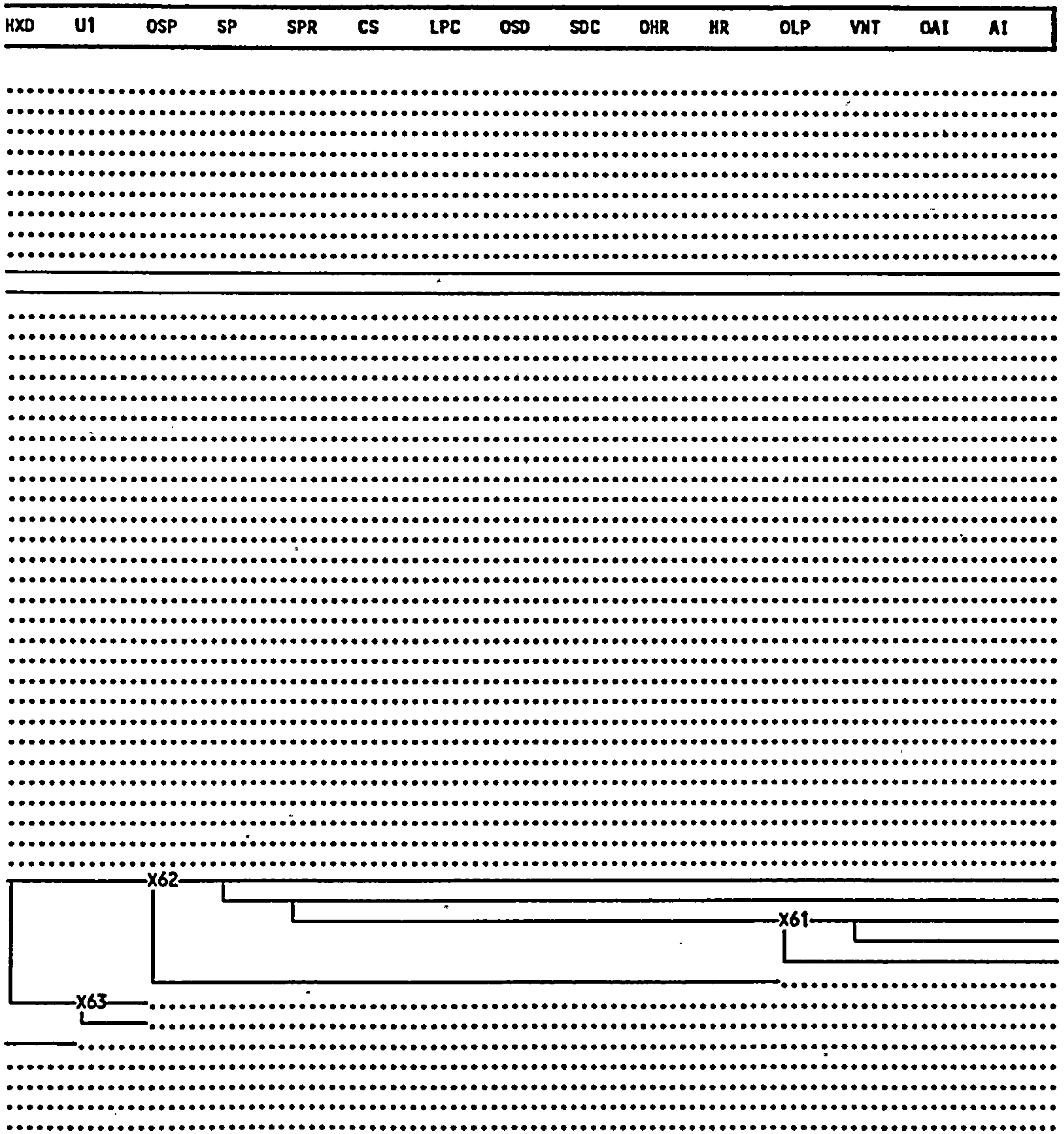
HXD U1 OSP SP SPR CS LPC OSD SDC OHR HR OLP VNT OAI AI



53		12606
54	X17	12607-12611
55	X17	12612-12616
56	X18	12617-12632
57	X19	12633-12678
58	X19	12679-12724
59	X19	12725-12770
60	X20	12771-12862
61	X21	12863-13092
62	X22	13093-13598
63	X22	13599-14104
64	X22	14105-14610
65	X23	14611-15622
66	X24	15623-18152
67	X25	18153-23718
68	X102	23719-34850
69		34851
70		34852
71		34853
72		34854
73		34855
74		34856
75		34857
76	X92	34858-34864
77		34865
78		34866
79		34867
80	X90	34868-34870
81	X26	34871-34890
82	X26	34891-34910
83	X26	34911-34930
84	X27	34931-34970
85	X28	34971-35070
86	X29	35071-35290
87	X29	35291-35510
88	X29	35511-35730
89	X30	35731-36170
90	X31	36171-37270
91	X32	37271-39690
92	X103	39691-44530
93	X33	44531-89058
94	X33	89059-133586
95		133587
96		133588
97		133589
98		133590
99		133591
100		133592
101		133593
102		133594
103	X34	133595-133597
104	X34	133598-133600



105	X35	133601-133610
106	X36	133611-133632
107	X36	133633-133654
108	X36	133655-133676
109	X37	133677-133720
110	X38	133721-133830
111	X39	133831-134072
112	X39	134073-134314
113	X39	134315-134556
114	X40	134557-135040
115	X41	135041-136250
116	X42	136251-138912
117	X104	138913-144236
118		144237
119		144238
120		144239
121		144240
122		144241
123		144242
124		144243
125	X43	144244-144246
126		144247
127		144248
128		144249
129		144250
130		144251
131		144252
132	X44	144253-144255
133	X45	144256-144264
134	X46	144265-144289
135	X46	144290-144314
136	X47	144315-144390
137	X48	144391-144544
138	X48	144545-144698
139	X48	144699-144852
140	X49	144853-145160
141	X50	145161-145930
142	X51	145931-147624
143	X51	147625-149318
144	X51	149319-151012
145	X52	151013-154400
146	X53	154401-162870
147	X54	162871-181504
148	X105	181505-218772
149	X55	218773-303956
150	X55	303957-389140
151	X55	389141-474324
152	X55	474325-559508
153		559509
154		559510
155	X59	559511-570158
156	X56	570159-592422



157	X57	592423-625334
158	X57	625335-658246
159	X57	658247-691158
160	X57	691159-724070
161	X59	724071-734718
162	X59	734719-745366
163	X57	745367-778278
164	X57	778279-811190
165	X57	811191-844102
166		844103
167		844104
168	X57	844105-877016
169	X57	877017-909928
170	X57	909929-942840
171	X57	942841-975752
172	X57	975753-1008664
173	X59	1008665-1019312
174	X59	1019313-1029960
175	X57	1029961-1062872
176	X57	1062873-1095784
177	X57	1095785-1128696
178	X58	1128697-1130632
179	X58	1130633-1132568
180	X33	1132569-1177096
181	X33	1177097-1221624
182	X33	1221625-1266152
183	X59	1266153-1276800
184	X59	1276801-1287448
185	X56	1287449-1309712
186	X56	1309713-1331976
187	X56	1331977-1354240
188	X56	1354241-1376504
189	X59	1376505-1387152
190	X59	1387153-1397800
191	X57	1397801-1430712
192	X57	1430713-1463624
193	X57	1463625-1496536
194	X57	1496537-1529448
195	X56	1529449-1551712
196		1551713
197		1551714
198		1551715
199		1551716
200		1551717
201	X61	1551718-1551720
202	X62	1551721-1551728
203	X62	1551729-1551736
204	X63	1551737-1551752
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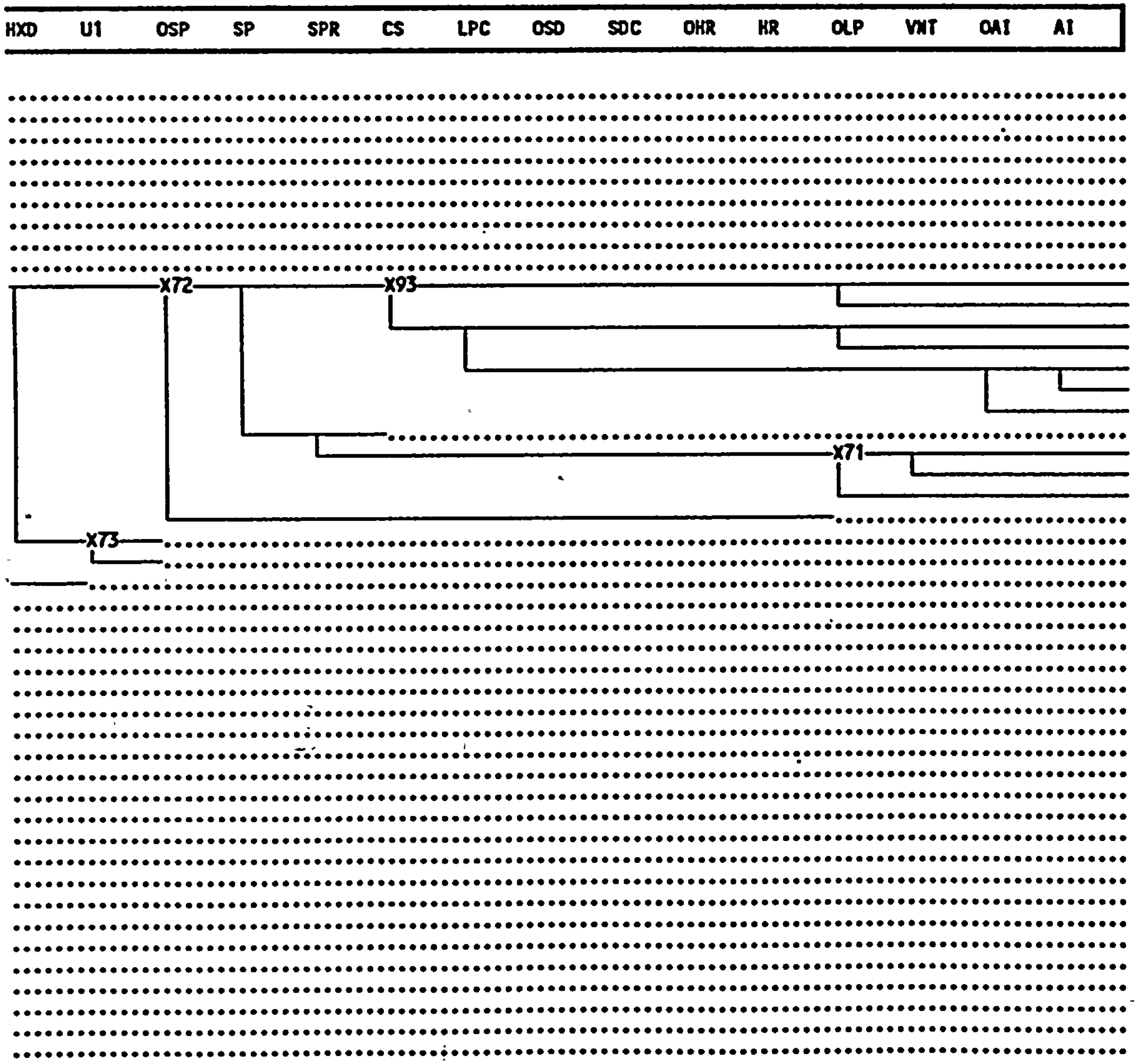
206	X64	1551793-1551832
207	X65	1551833-1551952
208	X65	1551953-1552072



209	X66	1552073-1552312
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211	X67	1552913-1553512
212	X68	1553513-1555312
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214	X69	1558913-1566112
215	X70	1566113-1580512
216	X69	1580513-1587712
217	X69	1587713-1594912
218		1594913
219		1594914
220		1594915
221		1594916
222		1594917
223		1594918
224		1594919
225	X93	1594920-1594926
226		1594927
227		1594928
228		1594929
229	X71	1594930-1594932
230	X72	1594933-1594952
231	X72	1594953-1594972
232	X73	1594973-1595012
233	X74	1595013-1595112
234	X74	1595113-1595212
235	X75	1595213-1595512
236	X75	1595513-1595812
237	X76	1595813-1596412
238	X77	1596413-1597912
239	X77	1597913-1599412
240	X78	1599413-1603912
241	X107	1603913-1612912
242	X78	1612913-1617412
243	X79	1617413-1654312
244	X80	1654313-1742512
245	X81	1742513-1933312
246	X69	1933313-1940512
247	X82	1940513-1958512
248	X83	1958513-2174512
249	X84	2174513-2606512
250	X84	2606513-3038512
251	X81	3038513-3229312
252	X84	3229313-3661312
253	X84	3661313-4093312
254	X84	4093313-4525312

MODEL Name: BFNFINAL

Top Event Legend for Tree: LPGTET

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Page 1

Top Event Designator.....	Top Event Description..........................
IE	Initiating Event
NA	THE EVENT IS AN ATWS
NRV	THE EVENT INVOLVES STUCK OPEN SRVS
OLA	OPERATOR FAILS TO CONTROL LPI DURING ATWS
FWA	FEEDWATER UNAVAILABLE
HRL	HPCI/RCIC UNAVAILABLE FOR 24 HOURS
HR6	HPCI/RCIC UNAVAILABLE FOR 6 HOURS
HS	CONDENSER UNAVAILABLE AS HEAT SINK
CDA	CONDENSATE UNAVAILABLE FOR INJECTION
OLC	OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE
LC	STARTUP BYPASS VALVE UNAVAILABLE
OJC	OPERATOR FAILS TO ALIGN ALTERNATE FLOW PATH GIVEN SU BYPASS VLV FAILED
JC	ALTERNATE FLOW PATH HARDWARE UNAVAILABLE
CRD	VESSEL INJECTION WITH CRDHS UNAVAILABLE
RVL	SRV ACTUATION FAILURE WHEN FEEDWATER AVAILABLE
ORP	OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY
R480	FAILURE TO RECOVER 480V RMOV BDS 2A OR 2B
RPA	RHR PUMP A UNAVAILABLE
HXA	RHR HEAT EXCHANGER A UNAVAILABLE
RPC	RHR PUMP C UNAVAILABLE
HXC	RHR HEAT EXCHANGER C UNAVAILABLE
U3	U2 TO U3 RHR CROSS CONNECT UNAVAILABLE
RPB	RHR PUMP B UNAVAILABLE
HXB	RHR HEAT EXCHANGER B UNAVAILABLE
RPD	RHR PUMP D UNAVAILABLE
HXD	RHR HEAT EXCHANGER D UNAVAILABLE

MODEL Name: BFNFINAL

Top Event Legend for Tree: LPGTET

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Top Event Designator.....	Top Event Description..............................
U1	U2 TO U1 RHR CROSS CONNECT UNAVAILABLE
OSP	OPERATOR FAILS TO ESTABLISH TORUS COOLING
SP	TORUS COOLING HARDWARE UNAVAILABLE
SPR	FAILURE TO RECOVER TORUS COOLING
CS	CS LOW PRESSURE INJECTION UNAVAILABLE
LPC	RHR LOW PRESSURE INJECTION PATH UNAVAILABLE
OSD	OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING
SDC	SHUTDOWN COOLING HARDWARE UNAVAILABLE
OHS	OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC
HR	HARDWATE TO MAINTAIN HPCI/RCIC W/O SPC UNAVAILABLE
OLI	OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
VN	TORUS VENT HARDWARE UNAVAILABLE
OA	OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTION
AI	ALTRNATE LOW PRESSURE INJECTION HARDWARE UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LPGTET

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Page 1

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SF........ Split Fraction Logic.............................................

           Y3:=TOR=S*(EECW+OEE=S)

           Y11:=DA=S*AA=S+EPR6=S+-OEE=F*GA=S

           Y12:=DB=S*AC=S+EPR6=S+-OEE=F*GC=S

           Y21:=DC=S*AB=S+EPR6=S+-OEE=F*GB=S

           Y22:=DD=S*AD=S+EPR6=S+-OEE=F*GD=S

           RHOK:=RH=S+R480=S+EPR6=S

           RIOK:=RI=S+R480=S+EPR6=S

           RKOK:=RK=S+EPR6=S

           RLOK:=RL=S+EPR6=S

           RHR1:=RPA=S*HXA=S

           RHR2:=RPB=S*HXB=S

           RHR3:=RP[illegible]S*HXC=S

           RHR4:=RPC[illegible]S*HXD=S

           RPDSUP:=A[illegible]=S*DD=S*(EECW+RCW=S)+EPR6=S+GD=S*-OEE=F

           RPBSUP:=A[illegible]=S*DB=S*(EECW+RCW=S)+EPR6=S+GC=S*-OEE=F

           RPCSUP:=A[illegible]=S*DC=S*(EECW+RCW=S)+EPR6=S+GB=S*-OEE=F

           RPASUP:=A[illegible]=S*DA=S*(EECW+RCW=S)+EPR6=S+GA=S*-OEE=F

           NORM:=OF=S+ORF=S+TB=F*IVC=F+(HPI=S+RCI=S)*-HRC=F*(OHC=S+OHC=F*OHL=S
           (HPL=S*RVD=DEP+RCL=S)*OHL=S

           E18FLW:=-OF=S*-ORF=S*((HPI=S+RCI=S)*HRC=S*(OHC=S+OHC=F*OHL=S)*RVD=N
           ODEP+-FWA=S*-HRL=S*-HR6=S*(RVD=DEP+RVC=SORV3))

           E24FLW:=-OF=S*-ORF=S*(-HPI=S*-RCI=S+-HRC=S+L8H=F+L8H=S*OHL=F)

           CRDSUP1:=UB42C=S*CST=S

           CRDSUP2:=AA=S*DA=S+EPR6=S

           CRDSUP3:=DJ=S*(PCA=S+PCA=F*-EECW*OEE=S)

           SIG3:=(LV=S+DW=S)

           RHRSW:=-SW2D=F*-SW1D=F

           RHRSW1:=SW2B=S+SW1B=S+SW2D=S+SW1D=S

           RHRPMP:=-RHR1*-RHR3

           HXAB:=-RHOK+SW2A=F*SW1A=F+NOGB+HXA=B

           HXBB:=-RIOK+SW2B=F*SW1B=F+NOGD+HXB=B

           HXCB:=-RHOK+SW2C=F*SW1C=F+NOGB+HXC=B

           LPCI:=(OSP=F+SP=F*SPR=F)*((RPA=S+RPC=S)*RKOK+(RPB=S+RPD=S)*RLOK)
           +(SP=S+SPR=S)*((RPA=S+RPC=S)*RKOK*(RPB=S+RPD=S)*RLOK+RVD=DEP*((RHR1

NAO        RPS=S
```

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LPGTET

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SF.......	Split Fraction Logic...
NAF	RPS=F
NAF	1
NRVF	RVC=SORV1+RVC=SORV2+RVC=SORV3+RVO=F
NRVO	-SORV*(-OF=S*(-RCI=S*-HPI=S+-HRC=S+OHL=F*OHC=F) +OAD=S*RVC=SORVO+RPS=S*RVC=SORVO)
NRVF	1
OLA1	1
FWAF	(-FWC=S*-ORF=S+RPS=F)*-OF=S
FWA1	FWC=S*RVC=SORV2+OF=S+ORF=S
FWAF	1
HRLF	-OHL=S
HRLO	OHL=S
HRLF	1
HR6F	-OHC=S*-OHL=S
HR6O	OHC=S+OHL=S
HR6F	1
HSF	-BVR=S+OIV=F
HSO	BVR=S
HS1	INIT=FLRB3S*(IVO=F+MCD=F)
HSF	1
CDA1	CD=S
CDAF	1
OLC1	FWA=S
OLC2	FWA=F
OLC2	1
LCF	PCA=F+DJ=F
LC1	1
OJC1	1
JC2	PCA=F+DJ=F
JC1	1
CRDF	(E18FLW+E24FLW)*(-CRDSUP1+-CRDSUP2+-CRDSUP3+RJ=F+NOGA+NOGD) +RCW=F+NORM*-CRDSUP1+INIT=BOC*ISO=F
CRD4	RCW=S*E24FLW*CRDSUP1*CRDSUP2*CRDSUP3*RJ=S
CRD3	RCW=S*E18FLW*CRDSUP1*CRDSUP2*CRDSUP3*RJ=S

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LPGTET

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SF........	Split Fraction Logic..
CRD2	RCW=S*NORM*CRDSUP1*-CRDSUP2
CRD1	RCW=S*NORM*CRDSUP1*CRDSUP2
CRDF	1
RVLO	NRV=F
RVL1	PWR4*CRD=S
RVL2	PWR6*CRD=S
RVL3	PWR4*CRD=F
RVL4	PWR6*CRD=F
RVL3	1
ORPF	(INIT=LOSP+INIT=L500)*EPR6=F*-EECW*OEE=F
ORP3	(INIT=LOSP+INIT=L500)*EPR6=S*-EECW*OEE=F
ORP2	-HPI=S*-RCI=S+-HRC=S
ORP'	1
R48	RH=F*AD=S+RI=F*AB=S
R48	1
RPA'	-RPASUP+-RHOK+ORP=F*(RC=F+-SIG1+(INIT=LOSP+INIT=L500*OUB=F)*EPR6=F* +INIT=FLRB2+INIT=FLRB3S
RPA1	RPASUP*RHOK*(SIG1*ORP=F+ORP=S)
RPAF	1
RPCF	-RPCSUP+-RHOK+ORP=F*(RB=F*RC=F+-SIG1+(INIT=LOSP+INIT=L500*OUB=F)*EP +INIT=BOC*ISO=F+NOGB+INIT=FLRB2+INIT=FLRB3S
RPC3	RPCSUP*RHOK*-(RPASUP*RC=S)*(SIG1*ORP=F+ORP=S)
RPC2	RPCSUP*RHOK*RPASUP*RC=S*RPA=F*(SIG1*ORP=F+ORP=S)
RPC1	RPCSUP*RHOK*RPA=S*(SIG1*ORP=F+ORP=S)
RPCF	1
RPBF	-RPBSUP+-RIOK+ORP=F*(RB=F+-SIG1+(INIT=LOSP+INIT=LOSP*OUB=F)*EPR6=F* +INIT=FLRB2+INIT=FLRB3S
RPB6	RPBSUP*RIOK*(-(RPASUP*RHOK)*RPC=F+RPA=F*(RPC=B+-(RPCSUP*RHOK*RB=S)))*(SIG1*ORP=F+ORP=S)
RPB5	RPBSUP*RIOK*(-(RPASUP*RHOK)*RPC=S+RPA=S*(RPC=B+-(RPCSUP*RHOK*RB=S)))*(SIG1*ORP=F+ORP=S)
RPB4	RPBSUP*RIOK*-(RPASUP*RHOK)*(RPC=B+-(RPCSUP*RHOK*RB=S))*(SIG1*ORP=F+ ORP=S)
RPB3	RPBSUP*RIOK*RPA=F*RPC=F*(SIG1*ORP=F+ORP=S)
RPB2	RPBSUP*RIOK*(RPA=S*RPC=F+RPA=F*RPC=S)*(SIG1*ORP=F+ORP=S)
RPB1	RPBSUP*RIOK*RPA=S*RPC=S*(SIG1*ORP=F+ORP=S)

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Split Fraction Logic for Event Tree: LPGTET

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SF........	Split Fraction Logic..
RPBF	1
RPDF	-RPDSUP+-RIOK+ORP=F*(RB=F*RC=F+-SIG1+(INIT=LOSP+INIT=L500*OUB=F)*EP +INIT=FLRB2+INIT=FLRB3S
RPD10	RPDSUP*RIOK*(RPA=F*(RPC=F*-(RPBSUP*RC=S)+(RPC=B+-(RPCSUP*RHOK)*RPB= +-(RPASUP*RHOK*RC=S)*RPC=F*RPB=F)*(SIG1*ORP=F+ORP=S)
RPD9	RPDSUP*RIOK*(RPA=S*(RPC=F*-(RPBSUP*RC=S)+(RPC=B+-(RPCSUP*RHOK))*RPB +RPC=S*(RPA=F*-(RPBSUP*RC=S)+-(RPASUP*RHOK*RC=S)*RPB=F) +RPB=S*(RPA=F*(RPC=B+-(RPC=S*RHOK))+-(RPASUP*RHOK*RC=S)*RPC=F)) *(SIG1*ORP=F+ORP=S)
RPD8	RPDSUP*RIOK*(RPA=S*(RPC=S*-(RPBSUP*RC=S)+(RPC=B+-(RPCSUP*RHOK))*RPB +-(RPASUP*RHOK*RC=S)*RPC=S*RPB=S)*(SIG1*ORP=F+ORP=S)
RPD7	RPDSUP*RIOK*(-(RPASUP*RHOK*RC=S)*(RPC=F*-(RPBSUP*RC=S) +(RPC=B+-(RPCSUP*RHOK))*RPB=F) +RPA=F*(RPC=B+-(RPCSUP*RHOK))*-(RPBSUP*RC=S))*(SIG1*ORP=F+ORP=S)
RPD6	RPDSUP*RIOK*(-(RPASUP*RHOK*RC=S)*(RPC=S*-(RPBSUP*RC=S) +(RPC=B+-(RPCSUP*RHOK))*RPB=S) +RPA=S*(RPC=B+-(RPCSUP*RHOK)*-(RPBSUP*RC=S)))*(SIG1*ORP=F+ORP=S)
RPD5	RPDSUP*RIOK*-(RPASUP*RHOK*RC=S) *(RPC=B+-(RPCSUP*RHOK))*-(RPBSUP*RC=S) *(SIG1*ORP=F+ORP=S)
RPD4	RPDSUP*RIOK*RPA=F*RPC=F*RPB=F*(SIG1*ORP=F+ORP=S)
RPD3	RPDSUP*RIOK*(RPA=F*(RPC=F*RPB=S+RPC=S*RPB=F) +RPA=S*RPC=F*RPB=F)*(SIG1*ORP=F+ORP=S)
RPD2	RPDSUP*RIOK*(RPA=F*RPC=S*RPB=S+RPA=S*RPC=F*RPB=S +RPA=S*RPC=S*RPB=F)*(SIG1*ORP=F+ORP=S)
RPD1	RPDSUP*RIOK*RPA=S*RPC=S*RPB=S*(SIG1*ORP=F+ORP=S)
RPDF	1
HXAF	-RHOK+SW2A=F*SW1A=F*(-INIT=LOSP*-INIT=L500+(INIT=LOSP+INIT=L500*OUB =F)*EPR6=F)+NOGB
HXA2	RHOK*(INIT=LOSP+INIT=L500*OUB=F)*EPR6=S
HXA1	RHOK*(SW2A=S+SW1A=S)
HXAF	1
HXCF	-RHOK+SW2C=F*SW1C=F*(-INIT=LOSP*-INIT=L500+(INIT=LOSP+INIT=L500*OUB =F)*EPR6=F)+NOGB
HXC4	RHOK*(INIT=LOSP+INIT=L500*OUB=F)*EPR6=S
HXC3	RHOK*HXAB*(SW2C=S+SW1C=S)
HXC2	RHOK*HXA=F*(SW2C=S+SW1C=S)
HXC1	RHOK*HXA=S*(SW2C=S+SW1C=S)
HXCF	1
HXBF	-RIOK+SW2B=F*SW1B=F*(-INIT=LOSP*-INIT=L500+(INIT=LOSP+INIT=L500*OUB =F)*EPR6=F)+NOGD

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LPGTET

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SF........	Split Fraction Logic..
HXB7	RIOK*(INIT=LOSP+INIT=L500*OUB=F)*EPR6=S
HXB6	RIOK*HXAB*HXCB*(SW2B=S+SW1B=S)
HXB5	RIOK*HXA=F*HXC=F*(SW2B=S+SW1B=S)
HXB4	RIOK*(HXA=F*HXCB+HXAB*HXC=F)*(SW2B=S+SW1B=S)
HXB3	RIOK*(HXA=S*HXCB+HXAB*HXC=S)*(SW2B=S+SW1B=S)
HXB2	RIOK*(HXA=S*HXC=F+HXA=F*HXC=S)*(SW2B=S+SW1B=S)
HXB1	RIOK*HXA=S*HXC=S*(SW2B=S+SW1B=S)
HXBF	1
HXDF	-RIOK+SW2D=F*SW1D=F*(-INIT=LOSP*-INIT=L500+(INIT=LOSP+INIT=L500*OUB =F)*EPR6=F)+NOGD
HXD11	RIOK*(INIT=LOSP+INIT=L500*OUB=F)*EPR6=S
HXD10	RIOK*HXAB*HXCB*HXBB*(SW2D=S+SW1D=S)
HXD9	RIOK*(HXAB*(HXCB*HXB=F+HXC=F*HXBB)+HXA=F*HXCB*HXBB)*(SW2D=S+SW1D=S)
HXD8	RIOK*(HXAB*(HXCB+HXBB)+HXCB*HXBB)*(SW2D=S+SW1D=S)
HXD7	RIOK*HXA=F*HXC=F*HXB=F*(SW2D=S+SW1D=S)
HXD6	RIOK*(HXA=F*(HXC=F*HXBB+HXCB*HXB=F)+HXAB*HXC=F*HXB=F)*(SW2D=S+SW1D= S)
HXD5	RIOK*(HXA=F*(HXC=F+HXB=F)+HXC=F*HXB=F)*(SW2D=S+SW1D=S)
HXD4	RIOK*(HXAB*(HXC=F+HXB=F)+HXCB*(HXA=F+HXB=F)+HXBB*(HXA=F+HXC=F))*(SW 2D=S+SW1D=S)
HXD3	RIOK*(HXA=F+HXC=F+HXB=F)*(SW2D=S+SW1D=S)
HXD2	RIOK*(HXAB+HXCB+HXBB)*(SW2D=S+SW1D=S)
HXD1	RIOK*SW2D=S*HXA=S*HXC=S*HXB=S*(SW2D=S+SW1D=S)
HXDF	1
U3F	1
U11	RF=S*RHRSW*(INIT=FLRB3S+INIT=FLRB2)
U11	RF=S*RHRSW1*RHRPMP*(AC=S*DB=S+AD=S*DD=S)*RI=S*(EECW+-EECW+RCW=S)
U1F	1
LPCF	-LPCI+(NPI=F*NPII=F)+NOGB*NOGD+TOR=F
LPC5	-(INIT=LLS+INIT=LLD)*(NPI=S+NPII=S)*(RPA=F*RPC=F+-RKOK+RPB=F*RPD=F+ -RLOK)
LPC4	-(INIT=LLS+INIT=LLD)*(NPI=S+NPII=S)*(RPA=S+RPC=S)*RKOK*(RPB=S+RPD=S)*RLOK
LPCF	1
CSF	-Y3+ORP=F*(-SIG3+INIT=LOSP)+-RHOK*-RIOK +NPI=F*NPII=F+INIT=BOC*ISO=F+INIT=FLRB2+INIT=FLRB3S

MODEL Name: BFNFINAL

Split Fraction Logic for Event T--e: LPGTET

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SF........	Split Fraction Logic..
CS5	RHOK*RIOK*Y11*Y12*Y21*Y22*ORP=S*NPI=S*NPII=S
CS6	RHOK*RIOK*Y11*Y12*Y21*Y22*SIG3*NPI=S*NPII=S
CS7	(RHOK*Y11*Y12*NPI=S+RIOK*Y21*Y22)*ORP=S
CS8	(RHOK*Y11*Y12*NPI=S+RIOK*Y21*Y22*NPII=S)*SIG3
CS9	RHOK*RIOK*NPI=S*NPII=S*ORP=S*((Y12+Y11)*Y21*Y22)
CS9	RHOK*RIOK*NPI=S*NPII=S*ORP=S*(Y11*Y12*(Y21+Y22))
CS10	RHOK*RIOK*NPI=S*NPII=S*SIG3*((Y11+Y12)*Y21*Y22)
CS10	RHOK*RIOK*NPI=S*NPII=S*SIG3*(Y11*Y12*(Y22+Y21))
CS11	ORP=S*RHOK*RIOK*(NPI=S*Y11*Y12+NPII=S*Y21*Y22)
CS12	SIG3*RHOK*RIOK*(NPI=S*Y11*Y12+NPII=S*Y21*Y22)
CS13	ORP=S*RHOK*RIOK*NPI=S*NPII=S*(Y12+Y11+Y21+Y22)
CS14	SIG3*RHOK*RIOK*NPI=S*NPII=S*(Y11+Y12+Y21+Y22)
CS15	ORP=S*(RHOK*NPI=S*(Y11+Y12)+RIOK*NPII=S*(Y21+Y22))
CS16	SIG3*(RHOK*NPI=S*(Y11+Y12)+RIOK*NPII=S*(Y21+Y22))
CSF	1
SPF	RPS=S*(-(RHR1+RHR3)+-RKOK)*(-(RHR2+RHR4)+-RLOK)*U1=F +RPS=F*(-RKOK+-RLOK+-(RHR1*RHR2*RHR3*RHR4))+NOGB*NOGD
SP3	RPS=S*(-(RHR1+RHR3)+-RKOK+-(RHR2+RHR4)+-RLOK+U1=S)
SP2	RPS=F*RHR1*RHR2*RHR3*RHR4*RKOK*RLOK
SP1	(RHR1+RHR3)*RKOK*(RHR2+RHR4)*RLOK*RPS=S
SPF	1
SPR1	(RVD=DEP+RVC=SORV1+RVC=SORV2+RVC=SORV3+-HR6=F)*-ORP=F
SPRF	1
OSPF	RPS=S*-(RHR1+RHR3)*-(RHR2+RHR4)*U1=F+RPS=F*-(RHR1*RHR2*RHR3*RHR4)+T OR=F
OSP3	RPS=S*(-(RHR1+RHR3)+-(RHR2+RHR4)+U1=S)
OSP2	RPS=F*RHR1*RHR3*RHR2*RHR4
OSP1	RPS=S*(RHR1+RHR3)*(RHR2+RHR4)
OSPF	1
SDCF	RB=F+-RHOK+(-(RHR1+RHR3)*(-(RHR2+RHR4)+-RIOK))
SDC2	RB=S+RHOK+(-(RHR1+RHR3)+-(RHR2+RHR4)+-RIOK)
SDC1	RB=S*RHOK*RIOK*(RHR1+RHR3)*(RHR2+RHR4)
SDCF	1
OSDF	E24FLW+RPS=F+(-(RHR1+RHR3)*-(RHR2+RHR4))

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: LPGTET

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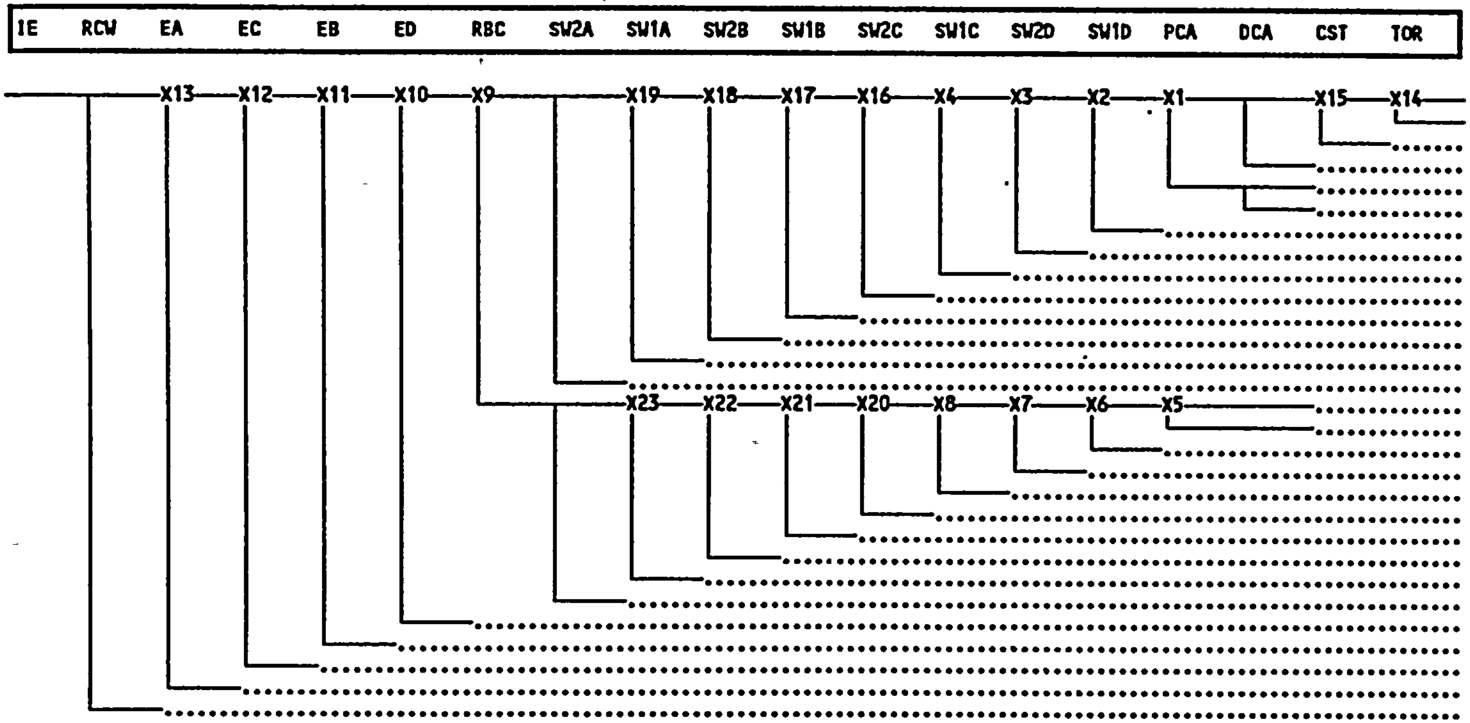
SF........	Split Fraction Logic...
OSD2	-(RHR1+RHR3)+-(RHR2+RHR4)
OSD1	(RHR1+RHR3)*(RHR2+RHR4)
OSDF	1
OHRF	1
HRF	1
OLP1	OSP=S*(SP=S+SPR=S)
OLPF	1
VNTF	1
OAIF	1
AIF	1



1		1
2		2
3	X14	3-4
4	X15	5-8
5	X15	9-12
6	X15	13-16
7	X1	17-32
8	X2	33-64
9	X3	65-128
10	X4	129-256
11	X16	257-512
12	X17	513-1024
13	X18	1025-2048
14	X19	2049-4096
15	X15	4097-4100
16	X15	4101-4104
17	X5	4105-4112
18	X6	4113-4128
19	X7	4129-4160
20	X8	4161-4224
21	X20	4225-4352
22	X21	4353-4608
23	X22	4609-5120
24	X23	5121-6144
25	X9	6145-12288
26	X10	12289-24576
27	X11	24577-49152
28	X12	49153-98304
29	X13	98305-196608

MODEL Name: BFNFINAL

Top Event Legend for Tree: MESUPT

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Top Event Designator.....	Top Event Description..............................
IE	Initiating Event
RCW	RAW COOLING WATER SYSTEM UNAVAILABLE
EA	EECW PUMP A UNAVAILABLE
EC	EECW PUMP C UNAVAILABLE
EB	EECW PUMP B UNAVAILABLE
ED	EECW PUMP D UNAVAILABLE
RBC	RX BUILDING COMPONENT COOLING WATER SYSTEM UNAVAILABLE
SW2A	RHRSW PUMP A2 UNAVAILABLE
SW1A	RHRSW PUMP A1 (SWING PUMP) UNAVAILABLE
SW2B	RHRSW PUMP B2 UNAVAILABLE
SW1B	RHRSW PUMP B1 (SWING PUMP) UNAVAILABLE
SW2C	RHRSW PUMP C2 UNAVAILABLE
SW1C	RHRSW PUMP C1 (SWING PUMP) UNAVAILABLE
SW2D	RHRSW PUMP D2 UNAVAILABLE
SW1D	RHRSW PUMP D1 (SWING PUMP) UNAVAILABLE
PCA	PLANT CONTROL AIR SYSTEM UNAVAILABLE
DCA	DRYWELL CONTROL AIR SYSTEM UNAVAILABLE
CST	CONDENSATE STORAGE TANK UNAVAILABLE
TOR	SUPPRESSION POOL (TORUS) UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: MESUPT

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SF........ Split Fraction Logic...

EECW:=(EA=S*(EB=S+EC=S+ED=S)+EB=S*(EC=S+ED=S)+
EC=S*ED=S)

CWPCA:=RCW=S+(EA=S*(EB=S+EC=S+ED=S)+EB=S*(EC=S+ED=S)+
EC=S*ED=S)*DI=S

NOLOCA1:=-(INIT=LLS+INIT=LLD+INIT=LLC+INIT=LLO+INIT=IOTV+INIT=IOTM+
INIT=ELOCA+INIT=MLOCA+INIT=SLOCA+INIT=VLOCA)

SIG1:=LV=S+DW=S*(NPI=S+NPII=S)

RCWF	(UB41A=F*UB41B=F*(UB42A=F*(UB42B=F+UB42C=F)+UB42B=F*UB42C=F))*EPR30 +OG5=F*(OUB=F+EPR30=F)+INIT=FLTB+INIT=LRCW
RCW15	AA=F*UB42A=F*UB42B=F*UB42C=F*(UB41A=F+UB41B=F)*-EPR30=F
RCW15	AA=F*(UB41A=F*UB41B=F*(UB42A=F+UB42B=F+UB42C=F)+ (UB41A=F+UB41B=F)*(UB42A=F*(UB42B=F+UB42C=F)+UB42B=F*UB42C=F))*-EPR
RCW13	AA=F*(UB41A=F+UB41B=F)*(UB42A=F+UB42B=F+UB42C=F)*-EPR30=F
RCW12	AA=F*UB42A=F*UB42B=F*UB42C=F*-EPR30=F
RCW12	AA=F*(UB42A=F*(UB42B=F+UB42C=F)+UB42B=F*UB42C=F+UB41A=F*UB41B=F)*-E PR30=F
RCW10	AA=F*(UB41A=F+UB41B=F+UB42A=F+UB42B=F+UB42C=F)*-EPR30=F
RCW9	AA=F
RCW7	UB41A=F*UB41B=F*(UB42A=F+UB42B=F+UB42C=F)*-EPR30=F
RCW7	UB42A=F*UB42B=F*UB42C=F*(UB41A=F+UB41B=F)*-EPR30=F
RCW7	(UB41A=F+UB41B=F)*(UB42A=F*(UB42B=F+UB42C=F)+UB42B=F*UB42C=F)*-EPR3 0=F
RCW5	(UB41A=F+UB41B=F)*(UB42A=F+UB42B=F+UB42C=F)*-EPR30=F
RCW4	UB42A=F*UB42B=F*UB42C=F*-EPR30=F
RCW4	(UB41A=F*UB41B=F+UB42A=F*(UB42B=F+UB42C=F)+UB42B=F*UB42C=F)*-EPR30= F
RCW2	(UB41A=F+UB41B=F+UB42A=F+UB42B=F+UB42C=F)*-EPR30=F
RCW1	AA=S*UB41A=S*UB41B=S*UB42A=S*UB42B=S*UB42C=S
RCWF	1
EAF	OG5=F*DE=F+A3EA=F+INIT=FLPH1+INIT=FLRB1+INIT=FLRB2
EA3	OG5=F*DE=S*A3EA=S
EA1	OG5=S*A3EA=S
EAF	1
EBF	OG5=F*DB=F+AC=F
EB12	OG5=F*DB=S*(DE=F+A3EA=F)*(DF=F+A3EB=F+-SIG1)
EB9	OG5=F*DB=S*AC=S*EA=F*EC=F
EB11	OG5=F*DB=S*((DE=F+A3EA=F)*EC=F+EA=F*(DF=F+A3EB=F+-SIG1))

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: MESUPT

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SF........	Split Fraction Logic..
EB8	OG5=F*DB=S*AC=S*(EA=F+EC=F)
EB10	OG5=F*DB=S*(DE=F+A3EA=F+DF=F+A3EB=F+-SIG1)
EB7	OG5=F*DB=S*AC=S*EA=S*EC=S
EB3	OG5=S*AC=S*EA=F*EC=F
EB6	OG5=S*A3EA=F*(DF=F+A3EB=F+-SIG1)
EB5	OG5=S*A3EA=F*EC=F
EB14	OG5=S*EA=F*(DF=F+A3EB=F+-SIG1)
EB13	OG5=S*AC=S*EA=S*EC=F
EB2	OG5=S*AC=S*EA=F*EC=S
EB4	OG5=S*A3EA=F
EB15	OG5=S*(DF=F+A3EB=F+-SIG1)
EB1	OG5=S*AC=S*EA=S*EC=S
EBF	1
ECF	DF=F+A3EB=F+-SIG1+INIT=LFRB2
EC3	(OG5=F*DE=F+A3EA=F)*SIG1
EC4	EA=F*SIG1
EC2	EA=S*SIG1
ECF	1
EDF	DD=F+AD=F+-SIG1
ED16	SIG1*(OG5=F*DE=F+A3EA=F)*(OG5=F*DB=F+AC=F)*(DF=F+A3EB=F)
ED8	SIG1*EA=F*EC=F*EB=F
ED15	SIG1*(OG5=F*DE=F+A3EA=F)*(OG5=F*DB=F+AC=F)*EC=F
ED14	SIG1*((OG5=F*DE=F+A3EA=F)*EB=F+EA=F*(OG5=F*DB=F+AC=F))*(DF=F+A3EB=F)
ED17	SIG1*((OG5=F*DE=F+A3EA=F)*EB=F+EA=F*(OG5=F*DB=F+AC=F))*DF=S*A3EB=S
ED13	SIG1*EA=F*EB=F*(DF=F+A3EB=F)
ED12	SIG1*((OG5=F*DE=F+A3EA=F)*EB=F+EA=F*(OG5=F*DB=F+AC=F))*EC=F
ED26	SIG1*EC=F*(EA=F+EB=F)
ED6	SIG1*EA=F*EB=F
ED11	SIG1*(OG5=F*(DE=F+DB=F)+A3EA=F+AC=F)*EC=F
ED10	SIG1*(EA=F+EB=F)*(DF=F+A3EB=F)
ED9	SIG1*(DF=F+A3EB=F)*(OG5=F*(DE=F+DB=F)+A3EA=F+AC=F)
ED7	SIG1*(OG5=F*DE=F+A3EA=F)*(OG5=F*DB=F+AC=F)
ED5	SIG1*(OG5=F*(DE=F+DB=F)+A3EA=F+AC=F)

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: MESUPT

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SF........	Split Fraction Logic..
ED3	SIG1*(DF=F+A3EB=F)
ED25	SIG1*EC=F
ED4	SIG1*(EA=F+EB=F)
ED2	SIG1*EA=S*EC=S*EB=S
EDF	1
RBCF	RCW=F*-(EECW*DJ=S)+OG5=F*SIG1*(AB=F+DC=F)*(AD=F+DD=F) +OG5=S*(AB=F+AD=F)+OG5=F*SIG1*RI=F +OG5=F*(AB=F+DC=F+AD=F+DD=F)*-SIG1
RBC20	OG5=F*SIG1*RCW=F*EECW*RI=S
RBC19	OG5=F*RCW=F*EECW*DJ=S
RBC17	OG5=S*RCW=F*EECW*DJ=S
RBC11	OG5=F*SIG1*RCW=S*RI=S
RBC10	OG5=F*RCW=S*-SIG1
RBC4	OG5=S*RCW=S
RBCF	1
SW2AF	AA=F+DA=F+INIT=FLPH1
SW2A1	AA=S*DA=S
SW2AF	1
SW1AF	AA=F+DA=F+INIT=FLPH1
SW1AB	SW2A=S
SW1A1	SW2A=F
SW1AF	1
SW2BF	AC=F+DB=F
SW2B1	AC=S*DB=S
SW2BF	1
SW1BF	A3EC=F+DG=F
SW1BB	SW2B=S
SW1B1	SW2B=F*AC=S*DB=S
SW1B2	SW2B=F
SW1BF	1
SW2CF	DC=F+AB=F
SW2C4	SW2A=F*SW1A=F*(AA=F+DA=F)
SW2C3	SW2A=F*SW1A=F
SW2C2	SW2A=F*SW1A=S

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: MESUPT

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SF........	Split Fraction Logic..
SW2C1	SW2A=S
SW2CF	1
SW1CF	DC=F+AB=F
SW1CB	SW2C=S
SW1C4	SW2A=F*SW1A=F*(AA=F+DA=F)
SW1C3	SW2A=F*SW1A=F
SW1C2	SW2A=F*SW1A=S
SW1C1	SW2A=S
SW1CF	1
SW2DF	DD=F+AD=F
SW2D6	SW2B=F*SW1B=S*(AC=F+DB=F)
SW2D5	SW2B=F*SW1B=F*(AC=F+DB=F)*(A3EC=F+DG=F)
SW2D4	SW2B=F*SW1B=F*(AC=F+DB=F+A3EC=F+DG=F)
SW2D3	SW2B=F*SW1B=F
SW2D2	SW2B=F*SW1B=S
SW2D1	SW2B=S
SW2DF	1
SW1DF	DH=F+A3ED=F
SW1DB	SW2D=S
SW1D10	(AC=F+DB=F)*(A3EC=F+DG=F)*(AD=F+DD=F)
SW1D9	(AC=F+DB=F)*SW1B=S*(AD=F+DD=F)
SW1D8	SW2B=F*SW1B=S*(AD=F+DD=F)
SW1D7	SW2B=S*(AD=F+DD=F)
SW1D6	(AC=F+DB=F)*((A3EC=F+DG=F)*SW2D=F+(AD=F+DD=F)*SW1B=F) +SW2B=F*(A3EC=F+DG=F)*(AD=F+DD=F)
SW1D5	(AC=F+DB=F)*SW1B=S*SW2D=F
SW1D4	SW2B=F*((A3EC=F+DG=F)*SW2D=F+(AD=F+DD=F)*SW1B=F) +(AC=F+DB=F)*SW1B=F*SW2D=F
SW1D3	SW2B=F*SW1B=F*SW2D=F
SW1D2	SW2B=F*SW1B=S*SW2D=F
SW1D1	SW2B=S*SW2D=F
SW1DF	1
PCAF	INIT=LOPA+-CWPCA+OG5=F*EPR30=F*(DA=F+AA=F+DC=F+AB=F)+INIT=FLTB
PCA4	CWPCA*OG5=F*EPR30=F

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: MESUPT

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SF........	Split Fraction Logic..
PCA3	CWPCA*(OG5=S+-EPR30=F)*AA=F*AB=F
PCA2	CWPCA*(OG5=S+-EPR30=F)*(AA=F+AB=F)
PCA1	CWPCA*(OG5=S+-EPR30=F)*AA=S*AB=S
PCAF	1
DCAF	PCA=F+RBC=F+DN=F+DO=F+RH=F*RI=F+INIT=LICB
DCA1	RH=S*RI=S
DCA2	RH=S+RI=S
DCAF	1
CSTF	INIT=FLRB3C
CST1	1
TORF	INIT=FLRB3S
TOR2	1

MODEL Name: BFNFINAL
Event Tree: MLOCA2

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1		1
2		2
3	X18	3-4
4	X19	5-8
5	X20	9-16
6	X20	17-24
7	X20	25-32
8	X1	33-64
9	X1	65-96
10	X1	97-128
11	X4	129-192
12	X2	193-352
13	X3	353-704
14	X3	705-1056
15	X3	1057-1408
16	X5	1409-2112
17	X6	2113-3872
18	X20	3873-3880
19	X20	3881-3888
20	X20	3889-3896
21	X20	3897-3904
22	X20	3905-3912
23	X7	3913-3952
24	X7	3953-3992
25	X7	3993-4032
26	X8	4033-4112
27	X9	4113-4312
28	X10	4313-4752
29	X10	4753-5192
30	X10	5193-5632
31	X11	5633-6512
32	X12	6513-8712
33	X15	8713-17424
34	X15	17425-26136
35	X15	26137-34848
36	X16	34849-69696
37	X17	69697-87120
38	X17	87121-104544

MODEL Name: BFNFINAL

Top Event Legend for Tree: MLOCA2

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Top Event Designator.....	Top Event Description..........................
IE	Initiating Event
RPS	AUTOMATIC (OR MANUAL) REACTOR SCRAM FAILURE
TB	AUTOMATIC (OR MANUAL) TURBINE TRIP FAILURE
IVC	FAILURE TO CLOSE AT LEAST ONE MSIV IN EACH LINE
HPI	HIGH PRESSURE COOLANT INJECTION SYSTEM UNAVAILABLE
RVD	FAILURE TO DEPRESSURIZE VIA THE SRVS
CRD	CONTROL ROD DRIVE HYDRAULIC UNAVAILABLE FOR DEBRIS BED COOLING
CS	ONE CORE SPRAY LOOP FAILS TO INJECT
RPA	RHR PUMP A UNAVAILABLE
HXA	RHR HEAT EXCHANGER A UNAVAILABLE
RPC	RHR PUMP C UNAVAILABLE
HXC	RHR HEAT EXCHANGER C UNAVAILABLE
U3	CROSS CONNECT TO UNIT 3 RHR SYSTEM UNAVAILABLE
RPB	RHR PUMP B UNAVAILABLE
HXB	RHR HEAT EXCHANGER B UNAVAILABLE
RPD	RHR PUMP D UNAVAILABLE
HXD	RHR HEAT EXCHANGER D UNAVAILABLE
U1	CROSS CONNECT TO UNIT 1 RHR SYSTEM UNAVAILABLE
OSP	OPERATOR FAILS TO INITIATE SP COOLING
SP	SUPPRESSION POOL COOLING HARDWARE UNAVAILABLE
SPR	FAILURE TO RECOVER TORUS COOLING
LPC	RHR LPCI INJECTION PATH UNAVAILABLE
CD	CONDENSATE UNAVAILABLE FOR DEBRIS BED COOLING
AI	ALTERNATE INJECTION UNAVAILABLE FOR DEBRIS BED COOLING
VNT	CONTAINMENT VENT UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: MLOCA2

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```
SF........ Split Fraction Logic..........................................
           NOGA:=GA=S*-EECW
           NOGB:=GB=S*-EECW
           NOGC:=GC=S*-EECW
           NOGD:=GD=S*-EECW
           NOGE:=GE=S*-EECW
           NOGF:=GF=S*-EECW
           NOGG:=GG=S*-EECW
           NOGH:=GH=S*-EECW
           HPISUP:=RB=S*RC=S
           Y1:=(DA=F+AA=F+DC=F+AC=F)
           Y2:=(DB=F+AB=F+DD=F+AD=F)
           Y3:=(TOR=F+-EECW)
           RHR1:=RPA=S*HXA=S
           RHR2:=RPB=S*HXB=S
           RHR3:=RPC=S*HXC=S
           RHR4:=RPD=S*HXD=S
           RPDSUP:=AD=S*DD=S*(EECW+RCW=S)*TOR=S
           RPBSUP:=AC=S*DB=S*(EECW+RCW=S)*TOR=S
           RPCSUP:=AB=S*DC=S*(EECW+RCW=S)*TOR=S
           RPASUP:=AA=S*DA=S*(EECW+RCW=S)*TOR=S
           NOSIG:=LM1=F*LM3=F+LM2=F*LM4=F
           SIG1:=LV=S+DW=S*(NPI=S+NPII=S)
           SIG3:=(LV=S+DW=S)
           POWER:=RH=S+RI=S
           PWR4:=RB=F*(RC=F+RD=F)+RC=F*RD=F
           PWR6:=RB=F+RC=F+RD=F+-DCA=S+RB=S*RC=S*RD=S*DCA=S
           RHRSW1:=SW2B=S+SW1B=S+SW2D=S+SW1D=S
           RHRPMP:=-RHR1*-RHR3
           LPCI:=(OSP=F+SP=F*SPR=F)*((RPA=S+RPC=S)*RK=S+(RPB=S+RPD=S)*RL=S)
           +(SP=S+SPR=S)*((RPA=S+RPC=S)*RK=S*(RPB=S+RPD=S)*RL=S)
           HXAB:=RH=F+SW2A=F*SW1A=F+NOGB+HXA=B
           HXBB:=RI=F+SW2B=F*SW1B=F+NOGD+HXB=B
           HXCB:=RH=F+SW2C=F*SW1C=F+NOGB+HXC=B
RPS10      -POWER+PCA=F
```

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: MLOCA2

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SF........	Split Fraction Logic..
RPS9	POWER*RB=F*RC=F*DB=F*DD=F
RPS8	POWER*RB=F*RC=F*(DB=F+DD=F)
RPS7	POWER*RB=F*RC=F
RPS6	POWER*(RB=F+RC=F)*DB=F*DD=F
RPS5	POWER*(RB=F+RC=F)*(DB=F+DD=F)
RPS4	POWER*(RB=F+RC=F)
RPS3	POWER*DB=F*DD=F
RPS2	POWER*(DB=F+DD=F)
RPS1	PCA=S*POWER*RB=S*RC=S*DB=S*DD=S
RPS11	1
TBF	AB=F+UB42A=F*UB42B=F+NOGB
TB3	AB=S*UB42A=F*UB42B=S
TB2	AB=S*UB42A=S*UB42B=F
TB1	AB=S*UB42A=S*UB42B=S
TBF	1
IVCF	NOSIG*PCA=S*DCA=S*(RH=S+RC=S)*(RI=S+RB=S)
IVC3	(-DCA=S+RH=F*RC=F)*(PCA=F+RI=F*RB=F)
IVC2	(-DCA=S+(RH=F+NOGB)*RC=F+PCA=F+(RI=F+NOGD)*RB=F)
IVC1	(RC=F*(RI=F+NOGD+RB=F)+(RH=F+NOGB)*(RI=F+NOGD+RB=F))*-NOSIG
IVC1	(RI=F+NOGD+RH=F+NOGB+RB=F+RC=F)*DCA=S*PCA=S*-NOSIG
IVC1	-NOSIG*RH=S*RI=S*RB=S*RC=S*DCA=S*PCA=S
IVCF	1
HPIF	-HPISUP+TOR=F+-SIG3
HPI2	CST=F
HPI1	CST=S
HPIF	1
RVD13	PWR4
RVD14	PWR6
RVD13	1
CRDF	RCW=F+UB42C=F+CST=F
CRD1	RCW=S*UB42C=S*CST=S
CRDF	1
RPAF	-RPASUP+RH=F+RC=F+-SIG1+NOGA+NOGB

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: MLOCA2

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SF........	Split Fraction Logic..
RPA1	RPASUP*RH=S*RC=S*SIG1
RPAF	1
RPCF	-RPCSUP+RH=F+RB=F*RC=F+-SIG1+NOGB
RPC1	RPCSUP*RH=S*(RB=S+RC=S)*RPA=S*SIG1
RPC3	RPCSUP*RH=S*(RB=S+RC=S)*(-RPASUP+RC=F)*SIG1
RPC2	RPCSUP*RH=S*(RB=S+RC=S)*RPASUP*RC=S*RPA=F*SIG1
RPCF	1
RPBF	-RPBSUP+RI=F+RB=F+-SIG1+NOGC+NOGD
RPB6	RPBSUP*RI=S*RB=S*(-(RPASUP*RH=S)*RPC=F+RPA=F*(RPC=B+-(RPCSUP* RH=S*RPB=S)))*SIG1
RPB5	RPBSUP*RI=S*RB=S*(-(RPASUP*RH=S)*RPC=S+RPA=S*(RPC=B+-(RPCSUP*RH=S*R PB=S)))*SIG1
RPB4	RPBSUP*RI=S*RB=S*-(RPASUP*RH=S)*(RPC=B+-(RPCSUP*RH=S*RB=S)) *SIG1
RPB3	RPBSUP*RI=S*RB=S*RPA=F*RPC=F*SIG1
RPB2	RPBSUP*RI=S*RB=S*(RPA=S*RPC=F+RPA=F*RPC=S)*SIG1
RPB1	RPBSUP*RI=S*RB=S*RPA=S*RPC=S*SIG1
RPBF	1
RPDF	-RPDSUP+RI=F+RB=F*RC=F+-SIG1+NOGD
RPD10	RPDSUP*RI=S*(RB=S+RC=S)*(RPA=F*(RPC=F*-(RPBSUP*RC=S)+(RPC=B+-(RPCSU P*RH=S))*RPB=F)+-(RPASUP*RH=S*RC=S)*RPC=F*RPB=F)*SIG1
RPD9	RPDSUP*RI=S*(RB=S+RC=S)*(RPA=S*(RPC=F*-(RPBSUP*RC=S)+ (RPC=B+-(RPCSUP*RH=S))*RPB=F)+RPC=S*(RPA=F* -(RPBSUP*RC=S)+-(RPASUP*RH=S*RC=S)*RPB=F)+RPB=S* (RPA=F*(RPC=B+-(RPCSUP*RH=S)+ -(RPASUP*RH=S*RC=S)*RPC=F)))*SIG1
RPD8	RPDSUP*RI=S*(RB=S+RC=S)*(RPA=S*(RPC=S*-(RPBSUP*RC=S)+ (RPC=B+-(RPCSUP*RH=S)+RPB=S))+-(RPASUP*RH=S* RC=S)*RPC=S*RPB=S)*SIG1
RPD7	RPDSUP*RI=S*(RB=S+RC=S)*(-(RPASUP*RH=S*RC=S)*(RPC=F*- (RPBSUP*RC=S)+(RPC=B+-(RPCSUP*RH=S))*RPB=F)+RPA=F* (RPC=B+-(RPCSUP*RH=S))*-(RPBSUP*RC=S))*SIG1
RPD6	RPDSUP*RI=S*(RB=S+RC=S)*(-(RPASUP*RH=S*RC=S)*(RPC=S*- (RPBSUP*RC=S)+(RPC=B+-(RPCSUP+RH=S)))*RPB=F +RPA=S*(RPC=B+-(RPCSUP*RH=S))*-(RPBSUP*RC=S))*SIG1
RPD5	RPDSUP*RI=S*(RB=S+RC=S)*-(RPASUP*RH=S*RC=S)* (RPC=B+-(RPCSUP*RH=S))*-(RPBSUP*RC=S)*SIG1
RPD4	RPDSUP*RI=S*(RB=S+RC=S)*RPA=F*RPC=F*RPB=F*SIG1
RPD3	RPDSUP*RI=S*(RB=S+RC=S)*(RPA=F*(RPC=F*RPB=S+RPC=S*RPB=F) +RPA=S*RPC=F*RPB=F)*SIG1
RPD2	RPDSUP*RI=S*(RB=S+RC=S)*(RPA=F*RPC=S*RPB=S+RPA=S*RPC=F*RPB=S+RPA

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: MLOCA2

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SF.......	Split Fraction Logic...
	=S*RPC=S*RPB=F)*SIG1
RPD1	RPDSUP*RI=S*(RB=S+RC=S)*RPA=S*RPC=S*RPB=S*SIG1
RPDF	1
HXAF	RH=F+SW2A=F*SW1A=F+NOGB
HXA1	RH=S*(SW2A=S+SW1A=S)
HXAF	1
HXCF	RH=F+SW2C=F*SW1C=F+NOGB
HXC1	RH=S*HXA=S*(SW2C=S+SW1C=S)
HXC2	RH=S*HXA=F*(SW2C=S+SW1C=S)
HXC3	RH=S*HXAB*(SW2C=S+SW1C=S)
HXCF	1
HXBF	RI=F+S[illegible]=F*SW1B=F+NOGD
HXB1	RI=S*[illegible]S*HXC=S*(SW2B=S+SW1B=S)
HXB6	RI=S*[illegible]*HXCB*(SW2B=S+SW1B=S)
HXB4	RI=S*([illegible]=F*HXCB+HXAB*HXC=F)*(SW2B=S+SW1B=S)
HXB3	RI=S*([illegible]=S*HXCB+HXAB*HXC=S)*(SW2B=S+SW1B=S)
HXB5	RI=S*H[illegible]F*HXC=F*(SW2B=S+SW1B=S)
HXB2	RI=S*(H[illegible]=S*HXC=F+HXA=F*HXC=S)*(SW2B=S+SW1B=S)
HXBF	1
HXDF	RI=F+SW2D=F*SW1D=F+NOGD
HXD10	HXAB*HXCB*HXBB*(SW2D=S+SW1D=S)
HXD9	(HXAB*(HXCB*HXB=F+HXC=F*HXBB)+HXA=F*HXCB*HXBB)*(SW2D=S+SW1D=S)
HXD8	(HXAB*(HXCB+HXBB)+HXCB*HXBB)*(SW2D=S+SW1D=S)
HXD7	HXA=F*HXC=F*HXB=F*(SW2D=S+SW1D=S)
HXD6	(HXA=F*(HXC=F*HXBB+HXCB*HXB=F)+HXAB*HXC=F*HXB=F)*(SW2D=S+SW1D=S)
HXD5	(HXA=F*(HXC=F+HXB=F)+HXC=F*HXB=F)*(SW2D=S+SW1D=S)
HXD4	(HXAB*(HXC=F+HXB=F)+HXCB*(HXA=F+HXB=F)+HXBB*(HXA=F+HXC=F))*(SW2D=S+ SW1D=S)
HXD3	(HXA=F+HXC=F+HXB=F)*(SW2D=S+SW1D=S)
HXD2	(HXAB+HXCB+HXBB)*(SW2D=S+SW1D=S)
HXD1	RI=S*HXA=S*HXC=S*HXB=S*(SW2D=S+SW1D=S)
HXDF	1
U3F	1
U11	RHRSW1*RF=S*RHRPMP

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: MLOCA2

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SF........	Split Fraction Logic..
U1F	1
OSPF	RPS=S*-(RHR1+RHR3)*-(RHR2+RHR4)*U1=F+RPS=F*-(RHR1*RHR2*RHR3*RHR4)
OSP3	RPS=S*(-(RHR1+RHR3)+-(RHR2+RHR4)+U1=S)
OSP2	RPS=F*RHR1*RHR2*RHR3*RHR4
OSP1	RPS=S*(RHR1+RHR3)*(RHR2+RHR4)
OSPF	1
SPF	(-(RHR1+RHR3)+RK=F)*(-(RHR2+RHR4)+RL=F)*U1=F
SP1	(RHR1+RHR3)*RK=S*(RHR2+RHR4)*RL=S
SP3	-(RHR1+RHR3)+RK=F+-(RHR2+RHR4)+RL=F+U1=S
SPF	1
SPR1	RPS=S*TB=S
SPRF	1
LPCF	NPI=F*NPII=F+-LPCI+NOGB*NOGD
LPC5	-(INIT=LLS+INIT=LLD)*(NPI=S+NPII=S)*(RK=F+RL=F+RPA=F*RPC=F+RPB=F*RP D=F)
LPC4	(NPI=S+NPII=S)*(-(INIT=LLS+INIT=LLD)*RK=S*RL=S *(RPA=S+RPC=S)*(RPB=S+RPD=S))
LPCF	1
CSF	Y3+-SIG3+RH=F*RI=F+Y1*Y2+NPI=F*NPII=F
CS2	-Y3*(Y1+RH=F+NPI=F+Y2+RI=F+NPII=F)*SIG3
CS1	-Y3*-Y1*RH=S*NPI=S*-Y2*RI=S*NPII=S*SIG3
CSF	1
CDF	PCA=F+RCW=F+DJ=F+UB42A=F*UB42B=F*UB42C=F
CD1	1
AIF	1
VNTF	1

MODEL Name: BFNFINAL

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Event Tree: MLOCACNTMT

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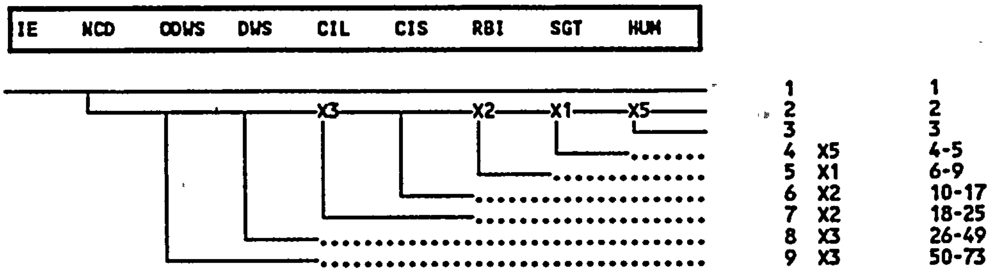

MODEL Name: BFNFINAL

Top Event Legend for Tree: MLOCACNTMT

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Page 1

Top Event Designator.....	Top Event Description..............................
IE	Initiating Event
NCD	CORE DAMAGE OCCURRED
ODWS	OPERATOR FAILS TO INITIATE DW SPRAY
DWS	DRYWELL SPRAY UNAVAILABLE
CIL	ISOLATION OF LARGE CONTAINMENT PENETRATIONS FAILED
CIS	ISOLATION OF SMALL CONTAINMENT PENETRATIONS FAILED
RBI	REACTOR BUILDING ISOLATION FAILURE
SGT	STANDBY GAS TREATMENT SYSTEM UNAVAILABLE
HUM	SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: MLOCACNTMT

14:45:41 13 AUG 1992
Page 1

SF........	Split Fraction Logic..
	RR12:=RHR1*RHR3+RHR1*U3=S+RHR3*U3=S
	RR11:=RHR1+RHR3+U3=S
	RR22:=RHR2*RHR4+RHR2*U1=S+RHR4*U1=S
	RR21:=RHR2+RHR4+U1=S
	HEATL:=(RHR1+RHR2+RHR3+RHR4+U1=S+U3=S)*OSP=S*(SP=S+SPR=S)
	HEAT:=(RHR1+RHR2+RHR3+RHR4+U1=S+U3=S)*(OSP=S*(SP=S+SPR=S)+OSD=S*SDC =S)
	AHEAT:=RR12*RR21+RR11*RR22
	NOLOCA:=-(INIT=LLS+INIT=LLD+INIT=LLC+INIT=LLO+INIT=ELOCA)
	VENT:=OLP=S*VNT=S
	SIG:=LVP=S+DWP=S
NCD1	INIT=MLOCA*RPS=S*(TB=S+IVC=S)*(HPI=S+RVD=S)*(CS=S+LPC=S)*HEATL
NCDF	1
CDWS1	RPS=S
CDWS2	RPS=F
CDWS2	1
DWSF	PX1=F*PX2=F+(-RR11+RH=F+NOGB)*(-RR21+RI=F+NOGD)+SP=F*SPR=F
DWS2	-RR11+RH=F+-RR21+RI=F+NOGB+NOGD
DWS1	PX1=S*PX2=S*RR11*RH=S*RR21*RI=S
DWSF	1
CILF	LVP=F*DWP=F
CIL2	PCA=F+DN=F
CIL1	1
CISF	LVP=F*DWP=F
CIS1	1
RBIF	LVP=F*DWP=F
RBI1	1
SGTF	RM=F*RN=F+RN=F*A3ED=F+RM=F*A3ED=F+DN=F*DO=F+AA=F*DM=F +RM=F*(DO=F+DM=F)+RN=F*(DN=F+AA=F)+-SIG +NOGD*(NOGA+NOGH+NOGB*NOGF+NOGB*NOGC+NOGE) +NOGA*NOGC*NOGG
SGT9	RM=F+RN=F+NOGA+NOGD
SGT8	A3ED=F*((DN=F+DO=F)*(AA=F+DM=F))+NOGB*NOGC*NOGE*NOGH
SGT6	A3ED=F*(AA=F+DM=F+DN=F+DO=F)+NOGH*(NOGA+NOGB*NOGG)
SGT5	A3ED=F+NOGH

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: MLOCACNTMT

14:45:42 13 AUG 1992
Page 2

SF........	Split Fraction Logic..
SGT4	(DN=F+DO=F)*(AA=F+DM=F)+NOGB*NOGC*NOGE
SGT2	AA=F+DM=F+DN=F+DO=F+NOGA+NOGB*NOGG
SGT1	RM=S*RN=S*A3ED=S*DN=S*AA=S*DO=S*DM=S*SIG
SGTF	1
HUMF	A3ED=F*(RM=F+RN=F)+RM=F*RN=F+NOGH*(NOGA+NOGD)+NOGA*NOGD
HUM3	(RM=S+NOGA+RN=S+NOGD)*A3ED=S
HUM2	RM=S*RN=S*(A3ED=F+NOGH)
HUM1	RM=S*RN=S*A3ED=S
HUMF	1

MODEL Name: BFNFINAL

Binning Logic for Event Tree: MLOCACNTMT

15:04:38 13 AUG 1992
Page 1

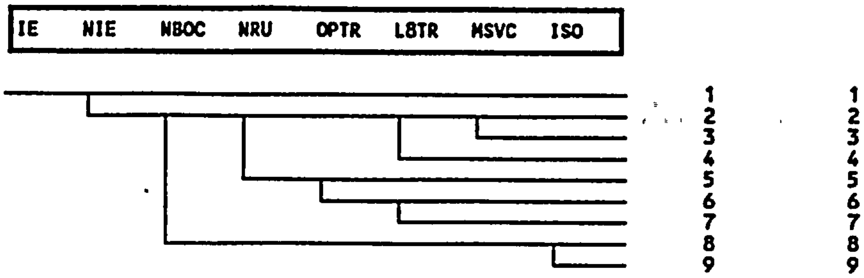
Bin.......	Binning Rules..
SUCCESS	NCD=S
MELT	NCD=F

MODEL Name: BFNFINAL

Page No. 1

11:07:03 13 AUG 1992

Event Tree: PRETREE



MODEL Name: BFNFINAL

Top Event Legend for Tree: PRETREE

11:07:04 13 AUG 1992
Page 1

Top Event Designator.....	Top Event Description..........................
IE	Initiating Event
NIE	INITIATOR IS BOC, FWRU, PRFOPEN
NBOC	INITIATOR IS BOC
NRU	INITIATOR IS FWRU
OPTR	OPERATOR FAILS TO TRIP FEED PUMPS ON FWRU
L8TR	LEVEL 8 TRIP OF FEED ON FWRU, PRFOPEN FAILS
MSVC	MSIVS FAIL TO ISOLATE ON LOW STMLN PRESSURE OR LEVEL
ISO	FAILURE TO ISOLATE THE BOC

MODEL Name: BFNFINAL

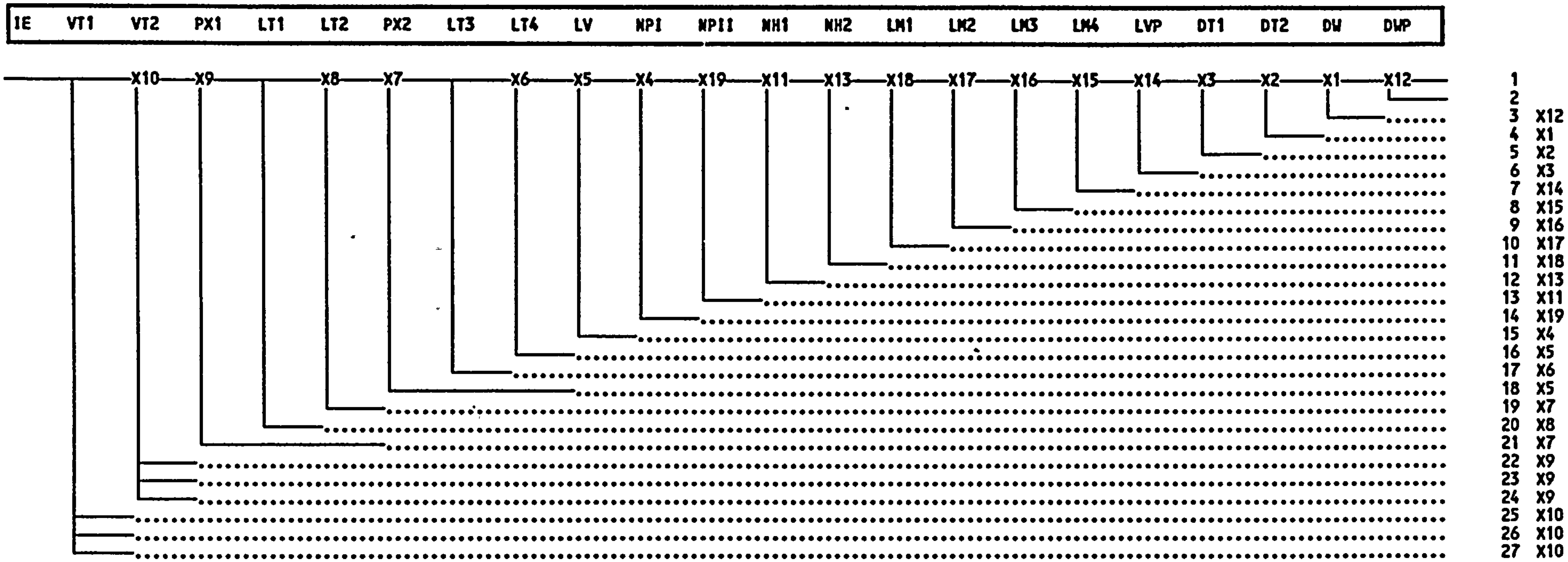
Split Fraction Logic for Event Tree: PRETREE

14:45:56 13 AUG 1992
Page 1

SF........	Split Fraction Logic..
	L8TSUP:=DH=S*DN=S*DJ=S
	NOSIG:=LM1=F*LM3=F+LM2=F*LM4=F
NIEF	INIT=BOC+INIT=FWRU+INIT=PRFO
NIEB	1
NBOCF	INIT=BOC
NBOCB	1
NRUF	INIT=FWRU
NRUB	1
OPTR1	1
L8TRF	VT1=L1B+-L8TSUP
L8TR2	VT2=L2B
L8TR1	-VT2=L2B
L8TRF	1
MSVCF	NOSIG*PCA=S*DCA=S*(RH=S+RC=S)*(RI=S+RB=S)
MSVC3	(-DCA=S+RH=F*RC=F)*(PCA=F+RI=F*RB=F)
MSVC2	(-DCA=S+RH=F*RC=F)
MSVC1	RH=F*RI=F*-NOSIG
MSVC1	RH=F*RB=F*-NOSIG
MSVC1	RC=F*RI=F*-NOSIG
MSVC1	RC=F*RB=F*-NOSIG
MSVC2	(PCA=F+RI=F*RB=F)
MSVC1	(RI=F+RH=F)*-NOSIG
MSVC1	(RB=F+RC=F)*-NOSIG
MSVC1	-NOSIG*DCA=S*PCA=S*RH=S*RC=S*RI=S*RB=S
MSVCF	1
ISO1	RI=S*RC=S*PX1=S*PX2=S
ISO1	RI=S*RC=S*(PX1=F+PX2=F)
ISO2	RI=S*RC=F*PX2=S
ISO2	RI=F*RC=S*PX1=S*PX2=S
ISO2	RI=F*RC=S*(PX1=F+PX2=F)
ISOF	RC=F*(RI=F+PX2=F)+PX1=F*PX2=F
ISOF	1

MODEL Name: BFNFINAL
Event Tree: SIGL

11:07:15 13 AUG 1992



1
2
3-4
5-8
9-16
17-32
33-64
65-128
129-256
257-512
513-1024
1025-2048
2049-4096
4097-8192
8193-16384
16385-32768
32769-65536
65537-81920
81921-163840
163841-327680
327681-409600
409601-819200
819201-1228800
1228801-1638400
1638401-3276800
3276801-4915200
4915201-6553600

MODEL name: BFNFINAL

Top Event Legend for Tree: SIGL

11:07:17 13 AUG 1992
Page 1

Top Event Designator.....	Top Event Description...........................
IE	Initiating Event
VT1	VESSEL INSTRUMENT TAP I CONDITION
VT2	VESSEL INSTRUMENT TAP II CONDITION
PX1	POWER SUPPLY DIVISION I UNAVAILABLE
LT1	LEVEL TRANSMITTER 1 UNAVAILABLE
LT2	LEVEL TRANSMITTER 2 UNAVAILABLE
PX2	POWER SUPPLY DIVISION II UNAVAILABLE
LT3	LEVEL TRANSMITTER 3 UNAVAILABLE
LT4	LEVEL TRANSMITTER 4 UNAVAILABLE
LV	VESSEL LEVEL SIGNAL UNAVAILABLE
NPI	DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE
NPII	DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE
NH1	DIV I HI RX PRESS SIGNAL UNAVAILABLE
NH2	DIV II HI RX PRESS SIGNAL UNAVAILABLE
LM1	PCIS LEVEL TRANSMITTER 1 UNAVAILABLE
LM2	PCIS LEVEL TRANSMITTER 2 UNAVAILABLE
LM3	PCIS LEVEL TRANSMITTER 3 UNAVAILABLE
LM4	PCIS LEVEL TRANSMITTER 4 UNAVAILABLE
LVP	LEVEL 3 SIGNAL (RPS/PCIS/SCIS) UNAVAILABLE
DT1	DRYWELL INSTRUMENT TAP I FAILURE
DT2	DRYWELL INSTRUMENT TAP II FAILURE
DW	DRYWELL PRESSURE SIGNAL UNAVAILABLE
DWP	RPS/PCIS/SCIS HIGH DRYWELL SIGNAL UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: SIGL

14:46:08 13 AUG 1992
Page 1

SF........	Split Fraction Logic..
VT1F	VT1=NOFLI*-(INIT=UI+INIT=LIA+INIT=LIB)
VT1S	VT1=U1*-(INIT=UI+INIT=LIA+INIT=LIB)
VT1S	VT1=L1A*-(INIT=UI+INIT=LIA+INIT=LIB)
VT1S	VT1=L1B*-(INIT=UI+INIT=LIA+INIT=LIB)
VT1S	VT1=NOFLI*INIT=UI
VT1F	VT1=U1*INIT=UI
VT1S	VT1=L1A*INIT=UI
VT1S	VT1=L1B*INIT=UI
VT1S	VT1=NOFLI*INIT=LIA
VT1S	VT1=U1*INIT=LIA
VT1F	VT1=L1A*INIT=LIA
VT1S	VT1=L1B*INIT=LIA
VT1S	VT1=NOFLI*INIT=LIB
VT1S	VT1=U1*INIT=LIB
VT1S	VT1=L1A*INIT=LIB
VT1F	VT1=L1B*INIT=LIB
VT2F	VT2=NOFLII*-(INIT=UII+INIT=LIIA+INIT=LIIB)
VT2S	VT2=U2*-(INIT=UII+INIT=LIIA+INIT=LIIB)
VT2S	VT2=L2A*-(INIT=UII+INIT=LIIA+INIT=LIIB)
VT2S	VT2=L2B*-(INIT=UII+INIT=LIIA+INIT=LIIB)
VT2S	VT2=NOFLII*INIT=UII
VT2F	VT2=U2*INIT=UII
VT2S	VT2=L2A*INIT=UII
VT2S	VT2=L2B*INIT=UII
VT2S	VT2=NOFLII*INIT=LIIA
VT2S	VT2=U2*INIT=LIIA
VT2F	VT2=L2A*INIT=LIIA
VT2S	VT2=L2B*INIT=LIIA
VT2S	VT2=NOFLII*INIT=LIIB
VT2S	VT2=U2*INIT=LIIB
VT2S	VT2=L2A*INIT=LIIB
VT2F	VT2=L2B*INIT=LIIB
PX1F	RC=F

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: SIGL

14:46:10 13 AUG 1992
Page 2

SF........	Split Fraction Logic..
PX11	RC=S
PX1F	1
LT1F	PX1=F+VT1=U1
LT11	1
LT2F	PX1=F+VT1=U1
LT22	PX1=S*LT1=F
LT21	PX1=S*LT1=S
LT2F	1
PX2F	RB=F
PX23	RB=S*RC=F
PX22	RB=S*PX1=F
PX21	1
LT3F	PX2=F+VT2=U2
LT34	PX2=S*PX1=F
LT33	PX2=S*LT1=F*LT2=F
LT32	PX2=S*(LT1=F+LT2=F)
LT31	PX2=S*LT1=S*LT2=S
LT3F	1
LT4F	PX2=F+VT2=U2
LT46	PX2=S*PX1=F*LT3=F
LT45	PX2=S*PX1=F*LT3=S
LT44	PX2=S*LT1=F*LT2=F*LT3=F
LT43	PX2=S*(LT1=F*(LT2=F+LT3=F)+LT2=F*LT3=F)
LT42	PX2=S*(LT1=F+LT2=F+LT3=F)
LT41	PX2=S*LT1=S*LT2=S*LT3=S
LT4F	1
LVF	LT1=F*LT3=F+LT2=F*LT4=F
LVS	1
NPIF	PX1=F
NPI1	PX1=S
NPIF	1
NPIIF	PX2=F
NPII3	PX1=F*PX2=S

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: SIGL

14:46:12 13 AUG 1992
Page 3

SF........	Split Fraction Logic..
NPII2	PX1=S*NPI=F*PX2=S
NPII1	NPI=S*PX2=S
NPIIF	1
DT11	1
DT21	1
DWF	(PX1=F+DT1=F)*(PX2=F+DT2=F)+-(INIT=ELOCA+INIT=LLC +INIT=LLD+INIT=LLO+INIT=LLS+INIT=MLOCA+INIT=SLOCA +INIT=IOTV+INIT=IOTM)
DW2	PX1=F+DT1=F+PX2=F+DT2=F
DW1	PX1=S*DT1=S*PX2=S*DT2=S
DWF	1
LVP1	-(INIT=UI+INIT=UII)
LVP2	INIT=UI+INIT=UII
LVP2	1
DWPF	DT1=F*DT2=F
DWP2	DT1=F+DT2=F
DWP1	DT1=S*DT2=S
DWPF	1
NH1F	PX1=F+INIT=UI
NH11	PX1=S*-INIT=UI
NH1F	1
NH2F	PX2=F+INIT=UII
NH23	PX2=S*-INIT=UII*PX1=F
NH22	PX2=S+-INIT=UII*PX1=S*NH1=F
NH21	PX2=S*-INIT=UII*NH1=S
NH2F	1
LM1F	VT1=U1
LM11	VT1=NOFLI+VT1=L1A+VT1=L1B
LM1F	1
LM2F	VT1=U1
LM22	LM1=F*(VT1=NOFLI+VT1=L1A+VT1=L1B)
LM21	LM1=S*(VT1=NOFLI+VT1=L1A+VT1=L1B)
LM2F	1
LM3F	VT2=U2

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: SIGL

14:46:14 13 AUG 1992
Page 4

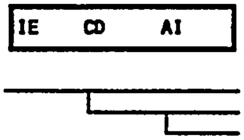
SF........	Split Fraction Logic..
LM34	VT1=U1*(VT2=NOFLII+VT2=L2A+VT2=L2B)
LM33	LM1=F*LM2=F*(VT2=NOFLII+VT2=L2A+VT2=L2B)
LM32	(LM1=F+LM2=F)*(VT2=NOFLII+VT2=L2A+VT2=L2B)
LM31	LM1=S*LM2=S*(VT2=NOFLII+VT2=L2A+VT2=L2B)
LM3F	1
LM4F	VT2=U2
LM46	VT1=U1*LM3=F*(VT2=NOFLII+VT2=L2A+VT2=L2B)
LM45	VT1=U1*LM3=S*(VT2=NOFLII+VT2=L2A+VT2=L2B)
LM44	LM1=F*LM2=F*LM3=F*(VT2=NOFLII+VT2=L2A+VT2=L2B)
LM43	(LM1=F*(LM2=F+LM3=F)+LM2=F*LM3=F)*(VT2=NOFLII+VT2=L2A+VT2=L2B)
LM42	(LM1=F+LM2=F+LM3=F)*(VT2=NOFLII+VT2=L2A+VT2=L2B)
LM41	LM1=S*LM2=S*LM3=S*(VT2=NOFLII+VT2=L2A+VT2=L2B)
LM4F	1

MODEL Name: BFNFINAL

Page No. 1

Event Tree: VSEQ

11:07:31 13 AUG 1992



1	1
2	2
3	3

MODEL Name: BFNFINAL

Top Event Legend for Tree: VSEQ

11:07:31 13 AUG 1992
Page 1

Top Event Designator.....	Top Event Description..............................
IE	Initiating Event
CD	CONDENSATE SYSTEM UNAVAILABLE
AI	ALTERNATE INJECTION UNAVAILABLE

MODEL Name: BFNFINAL

Split Fraction Logic for Event Tree: VSEQ

14:46:24 13 AUG 1992
Page 1

SF........	Split Fraction Logic..
CD1	1
AIF	1

MODEL Name: BFNFINAL

Binning Logic for Event Tree: VSEQ

15:05:17 13 AUG 1992
Page 1

Bin.......	Binning Rules..
NJAZ	CD=S+AI=S
NJHZ	1

Report of Initiators for Model: BFNFINAL

15:15:07 13 AUG 1992
Page 1

Initiator...	Frequency...	Description........................	Truncation.. Cutoff
BOC	6.6900E-04	BREAK OUTSIDE CONTAINMENT	1.0000E-12
CIV	5.6000E-01	CLOSURE OF ALL MSIVS	1.0000E-09
ELOCA	9.3900E-09	EXCESSIVE LOCA	1.0000E-13
FLPH1	2.5000E-02	EECW\RHRSW PUMPING STATION FLOOD	1.0000E-10
FLRB1	1.2000E-02	EECW FLOOD IN REACTOR BULIDING - SHUTDOWN UNIT	1.0000E-10
FLRB2	1.7000E-06	EECW/RHRSW FLOOD IN REACTOR BUILDING - OPERATING UNIT	1.0000E-11
FLRB3C	9.8000E-05	FLOOD FROM THE CONDENSATE STORAGE TANK	1.0000E-12
FLRB3S	9.6000E-05	FLOOD FROM THE TORUS	1.0000E-10
FLTB	4.5000E-02	TURBINE BUILDING FLOOD	1.0000E-09
FWRU	1.6000E-01	FEEDWATER RAMPUP	1.0000E-09
IOOV	4.1500E-02	INADVERTENT OPENING OF ONE SRV	5.0000E-10
IOTM	8.7900E-04	INADVERTENT OPENING OF THREE OR MORE SRVS	1.0000E-12
IOTV	5.8700E 03	INADVERTENT OPENING OF TWO SRVS	1.0000E-10
ISCRAM	1.5800E+00	INADVERTENT (OTHER) SCRAM	1.0000E-09
ISLOCA	4.6400E-08	INTERFACING SYSTEM LOCA	1.0000E-10
ISLOVA	1.0000E+00	INTERFACING SYSTEM LOCA	1.0000E-09
L500	7.6500E-02	LOSS OF 500KV GRID	1.0000E-10
LIA	5.9000E-03	DIV I LOWER A INSTRUMENT TAP FAILURE	1.0000E-10
LIB	5.9000E-03	DIV I LOWER B INSTRUMENT TAP FAILURE	1.0000E-10
LICA	3.5300E-03	LOSS OF I & C BOARD A	1.0000E-10
LICB	3.5400E-03	LOSS OF I & C BOARD B	1.0000E-10
LIIA	5.9000E-03	DIV II LOWER A INSTRUMENT TAP FAILURE	1.0000E-10
LIIB	5.9000E-03	DIV II LOWER B INSTRUMENT TAP FAILURE	1.0000E-10
LLC	8.2800E-05	CORE SPRAY LINE BREAK	1.0000E-13
LLD	3.1300E-04	RECIRC DISCHARGE LINE BREAK	1.0000E-13
LLO	1.0600E-04	OTHER LARGE LOCA	1.0000E-13
LLS	9.1900E-05	RECIRC SUCTION LINE BREAK	1.0000E-13
LOAC	3.9900E-02	LOSS OF ALL CONDENSATE	1.0000E-10
LOCV	3.2800E-01	LOSS OF CONDENSER VACUUM	1.0000E-09

Report of Initiators for Model: BFNFINAL

15:15:16 13 AUG 1992
Page 2

Initiator...	Frequency...	Description.........................	Truncation.. Cutoff
LOFW	5.0600E-01	TOTAL LOSS OF FEEDWATER	1.0000E-09
LOPA	7.8700E-02	LOSS OF PLANT AIR	1.0000E-09
LOSP	3.5200E-02	TOTAL LOSS OF OFFSITE POWER	1.0000E-08
LRCW	3.5300E-03	LOSS OF RAW COOLING WATER	1.0000E-09
LUPS	1.4300E-02	LOSS OF UNIT 2 120V PREFERRED POWER	1.0000E-09
MLOCA	3.3300E-04	MEDIUM LOCA	1.0000E-10
PLFW	2.8600E-01	PARTIAL LOSS OF FEEDWATER	1.0000E-09
PLOC	5.4600E-02	PARTIAL LOSS OF CONDENSATE	1.0000E-10
PRFO	4.8100E-02	PRESSURE REGULATOR FAILS OPEN	1.0000E-10
SCRAMR	3.8600E-01	SCRAM REQUIRED (MANUAL SCRAMS)	5.0000E-10
SLOCA	4.1500E-03	SMALL LOSS OF COOLANT ACCIDENT (LOCA)	1.0000E-11
TT	1.5900E+00	TURBINE TRIP	1.0000E-09
TTWB	3.1300E-01	TURBINE TRIP WITHOUT BYPASS	1.0000E-09
UI	6.6000E-04	DIV I UPPER INSTRUMENT TAP FAILURE	1.0000E-12
UII	6.6000E-04	DIV II UPPER INSTRUMENT TAP FAILURE	1.0000E-12
VLOCA	2.3400E-02	VERY SMALL LOCA (RECIRC PUMP SEAL LOCA)	1.0000E-10

Master Frequency File: BFN722

MODEL Name: BFNFINAL

Date Created: 26 JUL 1992 11:08

15:27:00 13 AUG 1992
Page 1

Split Fractions for System: No System
Description: No Description

Top Event: A3EA
Description: No Description

A3EA1	9.1230E-04	NORMAL SUPPLY AVAIL
A3EA2	1.4090E-03	LOSS OF NORMAL SUPPLY, DIESEL AVAIL
A3EAF	1.0000E+00	G.F.

Top Event: A3EB
Description: No Description

A3EB1	8.9340E-04	NORMAL SUPPLY AVAIL, A3EA SUCCESS
A3EB2	1.3790E-03	A3EA SUCCESS, NORMAL LOST, ALL DG AVAIL
A3EB3	2.1620E-02	A3EA FAIL, NORMAL SUPPLY AVAIL
A3EB4	2.2560E-02	A3EA FAIL, NORMAL SUPPLY LOST
A3EB5	1.4090E-03	A3EA BYPASS, NORMAL LOST
A3EBF	1.00[illegible]0E+00	G.F.

Top Event: A3EC
Description: No Description

A3EC1	8.[illegible]0E-04	A3EA,A3EB SUCCESS, NORMAL AVAIL
A3EC10	1.[illegible]0E-03	A3EA AND A3EB FAIL, UNIT BD 3B LOST
A3EC11	8.[illegible]0E-04	A3EA AND A3EB FAIL, UNIT BD 3A LOST
A3EC12	2.[illegible]0E-01	A3EA AND A3EB FAIL, NORMAL SUPPLIES LOST
A3EC13	9.[illegible]0E-04	A3EB BY SUPPORT, UNIT BD 3A UNAVAIL
A3EC14	1.[illegible]0E-03	A3EB BY SUPPORT, ALL NORMAL SUPPLIES UNAVAIL.
A3EC15	5.0[illegible]0E-04	A3EA FAIL, A3EB BY SUPPORT, UNIT BD 3A UNAVAIL
A3EC16	2.2[illegible]0E-02	A3EA FAIL, A3EB BY SUPPORT, ALL NORMAL SUPPLIES UNAVAIL
A3EC17	9.1230E-04	A3EA AND A3EB BY SUPPORT, UNIT BD 3B AVAIL
A3EC18	1.40[illegible]0E-03	A3EA AND A3EB BY SUPPORT, ALL NORMAL SUPPLIES UNAVAIL
A3EC2	1.4100E-03	A3EA,A3EB SUCCESS, UNIT BD 3B LOST
A3EC3	9.1350E-04	A3EA,A3EB SUCCESS, UNIT BD 3A LOST
A3EC4	1.3560E-03	A3EA,A3EB SUCCESS, NORMAL SUPPLIES LOST
A3EC5	2.2070E-02	A3EB FAILS, ALL NORMAL AVAIL
A3EC6	7.6150E-04	A3EA OR A3EB FAIL, UNIT BD 3B LOST
A3EC7	4.9510E-04	A3EA OR A3EB FAIL, UNIT BD 3A LOST
A3EC8	1.8040E-02	A3EA OR A3EB FAIL, NORMAL SUPPLIES LOST
A3EC9	1.0460E-03	A3EA AND A3EB FAIL, NORMAL SUPPLIES AVAIL
A3ECF	1.0000E+00	G.F.

Top Event: A3ED
Description: No Description

A3ED1	8.5550E-04	ALL NORMAL SUPPLIES AVAIL
A3ED10	1.8130E-02	ONE PREVIOUS TRAIN FAILS, ALL NORMAL SUPPLIES UNAVAIL
A3ED11	9.0760E-04	TWO PREVIOUS TRAINS FAIL
A3ED12	1.4370E-03	A3EA AND A3EB UNAVAIL, UNIT BD 3B UNAVAIL
A3ED13	3.8440E-02	A3EA AND A3EC FAIL, UNIT BD 3B UNAVAIL
A3ED14	8.2260E-04	A3EA AND A3EB FAIL, UNIT BD 3A UNAVAIL
A3ED15	4.1490E-02	A3EA AND A3EC FAIL, UNIT BD 3A UNAVAIL
A3ED16	1.3150E-02	TWO PREVIOUS TRAINS FAIL, NO NORMAL SUPPLIES
A3ED17	1.3330E-01	A3EA,A3EB,A3EC FAIL, ALL NORMAL SUPPLIES AVAIL
A3ED18	4.0630E-02	A3EA,A3EB,A3EC FAIL, UNIT BD 3B UNAVAIL
A3ED19	4.3840E-02	A3EA,A3EB,A3EC FAIL, UNIT BD 3A UNAVAIL
A3ED2	1.3800E-03	UNIT BD 3B UNAVAIL
A3ED20	9.5300E-01	A3EA,A3EB,A3EC FAIL, UNIT BD 3A AND 2 UNAVAIL

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A3ED21	1.4100E-03	A3EC BY SUPPORT, UNIT BD 3B UNAVAIL
A3ED22	8.9400E-04	A3EB BY SUPPORT, UNIT BD 3A UNAVAIL
A3ED23	1.3560E-03	A3EC BY SUPPORT, NO NORMAL POWER
A3ED24	7.6150E-04	A3EC BY SUPPORT, A3EB AND UNIT BD 3B UNAVAIL
A3ED25	2.1600E-02	A3EB BY SUPPORT, A3EC AND UNIT BD 3A FAIL
A3ED26	4.8270E-04	A3EB BY SUPPORT, A3EA AND UNIT BD 3A FAIL
A3ED27	1.8040E-02	A3EB BY SUPPORT, A3EA UNIT BD 3A AND UNIT BD 3B FAIL
A3ED28	1.4950E-03	A3EC BY SUPPORT, A3EA, A3EB AND UNIT BD 3B FAIL
A3ED29	4.1580E-02	A3EB BY SUPPORT, A3EA, A3EC AND UNIT BD 3A FAIL
A3ED3	8.9450E-04	UNIT BD 3A UNAVAIL
A3ED30	2.1860E-01	A3EC BY SUPPORT,A3EA, A3EB, UNIT BD 3A, UNIT BD 3B FAIL
A3ED31	8.9340E-04	A3EA AND A3EB BY SUPPORT, UNIT BD 3A FAILS
A3ED32	1.3790E-03	A3EA AND A3EB BY SUPPORT, UNIT BD 3A AND UNIT BD 3B FAIL
A3ED33	2.1620E-02	A3EA AND A3EB BY SUPPORT, A3EC AND UNIT BD 3A FAIL
A3ED34	2.2560E-02	A3EA AND A3EB BY SUPPORT, A3EC UNIT BD 3B AND UNIT BD 3A FAIL
A3ED35	1.4090E-03	ALL PREVIOUS TRAINS BY SUPPORT, AND NO NORMAL POWER
A3ED4	1.3330E-03	BOTH NORMAL SUPPLIES UNAVAIL
A3ED5	2.2550E-02	ONE PREVIOUS TRAIN FAILS
A3ED6	7.3280E-04	A3EA OR A3EB FAIL, UNIT BD 3B FAILS
A3ED7	2.2550E-02	A3EC FAILS AND UNIT BD 3B UNAVAIL
A3ED8	4.7480E-04	A3EA OR A3EB FAIL, UNIT BD 3A FAILS
A3ED9	2.1590E-02	A3EC FAILS, UNIT BD 3A UNAVAIL
A3EDF	1.0000E+00	G.F.

Top Event: AA
Description: No Description

AA1	4.8300E-04	NORMAL SUPPLY AVAIL
AA2	1.0910E-03	LOSS OF NORMAL SUPPLY, DIESEL AVAIL
AAF	1.0000E+00	G.F.

Top Event: AB
Description: No Description

AB1	4.8320E-04	NORMAL SUPPLY AVAIL, AA SUCCESS
AB2	1.0260E-03	AA SUCCESS, NORMAL LOST, ALL DG AVAIL
AB3	1.8110E-04	AA FAIL, NORMAL SUPPLY AVAIL
AB4	6.1260E-02	AA FAIL, NORMAL SUPPLY LOST
AB5	1.0910E-03	AA BYPASS, NORMAL LOST
ABF	1.0000E+00	G.F.

Top Event: AC
Description: No Description

AC1	4.8330E-04	AA,AB SUCCESS, NORMAL AVAIL
AC10	8.6120E-04	AA AND AB FAIL, SHUT2 LOST
AC11	4.3750E-04	AA AND AB FAIL, SHUT1 LOST
AC12	5.3050E-01	AA AND AB FAIL, NORMAL SUPPLIES LOST
AC13	4.8320E-04	AB BY SUPPORT, SHUT1 UNAVAIL
AC14	1.0260E-03	AB BY SUPPORT, ALL NORMAL SUPPLIES UNAVAIL.
AC15	3.6920E-04	AA FAIL, AB BY SUPPORT, SHUT1 UNAVAIL
AC16	6.1260E-02	AA FAIL, AB BY SUPPORT, ALL NORMAL SUPPLIES UNAVAIL
AC17	4.8300E-04	AA AND AB BY SUPPORT, SHUT2 AVAIL
AC18	1.0910E-03	AA AND AB BY SUPPORT, ALL NORMAL SUPPLIES UNAVAIL
AC2	1.0920E-03	AA,AB SUCCESS, SHUT 2 LOST
AC3	4.8330E-04	AA,AB SUCCESS, SHUT1 LOST
AC4	9.9520E-04	AA,AB SUCCESS, NORMAL SUPPLIES LOST

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AC5	1.8100E-04	AB FAILS, ALL NORMAL AVAIL
AC6	8.3420E-04	AA OR AB FAIL, SHUT2 LOST
AC7	3.6480E-04	AA OR AB FAIL, SHUT1 LOST
AC8	3.0640E-02	AA OR AB FAIL, NORMAL SUPPLIES LOST
AC9	3.0430E-04	AA AND AB FAIL, NORMAL SUPPLIES AVAIL
ACF	1.0000E+00	G.F.

Top Event: AD
Description: No Description

AD1	4.8350E-04	ALL NORMAL SUPPLIES AVAIL
AD10	2.3980E-02	ONE PREVIOUS TRAIN FAILS, ALL NORMAL SUPPLIES UNAVAIL
AD11	3.0430E-04	TWO PREVIOUS TRAINS FAIL
AD12	7.8220E-04	AA AND AB UNAVAIL, SHUT 2 UNAVAIL
AD13	7.2590E-02	AA AND AC FAIL, SHUT2 UNAVAIL
AD14	4.3760E-04	AA AND AB FAIL, SHUT 1 UNAVAIL
AD15	1.8290E-04	AA AND AC FAIL, SHUT 1 UNAVAIL
AD16	2.4150E-01	TWO PREVIOUS TRAINS FAIL, NO NORMAL SUPPLIES
AD17	4.8220E-04	AA,AB,AC FAIL, ALL NORMAL SUPPLIES AVAIL
AD18	9.2480E-02	AA,AB,AC FAIL, SHUT2 UNAVAIL
AD19	2.3810E-04	AA,AB,AC FAIL, SHUT1 UNAVAIL
AD2	1.0260E-03	SHUT 2 UNAVAIL
AD20	7.8620E-01	AA,AB,AC FAIL, SHUT1 AND 2 UNAVAIL
AD21	1.0920E-03	AC BY SUPPORT, SHUT2 UNAVAIL
AD22	4.8330E-04	AB BY SUPPORT, SHUT1 UNAVAIL
AD23	9.9520E-04	AC BY SUPPORT, NO NORMAL POWER
AD24	8.3420E-04	AC BY SUPPORT, AB AND SHUT2 UNAVAIL
AD25	1.8110E-04	AB BY SUPPORT, AC AND SHUT1 FAIL
AD26	3.6930E-04	AB BY SUPPORT, AA AND SHUT1 FAIL
AD27	3.0640E-02	AB BY SUPPORT, AA SHUT1 AND SHUT2 FAIL
AD28	8.6120E-04	AC BY SUPPORT, AA, AB AND SHUT2 FAIL
AD29	1.8690E-04	AB BY SUPPORT, AA, AC AND SHUT1 FAIL
AD3	4.8340E-04	SHUT 1 UNAVAIL
AD30	5.3050E-01	AC BY SUPPORT,AA, AB, SHUT1, SHUT2 FAIL
AD31	4.8320E-04	AA AND AB BY SUPPORT, SHUT1 FAILS
AD32	1.0260E-03	AA AND AB BY SUPPORT, SHUT1 AND SHUT2 FAIL
AD33	1.8110E-04	AA AND AB BY SUPPORT, AC AND SHUT1 FAIL
AD34	6.1260E-02	AA AND AB BY SUPPORT, AC SHUT2 AND SHUT1 FAIL
AD35	1.0910E-03	ALL PREVIOUS TRAINS BY SUPPORT, AND NO NORMAL POWER
AD4	9.7240E-04	BOTH NORMAL SUPPLIES UNAVAIL
AD5	1.8100E-04	ONE PREVIOUS TRAIN FAILS
AD6	7.7430E-04	AA OR AB FAIL, SHUT2 FAILS
AD7	6.1250E-02	AC FAILS AND SHUT2 UNAVAIL
AD8	3.6480E-04	AA OR AB FAIL, SHUT1 FAILS
AD9	1.8110E-04	AC FAILS, SHUT1 UNAVAIL
ADF	1.0000E+00	no description entered

Top Event: AI
Description: No Description

AIF	1.0000E+00	GUARANTEED FAILED

Top Event: BVR
Description: No Description

BVR1	1.3770E-02	ALL SUPPORT AVAIL.
BVRF	1.0000E+00	G.F.

Top Event: CD
Description: No Description

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CD1	1.3961E-03	ALL SUPPORT AVAILABLE
CD2	1.3940E-03	UB42C UNAVAILABLE
CD3	3.0003E-03	UB42B & UB42C UNAVAILABLE
CDF	1.0000E+00	GUARANTEED FAILURE

Top Event: CDA
Description: No Description

CDA1	0.0000E+00	CONDENSATE AVAILABLE
CDAF	1.0000E+00	CONDENSATE NOT AVAILABLE

Top Event: CIL
Description: PRIMARY CONTAINMENT ISOLATION FAILURE - LARGE (>3 INCHES)

CIL1	3.6609E-06	PCIS LARGE FAILURE, ALL SUPPORT AVAIL.
CIL2	5.5952E-04	PCIS LARGE FAILURE, PLANT CONTROL AIR UNAVAIL.
CILF	1.0000E+00	PCIS LARGE G.F.

Top Event: CIS
Description: CONTAINMENT ISOLATION FAILURE - SMALL BYPASS (<3 INCHES)

CIS1	6.8636E-04	PCIS SMALL FAILURE, ALL SUPPORT AVAIL.
CISF	1.0000E+00	PCIS G.F.

Top Event: CRD
Description: No Description

CRD1	1.3351E-03	NORMAL POST-SCRAM VESSEL INJECTION (ONE PUMP) REQUIRED FOR 24 HOURS - SUPPORTS FOR BOTH PUMPS AVAIL.
CRD2	4.4008E-02	NORMAL POST-SCRAM VESSEL INJECTION (ONE PUMP) REQUIRED FOR 24 HOURS - SUPPORTS FOR PUMP 2A AVAIL. AND SUPPORTS FOR PUMP 1B FAILED
CRD3	2.0415E-01	ENHANCED CRDHS VESSEL INJECTION (TWO PUMPS) REQUIRED FOR THE FINAL 18 HOURS OF THE 24 HOUR MISSION TIME - ALL SUPPORTS AVAIL..
CRD4	2.0249E-01	ENHANCED CRDHS VESSEL INJECTION (TWO PUMPS) REQUIRED FOR 24 HOURS - ALL SUPPORTS AVAIL..
CRDF	1.0000E+00	CRDHS VESSEL INJECTION (ENHANCED AND NORMAL POST-SCRAM) FAILED DUE TO SUPPORT SYSTEM FAILURE OR DUE TO PLANT CONDITIONS.

Top Event: CS
Description: CORE SPRAY SYSTEM

CS1	1.9948E-03	CORE SPRAY FAILURE; SUPPORT FOR BOTH LOOPS; TOP EVENT ORP=S
CS10	1.0336E-03	CORE SPRAY
CS11	7.3443E-03	CORE SPRAY
CS12	8.3427E-03	CORE SPRAY
CS13	1.1226E-03	CORE SPRAY
CS14	1.2452E-03	CORE SPRAY
CS15	7.6652E-03	CORE SPRAY
CS16	8.7562E-03	CORE SPRAY
CS2	2.1252E-03	CORE SPRAY FAILURE; SUPPORT FOR BOTH LOOPS; TOP EVENT ORP=F

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CS3	3.5519E-02	CORE SPRAY FAILURE; SUPPORT FOR ONE LOOP UNAVAIL.; TOP EVENT ORP=S
CS4	3.5639E-02	CORE SPRAY FAILURE; SUPPORT FOR ONE LOOP UNAVAIL.; TOP EVENT ORP=F
CS5	9.0062E-04	CORE SPRAY
CS6	9.9380E-04	CORE SPRAY
CS7	2.6615E-02	CORE SPRAY
CS8	2.7924E-02	CORE SPRAY
CS9	9.9322E-04	CORE SPRAY
CSF	1.0000E+00	CORE SPRAY G.F.

Top Event: CST
Description: No Description

CST1	3.8074E-05	UNAVAILABILITY OF CST
CSTF	1.0000E+00	GUARANTEED FAILURE

Top Event: [illegible]
Description: No Description

DA1	2.087[illegible]-03	ALL SUPPORT AV.
DA2	1.54[illegible]-03	AC POWER UNAVAIL.
DAF	1.00[illegible]+00	GUARANTEED FAIL.

Top Event: B
Description: No Description

DB1	2.04[illegible]-03	ALL SUPPORT AV.
DB2	1.51[illegible]-03	AC POWER UNAVAIL.
DBF	1.000[illegible]+00	GUARANTEED FAIL.

Top Event: [illegible]
Description: No Description

DC1	2.0467[illegible]-03	ALL SUPPORT AV.
DC2	1.5072E-03	AC POWER UNAVAIL.
DCF	1.0000E+00	GUARANTEED FAIL.

Top Event: DCA
Description: DRYWELL CONTROL AIR

DCA1	4.1526E-03	ALL SUPPORT AVAIL.
DCA2	2.4318E-02	UNAVAILABILITY OF DCA SYSTEM GIVEN SUPPORT TO ONE COMPRESSOR TRAIN AVAIL.
DCAF	1.0000E+00	G.F. GIVEN PCA=F, RBC=F, DO=F, DN=F, RH=F*RI=F

Top Event: DD
Description: No Description

DD1	2.0141E-03	ALL SUPPORT AV.
DD2	1.5425E-03	AC POWER UNAVAIL.
DDF	1.0000E+00	GUARANTEED FAIL.

Top Event: DE
Description: No Description

DE1	4.9570E-03	ALL SUPPORT AV.
DE2	4.6501E-03	AC POWER UNAVAIL.
DEF	1.0000E+00	GUARANTEED FAIL.

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Top Event: DF
Description: No Description

DF1	3.1963E-03	ALL SUPPORT AV.
DF2	2.6116E-03	AC POWER UNAVAIL.
DFF	1.0000E+00	GUARANTEED FAIL.

Top Event: DG
Description: No Description

DGA	4.9311E-03	ALL SUPPORT AV.
DGB	4.4975E-03	AC POWER UNAVAIL.
DGF	1.0000E+00	GUARANTEED FAIL.

Top Event: DH
Description: No Description

DH1	5.0032E-03	ALL SUPPORT AV.
DH2	4.4485E-03	AC POWER UNAVAIL.
DHF	1.0000E+00	GUARANTEED FAIL.

Top Event: DI
Description: No Description

DI1	5.0570E-04	no description entered
DI2	1.4530E-02	no description entered
DI3	2.1660E-02	no description entered
DIF	1.0000E+00	G.F.

Top Event: DJ
Description: No Description

DJ1	5.0510E-04	no description entered
DJ10	8.7840E-01	no description entered
DJ11	1.4530E-02	no description entered
DJ2	1.4710E-02	no description entered
DJ3	1.4780E-02	no description entered
DJ4	2.1630E-02	no description entered
DJ5	9.0280E-03	no description entered
DJ6	1.6200E-03	no description entered
DJ7	2.2570E-03	no description entered
DJ8	2.8690E-03	no description entered
DJ9	7.1290E-02	no description entered
DJF	1.0000E+00	G.F.

Top Event: DK
Description: No Description

DK1	1.3840E-02	no description entered
DKF	1.0000E+00	no description entered

Top Event: DL
Description: No Description

DL1	1.4010E-02	no description entered
DL2	1.9190E-03	no description entered
DL3	1.3840E-02	no description entered
DLF	1.0000E+00	no description entered

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Top Event: DM
Description: No Description

DM1	2.2495E-04	ALL SUPPORT AVAIL.
DM2	3.3726E-04	A3EC SUPPORT UNAVAIL.
DM3	1.8957E-03	AC SUPPORT UNAVAIL.
DMF	1.0000E+00	G.F.

Top Event: DN
Description: No Description

DN1	1.2147E-04	ALL SUPPORT AVAIL.
DN2	2.2887E-04	A3EA UNAVAIL.
DN3	1.1079E-03	AB UNAVAIL.
DNF	1.0000E+00	G.F.

Top Event: DO
Description: No Description

DO1	1.2147E-04	ALL SUPPORT AVAIL.
DO2	2.2887E-04	AC SUPPORT UNAVAIL.
DO3	1.1079E-03	AD SUPPORT UNAVAIL.
DOF	1.0000E+00	G.F.

Top Event: DT1
Description: No Description

DT11	4.0630E-06	UNAVAILABILITY OF DRYWELL DIVISION I INSTRUMENT TAPS

Top Event: DT2
Description: No Description

DT21	4.0320E-06	UNAVAILABILITY OF DRYWELL DIVISION II INSTRUMENT TAPS

Top Event: DV1
Description: No Description

DV11	4.8650E-03	LOOP B RDVC FAILED - ALL SUPPORT AVAIL.
DV12	8.4020E-03	LOOP B RDVC FAILURE - 250V DC RMOV BD 2A OR 2B UNAVAIL.
DV1B	0.0000E+00	G.S./BYPASSED
DV1F	1.0000E+00	G.F.

Top Event: DV2
Description: No Description

DV21	4.5200E-03	DV1 SUCCESS, DC POWER (RB,RC) AND DC POWER (DB,DB) AVAIL.
DV210	4.3410E-01	DV1 FAILED, ONE DC POWER (RB OR RC) AND ONE DC POWER (DB OR DD) AVAIL.
DV211	5.6850E-03	DV1 BYPASSED, DC POWER (RB,RC) AND ONE DC POWER (DB OR DD) AVAIL.
DV212	9.1560E-03	DV1 BYPASSED, ONE DC POWER (RB OR RC) AND ONE DC POWER (DB OR DD) AVAIL.
DV22	6.6070E-02	DV1 FAILED, DC POWER (RB,RC) ANF DC POWER (DB,DD) AVAIL.

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DV23	4.7450E-03	DV1 SUCCESS, ONE DC POWER (RB OR RC) AND DC POWER (DB,DD) AVAIL.
DV24	4.3330E-01	DV1 FAILED, ONE DC POWER (RB OR RC) ANF DC POWER (DB,DD) AVAIL.
DV25	4.8200E-03	DV1 BYPASSED, DC POWER (RB,RC) AND DC POWER (DB,DD) AVAIL.
DV26	8.3450E-03	DV1 BYPASSED, ONE DC POWER (RB OR RC) AND DC POWER (DB,DD) AVAIL.
DV27	5.3820E-03	DV1 SUCCESS, DC POWER (RB,RC) AND ONE DC POWER (DB OR DB) AVAIL.
DV28	6.7760E-02	DV1 FAILED, DC POWER (RB,RC) AND ONE DC POWER (DB OR DD) AVAIL.
DV29	5.5550E-03	DV1 SUCCESS, ONE DC POWER (RB OR RC) AND ONE DC POWER (DB OR DD) AVAIL.
DV2B	0.0000E+00	G.S.FULL
DV2F	1.0000E+00	G.F.

Top Event: DW
Description: No Description

DW1	5.2964E-05	UNAVAILABILITY OF SAI DRYWELL PRESSURE SIGNAL GIVEN ALL SUPPORT AVAIL.
DW2	4.9566E-03	UNAVAILABILITY OF SAI DRYWELL PRESS SIGNAL GIVEN NO DIVISION I OR II SUPPORT
DWF	1.0000E+00	G.F. OF CAS LOW RX PRESSURE SIGNAL

Top Event: DWP
Description: No Description

DWP1	2.8311E-05	UNAVAILABILITY OF FAIL SAFE DRYWELL PRESS SIGNAL - NO DW INSTR TAP FAILURE
DWP2	3.2848E-03	UNAVAILABILITY OF FAIL SAFE DRYWELL PRESS SIGNAL - DIV I OR II DW INSTR TAP FAILURE
DWPF	1.0000E+00	G.F. OF CAS LOW RX PRESSURE SIGNAL

Top Event: DWS
Description: DRYWELL SPRAY HARDWARE

DWS1	1.8223E-03	DRYWELL SPRAY FAILURE ALL SUPPORT AVAIL.
DWS2	2.2119E-02	DRYWELL SPRAY FAILURE, ONE LOOP SUPPORT FAILED
DWSF	1.0000E+00	DRYWELL SPRAY G.F.

Top Event: EA
Description: No Description

EA1	8.0190E-04	EECW PUMP A3, ALL SUPPORTS AVAIL.
EA3	3.7380E-03	EECW PUMP A3, OFFSITE POWER UNAVAIL.
EAF	1.0000E+00	G.F.

Top Event: EB
Description: No Description

EB1	7.9080E-04	EECW PUMP B3, ALL SUPPORTS AVAIL., PUMPS A3 AND C3 SUCCESS
EB10	3.6970E-03	EECW PUMP B3, OFFSITE POWER UNAVAIL., A3 G.F. AND C3 SUCCESS, OR C3 G.F., AND A3 SUCCESS
EB11	1.4570E-02	EECW PUMP B3, OFFSITE POWER UNAVAIL., A3 G.F. AND C3 FAILS, OR A3 FAILS AND C3 G.F.
EB12	3.7380E-03	EECW PUMP B3, LOSS OF OFFSITE POWER, BOTH A3 AND C3 G.F.
EB13	2.1650E-03	EECW PUMP B3, PUMP A3 SUCCESS, PUMP C3 FAILS

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EB14	8.2230E-03	EECW PUMP B3, A3 FAILS, C3 G.F., OTHER SUPPORTS AVAIL.
EB15	7.9590E-04	EECW PUMP B3, A3 SUCCESS, C3 G.F., OTHER SUPPORTS AVAIL.
EB2	6.3160E-03	EECW PUMP B3, PUMP C3 SUCCESS, PUMP A3 FAILS
EB3	1.6530E-01	EECW PUMP B3, BOTH PUMPS A3 AND C3 FAIL, OTHER SUPPORTS AVAIL.
EB4	7.9520E-04	EECW PUMP B3, PUMP A3 G.F., PUMP C3 SUCCESS, OTHER SUPPORTS AVAIL.
EB5	2.5880E-03	EECW PUMP B3, PUMP A3 G.F., PUMP C3 FAILS, OTHER SUPPORTS AVAIL.
EB6	8.0190E-04	EECW PUMP B3, BOTH PUMPS A3 AND C3 G.F., OTHER SUPPORTS AVAIL.
EB7	3.6670E-03	EECW PUMP B3, OFFSITE POWER UNAVAIL., BOTH PUMPS A3 AND C3 SUCCESS
EB8	1.1970E-02	EECW PUMP B3, OFFSITE POWER UNAVAIL., A3 FAILS AND C3 SUCCESS, OR C3 FAILS AND A3 SUCCESS
EB9	1.9320E-01	EECW PUMP B3, OFFSITE POWER UNAVAIL., BOTH PUMP A3 AND C3 FAIL
EBF	1.0000E+00	EECW PUMP B3 GUARANTEED FAILS

Top Event: EC
Description: No Description

EC2	3.7120E-03	EECW PUMP C3, ALL SUPPORTS AVAIL.
EC3	3.7180E-03	EECW PUMP C3, A3 G.F., ALL SUPPORTS AVAIL.
EC4	1.2000E-02	EECW PUMP C3, A3 FAILS, ALL SUPPORTS AVAIL.
ECF	1.0000E+00	EECW PUMP B3 G.F.

Top Event: ED
Description: No Description

ED10	1.0100E-02	EECW PUMP D3, C3 G.F., (A3 SUCCESS B3 FAILS) OR (B3 SUCCESS A3 FAILS), ALL SUPPORTS AVAIL.
ED11	1.3810E-02	EECW PUMP D3, C3 FAILS, (A3 SUCCESS OR B3 G.F.) OR (A3 G.F. B3 SUCCESS), ALL SUPPORTS AVAIL.
ED12	1.9570E-01	EECW PUMP D3, C3 FAILS, (A3 FAILS B3 G.F.) OR (A3 G.F. B3 FAILS), ALL SUPPORTS AVAIL.
ED13	2.4120E-01	EECW PUMP D3, C3 G.F., BOTH A3 B3 FAIL, ALL SUPPORTS AVAIL.
ED14	1.2000E-02	EECW PUMP D3, C3 G.F., (A3 G.F. B3 FAILS) OR (A3 FAILS B3 G.F.), ALL SUPPORTS AVAIL.
ED15	1.4280E-02	EECW PUMP D3, C3 FAILS, A3 B3 G.F., ALL SUPPORTS AVAIL.
ED16	3.7180E-03	EECW PUMP D3, ALL A3 B3 C3 G.F., ALL SUPPORTS AVAIL.
ED17	9.7680E-03	EECW PUMP D3, C3 SUCCESS, (A3 G.F. B3 FAILS) OR (A3 FAILS B3 G.F.), ALL SUPPORTS AVAIL.
ED2	3.6700E-03	EECW PUMP D3, ALL SUPPORT AVAIL.
ED25	1.3670E-02	EECW PUMP D3, C3 FAILS A3 AND B3 SUCCESS, ALL SUPPORTS AVAIL.
ED26	7.7650E-02	EECW PUMP D3, C3 FAILS, (A3 FAILS B3 SUCCESS) OR (B3 FAILS A3 SUCCESS), ALL SUPPORTS AVAIL.
ED3	3.7070E-03	EECW PUMP D3, C3 G.F., A3 B3 SUCCESS, ALL SUPPORTS AVAIL.
ED4	9.4090E-03	EECW PUMP D3, A3 FAILS B3 AND C3 SUCCESS, OR B3 FAILS A3 AND C3 SUCCESS, OTHER SUPPORTS AVAIL.
ED5	3.6740E-03	EECW PUMP D3, C3 SUCCESS, (A3 SUCCESS AND B3 G.F.) OR (A3 G.F AND B3 SUCCESS), ALL SUPPORTS AVAIL.
ED6	6.6260E-02	EECW PUMP D3, A3 AND B3 FAIL C3 SUCCESS, ALL SUPPORTS AVAIL.
ED7	3.6790E-03	EECW PUMP D3, C3 SUCCESS, A3 AND B3 G.F., ALL SUPPORTS AVAIL.
ED8	7.9160E-01	EECW PUMP D3, A3 B3 C3 ALL FAIL, ALL SUPPORTS

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		AVAIL.
ED9	3.7120E-03	EECW PUMP D3, C3 G.F., (A3 SUCCESS B3 G.F.) OR (A3 G.F. B3 SUCCESS), ALL SUPPORTS AVAIL.
EDF	1.0000E+00	EECW PUMP D3 G.F.

Top Event: EPR30
Description: No Description

EPR301	4.7500E-01	OFFSITE GRID RECOVERY, ONE DIESEL FAILS
EPR302	4.7300E-01	OFFSITE GRID RECOVERY, TWO DIESELS FAIL
EPR303	4.7200E-01	OFFSITE GRID RECOVERY, THREE DIESELS FAIL
EPR304	4.7000E-01	OFFSITE GRID RECOVERY, FOUR DIESELS FAIL
EPR30B	0.0000E+00	G.S.

Top Event: EPR6
Description: No Description

EPR61	2.7200E-01	OFFSITE GRID RECOVERY, ONE DIESEL FAILS
EPR62	2.7300E-01	OFFSITE GRID RECOVERY, TWO DIESELS FAIL
EPR63	2.6900E-01	OFFSITE GRID RECOVERY, THREE DIESELS FAIL
EPR64	2.6800E-01	OFFSITE GRID RECOVERY, FOUR DIESELS FAIL
EPR6B	0.0000E+00	G.S.

Top Event: FA
Description: No Description

FA1	1.5900E-02	ALL SUPPORT AV.
FAB	0.0000E+00	BYPASS
FAF	1.0000E+00	G.F.

Top Event: FB
Description: No Description

FB1	1.5830E-02	FA SUCCESSFUL
FB2	2.0290E-02	FA FAILS
FBB	0.0000E+00	BYPASS
FBF	1.0000E+00	G.F.

Top Event: FC
Description: No Description

FC1	1.5830E-02	FA, FB SUCCESSFUL
FC2	1.5830E-02	FA OR FB FAIL
FC3	2.3570E-01	FA AND FB FAIL
FCB	0.0000E+00	BYPASS
FCF	1.0000E+00	G.F.

Top Event: FD
Description: No Description

FD1	1.5830E-02	FA, FB, FC SUCCESSFUL
FD2	1.5830E-02	FA OR FB OR FC FAIL
FD3	1.5830E-02	TWO PREVIOUS TRAINS FAIL
FD4	9.4870E-01	FA, FB, FC FAIL
FDB	0.0000E+00	BYPASS
FDF	1.0000E+00	G.F.

Top Event: FE
Description: No Description

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FE1	1.5900E-02	ALL SUPPORT AV.
FEB	0.0000E+00	BYPASS
FEF	1.0000E+00	G.F.

Top Event: FF
Description: No Description

FF1	1.5830E-02	FE SUCCESSFUL
FF2	2.0290E-02	FE FAILS
FFB	0.0000E+00	BYPASS
FFF	1.0000E+00	G.F.

Top Event: FG
Description: No Description

FG1	1.5830E-02	FE, FF SUCCESSFUL
FG2	1.5830E-02	FE OR FF FAIL
FG3	2.3570E-01	FE AND FF FAIL
FGB	0.0000E+00	BYPASS
FGF	1.0000E+00	G.F.

Top Event: FH
Description: No Description

FH1	1.5830E-02	FE, FF, FG SUCCESSFUL
FH2	1.5830E-02	FE OR FF OR FG FAIL
FH3	1.5830E-02	TWO PREVIOUS TRAINS FAIL
FH4	9.4870E-01	FE, FF, FG FAIL
FHB	0.0000E+00	BYPASS
FHF	1.0000E+00	G.F.

Top Event: FIWTR
Description: No Description

FIWTRF	1.0000E+00	FIRE WATER NOT AVAILABLE
FIWTRS	0.0000E+00	FIRE WATER AVAILABLE

Top Event: FWA
Description: No Description

FWA1	0.0000E+00	FEEDWATER AVAILABLE
FWAF	1.0000E+00	FEEDWATER NOT AVAILABLE

Top Event: FWC
Description: No Description

FWC1	8.6480E-05	ALL SUPPORT AVAILABLE
FWC2	2.4800E-04	OPERATOR FAILS TO TRIP 2/3 FW PUMPS
FWCF	1.0000E+00	GUARANTEED FAILURE

Top Event: FWH
Description: No Description

FWH1	3.1420E-03	ALL SUPPORT AVAILABLE UNDER ONE OF THREE MFW PUMPS RUNNING CONDITION
FWH2	2.4606E-02	ALL SUPPORT AVAILABLE UNDER ONE OF ONE MFW PUMP (ASSUMED PUMP A) RUNNING CONDITION
FWHF	1.0000E+00	GUARANTEED FAIL

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Top Event: GA
Description: No Description

GA1	1.4180E-01	ALL SUPPORT AVAIL.
GAB	0.0000E+00	BYPASS
GAF	1.0000E+00	G.F.]

Top Event: GB
Description: No Description

GB1	1.3910E-01	ALL SUPPORT AVAIL.
GB2	1.5790E-01	GA FAILS
GB3	1.4180E-01	GA FAILS BY SUPPORT
GBB	0.0000E+00	BYPASS
GBF	1.0000E+00	G.F.

Top Event: GC
Description: No Description

GC1	1.3940E-01	ALL SUPPORT AVAIL.
GC2	1.3750E-01	ONE PREVIOUS TRAIN FAILS
GC3	1.3910E-01	ONE TRAIN FAILS BY SUPPORT
GC4	2.6680E-01	TWO PREVIOUS TRAINS FAIL
GC5	1.5790E-01	ONE TRAIN FAILS BY SUPPORT AND ONE INDEPENDANT
GC6	1.4180E-01	TWO TRAINS FAIL BY SUPPORT
GCB	0.0000E+00	BYPASS
GCF	1.0000E+00	G.F.

Top Event: GD
Description: No Description

GD1	1.4150E-01	ALL SUPPORT AVAIL.
GD10	1.4180E-01	THREE FAIL BY SUPPORT
GD2	1.2650E-01	ONE PREVIOUS TRAIN FAILS
GD3	2.0630E-01	TWO PREVIOUS TRAINS FAIL
GD4	4.3290E-01	THREE PREVIOUS TRAINS FAIL
GD5	1.3940E-01	ONE TRAIN FAILS BY SUPPORT
GD6	1.3750E-01	ONE TRAIN FAILS BY SUPPORT AND ONE INDEPENDANT
GD7	2.6680E-01	ONE TRAIN FAILS BY SUPPORT AND TWO INDEPENDANTLY
GD8	1.3910E-01	TWO FAIL BY SUPPORT
GD9	1.5790E-01	TWO FAIL BY SUPPORT AND ONE INDEPENDANTLY
GDB	0.0000E+00	BYPASS
GDF	1.0000E+00	G.F.

Top Event: GE
Description: No Description

GE1	1.7420E-01	ALL SUPPORT AVAIL.
GEB	0.0000E+00	BYPASS
GEF	1.0000E+00	G.F.

Top Event: GF
Description: No Description

GF1	1.7470E-01	ALL SUPPORT AVAIL.
GF2	1.7190E-01	GE FAILS
GF3	1.7420E-01	GE FAILS BY SUPPORT
GFB	0.0000E+00	BYPASS
GFF	1.0000E+00	G.F.

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Top Event: GG
Description: No Description

GG1	1.7860E-01	ALL SUPPORT AVAIL.
GG2	1.5630E-01	ONE PREVIOUS TRAIN FAILS
GG3	1.7470E-01	ONE TRAIN FAILS BY SUPPORT
GG4	2.4680E-01	TWO PREVIOUS TRAINS FAIL
GG5	1.7190E-01	ONE TRAIN FAILS BY SUPPORT AND ONE INDEPENDANT
GG6	1.7420E-01	TWO TRAINS FAIL BY SUPPORT
GGB	0.0000E+00	BYPASS
GGF	1.0000E+00	G.F.

Top Event: GH
Description: No Description

GH1	1.8540E-01	ALL SUPPORT AVAIL.
GH10	1.7420E-01	THREE FAIL BY SUPPORT
GH2	1.4730E-01	ONE PREVIOUS TRAIN FAILS
GH3	1.7860E-01	ONE TRAIN FAILS BY SUPPORT
GH4	2.0520E-01	TWO PREVIOUS TRAINS FAIL
GH5	1.5630E-01	ONE TRAIN FAILS BY SUPPORT AND ONE INDEPENDANT
GH6	1.7470E-01	TWO FAIL BY SUPPORT
GH7	3.7360E-01	THREE PREVIOUS TRAINS FAIL
GH8	2.4680E-01	ONE TRAIN FAILS BY SUPPORT AND TWO INDEPENDANTLY
GH9	1.7190E-01	TWO FAIL BY SUPPORT AND ONE INDEPENDANTLY
GHB	0.0000E+00	BYPASS
GHF	1.0000E+00	G.F.

Top Event: HPI
Description: SHORT TERM HPCI OPERATION

HPI1	8.5600E-02	HPCI FAILURE; GIVEN RCI=S; OHS=F (MODEL ASSUMES DW=F)
HPI2	8.5020E-02	HPCI FAILURE; GIVEN RCI=S AND OHS=S
HPI3	1.1240E-01	HPCI FAILURE; GIVEN RCI=F, OHS=F (MODEL ASSUMES DW=F)
HPI4	1.0990E-01	HPCI FAILURE; GIVEN RCI=F AND OHS=S
HPI5	8.7400E-02	HPCI FAILURE; GIVEN RCI=B, OHS=F (MODEL ASSUMES DW=F)
HPI6	8.6670E-02	HPCI FAILURE; GIVEN RCI=B AND OHS=S
HPIF	1.0000E+00	HPCI GUARANTEED FAILURE

Top Event: HPL
Description: HPCI LONG TERM FAILURE

HPL1	1.6800E-02	HPCI FAILURE LONG TERM, GIVEN SUCCESS OF RCIC(RCL=S) AND EARLY OPERATOR CONTROL OF HPCI/RCIC (OHC=S)
HPL2	8.2230E-02	HPCI FAILURE LONG TERM, RCL=S AND OHC=F
HPL3	8.3410E-02	HPCI FAILURE LONG TERM, RCL=F AND OHC=S
HPL4	1.3650E-01	HPCI FAILURE LONG TERM, RCL=F AND OHC=F
HPL5	1.8020E-02	HPCI FAILURE LONG TERM, RCL=B(BYPASSED) AND OHC=S
HPL6	8.8030E-02	HPCI FAILURE LONG TERM, RCL=B AND OHC=F
HPLF	1.0000E+00	HPCI GUARANTEED FAILURE LONG TERM

Top Event: HR
Description: HARDWARE REQUIRED TO KEEP
HPCI/RCIC RUNNING GIVEN
SPC FAILURE

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HRF	1.0000E+00	GUARANTEED FAILURE

Top Event: HR6
Description: SWITCH TO TRACT STATUS OF HPCI/RCIC

HR60	0.0000E+00	GUARANTEED SUCCESS WHEN TOP EVENT OHC IS SUCCESSFUL
HR6F	1.0000E+00	GUARANTEED FAILURE WHEN HPI AND RCI ARE FAILED OR OHC IS FAILED

Top Event: HRC
Description: RCIC/HPCI CONTROL HARDWARE

HRC1	5.6554E-04	HARDWARE FOR CONTROL OF RCIC & HPCI
HRC2	8.6574E-03	HARDWARE FOR CONTROL OF RCIC ONLY
HRC3	3.0573E-04	HARDWARE FOR CONTROL OF HPCI ONLY
HRC4	8.7362E-03	CONTROL OF HPCI/RCIC
HRC5	3.0261E-04	CONTROL OF HPCI/RCIC
HRC6	7.7013E-03	CONTROL OF HPCI/RCIC
HRCF	1.0000E+00	GUARANTEED FAILURE

Top Event: HRL
Description: HPCI/RCIC LONG TERM DUMMY TREE

HRLO	0.0000E+00	GUARANTEED SUCCESS WHEN TOP EVENT OHL IS SUCCESSFUL
HRLF	1.0000E+00	GUARANTEED FAILURE WHEN HPL AND RCL ARE FAILED OR OHL IS FAILED

Top Event: HS
Description: No Description

HSO	0.0000E+00	FEEDWATED AVAULABLE
HS1	3.2300E-03	OPERATOR RECOVERS MAIN CONDENSER DURING REACTOR BUILDING FLOOD FROM TORUS
HSF	1.0000E+00	FEEDWATER NOT AVAILABLE

Top Event: HUM
Description: No Description

HUM1	7.0813E-04	GIVEN ALL SUPPORT AVAIL.
HUM2	4.3520E-04	GIVEN ALL SUPPORT AVAIL. EXCEPT A3ED (TRAIN C)
HUM3	5.1983E-04	GIVEN ALL SUPPORT AVAIL. EXCEPT RN (TRAIN B)
HUMF	1.0000E+00	G.F.

Top Event: HXA
Description: RHR HEAT EXCHANGER A

HXA1	5.4880E-03	HX A FAILURE ALL SUPPORT AVAIL.
HXA2	8.7390E-03	HX A FAILURE ALL SUPPORT AVAIL. - FOLLOWING OOFSITE POER RECOVERY WITHIN 6 HOURS
HXAF	1.0000E+00	RHR HX A G.F.

Top Event: HXB
Description: RHR HEAT EXCHANGER B

HXB1	5.2700E-03	RHR HX B FAILURE ALL SUPPORT AVAIL., HXA & HXC =S
HXB2	2.0830E-02	RHR HX B FAILURE GIVEN HXA=F OR HXC=F
HXB3	5.3540E-03	RHR HX B FAILURE GIVEN HXA=B OR HXC=B
HXB4	2.9810E-02	RHR HX B FAILURE GIVEN HXA=F & HXC=B OR HXA=B & HXC=F
HXB5	3.2200E-01	RHR HX B FAILURE GIVEN HXA=F & HXC=F
HXB6	5.4880E-03	RHR HX B FAILURE GIVEN HXA=B & HXC=B
HXB7	8.7160E-03	RHR HX B FAILURE ALL SUPPORT AVAIL., HXA & HXC =S - FOLLOWING RECOVERY OF OFFSITE POWER WITHIN 6 HOURS
HXBF	1.0000E+00	RHR HX B G.F.

Top Event: HXC
Description: RHR HEAT EXCHANGER C

HXC1	5.3540E-03	RHR HX C FAILURE ALL SUPPORT AVAIL., HXA=S
HXC2	2.9810E-02	RHR HX C GIVEN HXA=F
HXC3	5.4880E-03	RHR HX C FAILURE GIVEN HXA=B
HXC4	8.5850E-03	RHR HX C FAILURE ALL SUPPORT AVAIL., HXA=S - FOLLOWING RECOVERY OF OFFSITE POWER WITHIN 6 HOURS
HXCF	1.0000E+00	RHR HX C G.F.

Top Event: HXD
Description: RHR HEAT EXCHANGER D

HXD1	5.2080E-03	RHR HX D FAILURE ALL SUPPORT AVAIL., HXA, HXB & HXC =S
HXD10	5.4880E-03	RHR HX D FAILURE GIVEN HXA=B & HXC=B & HXB=B
HXD11	8.4500E-03	RHR HX D FAILURE ALL SUPPORT AVAIL., HXA, HXB & HXC =S - FOLLOWING OFFSITE POWER RECOVERY
HXD2	5.2700E-03	RHR HX D FAILURE GIVEN HXA=B OR HXC=B OR HXB=B
HXD3	1.7120E-02	RHR HX D FAILURE GIVEN HXA=F OR HXC=F OR HXB=F
HXD4	2.0830E-02	RHR HX D FAILURE GIVEN ONE PREVIOUS HX BYPASS AND ONE FAILED
HXD5	1.9510E-01	RHR HX D FAILURE GIVEN TWO PREVIOUS HX FAILURES
HXD6	3.2200E-01	RHR HX D FAILURE GIVEN TWO PREVIOUS HX FAILED & ONE BYPASSED
HXD7	5.8910E-01	RHR HX D FAILURE GIVEN HXA=F & HXC=F & HXB=F
HXD8	5.3540E-03	RHR HX D FAILURE GIVEN TWO PREVIOUS HX BYPASSED
HXD9	2.9810E-02	RHR HX D FAILURE GIVEN TWO PREVIOUS HX BYPASSED & ONE FAILED
HXDF	1.0000E+00	RHR HX D G.F.

Top Event: INA
Description: No Description

INAF	1.0000E+00	GUARANTEED FAILED
INAS	0.0000E+00	INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC

Top Event: INB
Description: No Description

INBF	1.0000E+00	GUARANTEED FAILED
INBS	0.0000E+00	INTACT CONTAINMENT, WTR TO DEBRIS, DWS, NO SPC, VENT

Top Event: INC
Description: No Description

INCF	1.0000E+00	GUARANTEED FAILED
INCS	0.0000E+00	INTACT CONTAINMENT, WTR TO DEBRIS, DWS, NO SPC, NO

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Top Event: IND
Description: No Description

INDF	1.0000E+00	GUARANTEED FAILED
INDS	0.0000E+00	INTACT CONTAINMENT, WTR TO DEBRIS, NO DWS, SPC

Top Event: INE
Description: No Description

INEF	1.0000E+00	GUARANTEED FAILED
INES	0.0000E+00	INTACT CONTAINMENT, WTR TO DEBRIS, NO DWS, NO SPC, VENT

Top Event: INF
Description: No Description

INFF	1.0000E+00	GUARANTEED FAILED
INFS	0.0000E+00	INTACT CONTAINMENT, WTR TO DEBRIS, NO DWS, NO SPC, NO VENT

Top Event: ING
Description: No Description

INGF	1.0000E+00	GUARANTEED FAILED
INGS	0.0000E+00	INTACT CONTAINMENT, NO WTR TO DEBRIS, VENT

Top Event: INH
Description: No Description

INHF	1.0000E+00	GUARANTEED FAILED
INHS	0.0000E+00	INTACT CONTAINMENT, NO WTR TO DEBRIS, NO VENT

Top Event: ISO
Description: No Description

ISO1	2.2228E-04	RCIC STEAMLINE ISOLATION FAILURE, ALL SUPPORT AVAILABLE
ISO2	4.2375E-03	RCIC STEAMLINE ISOLATION GIVEN SUPPORT TO FCV-71-2 OR FCV-71-3 FAILED
ISOF	1.0000E+00	RCIC STEAMLINE ISOLATION GUARANTEED FAILURE

Top Event: IVC
Description: No Description

IVC0	0.0000E+00	G.S.
IVC1	7.7839E-05	ALL SUPPORT AVAIL.
IVC2	4.9663E-05	LOSS OF PCA OR POWER TO THE OUTBOARD VALVES
IVC3	5.0102E-05	LOSS OF DCA&PCA OR DCA&PWR TO OUTBD VLVS OR PCA&PWR TO INBD VLVS OR PWR TO INBD&OUTBD VLVS
IVCF	1.0000E+00	GUARANTEED FAIL

Top Event: IVO
Description: No Description

IVO1	1.1620E-15	ALL SUPPORT AVAIL.
IVOB	0.0000E+00	BYPASSED

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IVOF	1.0000E+00	G.F.

Top Event: JA
Description: No Description

JAF	1.0000E+00	GUARANTEED FAILED
JAS	0.0000E+00	BYPASS CONTAINMENT, WTR TO DEBRIS

Top Event: JC
Description: No Description

JC1	4.4860E-02	BYPASS UNAVAILABLE GIVEN LC HARDWARE FAILURE
JC2	2.6690E-04	BYPASS UNAVAILABLE GIVEN LC SUPPORTS FAILED

Top Event: JH
Description: No Description

JHF	1.0000E+00	GUARANTEED FAILED
JHS	0.0000E+00	BYPASS CONTAINMENT, NO WTR TO DEBRIS

Top Event: KC
Description: No Description

KCF	1.0000E+00	GUARANTEED FAILED
KCS	0.0000E+00	EARLY CONTAINMENT, WTR TO DEBRIS, DWS

Top Event: KF
Description: No Description

KFF	1.0000E+00	GUARANTEED FAILED
KFS	0.0000E+00	EARLY CONTAINMENT, WTR TO DEBRIS, NO DWS

Top Event: KH
Description: No Description

KHF	1.0000E+00	GUARANTEED FAILED
KHS	0.0000E+00	EARLY CONTAINMENT, NO WTR TO DEBRIS, NO DWS

Top Event: L8F
Description: No Description

L8F0	0.0000E+00	GUARANTEED SUCCESS
L8F1	6.8261E-03	ALL SUPPORT AVAILABLE
L8F2	8.5858E-03	LOOP II VESSEL INTRUMENT TAPS UNAVAILABLE
L8FF	1.0000E+00	GUARANTEED FAILURE

Top Event: L8H
Description: LEVEL 8 TRIP OF RCIC/HPCI

L8H1	2.7872E-02	LEVEL 8 TRIP, ALL SUPPORT AVAILABLE
L8H2	1.1184E-02	LEVEL 8 TRIP, HPCI ONLY
L8H3	1.6763E-02	LEVEL 8 TRIP, RCIC ONLY
L8HF	1.0000E+00	LEVEL 8 TRIP, GUARANTEED FAILURE

Top Event: L8TR
Description: No Description

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L8TR1	6.8250E-03	ALL SUPPORT AVAILABLE
L8TR2	8.5850E-03	LOOP II VESSEL INSTRUMENT TAPS UNAVAILABLE
L8TRF	1.0000E+00	GUARANTEED FAILURE

Top Event: LC
Description: No Description

LC1	5.8080E-03	STARTUP LEVEL CONTROL FLOWPATH UNAVAILABLE
LCF	1.0000E+00	QUARANTED FAILS

Top Event: LEC
Description: No Description

LECF	1.0000E+00	GUARANTEED FAILED
LECS	0.0000E+00	LATE CONTAINMENT, WTR TO DEBRIS, DWS

Top Event: LF
Description: No Description

LFF	1.0000E+00	GUARANTEED FAILED
LFS	0.0000E+00	LATE CONTAINMENT, WTR TO DEBRIS, NO DWS

Top Event: LH
Description: No Description

LHF	1.0000E+00	GUARANTEED FAILED
LHS	0.0000E+00	LATE CONTAINMENT, NO WTR TO DEBRIS, NO DWS

Top Event: LM1
Description: No Description

LM11	2.0690E-03	ALL SUPPORT AVAIL.
LM1F	1.0000E+00	G.F.

Top Event: LM2
Description: No Description

LM21	2.0510E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56B) GIVEN LM1 SUCCESS
LM22	1.0670E-02	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56B) GIVEN LM1 FAILED
LM2F	1.0000E+00	G.F.

Top Event: LM3
Description: No Description

LM31	2.0350E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56C) - LM1 AND LM2 SUCCESS
LM32	9.8830E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56C) - LM1(LM2) FAILED AND LM2(LM1) SUCCESS
LM33	8.3430E-02	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56C) - LM1 AND LM2 FAILED
LM34	2.0690E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56C) - LM1 AND LM2 DISABLED/BYPASSED
LM3F	1.0000E+00	G.F.

Top Event: LM4
Description: No Description

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LM41	2.0200E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56D) - LM1, LM2 AND LM3 SUCCESS
LM42	9.5740E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56D) - LM1, LM2 OR LM3 FAILED
LM43	4.0840E-02	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56D) - TWO OF LM1, LM2 AND LM3 FAILED
LM44	5.5140E-01	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56D) - LM1, LM2 AND LM3 FAILED
LM45	2.0510E-03	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56D) - LM1, LM2 DISABLED AND LM3 SUCCESS
LM46	1.0670E-02	FAILURE OF MSIV LOW RX LEVEL 1 SIGNAL (56D) - LM1, LM2 DISABLED AND LM3 FAILED
LM4F	1.0000E+00	G.F.

Top Event: LPC
Description: LOW PRESSURE COOLANT INJECTION (LPCI) PATH

LPC4	2.8416E-04	LPCI FAILURE GENERAL TRANSIENT ALL SUPPORT AVAIL.
LPC5	6.1766E-03	LPCI FAILURE GENERAL TRANSIENT, ONE RHR LOOP FAILED
LPCF	1.0000E+00	LPCI G.F.

Top Event: LPRES
Description: No Description

LPRESF	1.0000E+00	HIGH PRESSURE AT VESSEL MELT-THROUGH
LPRESS	0.0000E+00	LOW PRESSURE AT VESSEL MELT-THROUGH

Top Event: LT1
Description: No Description

LT11	2.9400E-03	ALL SUPPORT AVAIL.
LT1F	1.0000E+00	G.F.

Top Event: LT2
Description: No Description

LT21	2.6530E-03	UNAVAILABILITY OF DIV I, CHANNEL 58B LOW RX LEVEL SIGNAL GIVEN LT1 SUCCESS
LT22	1.0030E-01	UNAVAILABILITY OF DIV I, CHANNEL 58B LOW RX LEVEL SIGNAL GIVEN LT1 FAILED
LT2F	1.0000E+00	G.F.

Top Event: LT3
Description: No Description

LT31	2.3830E-03	FAILURE OF DIV II, CHANNEL 58C LOW RX LEVEL SIGNAL - LT1 AND LT2 SUCCESS
LT32	1.0410E-01	FAILURE OF DIV II (58C) LOW RX LEVEL SIGNAL - LT1(LT2) FAILED AND LT2(LT1) SUCCESS
LT33	6.6410E-02	FAILURE OF DIV II, CHANNEL 58C LOW RX LEVEL SIGNAL - LT1 AND LT2 FAILED
LT34	2.9400E-03	FAILURE OF DIV II, CHANNEL 58C LOW RX LEVEL SIGNAL - LT1 AND LT2 DISABLED/BYPASSED
LT3F	1.0000E+00	G.F.

Top Event: LT4
Description: No Description

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LT41	2.1120E-03	FAILURE OF DIV II (58D) LOW RX LEVEL SIGNAL - LT1, LT2 AND LT3 SUCCESS
LT42	1.1570E-01	FAILURE OF DIV II (58D) LOW RX LEVEL SIGNAL - LT1, LT2 OR LT3 FAILED
LT43	4.9890E-03	FAILURE OF DIV II (58D) LOW RX LEVEL SIGNAL - TWO OF LT1, LT2 AND LT3 FAILED
LT44	9.2990E-01	FAILURE OF DIV II (58D) LOW RX LEVEL SIGNAL - LT1, LT2 AND LT3 FAILED
LT45	2.6530E-03	FAILURE OF DIV II (58D) LOW RX LEVEL SIGNAL - LT1, LT2 DISABLED AND LT3 SUCCESS
LT46	1.0030E-01	FAILURE OF DIV II (58D) LOW RX LEVEL SIGNAL - LT1, LT2 DISABLED AND LT3 FAILED
LT4F	1.0000E+00	G.F.

Top Event: LV
Description: No Description

LVF	1.0000E+00	G.F. OF LOW RX LEVEL TRIP LOGIC
LVS	0.0000E+00	G.S. OF LOW RX LEVEL TRIP LOGIC

Top Event: LVP
Description: No Description

LVP1	2.9975E-05	UNAVAILABILITY OF FAIL SAFE LOW RX LEVEL SIGNAL GIVEN NO INSTR TAP FAILURE
LVP2	3.6651E-03	UNAVAILABILITY OF FAIL SAFE LOW RX LEVEL SIGNAL - LOOP I OR II INSTR TAP FAILURE

Top Event: MCD
Description: No Description

MCD1	3.1260E-02	ALL SUPPORT AVAILABLE
MCDF	1.0000E+00	GUARANTEED FAILURE

Top Event: MELT
Description: No Description

MELTF	1.0000E+00	CORE DAMAGE HAS OCCURRED
MELTS	0.0000E+00	NO CORE DAMAGE HAS OCCURRED

Top Event: MSVC
Description: No Description

MSVC1	7.7830E-05	ALL SUPPORT AVAIL.
MSVC2	4.9660E-05	LOSS OF SUPPORT EITHER INBOARD OR OUTBOARD MSIVs
MSVC3	5.0090E-05	LOSS OF SUPPORT TO BOTH INBOARD AND OUTBOARD MSIVs
MSVCF	1.0000E+00	G.F.

Top Event: MT1
Description: No Description

MT11	7.5428E-04	ALL SUPPORT AVAIL.
MT1F	1.0000E+00	G.F.

Top Event: MT2
Description: No Description

MT21	1.1271E-04	ALL SUPPORT AVAIL.

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MT2F	1.0000E+00	G.F.

Top Event: MT3
Description: No Description

MT31	7.5428E-04	ALL SUPPORT AVAIL.
MT3F	1.0000E+00	G.F.

Top Event: NA
Description: No Description

NA0	0.0000E+00	THE EVENT IS NOT AN ATWS
NAF	1.0000E+00	THE EVENT IS AN ATWS

Top Event: NBOC
Description: No Description

NBOCB	0.0000E+00	THE EVENT IS NOR A BREAK OUTSIDE CONTAINMENT
NBOCF	1.0000E+00	THE EVENT IS A BREAK OUTSIDE CONTAINMENT

Top Event: NCD
Description: No Description

NCD1	0.0000E+00	NO CORE DAMAGE HAS OCCURRED
NCDF	1.0000E+00	CORE DAMAGE HAS OCCURRED

Top Event: NH1
Description: No Description

NH11	3.0330E-03	SAI DIVISION I POWER SUPPLY AVAIL.
NH1F	1.0000E+00	G.F.

Top Event: NH2
Description: No Description

NH21	2.9980E-03	SAI DIVISION II POWER AVAIL. AND NH1 IS SUCCESS
NH22	1.4630E-02	SAI DIVISION II POWER AVAIL. AND NH1 IS FAILED
NH23	3.0330E-03	SAI DIVISION II POWER AVAIL. AND NH1 IS DISABLED/BYPASSED
NH2F	1.0000E+00	G.F.

Top Event: NIE
Description: No Description

NIEB	0.0000E+00	INITIATOR IS NOT BOC, FWRU, OR PRFO
NIEF	1.0000E+00	INITIATOR IS BOC, OR FWRU, OR PRFO

Top Event: NPI
Description: No Description

NPI1	2.7960E-04	SAI DIV I LOW RX PRESSURE PERMISSIVE SIGNAL FAILED GIVEN DIV I SUPPORT AVAIL.
NPIF	1.0000E+00	G.F.

Top Event: NPII
Description: No Description

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NPII1	2.6200E-04	SAI DIV II LOW RX PRESSURE PERMISSIVE SIGNAL FAILED GIVEN DIV I SIGNAL SUCCESS
NPII2	6.3410E-02	SAI DIV II LOW RX PRESSURE PERMISSIVE SIGNAL FAILED GIVEN DIV I SIGNAL FAILED
NPII3	2.7960E-04	SAI DIV II LOW RX PRESSURE PERMISSIVE SIGNAL FAILED GIVEN DIV I SIGNAL DISABLED
NPIIF	1.0000E+00	G.F.

Top Event: NRU
Description: No Description

NRUB	0.0000E+00	INITIATOR IS NOT FWRU
NRUF	1.0000E+00	INITAITOR IS FWRU

Top Event: NRV
Description: No Description

NRVO	0.0000E+00	NO STUCK OPEN SRVS
NRVF	1.0000E+00	STUCK OPEN SRVS

Top Event: OAD
Description: No Description

OAD1	1.4910E-03	INHIBIT ADS, ATWS, UNISOLATED VESSEL
OAD2	1.4700E-03	INHIBIT ADS, ATWS, ISOLATED VESSEL

Top Event: OAI
Description: No Description

OAIF	1.0000E+00	GUARANTEED FAILED

Top Event: OAL
Description: No Description

OAL1	1.6490E-02	LOWER AND CONTROL VESSEL LEVEL, ATWS, UNISOLATED VESSEL
OAL2	1.8550E-02	LOWER AND CONTROL VESSEL LEVEL, ATWS, ISOLATED VESSEL

Top Event: OBC
Description: No Description

OBC1	7.9338E-04	ALL SUPPORT AVAIL.
OBCF	1.0000E+00	G.F.

Top Event: OBD
Description: No Description

OBD1	1.3120E-01	ALL SUPPORT AVAIL.
OBD2	8.6016E-04	LONG TERM HPCI OR RCIC AVAIALBLE
OBDF	1.0000E+00	G.F.

Top Event: ODWS
Description: OPERATOR ALIGNS DRYWELL SPRAY

ODWS1	9.6280E-03	OPERATOR ALIGNS DRYWELL SPRAY, NON-ATWS
ODWS2	2.7370E-02	OPERATOR ALIGNS DRYWELL SPRAY DURING ATWS

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OOWSF	1.0000E+00	G.F.

Top Event: OEE
Description: No Description

OEE1	5.0050E-04	OPERATOR RECOVERS EECW, NON-ATWS
OEE2	1.6400E-02	OPERATOR RECOVERS EECW, ATWS
OEEB	0.0000E+00	BYPASS
OEEF	1.0000E+00	GUARANTEED FAILED

Top Event: OF
Description: No Description

OF1	3.8410E-04	CONTROL VESSEL LEVEL WITH FEEDWATER, AUTO-CONTROL = S, 1 FEED PUMP
OF2	2.4910E-03	CONTROL VESSEL LEVEL WITH FEEDWATER, AUTO-CONTROL = F, 1 FEED PUMP
OF3	3.3590E-01	CONTROL VESSEL LEVEL WITH FEEDWATER, 3 FEED PUMPS
OF4	7.7770E-03	CONTROL VESSEL LEVEL WITH FEEDWATER, ATWS
OFF	1.0000E+00	GUARANTEED FAILURE

Top Event: OFT
Description: No Description

OFT1	1.8170E-03	OPERATOR TRIPS TWO FEED PUMPS
OFTF	1.0000E+00	GUARANTEED FAILED, OPTR=F
OFTS	0.0000E+00	GUARANTEED SUCCESS, OPTR=S

Top Event: OG16
Description: No Description

OG161	5.9198E-04	161KV OFFSITE POWER
OG16F	1.0000E+00	161KV OFFSITE POWER GUARANTEED FAIL.

Top Event: OG5
Description: No Description

OG51	3.9230E-04	500KV OFFSITE GRID UNAVAIL.
OG5F	1.0000E+00	G.F.

Top Event: OHC
Description: OPERATOR CONTROLS LEVEL
SHORT TERM USING
HPCI/RCIC

OHC1	1.0610E-03	CONTROL OF HPCI AND RCIC
OHC2	9.1750E-04	CONTROL OF HPCI ONLY
OHC3	7.3590E-04	CONTROL OF RCIC ONLY
OHC4	1.0350E-02	CONTROL OF HPCI DURING ATWS

Top Event: OHL
Description: LONG TERM CONTROL OF
HPCI/RCIC

OHL1	1.4740E-03	LONG TERM CONTROL OF HPCI/RCIC GIVEN OHC=S
OHL2	4.4930E-03	LONG TERM CONTROL OF HPCI AND/OR RCIC GIVEN OHC=F

Top Event: OHR

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Description: OPERATOR ACTION TO KEEL
HPCI/RCIC RUNNING GIVEN
SPC FAILURE

OHRF	1.0000E+00	GUARANTEED FAILURE

Top Event: OHS
Description: OPERATOR STARTS RCIC/HPCI

OHS1	8.4290E-03	OPERATOR STARTS OF HPCI - NON-ATWS, 2 SORVS
OHS2	7.8720E-04	OPERATOR STARTS RCIC/HPCI - NON-ATWS, NO SORV
OHS3	5.2570E-03	OPERATOR STARTS HPCI DURING ATWS
OHSF	1.0000E+00	OPERATOR STARTS RCIC/HPCI - GUARANTEED FAILURE

Top Event: OIV
Description: No Description

OIV1	2.2560E-03	OPERATOR DEFEATS MSIV CLOSURE INTERLOCK, NON-ATWS
OIVF	1.0000E+00	G.F.

Top Event: OJC
Description: No Description

OJC1	3.2040E-02	OPERATOR CONTROLS VESSEL LEVEL WITH CONDENSATE USING ALTERNATE FLOW PATH

Top Event: OLA
Description: No Description

OLA1	7.7450E-02	OPERATOR MAINTAINS VESSEL LEVEL AT T.A.F. WITH RHR/CS

Top Event: OLC
Description: No Description

OLC1	4.7900E-04	OPERATOR CONTROLS VESSEL LEVEL WITH CONDENSATE, FEEDWATER SUCCESSFUL
OLC2	6.9510E-04	OPERATOR CONTROLS VESSEL LEVEL WITH CONDENSATE, FEEDWATER FAILED
OLCF	1.0000E+00	GUARANTEED FAILED

Top Event: OLP
Description: OPERATOR CONTROLS LPCI/CS
OR ALIGNS VENT PATH

OLP1	4.7900E-04	OPERATOR CONTROLS LPCI/CS
OLPF	1.0000E+00	G.F.

Top Event: OPTR
Description: No Description

OPTR1	1.7960E-03	OPERATOR TRIPS 2 FEEDWATER PUMPS DURING A FEEDWATER RAMPUP

Top Event: ORF
Description: No Description

ORF1	4.1980E-04	OPERATOR RESTARTS FEEDWATER FOLLOWING LEVEL 8 TRIP

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ORFF	1.0000E+00	GUARANTEED FAILURE

Top Event: ORP
Description: OPERATOR MANUALLY STARTS RHR/CS

ORP1	9.5840E-05	OPERATOR FAILS TO START THE RHR AND CS PUMPS
ORP2	2.5820E-02	OPERATOR STARTS RHR/CS, HIGH PRESSURE INJECTION FAILED
ORP3	4.3660E-02	OPERATOR RESTORES EECW, STARTS RHR/CS, LOSP WITH POWER RECOVERED
ORPF	1.0000E+00	GUARANTEED FAILED

Top Event: OSD
Description: OPERATOR ACTION TO ALIGN SHUTDOWN COOLING

OSD1	1.0130E-03	OPERATOR ALIGNS SDC BOTH RHR LOOPS AVAIL.
OSD2	1.5380E-03	OPERATOR ALIGNS SDC ONE RHR LOOP AVAIL.
OSDF	1.0000E+00	G.F.

Top Event: OSL
Description: No Description

OSL1	5.4420E-03	OPERATOR STARTS SLC, UNISOLATED VESSEL
OSL2	1.2420E-02	OPERATOR STARTS SLC, ISOLATED VESSEL

Top Event: OSP
Description: OPERATOR ALIGNS SUPPRESSION POOL COOLING

OSP1	7.8170E-05	OPERATOR ALIGNS SPC BOTH RHR LOOPS AVAIL., NON-ATWS
OSP2	5.7740E-03	OPERATOR ALIGNS SPC BOTH RHR LOOPS AVAIL. - ATWS
OSP3	7.2130E-05	OPERATOR ALIGNS SPC ONE RHR LOOP AVAIL., NON-ATWS
OSPF	1.0000E+00	G.F.

Top Event: OSV
Description: No Description

OSV1	2.3330E-03	OPERATOR DEFEATS MSIV CLOSURE INTERLOCK DURING ATWS
OSVF	1.0000E+00	GUARANTEED FAILED

Top Event: OSW
Description: No Description

OSW1	7.5160E-04	OPERATOR TRANSFERS MODE SWITCH TO REFUEL/SHUTDOWN

Top Event: OUB
Description: No Description

OUB1	2.8540E-03	OPERATOR TRANSFERS UNIT BOARDS, UNIT 1 OR 2 POWER LOST
OUB2	4.9230E-03	OPERATOR TRANSFERS UNIT BOARDS, UNIT 1 AND 2 POWER LOST

Top Event: PCA

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Description: PLANT CONTROL AIR

PCA1	4.4467E-03	ALL SUPPORT AVAIL.
PCA2	4.8760E-03	UNAVAILABILITY OF PCA SYSTEM GIVEN SUPPORT TO COMPRESSOR A OR D UNAVAIL.
PCA3	3.2886E-02	UNAVAILABILITY OF PCA SYSTEM GIVEN SUPPORT COMPRESSORS A AND D UNAVAIL.
PCA4	5.1329E-02	UNAVAILABILITY OF PCA SYSTEM GIVEN SUPPORT TO COMPRESSORS B AND C UNAVAIL.
PCAF	1.0000E+00	G.F.

Top Event: PX1
Description: No Description

PX11	7.9450E-04	POWER AVAIL. FROM 250 V DC RMOV BOARD 2B
PX1F	1.0000E+00	G.F.

Top Event: PX2
Description: No Description

PX21	7.9200E-04	POWER AVAIL. FROM 250V DC RMOV BOARD 2A AND PX1 IS SUCCESS
PX22	3.8810E-03	POWER AVAIL. FROM 250V DC RMOV BOARD 2A AND PX1 IS FAILED
PX23	7.9450E-04	POWER AVAIL. FROM 250V DC RMOV BOARD 2A AND PX1 IS DISABLED/BYPASSED
PX2F	1.0000E+00	G.F.

Top Event: R480
Description: No Description

R4801	1.3000E-02	RECOVER 480 V RMOV BD 2A OR 2B
R480B	0.0000E+00	BYPASS

Top Event: RA
Description: No Description

RA1	2.5380E-04	ALL SUPPORT AV.
RAF	1.0000E+00	GUARANTEED FAIL.

Top Event: RB
Description: No Description

RB1	1.4420E-04	ALL SUPPORT AV.
RBF	1.0000E+00	GUARANTEED FAIL.

Top Event: RBC
Description: No Description

RBC10	7.1009E-03	LOSP WITH NO ACCIDENT SIGNAL AND EECW UNAVAIL.
RBC11	1.1418E-02	LOSP WITH AN ACCIDENT SIGNAL AND EECW UNAVAIL.
RBC17	7.5184E-03	GIVEN ALL SUPPORT AVAIL. EXCEPT RCW
RBC19	1.3106E-02	GIVEN ALL SUPPORT AVAIL. EXCEPT LOSP & RCW UNAVAIL..
RBC20	1.7493E-02	GIVEN ALL SUPPORT AVAIL. WITH AN ACCIDENT SIGNAL EXCEPT LOSP & RCW
RBC4	1.7345E-03	GIVEN ALL SUPPORT AVAIL. EXCEPT EECW
RBCF	1.0000E+00	G.F.

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Top Event: RBI
Description: No Description

RBI1	1.1832E-01	ALL SUPPORT AVAIL.
RBIF	1.0000E+00	G.F.

Top Event: RBISO
Description: No Description

RBISOF	1.0000E+00	REACTOR BUILDING NOT ISOLATED
RBISOS	0.0000E+00	REACTOR BUILDING ISOLATED

Top Event: RC
Description: No Description

RC1	1.4420E-04	ALL SUPPORT AV.
RCF	1.0000E+00	GUARANTEED FAIL.

Top Event: RCI
Description: SHORT TERM RCIC OPERATION

RCI1	6.6250E-02	RCIC FAILURE; ALL RCIC SUPPORT AVAILABLE
RCI2	6.6940E-02	RCIC FAILURE; GIVEN MANUAL START OF RCIC/HPCI FAILED(OHS=F)
RCIF	1.0000E+00	RCIC GUARANTEED FAILURE

Top Event: RCL
Description: RCIC LONG TERM OPERATION

RCL1	1.8220E-02	RCIC FAILURE; LONG TERM OPERATION; GIVEN EARLY OPERATOR CONTROL OF HPCI/RCIC (OHC=S)
RCL2	1.0700E-01	RCIC FAILURE; LONG TERM OPERATION; GIVEN OHC=F
RCLF	1.0000E+00	GUARANTEED FAILURE OF RCIC LONG TERM OPERATION

Top Event: RCW
Description: No Description

RCW1	2.5213E-05	ALL SUPPORT AVAIL.
RCW10	4.2960E-05	POWER TO ONE OPERATING RCW PUMP (1A) AND PUMP 1D UNAVAIL.
RCW12	1.1619E-03	POWER TO ALL UNIT 2 RCW PUMPS AND RCW PUMP 1D UNAVAIL.
RCW13	8.2220E-04	POWER TO ONE OPERATING UNIT 1 AND ONE UNIT 2 PUMP, AND PUMP 1D UNAVAIL.
RCW15	5.3649E-01	POWER TO ONE OPERATING UNIT 1 AND ALL UNIT 2 PUMPS, AND PUMP 1D UNAVAIL.
RCW2	2.4872E-05	POWER TO ONE RCW PUMP (1A) UNAVAIL.
RCW4	4.4808E-04	POWER TO ALL UNIT 2 RCW PUMPS UNAVAIL.
RCW5	3.2888E-05	POWER TO ONE UNIT 1 PUMP AND ONE UNIT 2 PUMP UNAVAIL.
RCW7	2.0175E-03	POWER TO ONE UNIT 1 PUMP AND ALL UNIT 2 PUMPS UNAVAIL.
RCW9	2.5659E-05	POWER TO RCW PUMP 1D UNAVAIL.
RCWF	1.0000E+00	G.F.

Top Event: RD
Description: No Description

RD1	1.4420E-04	ALL SUPPORT AV.
RDF	1.0000E+00	GUARANTEED FAIL.

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Top Event: RE
Description: No Description

RE1	2.7103E-04	ALL SUPPORT AVA
REF	1.0000E+00	GUARANTEED FAIL

Top Event: RF
Description: No Description

RF1	2.7103E-04	ALL SUPPORTS AVA
RFF	1.0000E+00	GUARANTEED FAIL.

Top Event: RG
Description: No Description

RG1	5.4206E-04	ALL SUPPORT AVAIL.
RGF	1.0000E+00	G.F.

Top Event: RH
Description: No Description

RH1	1.6143E-04	ALL SUPPORTS AVA
RHF	1.0000E+00	GUARANTEED FAIL.

Top Event: RI
Description: No Description

RI1	1.6143E-04	ALL SUPPORTS AVA
RIF	1.0000E+00	G.F.

Top Event: RJ
Description: No Description

RJ1	1.6143E-04	ALL SUPPORTS AVA
RJF	1.0000E+00	GUARANTEED FAIL.

Top Event: RK
Description: No Description

RK1	1.3490E-04	ALL SUPPORT AVAL
RK2	1.0160E-03	LOSS OF ALT SUPPLY
RK3	2.4290E-02	LOSS OF NORMAL SUPPLY
RKF	1.0000E+00	G.F.

Top Event: RL
Description: No Description

RL1	1.3490E-04	ALL SUPPORT, RK SUCCESS
RL2	1.5230E-04	ALL SUPPORT, RK FAILS
RL3	1.3490E-04	RK FAILS BY SUPPORT
RL4	1.0170E-03	RK SUCCESS, SD BD 2A FAILS
RL5	9.7800E-04	RK FAILS, SD BD 2A FAILS
RL6	2.4290E-02	RK SUCCESS, SD BD 2B FAILS
RL7	2.3950E-02	RK FAILS, SD BD 2B FAILS
RLF	1.0000E+00	G.F.

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Top Event: RM
Description: No Description

RM1	3.4305E-04	ALL SUPPORTS AVA
RMF	1.0000E+00	GUARANTEED FAIL

Top Event: RN
Description: No Description

RN1	3.4305E-04	ALL SUPPORTS AVAIL.
RNF	1.0000E+00	GUARANTEED FAIL.

Top Event: RO
Description: No Description

RO1	2.7103E-04	ALL SUPPORTS AVAIL.
ROF	1.0000E+00	GUARANTEED FAIL.

Top Event: RP
Description: RHR PUMPS DUMMY TREE

RP1	2.5662E-04	ALL SUPPORTS AVAIL.
RPF	1.0000E+00	GUARANTEED FAIL.

Top Event: RPA
Description: RHR PUMP TRAIN A

RPA1	1.3130E-02	RHR PUMP A FAILS, ALL SUPPORT AVAILABLE
RPAF	1.0000E+00	RHR PUMP A GUARANTEED FAILURE

Top Event: RPB
Description: RHR PUMP TRAIN B

RPB1	1.2750E-02	RHR PUMP B FAILURE ALL SUPPORT AVAILABLE, RPA=S, RPC=S
RPB2	1.9040E-02	RHR PUMP B FAILURE GIVEN RPA=F OR RPC=F (WITH OTHER SUCCESS)
RPB3	3.7290E-02	RHR PUMP B FAILURE GIVEN RPA=F AND RPC=F
RPB4	1.3130E-02	RHR PUMP B FAILURE GIVEN RPA=B AND RPC=B
RPB5	1.2890E-02	RHR PUMP B FAILURE GIVEN RPA=B OR RPC=B (WITH OTHER SUCCESS)
RPB6	3.4260E-01	RHR PUMP B FAILURE GIVEN RPA=F AND RPC=B, OR RPA=B AND RPC=F
RPBF	1.0000E+00	RHR PUMP B GUARANTEED FAILURE

Top Event: RPC
Description: RHR PUMP TRAIN C

RPC1	8.7460E-03	RHR PUMP C FAILURE, ALL SUPPORT AVAILABLE, RPA=S
RPC2	3.4260E-01	RHR PUMP C FAILURE GIVEN RPA=F
RPC3	1.3130E-02	RHR PUMP C FAILURE GIVEN RPA NOT ASKED
RPCF	1.0000E+00	RHR PUMP C GUARANTEED FAILURE

Top Event: RPD
Description: RHR PUMP TRAIN D

RPD1	8.5010E-03	RHR PUMP D FAILURE ALL SUPPORT AVAILABLE, RP(A,B,C)=S,S,S
RPD10	4.0910E-01	RHR PUMP D FAILURE GIVEN 1 PREVIOUS BYPASS AND 2

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		FAILURES (MODELD AS RPC & RPD FAILED)
RPD2	3.4200E-01	RHR PUMP D FAILURE GIVEN RPA,RPC OR RPB=F (MODELED AS RPB=F)
RPD3	2.5890E-01	RHR PUMP D FAILURE GIVEN 2 PREVIOUS FAILURES (MODELED AS RPA OR RPC FAILED AND RPB FAILED)
RPD4	6.2610E-01	RHR PUMP D FAILURE GIVEN RPA, RPC AND RPB =F
RPD5	1.3130E-02	RHR PUMP D FAILURE GIVEN RPA, RPC AND RPB=B
RPD6	1.2890E-02	RHR PUMP D FAILURE GIVEN RPA OR RPC=B, AND RPB=B
RPD7	3.4260E-01	RHR PUMP D FAILURE GIVEN 2 PREVIOUS BYPASSES AND A FAILURE (MODELED AS RPB=F)
RPD8	1.2750E-02	RHR PUMP D FAILURE GIVEN 1 PREVIOUS BYPASS AND 2 SUCCESSES (MODELED AS RPB=B)
RPD9	3.4040E-01	RHR PUMP D FAILURE GIVEN 1 PREVIOUS SUCCESS, 1 BYPASS, 1 SUCCESS, 1 FAILURE (MODELED AS RPB=F)
RPDF	1.0000E+00	RHR PUMP D GUARANTEED FAILUIRE

Top Event: RPS
Description: No Description

RPS0	0.0000E+00	REACTOR SCRAM - G.S.
RPS1	1.7848E-05	REACTOR SCRAM - ALL SUPP. AVAIL.
RPS10	1.3696E-06	REACTOR SCRAM - LOSS OF CONTROL AIR OR (RH AND RI)
RPS11	1.0257E-03	REACTOR SCRAM - LOFW, LVP FAILED(MANUAL SCRAM ONLY)
RPS2	1.7848E-05	REACTOR SCRAM - LOSS OF DB OR DD
RPS3	1.8701E-05	REACTOR SCRAM - LOSS OF DB AND DD
RPS4	1.7848E-05	REACTOR SCRAM - LOSS OF RB OR RC
RPS5	1.7848E-05	REACTOR SCRAM - LOSS OF (RB OR RC) AND (DB OR DD)
RPS6	1.8701E-05	REACTOR SCRAM - LOSS OF (RB OR RC) AND DB AND DD
RPS7	1.7848E-05	REACTOR SCRAM - LOSS OF RB AND RC
RPS8	1.7848E-05	REACTOR SCRAM - LOSS OF RB AND RC AND (DB OR DD)
RPS9	1.8701E-05	REACTOR SCRAM - LOSS OF RB AND RC AND DB AND DD

Top Event: RPT
Description: No Description

RPT1	1.0732E-04	RPTS WITH TURBINE TRIPPED - ALL SUPPORTS AVAILABILE
RPT2	1.1123E-04	RPTS WITH TURBINE TRIPPED - ONE ATWS-RPT DIV DISABLED
RPT3	1.1308E-04	RPTS WITH TURBINE TRIPPED - ATWS-RPT (BOTH DIVISIONS) DISABLED
RPT4	1.1536E-04	RPTS WITH TURBINE TRIPPED - ONE RPT-EOC DIV DISABLED
RPT5	8.2781E-03	RPTS WITH TURBINE TRIPPED - ONE ATWS-RPT AND ONE EOC-RPT DIV TO SAME PAIR OF BREAKERS DISABLED
RPT6	1.1752E-04	RPTS WITH TURBINE TRIPPED - ONE EOC-RPT DIV AND OPPOSITE ATWS-RPT DIV DISABLED
RPT7	8.0644E-03	RPTS WITH TURBINE TRIPPED - ONE EOC-RPT AND BOTH ATWS-RPT DIVISIONS DISABLED
RPT8	1.4739E-04	RPTS WITH NO TURBINE TRIP (EOC-RPT UNAVAIL.) - ALL SUPPORTS AVAIL. TO ATWS-RPT
RPT9	9.2513E-03	RPTS WITH NO TURBINE TRIP - ONE ATWS-RPT DIV DISABLED
RPTF	1.0000E+00	RPTS WITH NO SUPPORTS AVAIL. (GUARANTEED FAILED)

Top Event: RVC
Description: No Description

RVC0	9.3210E-01	NON-ATWS, 0 SRV STUCK OPEN
RVC1	6.1540E-02	NON-ATWS, 1 SRV STUCK OPEN
RVC2	4.2540E-03	NON-ATWS, 2 SRVs STUCK OPEN
RVC3	4.4020E-04	NON-ATWS, 3 OR MORE SRVs STUCK OPEN

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RVC4	8.9920E-01	ATWS, 0 SRV STUCK OPEN
RVC5	9.2600E-02	ATWS, 1 SRV STUCK OPEN
RVC6	9.6170E-03	ATWS, 2 SRVs STUCK OPEN
RVC7	2.3340E-03	ATWS, 3 OR MORE SRVs STUCK OPEN
RVC8	0.0000E+00	NOT BRANCH OF INTEREST
RVC9	1.0000E+00	BRANCH OF INTEREST

Top Event: RVD
Description: No Description

RVD0	0.0000E+00	SF RVD0
RVD1	9.9310E-01	SF RVD1
RVD10	9.9310E-01	SF RVD10
RVD11	9.4460E-01	SF RVD11
RVD12	9.4910E-01	SF RVD12
RVD13	6.9000E-03	SF RVD13
RVD14	5.8000E-03	SF RVD14
RVD15	5.2000E-02	SF RVD15
RVD16	5.1700E-02	SF RVD16
RVD17	7.3000E-03	SF RVD17
RVD18	5.6000E-03	SF RVD18
RVD19	5.6100E-02	SF RVD19
RVD2	9.9420E-01	SF RVD2
RVD20	6.0500E-02	SF RVD20
RVD21	1.0100E-02	SF RVD21
RVD22	6.9000E-03	SF RVD22
RVD23	5.5400E-02	SF RVD23
RVD24	5.0899E-02	SF RVD24
RVD25	2.0340E-08	SF RVD25
RVD26	2.2610E-08	SF RVD26
RVD29	9.3310E-08	SF RVD29
RVD3	9.4800E-01	SF RVD3
RVD30	5.7720E-09	SF RVD30
RVD31	7.1950E-07	SF RVD31
RVD32	1.2860E-06	SF RVD32
RVD33	1.2940E-07	SF RVD33
RVD34	5.7730E-09	SF RVD34
RVD35	7.1040E-07	SF RVD35
RVD36	1.2860E-06	SF RVD36
RVD37	6.9000E-03	SF RVD37
RVD38	5.8000E-03	SF RVD38
RVD39	7.3000E-03	SF RVD39
RVD4	9.4830E-01	SF RVD4
RVD40	5.6000E-03	SF RVD40
RVD41	5.6100E-02	SF RVD41
RVD42	6.0499E-02	SF RVD42
RVD43	0.0000E+00	NOT BRANCH OF INTEREST
RVD44	0.0000E+00	NOT BRANCH OF INTEREST
RVD45	1.0000E+00	BRANCH OF INTEREST
RVD5	9.9270E-01	SF RVD5
RVD6	9.9440E-01	SF RVD6
RVD7	9.4390E-01	SF RVD7
RVD8	9.3950E-01	SF RVD8
RVD9	9.8990E-01	SF RVD9

Top Event: RVL
Description: No Description

RVL0	0.0000E+00	ATWS-EVENT TREE BYPASS
RVL1	2.0340E-08	RELIEF OR SAFETY MODE - PWR4
RVL2	2.2610E-08	RELIEF OR SAFETY MODE - PWR6
RVL3	6.8870E-03	RELIEF MODE - PWR4
RVL4	5.7910E-03	RELIEF MODE - PWR6

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Top Event: RVO
Description: No Description

RVO1	1.3220E-05	NON-ATWS
RVO2	1.3720E-05	ATWS
RVOB	0.0000E+00	BYPASS

Top Event: SDC
Description: SHUTDOWN COOLING HARDWARE

SDC1	1.1326E-02	SHUTDOWN COOLING FAILURE ALL SUPPORT AVAIL.
SDC2	2.6635E-02	SHUTDOWN COOLING FAILURE, ONE RHR LOOP FAILED
SDCF	1.0000E+00	SHUTDOWN COOLING G.F.

Top Event: SGT
Description: No Description

SGT1	1.5514E-03	GIVEN ALL SUPPORT
SGT2	1.1099E-02	GIVEN ALL SUPPORT AVAIL. EXCEPT DN
SGT4	1.2845E-02	GIVEN ALL SUPPORT AVAIL. EXCEPT DN & AA UNAVAIL.
SGT5	2.6906E-02	GIVEN ALL SUPPORT AVAIL. EXCEPT A3ED
SGT6	2.8724E-02	GIVEN ALL SUPPORT AVAIL. EXCEPT A3ED AND AA UNAVAIL.
SGT8	3.0454E-02	GIVEN ALL SUPPORT AVAIL. EXCEPT A3ED, DN & AA UNAVAIL.
SGT9	3.0668E-02	GIVEN ALL SUPPORT AVAIL. EXCEPT RM
SGTF	1.0000E+00	GUARNTEED FAILURE

Top Event: SGTOP
Description: No Description

SGTOPF	1.0000E+00	STANDBY GAS TREATMENT OR HUMIDIFIERS NOT OPERATING
SGTOPS	0.0000E+00	STANDBY GAS TREATMENT AND HUMIDIFIERS OPERATING

Top Event: SHUT1
Description: No Description

SHUT11	1.0750E-04	no description entered
SHUT12	2.3880E-03	no description entered
SHUT13	1.5410E-04	no description entered
SHUT1F	1.0000E+00	no description entered

Top Event: SHUT2
Description: No Description

SHT21	1.0750E-04	no description entered
SHT210	1.9540E-03	no description entered
SHT211	1.5410E-04	no description entered
SHT212	2.3880E-03	no description entered
SHT213	1.5410E-04	no description entered
SHT214	1.8390E-01	no description entered
SHT215	1.6880E-04	no description entered
SHT216	2.6160E-03	no description entered
SHT217	1.1560E-04	no description entered
SHT22	1.0750E-04	no description entered
SHT23	1.0750E-04	no description entered
SHT24	1.0750E-04	no description entered
SHT25	2.3880E-03	no description entered
SHT26	1.5410E-04	no description entered
SHT27	2.5490E-05	no description entered

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SHT28	1.1730E-04	no description entered
SHT29	5.0810E-05	no description entered
SHT2F	1.0000E+00	no description entered

Top Event: SL
Description: No Description

SL1	5.7591E-03	ALL SUPPORT AVAIL.
SL2	2.7449E-02	SUPPORT TO ONE SLC PUMP TRAIN AND TWO RWCU ISOLATION VALVES AVAIL.
SL3	3.1245E-02	SUPPORT TO ONE SLC PUMP TRAIN AND ONE RWCU ISOLATION VALVE AVAIL.
SLF	1.0000E+00	G.F.

Top Event: SP
Description: SUPPRESSION POOL COOLING HARDWARE

SP1	7.4123E-04	SUPPRESSION POOL COOLING ALL SUPPORT AVAIL.
SP2	2.5350E-02	SUPPRESSION POOL COOLING DURING ATWS
SP3	1.3160E-02	SUPPRESSION POOL COOLING, ONE LOOP RHR FAILED
SPF	1.0000E+00	SUPPRESSION POOL COOLING G.F.

Top Event: SPR
Description: No Description

SPR1	7.0000E-02	OPERATOR RECOVERS SUPPRESSION POOL COOLING
SPRF	1.0000E+00	OPERATOR FAILS TO RECOVER SUPPRESSION POOL COOLING

Top Event: SW1A
Description: No Description

SW1A1	1.3430E-02	RHRSW PUMP A1, A2 FAILS, ALL SUPPORTS AVAIL.
SW1AB	0.0000E+00	RHRSW PUMP A1 BYPASS, A2 SUCCESS
SW1AF	1.0000E+00	RHRSW PUMP A1 G.F.

Top Event: SW1B
Description: No Description

SW1B1	1.3890E-02	RHRSW PUMP B1, B2 FAILS, ALL SUPPORTS AVAIL.
SW1B2	6.6980E-02	RHRSW PUMP B12, B2 G.F., ALL SUPPORTS AVAIL.
SW1BB	0.0000E+00	RHRSW PUMP B1 BYPASS, B2 SUCCESS
SW1BF	1.0000E+00	RHRSW PUMP B1 G.F.

Top Event: SW1C
Description: No Description

SW1C1	1.2520E-02	RHRSW PUMP C1, ALL SUPPORTS AVAIL., C2 FAILS, A2 SUCCESS, A1 BYPASS
SW1C2	7.9910E-02	RHRSW PUMP C1, ALL SUPPORTS AVAIL., A2 FAILS, A1 SUCCESS, C2 FAILS
SW1C3	3.1470E-01	RHRSW PUMP C1, ALL SUPPORTS AVAIL., A2, A1, C2 ALL FAIL
SW1C4	1.3430E-02	RHRSW PUMP C1, ALL SUPPORTS AVAIL., C2 FAILS, A2 AND A1 G.F.
SW1CB	0.0000E+00	RHRSW PUMP C1 BYPASS, C2 SUCCESS
SW1CF	1.0000E+00	RHRSW PUMP C1 G.F.

Top Event: SW1D

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Description: No Description

SW1D1	1.3070E-02	RHRSW PUMP D1, ALL SUPPORTS AVAIL., D2 FAILS
SW1D10	6.6980E-02	RHRSW PUMP D1, ALL SUPPORTS AVAIL., B1, B2 AND D2 ALL G.F.
SW1D2	6.0900E-02	RHRSW PUMP D1, ALL SUPPORTS AVAIL., B2 AND D2 FAIL, B1 SUCCESS
SW1D3	3.1100E-01	RHRSW PUMP D1, ALL SUPPORTS AVAIL., B2, B1 AND D2 ALL FAIL
SW1D4	8.1210E-02	RHRSW PUMP D1, B1 FAILS, (B2 G.F. AND D2 FAILS) OR (D2 G.F. AND B2 FAILS), ALL SUPPORTS AVAIL.
SW1D5	1.2880E-02	RHRSW PUMP D1, B1 SUCCESS, B2 G.F., D2 FAILS, ALL SUPPORTS AVAIL.
SW1D6	1.3890E-02	RHRSW PUMP D1, ALL SUPORTS AVAIL., 2/3 OF (B2,B1,D2) G.F. AND THE THIRD ONE FAILS
SW1D7	6.8960E-02	RHRSW PUMP D1, ALL SUPPORTS AVAIL., B2 SUCCESS, B1 BYPASS, D2 FAILS
SW1D8	1.2880E-02	RHRSW PUMP D1, ALL SUPPORTS AVAIL., D2 G.F, B1 SUCCESS, B2 FAILS
SW1D9	7.0930E-02	RHRSW PUMP D1, ALL SUPPORTS AVAIL., B2 AND D2 G.F., B1 SUCCESS
SW1DB	0.0000E+00	RHRSW PUMP D1 BYPASS
SW1DF	1.0000E+00	RHRSW PUMP D1 G.F.

Top Event: SW2A
Description: No Description

SW2A1	3.5890E-02	RHRSW PUMP A2, ALL SUPPORTS AVAIL.
SW2AF	1.0000E+00	RHRSW PUMP A2 G.F.

Top Event: SW2B
Description: No Description

SW2B1	3.5910E-02	RHRSW PUMP B2, ALL SUPPORTS AVAIL.
SW2BF	1.0000E+00	RHRSW PUMP B2 G.F.

Top Event: SW2C
Description: No Description

SW2C1	3.6860E-02	RHRSW PUMP C2, A2 SUCCESS, A1 BYPASS, ALL SUPPORT AVAIL.
SW2C2	8.8990E-03	RHRSW PUMP C2, A2 FAILS, A1 SUCCESS, ALL SUPPORT AVAIL.
SW2C3	7.6260E-02	RHRSW PUMP C2, A2 AND A1 FAIL, ALL SUPPORTS AVAIL.
SW2C4	3.5890E-02	RHRSW PUMP C2, A2 AND A1 G.F., ALL SUPPORTS AVAIL.
SW2CF	1.0000E+00	RHRSW PUMP C2 G.F.

Top Event: SW2D
Description: No Description

SW2D1	3.6800E-02	RHRSW PUMP D2, ALL SUPPORTS AVAIL., 2B SUCCCESS, 1B BYPASS
SW2D2	1.1170E-02	RHRSW PUMP D2, ALL SUPPORTS AVAIL., B2 FAILS, B1 SUCCESS
SW2D3	7.0110E-02	RHRSW PUMP D2, ALL SUPPORTS AVAIL., B2 AND B1 FAILS
SW2D4	1.1990E-02	RHRSW PUMP D2, ALL SUPPORTS AVAIL., B2 FAILS, B1 G.F.
SW2D5	3.5910E-02	RHRSW PUMP D2, ALL SUPPORTS AVAIL., B2 AND B1 G.F.
SW2D6	3.7950E-02	RHRSW PUMP D2, ALL SUPPORTS AVAIL., B2 G.F., B1 SUCCESS
SW2DF	1.0000E+00	RHRSW PUMP D2 G.F.

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Top Event: TB
Description: No Description

TB0	0.0000E+00	G.S.
TB1	1.6219E-02	ALL SUPPORT AVAIL.
TB2	6.0058E-02	UB42B FAILS
TB3	6.0794E-02	UB42A FAILS
TBB	0.0000E+00	G.S.
TBF	1.0000E+00	G.F.

Top Event: TOR
Description: No Description

TOR1	3.6254E-04	GIVEN MEDIUM, LARGE, OR EXCESSIVE LOCA
TOR2	1.2970E-06	GIVEN GENERAL TRANSIENTS OR SMALL LOCA
TORF	1.0000E+00	G.F.

Top Event: U1
Description: UNIT 1 RHR CROSSTIE

U11	5.3057E-02	TOP EVENT U1 WITH ALL SUPPORT SYSTEMS AVAIL.
U1F	1.0000E+00	TOP EVENT U1 GUARANTEED FAILED DUE TO SUPPORT SYSTEM FAILURE

Top Event: U3
Description: UNIT 3 RHR CROSSTIE

U3F	1.0000E+00	UNIT 3 CROSSTIE G.F.

Top Event: UB41A
Description: No Description

UB41A1	2.3330E-04	ONE TRAIN WITH NO TRANSFER
UB41A2	2.2390E-04	ONE TRAIN WITH TRANSFER
UB41AF	1.0000E+00	G.F.

Top Event: UB41B
Description: No Description

UB41B1	2.3330E-04	UNIT BOARD 1B FAILS WITH NO TRANSFER
UB41B2	2.2400E-04	UNIT BOARD 1B FAILS WITH TRANSFER, UNIT BOARD 1A SUCCESS
UB41B3	3.5360E-05	UNIT BOARD 1B FAILS WITH TRANSFER, UNIT BOARD 1A FAILED
UB41BF	1.0000E+00	G.F.

Top Event: UB42A
Description: No Description

UB42A1	2.3330E-04	UNIT BOARD 2A FAILS WITH NO TRANSFER
UB42A2	2.2390E-04	UNIT BOARD 2A FAILS WITH TRANSFER, UNIT BOARD 1A & 1B GUARANTEED FAILED
UB42A3	2.2400E-04	UNIT BOARD 2A FAILS WITH TRANSFER, UNIT BOARD 1A & 1B SUCCESS
UB42A4	3.5360E-05	UNIT BOARD 2A FAILS WITH TRANSFER, UNIT BOARD 1A OR 1B FAILED
UB42A5	1.9060E-05	UNIT BOARD 2A FAILS WITH TRANSFER, UNIT BOARD 1A & 1B FAILED

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U842AF	1.0000E+00	G.F.

Top Event: U842B
Description: No Description

U842B1	2.3330E-04	UNIT BOARD 2B FAILS WITH NO TRANSFER
U842B2	2.2400E-04	UNIT BOARD 2B FAILS WITH TRANSFER, UNIT BOARD 1A & 1B GUARANTEED FAILED
U842B3	3.5360E-05	UNIT BOARD 2B FAILS WITH TRANSFER, UNIT BOARD 2A FAILED, UNIT BOARD 1A & 1B GUARANTEED FAILED
U842B4	2.2410E-04	UNIT BOARD 2B FAILS WITH TRANSFER, UNIT BOARD 1A, 1B & 2A SUCCESS
U842B5	3.5370E-05	UNIT BOARD 2B FAILS WITH TRANSFER, UNIT BOARD 1A, 1B OR 2A FAILED
U842B6	1.9060E-05	UNIT BOARD 2B FAILS WITH TRANSFER, 2 OF UNIT BOARDS 1A, 1B AND 2A FAILED
U842B7	5.9330E-05	UNIT BOARD 2B FAILS WITH TRANSFER, UNIT BOARD 1A,1B & 2A FAILED
U842BF	1.0000E+00	G.F.

Top Event: U842C
Description: No Description

U842C1	1.2844E-04	ALL SUPPORTS AVAIL.
U842C2	1.5245E-04	OG16 UNAVAIL.
U842CF	1.0000E+00	G.F.

Top Event: U843A
Description: No Description

U843A1	2.2316E-04	ALL SUPPORTS AVAIL.
U843AF	1.0000E+00	G.F.

Top Event: U843B
Description: No Description

U843B1	2.3311E-04	ALL SUPPORTS AVAIL.
U843BF	1.0000E+00	G.F.

Top Event: V1
Description: No Description

V1S	0.0000E+00	GUARANTEED SUCCESS

Top Event: V2
Description: No Description

V2S	0.0000E+00	GUARANTEED SUCCESS

Top Event: V3
Description: No Description

V3S	0.0000E+00	GUARANTEED SUCCESS

Top Event: VNT
Description: No Description

VNTF	1.0000E+00	G.F.

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Top Event: VT1
Description: No Description

VT1F	1.0000E+00	REACTOR VESSEL LOOP I INSTRUMENT TAPS FAILURE HAS NOT OCCURRED
VT1S	0.0000E+00	REACTOR VESSEL LOOP I INSTRUMENT TAPS FAILURE OCCURRED

Top Event: VT2
Description: No Description

VT2F	1.0000E+00	REACTOR VESSEL LOOP II INSTRUMENT TAPS FAILURE HAS NOT OCCURRED
VT2S	0.0000E+00	REACTOR VESSEL LOOP II INSTRUMENT TAPS FAILURE OCCURRED

Top Event: WET
Description: No Description

WETF	1.0000E+00	NO WATER ON DRYWELL FLOOR AT VESSEL MELT-THROUGH
WETS	0.0000E+00	WATER ON DRYWELL FLOOR AT VESSEL MELT-THROUGH

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MODEL Name: BFNFINAL   Top-Ranking Sequences Contributing to Group : ALL Frequency   15:43:48 13 AUG 1992

Rank No.	Sequence Description (Events)	Guaranteed Events/Comments (Events)	End State	Frequency (per year)	Percent
1	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	6.53E-06	13.65
2	TURBINE BUILDING FLOOD - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAV	1.38E-06	2.88
3	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING	PIHV	1.28E-06	2.67

		- RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE			
4	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	1.18E-06	2.47
5	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - REACTOR BUILDING ISOLATION FAILURE	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHZ	8.76E-07	1.83
6	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE	PIHV	6.67E-07	1.40

		- DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
7	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - HPCI UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	6.07E-07	1.27
8	CLOSURE OF ALL MSIVS - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL - CS LOW PRESSURE INJECTION UNAVAILABLE	PIDV	5.43E-07	1.14

		- RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
9	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	4.51E-07	.94
10	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	4.33E-07	.91
11	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL B UNAVAILABLE - DG C UNAVAILABLE	- DG B UNAVAILABLE - DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE	PIHX	4.10E-07	.86

- DG D UNAVAILABLE
- FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS
- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-
  STATE - PLANT DEPRESSURIZED

- DG 3D UNAVAILABLE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- OPERATOR FAILS TO RECOVER EECW (START SWING PUMP)
- MSIVS FAIL TO REMAIN OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- RCIC UNAVAILABLE LONG TERM
- HPCI UNAVAILABLE LONG TERM
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY
- RHR PUMP A UNAVAILABLE
- RHR PUMP C UNAVAILABLE
- RHR PUMP B UNAVAILABLE
- RHR PUMP D UNAVAILABLE
- U2 TO U1 RHR CROSS CONNECT UNAVAILABLE
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- RHR LOW PRESSURE INJECTION PATH UNAVAILABLE
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- DRYWELL SPRAY UNAVAILABLE
- STANDBY GAS TREATMENT SYSTEM UNAVAILABLE
- SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE

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12 TOTAL LOSS OF OFFSITE POWER — PIHX — 4.10E-07 — .86

- FUEL OIL SYSTEM FOR DIESEL A UNAVAILABLE
- DG B UNAVAILABLE
- DG C UNAVAILABLE
- DG D UNAVAILABLE
- FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS
- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-
  STATE - PLANT DEPRESSURIZED

- DG A UNAVAILABLE
- DG 3A UNAVAILABILITY
- DG 3B UNAVAILABLE
- DG 3C UNAVAILABLE
- DG 3D UNAVAILABLE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- OPERATOR FAILS TO RECOVER EECW (START SWING PUMP)
- MSIVS FAIL TO REMAIN OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- RCIC UNAVAILABLE LONG TERM
- HPCI UNAVAILABLE LONG TERM
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY
- RHR PUMP A UNAVAILABLE
- RHR PUMP C UNAVAILABLE
- RHR PUMP B UNAVAILABLE
- RHR PUMP D UNAVAILABLE
- U2 TO U1 RHR CROSS CONNECT UNAVAILABLE
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- RHR LOW PRESSURE INJECTION PATH UNAVAILABLE
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- DRYWELL SPRAY UNAVAILABLE
- STANDBY GAS TREATMENT SYSTEM UNAVAILABLE
- SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE

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13 TOTAL LOSS OF FEEDWATER — PIDV — 3.85E-07 — .81

- 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE
- 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA-
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 1 RELIEF VALVE STUCK OPEN

- 250 RMOV BD 2A UNAVAILABLE
- 250 V RMOV BD 2B UNAVAILABLE
- POWER SUPPLY DIVISION I UNAVAILABLE
- POWER SUPPLY DIVISION II UNAVAILABLE
- DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE
- DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE

		- DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
14	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3C UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE	PIHX	3.22E-07	.67
15	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3D UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	3.00E-07	.63
16	LOSS OF CONDENSER VACUUM - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE	PIDV	2.98E-07	.62

		- DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MAIN CONDENSER UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO DEPRESSURIZE USING TBV'S - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
17	TURBINE TRIP WITHOUT BYPASS - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - TBVS FAIL TO RELIEVE\MAINTAIN RX PRESSURE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO DEPRESSURIZE USING TBV'S - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	2.94E-07	.61
18	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3A UNAVAILABILITY - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	2.91E-07	.61
19	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3D UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE	PIHX	2.89E-07	.60

- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-
  STATE - PLANT DEPRESSURIZED
- RHR PUMP B UNAVAILABLE
- RHR PUMP C UNAVAILABLE
- RHR PUMP D UNAVAILABLE
- U2 TO U1 RHR CROSS CONNECT UNAVAILABLE
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- RHR LOW PRESSURE INJECTION PATH UNAVAILABLE
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- DRYWELL SPRAY UNAVAILABLE
- STANDBY GAS TREATMENT SYSTEM UNAVAILABLE
- SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE

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20 TOTAL LOSS OF OFFSITE POWER — PIHV 2.70E-07 .56
- DG A UNAVAILABLE
- DG B UNAVAILABLE
- DG C UNAVAILABLE
- FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES
- DG 3B UNAVAILABLE
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS
- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-
  STATE - PLANT DEPRESSURIZED
- RHR PUMP D UNAVAILABLE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- DRYWELL CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- RCIC UNAVAILABLE LONG TERM
- HPCI UNAVAILABLE LONG TERM
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- RHR PUMP A UNAVAILABLE
- RHR PUMP C UNAVAILABLE
- RHR PUMP B UNAVAILABLE
- U2 TO U1 RHR CROSS CONNECT UNAVAILABLE
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- RHR LOW PRESSURE INJECTION PATH UNAVAILABLE
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- DRYWELL SPRAY UNAVAILABLE

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21 TOTAL LOSS OF OFFSITE POWER — PIHX 2.69E-07 .56
- DG A UNAVAILABLE
- DG B UNAVAILABLE
- DG D UNAVAILABLE
- FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES
- DG 3C UNAVAILABLE
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS
- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-
  STATE - PLANT DEPRESSURIZED
- RHR PUMP B UNAVAILABLE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- RCIC UNAVAILABLE LONG TERM
- HPCI UNAVAILABLE LONG TERM
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- RHR PUMP A UNAVAILABLE
- RHR PUMP C UNAVAILABLE
- RHR PUMP D UNAVAILABLE
- U2 TO U1 RHR CROSS CONNECT UNAVAILABLE
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- RHR LOW PRESSURE INJECTION PATH UNAVAILABLE
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- DRYWELL SPRAY UNAVAILABLE
- STANDBY GAS TREATMENT SYSTEM UNAVAILABLE
- SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE

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22 TOTAL LOSS OF OFFSITE POWER — PIHX 2.69E-07 .56
- DG A UNAVAILABLE
- DG B UNAVAILABLE
- DG D UNAVAILABLE
- FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES
- DG 3A UNAVAILABILITY
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- RCIC UNAVAILABLE LONG TERM
- HPCI UNAVAILABLE LONG TERM
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- RHR PUMP A UNAVAILABLE

	- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
23	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3B UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	2.68E-07	.56
24	INADVERTENT OPENING OF THREE OR MORE SRVS - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 3 OR MORE VALVES STUCK OPEN	OIAV	2.44E-07	.51
25	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG C UNAVAILABLE - DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHX	2.42E-07	.51

		- STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
26	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL D UNAVAILABE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG D UNAVAILABLE - DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	2.42E-07	.51
27	LOSS OF ALL CONDENSATE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MAIN CONDENSER UNAVAILABLE - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK	MIAV	2.30E-07	.48
28	TOTAL LOSS OF OFFSITE POWER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAV	2.18E-07	.46
29	TOTAL LOSS OF OFFSITE POWER - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - FAILURE TO RECOVER TORUS COOLING	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE	NIHV	2.12E-07	.44

		- U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - TORUS COOLING HARDWARE UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE			
30	TOTAL LOSS OF OFFSITE POWER - FUEL OIL SYSTEM FOR DIESEL A UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL B UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL C UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL D UNAVAILABE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED	- DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL 3A UNAVAILABLE - DG 3A UNAVAILABILITY - FUEL OIL SYSTEM FOR DIESEL 3B UNAVAILABLE - DG 3B UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL 3C UNAVAILABLE - DG 3C UNAVAILABLE - FUEL OIL FOR DIESEL 3D UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	2.07E-07	.43
31	TURBINE TRIP - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 3 OR MORE VALVES STUCK OPEN - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE	OIAV	1.98E-07	.41
32	INADVERTENT (OTHER) SCRAM - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 3 OR MORE VALVES STUCK OPEN - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE	OIAV	1.93E-07	.40
33	TURBINE BUILDING FLOOD - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK - REACTOR BUILDING ISOLATION FAILURE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	MIAZ	1.85E-07	.39

		- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE			
34	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE - REACTOR BUILDING ISOLATION FAILURE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT' - DRYWELL SPRAY UNAVAILABLE	PIHZ	1.71E-07	.36
35	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DG B UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	1.68E-07	.35
36	TOTAL LOSS OF OFFSITE POWER - FUEL OIL SYSTEM FOR DIESEL A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DG A UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING	PIHV	1.68E-07	.35

		- RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE			
37	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE - REACTOR BUILDING ISOLATION FAILURE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHZ	1.59E-07	.33
38	TOTAL LOSS OF OFFSITE POWER - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	NIHV	1.39E-07	.29
39	TURBINE BUILDING FLOOD - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	NIHV	1.34E-07	.28
40	FEEDWATER RAMPUP - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE	PIDV	1.22E-07	.25

		- DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
41	TOTAL LOSS OF OFFSITE POWER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	OIAV	1.20E-07	.25
42	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - HPCI UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	1.19E-07	.25
43	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 2 RELIEF VALVES STUCK OPEN	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	1.16E-07	.24
44	LOSS OF ALL CONDENSATE	- 250 RMOV BD 2A UNAVAILABLE	PIHV	1.11E-07	.23

	- 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - VESSEL INJECTION WITH CRDHS UNAVAILABLE	- 250 V RMOV BD 2B UNAVAILABLE POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MAIN CONDENSER UNAVAILABLE - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
45	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - POWER SUPPLY DIVISION II UNAVAILABLE - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 V RMOV BD 2B UNAVAILABLE POWER SUPPLY DIVISION I UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIHV	1.11E-07	.23
46	TOTAL LOSS OF OFFSITE POWER - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIHV	1.11E-07	.23

47	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - HPCI UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	1.10E-07	.23
48	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - FUEL OIL SYSTEM FOR DIESEL 3B UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	1.05E-07	.22
49	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - FUEL OIL SYSTEM FOR DIESEL 3C UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM	PIHX	1.05E-07	.22

	STATE - PLANT DEPRESSURIZED	- CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
50	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - FUEL OIL FOR DIESEL 3D UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	1.05E-07	.22
51	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - FUEL OIL SYSTEM FOR DIESEL 3A UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE	PIHX	1.05E-07	.22

No.	Sequence	Sequence (cont.)	Class	Frequency	Percent
		- RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
52	MEDIUM LOCA - HIGH PRESSURE COOLANT INJECTION SYSTEM UNAVAILABLE - FAILURE TO DEPRESSURIZE VIA THE SRVS		OIAV	1.03E-07	.22
53	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DG C UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	9.94E-08	.21
54	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DIV II HI RX PRESS SIGNAL UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	PIHX	9.69E-08	.20

		- DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
55	LOSS OF RAW COOLING WATER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAV	9.53E-08	.20
56	TURBINE BUILDING FLOOD - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	OIAV	9.49E-08	.20
57	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - RHRSW PUMP B1 (SWING PUMP) UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	9.40E-08	.20
58	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	9.33E-08	.20

59	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL D UNAVAILABE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DG D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	9.21E-08	.19
60	INADVERTENT (OTHER) SCRAM - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - TURBINE TRIP FAILURE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO DEPRESSURIZE USING TBV'S - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	9.18E-08	.19
61	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - REACTOR BUILDING ISOLATION FAILURE	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	PIHZ	8.96E-08	.19

No.	Events	Events (cont.)	Code	Frequency	%
		- CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
62	TURBINE BUILDING FLOOD - HPCI/RCIC CONTROL HARDWARE UNAVAILABLE - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAV	8.88E-08	.19
63	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	8.81E-08	.18
64	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - RHRSW PUMP D1 (SWING PUMP) UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	8.75E-08	.18
65	CLOSURE OF ALL MSIVS - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - POWER SUPPLY DIVISION II UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-	- 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE	PIDV	8.60E-08	.18

	STATE - PLANT DEPRESSURIZED	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
66	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	8.47E-08	.18
67	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3EA AND 480 SD BD 3EA UNAVAILAB - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- 250 V RMOV 1A UNAVAILABLE - 250 V RMOV 2C UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAV	8.16E-08	.17
68	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	8.16E-08	.17

69	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - HPCI UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - REACTOR BUILDING ISOLATION FAILURE	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHZ	8.14E-08	.17
70	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- 250 V RMOV BD 2B UNAVAILABLE POWER SUPPLY DIVISION I UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE DIV I HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAV	8.07E-08	.17
71	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - FUEL OIL SYSTEM FOR DIESEL B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DG B UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE	PIHX	8.02E-08	.17

		- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
72	TOTAL LOSS OF OFFSITE POWER - FUEL OIL SYSTEM FOR DIESEL A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP B UNAVAILABLE	- DG A UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	8.02E-08	.17
73	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	7.85E-08	.16
74	TURBINE TRIP - AUTOMATIC/MANUAL REACTOR SCRAM FAILURE - STANDBY LIQUID CONTROL SYSTEM UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	- DRYWELL PRESSURE SIGNAL UNAVAILABLE	MIAV	7.68E-08	.16
75	CLOSURE OF ALL MSIVS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL	OIAV	7.37E-08	.15

76	CLOSURE OF ALL MSIVS - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - REACTOR BUILDING ISOLATION FAILURE	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDZ	7.29E-08	.15
77	CLOSURE OF ALL MSIVS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 3 OR MORE VALVES STUCK OPEN - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN	OIAV	7.29E-08	.15
78	LOSS OF PLANT AIR - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	7.23E-08	.15
79	TOTAL LOSS OF OFFSITE POWER - 4KV SD BD A AND 480V SD BD 1A POWER UNAVAILABLE - 4KV SD BD B AND 480V SD BD 2A UNAVAILABLE - 4KV SD BD C AND 480V SD BD 1B UNAVAILABLE - 4KV SD BD D AND 480V SD BD 2B UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE	NIHX	6.91E-08	.14

		- OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
80	LOSS OF 500KV GRID - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MAIN CONDENSER UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO DEPRESSURIZE USING TBV'S - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	6.83E-08	.14
81	LOSS OF 500KV GRID - OPERATOR FAILS TO RESTORE POWER TO UNIT BOARDS - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - TURBINE TRIP FAILURE - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	NIHX	6.76E-08	.14
82	TURBINE TRIP - AUTOMATIC/MANUAL REACTOR SCRAM FAILURE - OPERATOR FAILS TO START SLC	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, STATE - PLANT DEPRESSURIZED	MKCV	6.74E-08	.14
83	TURBINE TRIP - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - AUTOMATIC/MANUAL REACTOR SCRAM FAILURE	- 250 V RMOV BD 2B UNAVAILABLE POWER SUPPLY DIVISION I UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE	MIAV	6.63E-08	.14

	- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	- DIV I HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - STANDBY LIQUID CONTROL SYSTEM UNAVAILABLE			
84	TOTAL LOSS OF OFFSITE POWER - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - FAILURE TO RECOVER 480V RMOV BDS 2A OR 2B - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	NIHV	6.42E-08	.13
85	TOTAL LOSS OF OFFSITE POWER - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE	OIAV	6.40E-08	.13
86	TOTAL LOSS OF OFFSITE POWER - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - RHR PUMP A UNAVAILABLE - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	NIHV	6.40E-08	.13
87	TOTAL LOSS OF FEEDWATER - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA- - POWER SUPPLY DIVISION II UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)	- 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE	PIDV	6.37E-08	.13

	STATE - 1 RELIEF VALVE STUCK OPEN	- DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE			
88	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO INITIATE DW SPRAY	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	6.34E-08	.13
89	TOTAL LOSS OF FEEDWATER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 3 OR MORE VALVES STUCK OPEN - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE	OIAV	6.19E-08	.13
90	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - REACTOR BUILDING ISOLATION FAILURE	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE	PIHZ	6.05E-08	.13

		- RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
91	CLOSURE OF ALL MSIVS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 2 RELIEF VALVES STUCK OPEN - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL	OIAV	6.02E-08	.13
92	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- 250 RMOV BD 2A UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE (6 HOURS) - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MIAV	5.98E-08	.13
93	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	PIHV	5.91E-08	.12
94	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN	- DG 3A UNAVAILABILITY - DG 3B UNAVAILABLE - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN	PIHZ	5.82E-08	.12

	- FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - REACTOR BUILDING ISOLATION FAILURE	- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE			
95	TOTAL LOSS OF OFFSITE POWER - 4KV SD BD A AND 480V SD BD 1A POWER UNAVAILABLE - 4KV SD BD B AND 480V SD BD 2A UNAVAILABLE - 4KV SD BD C AND 480V SD BD 1B UNAVAILABLE - 4KV SD BD D AND 480V SD BD 2B UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - OPERATOR FAILS TO RECOVER EECW (START SWING PUMP) - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	NIHX	5.78E-08	.12
96	TOTAL LOSS OF FEEDWATER - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - 250 V DC CONTROL POWER FOR 4KV SD BD 3EC AND 480V SD BD 3EB UNAVAILA - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - OPERATOR FAILS TO DEPRESSURIZE USING TBV'S - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED	- 250 RMOV BD 2A UNAVAILABLE - 250 V RMOV BD 2B UNAVAILABLE - POWER SUPPLY DIVISION I UNAVAILABLE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV I VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV I HI RX PRESS SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CS LOW PRESSURE INJECTION UNAVAILABLE - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - DRYWELL SPRAY UNAVAILABLE	PIDV	5.77E-08	.12
97	CLOSURE OF ALL MSIVS - AUTOMATIC/MANUAL REACTOR SCRAM FAILURE - OPERATOR FAILS TO START SLC	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, STATE - PLANT DEPRESSURIZED - CONDENSER UNAVAILABLE AS HEAT SINK	MKCV	5.67E-08	.12

98	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3C UNAVAILABLE - DG 3D UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE - SBGT SYSTEM RELATIVE HUMIDITY HEATERS UNAVAILABLE	PIHX	5.58E-08	.12
99	TOTAL LOSS OF OFFSITE POWER - DG B UNAVAILABLE - DG D UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - RHR PUMP A UNAVAILABLE - RHR PUMP B UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP D UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE	NIHV	5.57E-08	.12
100	TOTAL LOSS OF OFFSITE POWER - DG A UNAVAILABLE - DG B UNAVAILABLE - DG C UNAVAILABLE - FAILURE TO RECOVER OFFSITE POWER IN 30 MINUTES - DG 3A UNAVAILABILITY - DG 3C UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - FAILURE TO RECOVER ELECTRIC POWER IN 6 HOURS - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - RHR PUMP D UNAVAILABLE	- DRYWELL PRESSURE SIGNAL UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - RCIC UNAVAILABLE LONG TERM - HPCI UNAVAILABLE LONG TERM - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - RHR PUMP A UNAVAILABLE - RHR PUMP C UNAVAILABLE - RHR PUMP B UNAVAILABLE - U2 TO U1 RHR CROSS CONNECT UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - RHR LOW PRESSURE INJECTION PATH UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - DRYWELL SPRAY UNAVAILABLE - STANDBY GAS TREATMENT SYSTEM UNAVAILABLE	PIHX	5.57E-08	.12

MODEL Name: BFNFINAL
End State Totals for Sequences For Group: ALL Sorted By Frequency
Total Frequency of Sequences = 4.7813E-05

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Bin Name: PIHX	Total: 1.9062E-05
Bin Name: PIHV	Total: 6.6080E-06
Bin Name: OIAV	Total: 4.1794E-06
Bin Name: MIAV	Total: 4.1444E-06
Bin Name: PIDV	Total: 3.8060E-06
Bin Name: PIHZ	Total: 3.0128E-06
Bin Name: NIHV	Total: 2.4121E-06
Bin Name: NIHX	Total: 1.0385E-06
Bin Name: MIAZ	Total: 4.6490E-07
Bin Name: PIDZ	Total: 4.1182E-07
Bin Name: OIAZ	Total: 3.7688E-07
Bin Name: MKCV	Total: 3.3564E-07
Bin Name: NIHZ	Total: 3.0663E-07
Bin Name: MICV	Total: 2.5042E-07
Bin Name: NLFV	Total: 2.3861E-07
Bin Name: OIAX	Total: 1.5620E-07
Bin Name: OLFV	Total: 1.4453E-07
Bin Name: PLFV	Total: 1.2726E-07
Bin Name: OJAV	Total: 1.1655E-07
Bin Name: PLFX	Total: 1.1359E-07
Bin Name: MLCV	Total: 8.7853E-08
Bin Name: OLCV	Total: 8.1799E-08
Bin Name: NJAZ	Total: 4.6335E-08
Bin Name: MKCZ	Total: 3.5352E-08
Bin Name: OIDV	Total: 2.8120E-08
Bin Name: NIDV	Total: 2.5133E-08
Bin Name: MICZ	Total: 2.0599E-08
Bin Name: PIFV	Total: 1.9289E-08
Bin Name: PJHV	Total: 1.6794E-08
Bin Name: NLFZ	Total: 1.4854E-08
Bin Name: OLFZ	Total: 1.4744E-08
Bin Name: NLFX	Total: 1.3674E-08
Bin Name: OJAZ	Total: 1.2783E-08

MODEL Name: BFNFINAL
End State Totals for Sequences For Group: ALL Sorted By Frequency
Total Frequency of Sequences = 4.7813E-05

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Bin Name: MIAX	Total: 1.2327E-08
Bin Name: PLFZ	Total: 1.0903E-08
Bin Name: OKCV	Total: 1.0450E-08
Bin Name: OIFV	Total: 9.9060E-09
Bin Name: MLCZ	Total: 8.8080E-09
Bin Name: PKHX	Total: 8.1372E-09
Bin Name: OLCZ	Total: 7.9565E-09
Bin Name: NIFV	Total: 5.0123E-09
Bin Name: OICV	Total: 4.3350E-09
Bin Name: NKFV	Total: 3.4998E-09
Bin Name: NIDZ	Total: 2.0984E-09
Bin Name: PJHZ	Total: 2.0701E-09
Bin Name: OIDZ	Total: 1.0258E-09
Bin Name: PJAV	Total: 1.0159E-09
Bin Name: OIFX	Total: 7.0433E-10
Bin Name: OIFZ	Total: 6.2852E-10
Bin Name: OKCZ	Total: 4.1795E-10
Bin Name: PIFZ	Total: 3.9835E-10
Bin Name: OICZ	Total: 1.8343E-10
Bin Name: PIDX	Total: 1.0619E-10

MODEL Name: BFNFINAL

Top Event Importance for Group : ALL

Sorted by Probabilistic Importance

Group Frequency = 4.7813E-05

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......	Top...............	Probabilistic..	Guar. Event....	Total..........	Frequency......
1.	RVC(SORV0)	6.7575E-01	9.6923E-02	7.7267E-01	3.6944E-05
2.	RVD(DEP)	6.6217E-01	7.7762E-03	6.6994E-01	3.2032E-05
3.	EPR30	6.4287E-01	0.0000E+00	6.4287E-01	3.0738E-05
4.	EPR6	6.2469E-01	0.0000E+00	6.2469E-01	2.9868E-05
5.	GB	5.5746E-01	4.4322E-02	6.0178E-01	2.8773E-05
6.	GA	5.2492E-01	4.2537E-02	5.6746E-01	2.7132E-05
7.	GC	4.7324E-01	2.7664E-02	5.0090E-01	2.3950E-05
8.	GD	4.2449E-01	2.6021E-02	4.5051E-01	2.1540E-05
9.	RPD	2.0587E-01	4.4970E-01	6.5556E-01	3.1345E-05
10.	HPI	1.5545E-01	1.3412E-01	2.8957E-01	1.3845E-05
11.	RPB	1.4705E-01	5.0595E-01	6.5300E-01	3.1222E-05
12.	DG	1.3999E-01	0.0000E+00	1.3999E-01	6.6935E-06
13.	RVC(SORV1)	1.3804E-01	4.1375E-03	1.4218E-01	6.7982E-06
14.	RCI	1.2926E-01	1.3908E-01	2.6834E-01	1.2830E-05
15.	DH	1.1585E-01	8.7092E-05	1.1593E-01	5.5432E-06
16.	RBI	9.7268E-02	6.4072E-03	1.0367E-01	4.9571E-06
17.	RVD(NODEP)	9.2744E-02	0.0000E+00	9.2744E-02	4.4344E-06
18.	GG	6.3817E-02	2.8226E-01	3.4607E-01	1.6547E-05
19.	GH	6.3367E-02	2.8239E-01	3.4576E-01	1.6532E-05
20.	GE	6.2402E-02	2.8211E-01	3.4451E-01	1.6472E-05
21.	OLP	6.2168E-02	6.5352E-01	7.1569E-01	3.4220E-05
22.	GF	6.1527E-02	2.8201E-01	3.4354E-01	1.6426E-05

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......	Top...............	Probabilistic..	Guar. Event....	Total..........	Frequency......
23.	RPA	4.5920E-02	5.8218E-01	6.2810E-01	3.0032E-05
24.	FB	4.4322E-02	0.0000E+00	4.4322E-02	2.1192E-06
25.	RPC	4.4277E-02	5.8113E-01	6.2540E-01	2.9903E-05
26.	FA	4.2450E-02	8.7092E-05	4.2537E-02	2.0338E-06
27.	FC	2.7577E-02	0.0000E+00	2.7577E-02	1.3186E-06
28.	RPS	2.6730E-02	0.0000E+00	2.6730E-02	1.2780E-06
29.	FD	2.5934E-02	0.0000E+00	2.5934E-02	1.2400E-06
30.	SPR	2.4216E-02	3.3530E-04	2.4551E-02	1.1739E-06
31.	RVC(SORV2)	2.1859E-02	0.0000E+00	2.1859E-02	1.0451E-06
32.	CRD	1.9016E-02	8.1230E-01	8.3132E-01	3.9748E-05
33.	RVC(SORV3)	1.7781E-02	9.4195E-03	2.7201E-02	1.3006E-06
34.	PX2	1.5918E-02	1.1788E-01	1.3379E-01	6.3971E-06
35.	U1	1.5905E-02	6.3990E-01	6.5581E-01	3.1357E-05
36.	FF	1.2549E-02	6.3861E-03	1.8935E-02	9.0533E-07
37.	SW2D	1.2107E-02	4.5783E-01	4.6994E-01	2.2470E-05
38.	SW2B	1.1377E-02	5.0996E-01	5.2133E-01	2.4927E-05
39.	AB	1.0573E-02	6.0148E-01	6.1205E-01	2.9264E-05
40.	AD	9.8749E-03	4.4767E-01	4.5754E-01	2.1877E-05
41.	AA	9.4178E-03	5.6478E-01	5.7420E-01	2.7455E-05
42.	TB	8.9954E-03	6.9667E-03	1.5962E-02	7.6320E-07
43.	AC	8.8172E-03	5.0081E-01	5.0963E-01	2.4367E-05
44.	SW1B	8.7009E-03	4.9201E-01	5.0071E-01	2.3940E-05

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45.	CS	8.3393E-03	1.3907E-01	1.4741E-01	7.0481E-06
46.	SW2A	8.0488E-03	5.7519E-01	5.8324E-01	2.7887E-05
47.	OSL	7.7762E-03	3.3569E-04	8.1118E-03	3.8786E-07
48.	SW2C	7.6352E-03	6.1295E-01	6.2058E-01	2.9672E-05
49.	CIL	7.4854E-03	1.3605E-04	7.6214E-03	3.6441E-07
50.	ORP	7.1886E-03	2.7814E-01	2.8533E-01	1.3643E-05
51.	SW1D	7.0982E-03	4.6825E-01	4.7535E-01	2.2728E-05
52.	FG	7.0781E-03	1.2182E-02	1.9260E-02	9.2089E-07
53.	FH	7.0430E-03	6.3861E-03	1.3429E-02	6.4209E-07
54.	FE	6.9346E-03	6.4732E-03	1.3408E-02	6.4107E-07
55.	NH2	6.8205E-03	1.3379E-01	1.4061E-01	6.7232E-06
56.	FWC(SORV3)	6.5989E-03	0.0000E+00	6.5989E-03	3.1552E-07
57.	FWC(SORV1)	6.5487E-03	0.0000E+00	6.5487E-03	3.1312E-07
58.	R480	6.5229E-03	0.0000E+00	6.5229E-03	3.1188E-07
59.	OUB	6.3537E-03	0.0000E+00	6.3537E-03	3.0379E-07
60.	DE	6.0022E-03	0.0000E+00	6.0022E-03	2.8698E-07
61.	HR6(DEP)	5.9171E-03	0.0000E+00	5.9171E-03	2.8292E-07
62.	SL	5.8769E-03	5.0433E-03	1.0920E-02	5.2213E-07
63.	RF	5.5444E-03	5.0963E-01	5.1518E-01	2.4632E-05
64.	MCD	4.8088E-03	3.8873E-02	4.3682E-02	2.0886E-06
65.	ODWS	4.8059E-03	8.7092E-05	4.8930E-03	2.3395E-07
66.	HRC	4.7955E-03	0.0000E+00	4.7955E-03	2.2929E-07

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67.	RCW	4.7459E-03	7.4509E-01	7.4983E-01	3.5852E-05
68.	HXA	4.4636E-03	1.3216E-03	5.7852E-03	2.7661E-07
69.	SP	4.2324E-03	2.1564E-02	2.5796E-02	1.2334E-06
70.	OSP	3.9850E-03	6.3085E-01	6.3483E-01	3.0353E-05
71.	HXB	3.8998E-03	4.5627E-03	8.4625E-03	4.0462E-07
72.	HXC	3.8260E-03	9.5485E-04	4.7808E-03	2.2859E-07
73.	CD	3.6623E-03	8.1979E-01	8.2345E-01	3.9372E-05
74.	RVD	3.1695E-03	0.0000E+00	3.1695E-03	1.5154E-07
75.	SDC	3.1460E-03	6.2009E-04	3.7661E-03	1.8007E-07
76.	DL	3.0892E-03	4.5767E-01	4.6076E-01	2.2031E-05
77.	RVO	3.0651E-03	8.7092E-05	3.1522E-03	1.5072E-07
78.	OBD	2.9175E-03	4.1251E-02	4.4168E-02	2.1118E-06
79.	SGT	2.6472E-03	4.7384E-01	4.7649E-01	2.2782E-05
80.	HPL	2.6424E-03	5.1951E-01	5.2215E-01	2.4966E-05
81.	RK	2.6154E-03	4.4216E-01	4.4478E-01	2.1266E-05
82.	RCL	2.4599E-03	4.9402E-01	4.9648E-01	2.3738E-05
83.	RC	2.3641E-03	1.4008E-01	1.4244E-01	6.8107E-06
84.	HXD	2.3052E-03	1.5311E-03	3.8363E-03	1.8343E-07
85.	PX1	2.2317E-03	1.4244E-01	1.4468E-01	6.9174E-06
86.	NPII	2.1821E-03	1.3937E-01	1.4155E-01	6.7679E-06
87.	RBC	2.0806E-03	4.6500E-01	4.6709E-01	2.2333E-05
88.	ED	2.0696E-03	4.5805E-01	4.6012E-01	2.2000E-05

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89.	DK	2.0447E-03	6.1229E-01	6.1433E-01	2.9373E-05
90.	RB	2.0287E-03	1.1585E-01	1.1788E-01	5.6360E-06
91.	NPI	1.9222E-03	1.4459E-01	1.4651E-01	7.0052E-06
92.	RVC	1.8829E-03	0.0000E+00	1.8829E-03	9.0027E-08
93.	IVC	1.8460E-03	5.5072E-04	2.3968E-03	1.1460E-07
94.	TOR	1.7054E-03	4.8162E-04	2.1871E-03	1.0457E-07
95.	ORF	1.5262E-03	1.0959E-04	1.6358E-03	7.8214E-08
96.	BVR	1.5095E-03	1.7411E-02	1.8920E-02	9.0464E-07
97.	PCA	1.2409E-03	7.2899E-01	7.3023E-01	3.4915E-05
98.	DA	1.2360E-03	0.0000E+00	1.2360E-03	5.9096E-08
99.	INB	1.1347E-03	7.9733E-01	7.9847E-01	3.8178E-05
100.	DC	1.1237E-03	8.7092E-05	1.2107E-03	5.7890E-08
101.	OAD	1.1236E-03	0.0000E+00	1.1236E-03	5.3724E-08
102.	LM3	1.0337E-03	5.9604E-03	6.9941E-03	3.3441E-07
103.	LM2	1.0337E-03	5.9660E-03	6.9996E-03	3.3468E-07
104.	NH1	9.5766E-04	1.4459E-01	1.4555E-01	6.9593E-06
105.	DF	9.4469E-04	8.7092E-05	1.0318E-03	4.9333E-08
106.	LT4	8.9911E-04	5.8791E-03	6.7782E-03	3.2409E-07
107.	LM4	8.5837E-04	5.9604E-03	6.8187E-03	3.2603E-07
108.	LM1	8.5830E-04	1.2415E-04	9.8245E-04	4.6974E-08
109.	LT3	8.1771E-04	0.0000E+00	8.1771E-04	3.9098E-08
110.	LT2	8.1225E-04	5.5980E-06	8.1785E-04	3.9104E-08

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111.	LT1	8.1212E-04	9.2690E-05	9.0481E-04	4.3262E-08
112.	DCA	7.7103E-04	2.6975E-01	2.7052E-01	1.2935E-05
113.	OSV	7.0869E-04	4.4383E-03	5.1469E-03	2.4609E-07
114.	FWC(SORV0)	5.8628E-04	0.0000E+00	5.8628E-04	2.8032E-08
115.	EC	5.8577E-04	3.6749E-01	3.6807E-01	1.7599E-05
116.	OHL	5.8526E-04	0.0000E+00	5.8526E-04	2.7983E-08
117.	OEE	5.7051E-04	2.9098E-01	2.9155E-01	1.3940E-05
118.	DB	5.4464E-04	5.5444E-03	6.0890E-03	2.9114E-07
119.	DJ	5.1673E-04	7.9377E-04	1.3105E-03	6.2660E-08
120.	FWC(SORV2)	5.0727E-04	0.0000E+00	5.0727E-04	2.4254E-08
121.	DD	4.8350E-04	8.7092E-05	5.7059E-04	2.7282E-08
122.	U3	4.7669E-04	6.3029E-01	6.3077E-01	3.0159E-05
123.	SW1C	3.5886E-04	6.1295E-01	6.1331E-01	2.9324E-05
124.	HR6(NODEP)	3.1032E-04	0.0000E+00	3.1032E-04	1.4837E-08
125.	EB	2.9947E-04	5.0971E-01	5.1001E-01	2.4385E-05
126.	EA	2.9596E-04	3.5469E-01	3.5499E-01	1.6973E-05
127.	OG5	2.5698E-04	7.0437E-01	7.0463E-01	3.3691E-05
128.	RH	2.3678E-04	6.1205E-01	6.1229E-01	2.9276E-05
129.	OHS	2.3468E-04	5.7537E-03	5.9884E-03	2.8633E-07
130.	FWH	2.3362E-04	1.0239E-01	1.0262E-01	4.9069E-06
131.	OHC	2.2779E-04	1.0793E-04	3.3573E-04	1.6052E-08
132.	OLC	2.0627E-04	1.3655E-02	1.3861E-02	6.6275E-07

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133.	ISO	1.7343E-04	1.2382E-05	1.8581E-04	8.8842E-09
134.	LPC	1.6889E-04	7.8124E-01	7.8141E-01	3.7362E-05
135.	RD	1.6579E-04	5.9151E-03	6.0809E-03	2.9075E-07
136.	NIE	1.5745E-04	8.8306E-03	8.9881E-03	4.2975E-07
137.	OSW	1.5614E-04	0.0000E+00	1.5614E-04	7.4654E-09
138.	RL	1.4323E-04	4.4216E-01	4.4230E-01	2.1148E-05
139.	NBOC	1.2566E-04	3.7427E-04	4.9992E-04	2.3903E-08
140.	A3EA	1.1158E-04	3.5449E-01	3.5460E-01	1.6955E-05
141.	OLA	1.1009E-04	0.0000E+00	1.1009E-04	5.2637E-09
142.	A3EB	1.0926E-04	3.5258E-01	3.5269E-01	1.6863E-05
143.	A3EC	1.0550E-04	3.7065E-01	3.7076E-01	1.7727E-05
144.	A3ED	1.0519E-04	3.6403E-01	3.6414E-01	1.7411E-05
145.	OF	1.0098E-04	0.0000E+00	1.0098E-04	4.8283E-09
146.	CIS	1.0054E-04	0.0000E+00	1.0054E-04	4.8072E-09
147.	DWS	9.4047E-05	7.7223E-01	7.7232E-01	3.6927E-05
148.	U842B	8.7092E-05	7.0015E-01	7.0024E-01	3.3481E-05
149.	RM	8.7092E-05	5.7412E-01	5.7420E-01	2.7455E-05
150.	OSD	8.4872E-05	9.3707E-03	9.4556E-03	4.5211E-07
151.	SW1A	7.8075E-05	5.7531E-01	5.7539E-01	2.7511E-05
152.	DI	7.3980E-05	0.0000E+00	7.3980E-05	3.5373E-09
153.	RVL	7.1810E-05	8.7092E-05	1.5890E-04	7.5976E-09
154.	AI	6.5773E-05	1.5091E-02	1.5157E-02	7.2470E-07

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155.	L8H	6.2107E-05	0.0000E+00	6.2107E-05	2.9696E-09
156.	LVP	6.0004E-05	5.9604E-03	6.0204E-03	2.8786E-07
157.	LV	5.9252E-05	3.8250E-04	4.4176E-04	2.1122E-08
158.	HR	4.8963E-05	1.1998E-04	1.6894E-04	8.0776E-09
159.	OFT	4.8790E-05	0.0000E+00	4.8790E-05	2.3328E-09
160.	RI	4.4206E-05	4.5763E-01	4.5767E-01	2.1883E-05
161.	MELT	3.9361E-05	9.8405E-01	9.8409E-01	4.7053E-05
162.	DV2	3.6391E-05	1.6751E-04	2.0390E-04	9.7491E-09
163.	RA	3.4645E-05	5.9151E-03	5.9497E-03	2.8448E-07
164.	OAL	3.4024E-05	0.0000E+00	3.4024E-05	1.6268E-09
165.	MT1	2.9124E-05	0.0000E+00	2.9124E-05	1.3925E-09
166.	DO	2.7405E-05	3.2110E-01	3.2113E-01	1.5354E-05
167.	DV1	1.0876E-05	4.1826E-05	5.2701E-05	2.5198E-09
168.	CST	1.0754E-05	9.4520E-05	1.0527E-04	5.0335E-09
169.	OG16	8.4598E-06	6.9380E-01	6.9381E-01	3.3173E-05
170.	SHUT1	7.0930E-06	7.0024E-01	7.0025E-01	3.3481E-05
171.	HUM	7.0236E-06	4.4755E-01	4.4755E-01	2.1399E-05
172.	RG	5.3755E-06	5.0963E-01	5.0964E-01	2.4368E-05
173.	MT3	4.5966E-06	0.0000E+00	4.5966E-06	2.1978E-10
174.	LC	3.9473E-06	0.0000E+00	3.9473E-06	1.8873E-10
175.	RJ	3.8307E-06	4.5754E-01	4.5755E-01	2.1877E-05
176.	OIV	3.2319E-06	2.9562E-02	2.9565E-02	1.4136E-06

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177.	UB42C	3.0477E-06	6.9936E-01	6.9936E-01	3.3439E-05
178.	SHUT2	2.2756E-06	7.0024E-01	7.0024E-01	3.3481E-05
179.	UB43A	0.0000E+00	7.0025E-01	7.0025E-01	3.3481E-05
180.	VT2(NOFLII)	0.0000E+00	9.8405E-01	9.8405E-01	4.7051E-05
181.	VT1(NOFLI)	0.0000E+00	9.8404E-01	9.8404E-01	4.7050E-05
182.	UB43B	0.0000E+00	7.0025E-01	7.0025E-01	3.3481E-05
183.	RP	0.0000E+00	3.7076E-01	3.7076E-01	1.7727E-05
184.	DW	0.0000E+00	9.6535E-01	9.6535E-01	4.6157E-05
185.	L8F	0.0000E+00	1.4483E-04	1.4483E-04	6.9250E-09
186.	UB41A	0.0000E+00	7.0015E-01	7.0015E-01	3.3477E-05
187.	FWC	0.0000E+00	1.4483E-04	1.4483E-04	6.9250E-09
188.	UB41B	0.0000E+00	7.0015E-01	7.0015E-01	3.3477E-05
189.	L8TR	0.0000E+00	8.3468E-05	8.3468E-05	3.9909E-09
190.	JC	0.0000E+00	4.3341E-04	4.3341E-04	2.0723E-08
191.	V1	0.0000E+00	8.7092E-05	8.7092E-05	4.1642E-09
192.	V2	0.0000E+00	8.7092E-05	8.7092E-05	4.1642E-09
193.	V3	0.0000E+00	8.7092E-05	8.7092E-05	4.1642E-09
194.	UB42A	0.0000E+00	7.0015E-01	7.0015E-01	3.3477E-05
195.	LF	0.0000E+00	2.5044E-04	2.5044E-04	1.1974E-08
196.	VT1	0.0000E+00	8.7092E-05	8.7092E-05	4.1642E-09
197.	OHR	0.0000E+00	9.6751E-02	9.6751E-02	4.6260E-06
198.	KC	0.0000E+00	2.4375E-02	2.4375E-02	1.1654E-06

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199.	KF	0.0000E+00	1.8465E-02	1.8465E-02	8.8288E-07
200.	JH	0.0000E+00	3.2361E-02	3.2361E-02	1.5473E-06
201.	LEC	0.0000E+00	1.4347E-02	1.4347E-02	6.8598E-07
202.	KH	0.0000E+00	1.8295E-02	1.8295E-02	8.7474E-07
203.	IVO	0.0000E+00	8.2721E-01	8.2721E-01	3.9552E-05
204.	FIWTR	0.0000E+00	9.8413E-01	9.8413E-01	4.7055E-05
205.	NRV	0.0000E+00	1.9368E-01	1.9368E-01	9.2603E-06
206.	JA	0.0000E+00	3.2756E-02	3.2756E-02	1.5662E-06
207.	INH	0.0000E+00	3.5338E-02	3.5338E-02	1.6896E-06
208.	NA	0.0000E+00	2.6506E-02	2.6506E-02	1.2673E-06
209.	SGTOP	0.0000E+00	4.2677E-01	4.2677E-01	2.0405E-05
210.	RN	0.0000E+00	4.5763E-01	4.5763E-01	2.1881E-05
211.	RBISO	0.0000E+00	9.7355E-02	9.7355E-02	4.6549E-06
212.	LPRES	0.0000E+00	2.0266E-01	2.0266E-01	9.6897E-06
213.	RE	0.0000E+00	5.7412E-01	5.7412E-01	2.7450E-05
214.	VT1(U1)	0.0000E+00	5.5980E-06	5.5980E-06	2.6766E-10
215.	DN	0.0000E+00	3.4296E-01	3.4296E-01	1.6398E-05
216.	DM	0.0000E+00	3.2636E-01	3.2636E-01	1.5604E-05
217.	RO	0.0000E+00	3.5469E-01	3.5469E-01	1.6959E-05
218.	FWA	0.0000E+00	9.6837E-01	9.6837E-01	4.6301E-05
219.	OJC	0.0000E+00	1.4175E-02	1.4175E-02	6.7777E-07
220.	OAI	0.0000E+00	2.4235E-01	2.4235E-01	1.1588E-05

MODEL Name: BFNFINAL

Top Event Importance for Group : ALL

Sorted by Probabilistic Importance

Group Frequency = 4.7813E-05

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......	Top...............	Probabilistic..	Guar. Event....	Total..........	Frequency......
221.	IE	0.0000E+00	2.6416E-02	2.6416E-02	1.2630E-06
222.	LT3(NOFLII)	0.0000E+00	1.4241E-02	1.4241E-02	6.8092E-07
223.	NCD	0.0000E+00	9.8413E-01	9.8413E-01	4.7055E-05
224.	PX2(NOFLI)	0.0000E+00	1.4241E-02	1.4241E-02	6.8092E-07
225.	HRL	0.0000E+00	6.7672E-01	6.7672E-01	3.2356E-05
226.	HR6	0.0000E+00	2.8271E-01	2.8271E-01	1.3517E-05
227.	CDA	0.0000E+00	7.3369E-01	7.3369E-01	3.5080E-05
228.	HS	0.0000E+00	8.2311E-01	8.2311E-01	3.9356E-05
229.	ING	0.0000E+00	7.0797E-01	7.0797E-01	3.3851E-05
230.	INE	0.0000E+00	7.0821E-01	7.0821E-01	3.3862E-05
231.	VNT	0.0000E+00	8.8367E-03	8.8367E-03	4.2251E-07
232.	IND	0.0000E+00	7.0830E-01	7.0830E-01	3.3866E-05
233.	INF	0.0000E+00	7.2175E-01	7.2175E-01	3.4509E-05
234.	WET	0.0000E+00	7.7295E-01	7.7295E-01	3.6957E-05
235.	OBC	0.0000E+00	2.9514E-03	2.9514E-03	1.4112E-07
236.	NRU	0.0000E+00	7.6237E-03	7.6237E-03	3.6451E-07
237.	INC	0.0000E+00	7.9166E-01	7.9166E-01	3.7852E-05
238.	INA	0.0000E+00	7.9733E-01	7.9733E-01	3.8123E-05

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

Sorted by Importance

Group Frequency = 4.7813E-05

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
1.	VT1F	9.9903E-01	9.6908E-04	0.0000E+00	0.0000E+00	1.0000E+00	4.7767E-05
2.	MELTF	9.9903E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.7767E-05
3.	VT2F	9.9903E-01	9.6908E-04	0.0000E+00	0.0000E+00	1.0000E+00	4.7767E-05
4.	NCDF	9.9903E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.7767E-05
5.	FIWTRF	9.9903E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.7767E-05
6.	FWAF	9.8278E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.6990E-05
7.	DWF	9.7979E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.6847E-05
8.	IVOF	8.2754E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.9568E-05
9.	HSF	8.2320E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.9360E-05
10.	CDF	8.1990E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.9202E-05
11.	INAF	8.0381E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.8433E-05
12.	INBF	8.0381E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.8433E-05
13.	CRDF	7.9940E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.8222E-05
14.	INCF	7.9805E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.8157E-05
15.	LPCF	7.8761E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.7658E-05
16.	WETF	7.7928E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.7260E-05
17.	DWSF	7.7852E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.7224E-05
18.	RCWF	7.4517E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.5629E-05
19.	CDAF	7.3524E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.5155E-05
20.	PCAF	7.2319E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.4578E-05
21.	INDF	7.0865E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3883E-05
22.	INEF	7.0865E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3883E-05
23.	INFF	7.0790E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3847E-05
24.	INGF	7.0790E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3847E-05
25.	OG5F	7.0437E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3679E-05
26.	UB43BF	7.0025E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
27.	UB43AF	7.0025E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
28.	UB41AF	7.0024E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
29.	UB42BF	7.0024E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
30.	UB42AF	7.0024E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
31.	UB41BF	7.0024E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
32.	SHUT1F	7.0024E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
33.	SHT2F	7.0024E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3481E-05
34.	UB42CF	6.9927E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3435E-05
35.	OG16F	6.9380E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3173E-05
36.	HRLF	6.7173E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.2118E-05
37.	RVCO	6.6076E-01	3.8737E-01	9.4099E+00	-4.3140E-04	9.3210E-01	3.1593E-05
38.	OLPF	6.5352E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.1247E-05
39.	U1F	6.3994E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.0598E-05
40.	OSPF	6.3079E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.0160E-05
41.	U3F	6.3055E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.0149E-05
42.	SW2CF	6.1295E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.9307E-05
43.	SW1CF	6.1295E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.9307E-05
44.	DKF	6.1237E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.9280E-05

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

Sorted by Importance

Group Frequency = 4.7813E-05

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
45.	RHF	6.1214E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.9268E-05
46.	ABF	6.0156E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.8763E-05
47.	RPAF	5.8237E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7845E-05
48.	RPCF	5.8132E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7795E-05
49.	SW1AF	5.7519E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7502E-05
50.	SW2AF	5.7519E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7502E-05
51.	RMF	5.7420E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7455E-05
52.	REF	5.7420E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7455E-05
53.	AAF	5.6478E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7004E-05
54.	RVD2	5.3752E-01	4.6562E-01	9.2600E+01	-4.4053E-03	9.9420E-01	2.5700E-05
55.	GA1	5.2501E-01	4.0447E+00	4.9693E-01	1.6963E-04	1.4180E-01	2.5103E-05
56.	HPLF	5.1398E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4575E-05
57.	SW2BF	5.0996E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4383E-05
58.	EBF	5.0979E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4375E-05
59.	RGF	5.0972E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4371E-05
60.	RFF	5.0972E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4371E-05
61.	RPBF	5.0614E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4200E-05
62.	ACF	5.0090E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.3950E-05
63.	SW1BF	4.9788E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.3805E-05
64.	RCLF	4.8874E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.3368E-05
65.	SW1DF	4.7399E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.2663E-05
66.	SGTF	4.7393E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.2660E-05
67.	GB2	4.7181E-01	3.4967E+00	5.3186E-01	1.4176E-04	1.5790E-01	2.2559E-05
68.	RBCF	4.6500E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.2233E-05
69.	EDF	4.5826E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1911E-05
70.	SW2DF	4.5783E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1891E-05
71.	DLF	4.5767E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1883E-05
72.	RIF	4.5763E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1881E-05
73.	RNF	4.5763E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1881E-05
74.	RJF	4.5763E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1881E-05
75.	RPDF	4.4989E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1511E-05
76.	ADF	4.4776E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1409E-05
77.	HUMF	4.4763E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1403E-05
78.	RLF	4.4216E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1141E-05
79.	RKF	4.4216E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1141E-05
80.	SGTOPF	4.2677E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.0405E-05
81.	GC4	3.9897E-01	1.9736E+00	6.4574E-01	6.3487E-05	2.6680E-01	1.9076E-05
82.	RPF	3.7076E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.7727E-05
83.	A3ECF	3.7065E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.7722E-05
84.	A3EDF	3.6403E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.7406E-05
85.	EAF	3.5478E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6963E-05
86.	ROF	3.5469E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6959E-05
87.	A3EAF	3.5457E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6953E-05
88.	ECF	3.5345E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6900E-05

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

Sorted by Importance

Group Frequency = 4.7813E-05

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
89.	A3EBF	3.5267E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6862E-05
90.	DNF	3.4296E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6398E-05
91.	DMF	3.2636E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.5604E-05
92.	DOF	3.2110E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.5353E-05
93.	HR6F	2.9625E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4165E-05
94.	OEEF	2.9106E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.3917E-05
95.	EPR303	2.8783E-01	1.3219E+00	7.1225E-01	2.9149E-05	4.7200E-01	1.3762E-05
96.	EPR63	2.8511E-01	1.7747E+00	7.1492E-01	5.0671E-05	2.6900E-01	1.3632E-05
97.	GHF	2.8239E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.3502E-05
98.	GGF	2.8234E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.3500E-05
99.	GEF	2.8220E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.3493E-05
100.	GFF	2.8210E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.3488E-05
101.	EPR304	2.7866E-01	1.3141E+00	7.2145E-01	2.8337E-05	4.7000E-01	1.3324E-05
102.	ORPF	2.7663E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.3227E-05
103.	EPR64	2.7389E-01	1.7479E+00	7.2620E-01	4.8849E-05	2.6800E-01	1.3096E-05
104.	DCAF	2.6982E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.2901E-05
105.	OAIF	2.4896E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.1904E-05
106.	GD4	2.2700E-01	1.1861E+00	8.5791E-01	1.5694E-05	4.3290E-01	1.0854E-05
107.	NRVF	2.0790E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	9.9403E-06
108.	LPRESF	1.9702E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	9.4204E-06
109.	RPD10	1.7750E-01	1.2549E+00	8.2355E-01	2.0622E-05	4.0910E-01	8.4871E-06
110.	NH1F	1.5075E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	7.2079E-06
111.	NPIF	1.5074E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	7.2076E-06
112.	PX1F	1.4843E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	7.0970E-06
113.	RCF	1.4598E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.9800E-06
114.	CSF	1.4516E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.9405E-06
115.	RCIF	1.4436E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.9022E-06
116.	RVC1	1.4395E-01	3.0512E+00	8.6549E-01	1.0451E-04	6.1540E-02	6.8826E-06
117.	DGA	1.4299E-01	2.9353E+01	8.5949E-01	1.3624E-03	4.9311E-03	6.8369E-06
118.	NPIIF	1.3995E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.6915E-06
119.	NH2F	1.3995E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.6915E-06
120.	HPIF	1.3973E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.6810E-06
121.	RPB6	1.2991E-01	1.2460E+00	8.7181E-01	1.7890E-05	3.4260E-01	6.2114E-06
122.	RCI1	1.2981E-01	2.1933E+00	9.1533E-01	6.1105E-05	6.6250E-02	6.2066E-06
123.	PX2F	1.2364E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	5.9118E-06
124.	GD3	1.2167E-01	1.4432E+00	8.8479E-01	2.6701E-05	2.0630E-01	5.8176E-06
125.	RBF	1.2159E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	5.8135E-06
126.	DH1	1.1943E-01	2.4485E+01	8.8191E-01	1.1285E-03	5.0032E-03	5.7106E-06
127.	RVC9	1.1090E-01	8.8910E-01	0.0000E+00	0.0000E+00	1.0000E+00	5.3027E-06
128.	FWHF	1.0853E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	5.1890E-06
129.	RBISOF	9.8421E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.7059E-06
130.	RBI1	9.8421E-02	8.3279E-01	1.0224E+00	-9.0677E-06	1.1832E-01	4.7059E-06
131.	OHRF	9.6751E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.6260E-06
132.	RVD22	9.2484E-02	1.4218E+01	9.0816E-01	6.3641E-04	6.9000E-03	4.4220E-06

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

Sorted by Importance

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
133.	HPI4	9.2093E-02	1.7127E+00	9.1200E-01	3.8286E-05	1.0990E-01	4.4033E-06
134.	OLP1	6.9806E-02	1.4657E+02	9.3024E-01	6.9634E-03	4.7900E-04	3.3377E-06
135.	GE1	6.2402E-02	9.4017E-01	1.0126E+00	-3.4640E-06	1.7420E-01	2.9836E-06
136.	RVD5	5.6744E-02	9.4367E-01	8.6597E+00	-3.6893E-04	9.9270E-01	2.7131E-06
137.	GB1	5.2018E-02	1.2439E+00	9.6059E-01	1.3547E-05	1.3910E-01	2.4872E-06
138.	GF1	5.1806E-02	9.4368E-01	1.0119E+00	-3.2632E-06	1.7470E-01	2.4770E-06
139.	EPR302	4.9123E-02	1.0532E+00	9.5226E-01	4.8258E-06	4.7300E-01	2.3488E-06
140.	GG1	4.7785E-02	9.6921E-01	1.0067E+00	-1.7922E-06	1.7860E-01	2.2848E-06
141.	EPR62	4.7408E-02	1.1255E+00	9.5286E-01	8.2565E-06	2.7300E-01	2.2667E-06
142.	OBDF	4.7050E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.2496E-06
143.	RPA1	4.5973E-02	4.0847E+00	9.5896E-01	1.4945E-04	1.3130E-02	2.1981E-06
144.	HPI2	4.5116E-02	8.9798E-01	1.0095E+00	-5.3312E-06	8.5020E-02	2.1572E-06
145.	GBF	4.4322E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1192E-06
146.	GC2	4.3492E-02	1.2470E+00	9.6063E-01	1.3692E-05	1.3750E-01	2.0795E-06
147.	GAF	4.2450E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.0297E-06
148.	FA1	4.2450E-02	2.9695E+00	9.6818E-01	9.5692E-05	1.5900E-02	2.0297E-06
149.	GH1	4.1779E-02	9.7725E-01	1.0052E+00	-1.3351E-06	1.8540E-01	1.9976E-06
150.	MCDF	3.8786E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.8545E-06
151.	RVD9	3.7315E-02	9.6307E-01	4.6199E+00	-1.7485E-04	9.8990E-01	1.7842E-06
152.	FB1	3.6378E-02	2.6402E+00	9.7362E-01	7.9686E-05	1.5830E-02	1.7393E-06
153.	GD7	3.4622E-02	1.0634E+00	9.7692E-01	4.1356E-06	2.6680E-01	1.6554E-06
154.	GB3	3.3632E-02	1.2027E+00	9.6651E-01	1.1292E-05	1.4180E-01	1.6081E-06
155.	RPC2	3.1436E-02	1.0586E+00	9.6944E-01	4.2653E-06	3.4260E-01	1.5031E-06
156.	OIVF	2.9897E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4295E-06
157.	INHF	2.9433E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4073E-06
158.	GC1	2.7642E-02	1.1219E+00	9.8026E-01	6.7713E-06	1.3940E-01	1.3217E-06
159.	GCF	2.7577E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.3186E-06
160.	EPR301	2.7253E-02	1.0180E+00	9.8367E-01	1.6436E-06	4.7500E-01	1.3031E-06
161.	JAF	2.6707E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.2770E-06
162.	NAF	2.6506E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.2673E-06
163.	JHF	2.6312E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.2581E-06
164.	GDF	2.5934E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.2400E-06
165.	RVC3	2.4380E-02	5.6335E+01	9.7563E-01	2.6469E-03	4.4020E-04	1.1657E-06
166.	SPR1	2.4216E-02	1.3206E+00	9.7587E-01	1.6481E-05	7.0000E-02	1.1578E-06
167.	RVC2	2.2366E-02	6.2129E+00	9.7773E-01	2.5031E-04	4.2540E-03	1.0694E-06
168.	RPS1	2.1771E-02	0.0000E+00	9.7823E-01	0.0000E+00	1.7848E-05	1.0410E-06
169.	SPF	2.1477E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0269E-06
170.	GD2	1.9920E-02	1.1053E+00	9.8475E-01	5.7650E-06	1.2650E-01	9.5247E-07
171.	CRD4	1.9237E-02	1.0669E+00	9.8301E-01	4.0108E-06	2.0249E-01	9.1980E-07
172.	FC1	1.9177E-02	1.5900E+00	9.9051E-01	2.8664E-05	1.5830E-02	9.1691E-07
173.	KCF	1.8326E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	8.7623E-07
174.	EPR61	1.8285E-02	1.0411E+00	9.8463E-01	2.7021E-06	2.7200E-01	8.7426E-07
175.	KFF	1.8253E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	8.[illegible]273E-07
176.	KHF	1.8083E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	8.[illegible]59E-07

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

Sorted by Importance

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value......	Frequency......
177.	BVRF	1.7411E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	8.3247E-07
178.	RVD6	1.7007E-02	9.8309E-01	4.0030E+00	-1.4439E-04	9.9440E-01	8.1318E-07
179.	RVD10	1.6728E-02	9.8339E-01	3.3909E+00	-1.1511E-04	9.9310E-01	7.9984E-07
180.	FD1	1.6721E-02	1.4541E+00	9.9270E-01	2.2060E-05	1.5830E-02	7.9951E-07
181.	HPI6	1.6306E-02	1.1499E+00	9.8578E-01	7.8454E-06	8.6670E-02	7.7962E-07
182.	U11	1.5933E-02	1.2808E+00	9.8427E-01	1.4177E-05	5.3057E-02	7.6180E-07
183.	GH2	1.5645E-02	9.6777E-01	1.0056E+00	-1.8072E-06	1.4730E-01	7.4806E-07
184.	RVC4	1.5572E-02	9.8617E-01	1.1233E+00	-6.5583E-06	8.9920E-01	7.4454E-07
185.	PX23	1.4919E-02	1.9746E+01	9.8509E-01	8.9700E-04	7.9450E-04	7.1333E-07
186.	LECF	1.4184E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.7817E-07
187.	RPB3	1.3109E-02	1.3357E+00	9.8700E-01	1.6672E-05	3.7290E-02	6.2679E-07
188.	GD6	1.2919E-02	1.0778E+00	9.8759E-01	4.3150E-06	1.3750E-01	6.1771E-07
189.	RPD4	1.2899E-02	1.0077E+00	9.8710E-01	9.8504E-07	6.2610E-01	6.1673E-07
190.	GG2	1.2499E-02	9.7605E-01	1.0044E+00	-1.3574E-06	1.5630E-01	5.9763E-07
191.	RPC3	1.1770E-02	1.8742E+00	9.8837E-01	4.2355E-05	1.3130E-02	5.6279E-07
192.	SW2B1	1.1668E-02	8.3585E-01	1.0061E+00	-8.1408E-06	3.5910E-02	5.5789E-07
193.	RPD9	1.1569E-02	1.0199E+00	9.8972E-01	1.4443E-06	3.4040E-01	5.5316E-07
194.	GF2	9.4270E-03	9.9273E-01	1.0015E+00	-4.1965E-07	1.7190E-01	4.5074E-07
195.	AA2	9.4129E-03	9.4950E+00	9.9072E-01	4.0662E-04	1.0910E-03	4.5006E-07
196.	OSDF	9.2628E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.4289E-07
197.	AB4	9.0938E-03	1.1394E+00	9.9091E-01	7.0977E-06	6.1260E-02	4.3481E-07
198.	VNTF	9.0125E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.3092E-07
199.	AIF	9.0125E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.3092E-07
200.	NIEF	8.7435E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.1806E-07
201.	SW1B2	8.6718E-03	9.4596E-01	1.0039E+00	-2.7696E-06	6.6980E-02	4.1463E-07
202.	TB2	8.4815E-03	1.0636E+00	9.9594E-01	3.2349E-06	6.0058E-02	4.0553E-07
203.	SW2A1	8.3410E-03	8.0856E-01	1.0071E+00	-9.4940E-06	3.5890E-02	3.9881E-07
204.	AC12	7.9893E-03	1.0071E+00	9.9201E-01	7.2007E-07	5.3050E-01	3.8200E-07
205.	FB2	7.9446E-03	1.3491E+00	9.9277E-01	1.7038E-05	2.0290E-02	3.7986E-07
206.	AD20	7.9105E-03	1.0022E+00	9.9209E-01	4.8109E-07	7.8620E-01	3.7823E-07
207.	RVD45	7.7762E-03	9.9222E-01	0.0000E+00	0.0000E+00	1.0000E+00	3.7181E-07
208.	SW2C1	7.6951E-03	8.4730E-01	1.0058E+00	-7.5803E-06	3.6860E-02	3.6793E-07
209.	NRUF	7.6237E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.6451E-07
210.	CS7	7.6119E-03	1.2693E+00	9.9264E-01	1.3228E-05	2.6615E-02	3.6395E-07
211.	SW2D1	7.5491E-03	8.6021E-01	1.0053E+00	-6.9390E-06	3.6800E-02	3.6095E-07
212.	ORP2	7.3667E-03	9.7335E-01	1.0007E+00	-1.3078E-06	2.5820E-02	3.5223E-07
213.	TBF	7.0537E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.3726E-07
214.	FH1	6.9371E-03	7.6486E-01	1.0038E+00	-1.1424E-05	1.5830E-02	3.3169E-07
215.	FG1	6.9243E-03	7.5712E-01	1.0039E+00	-1.1800E-05	1.5830E-02	3.3107E-07
216.	FE1	6.8499E-03	7.3695E-01	1.0043E+00	-1.2780E-05	1.5900E-02	3.2752E-07
217.	MCD1	6.8431E-03	1.1139E+00	9.9632E-01	5.6223E-06	3.1260E-02	3.2719E-07
218.	NH22	6.8230E-03	6.2478E-01	1.0056E+00	-1.8207E-05	1.4630E-02	3.2623E-07
219.	FF1	6.7175E-03	7.3735E-01	1.0042E+00	-1.2760E-05	1.5830E-02	3.2119E-07
220.	R4801	6.5229E-03	1.3169E+00	9.9583E-01	1.5354E-05	1.3000E-02	3.1188E-07

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

Sorted by Importance

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
221.	FC3	6.4453E-03	1.0194E+00	9.9402E-01	1.2137E-06	2.3570E-01	3.0817E-07
222.	OUB2	6.4408E-03	2.2975E+00	9.9358E-01	6.2344E-05	4.9230E-03	3.0796E-07
223.	FGF	6.3861E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.0534E-07
224.	FFF	6.3861E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.0534E-07
225.	FEF	6.3861E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.0534E-07
226.	FHF	6.3861E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.0534E-07
227.	FD4	6.3861E-03	1.0003E+00	9.9471E-01	2.6666E-07	9.4870E-01	3.0534E-07
228.	RDF	5.9157E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.8285E-07
229.	RAF	5.9157E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.8285E-07
230.	SL1	5.8769E-03	2.0068E+00	9.9417E-01	4.8416E-05	5.7591E-03	2.8100E-07
231.	SW1D7	5.7561E-03	9.7393E-01	1.0019E+00	-1.3388E-06	6.8960E-02	2.7522E-07
232.	GD1	5.2819E-03	9.8875E-01	1.0019E+00	-6.2639E-07	1.4150E-01	2.5255E-07
233.	CD1	5.1803E-03	4.5414E+00	9.9505E-01	1.6956E-04	1.3961E-03	2.4769E-07
234.	SLF	5.0433E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4114E-07
235.	RPS4	4.9585E-03	0.0000E+00	9.9504E-01	0.0000E+00	1.7848E-05	2.3708E-07
236.	HXBF	4.7577E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.2748E-07
237.	RCW15	4.6943E-03	1.0003E+00	9.9963E-01	3.3181E-08	5.3649E-01	2.2445E-07
238.	OSL1	4.6797E-03	1.8413E+00	9.9540E-01	4.0445E-05	5.4420E-03	2.2375E-07
239.	ODWS1	4.6655E-03	5.1228E-01	1.0047E+00	-2.3546E-05	9.6280E-03	2.2307E-07
240.	OSVF	4.4383E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.1221E-07
241.	HXA1	4.4242E-03	1.4830E+00	9.9733E-01	2.3221E-05	5.4880E-03	2.1154E-07
242.	DE1	4.4119E-03	1.4652E+00	9.9768E-01	2.2354E-05	4.9570E-03	2.1095E-07
243.	HRC1	4.3571E-03	8.1167E+00	9.9597E-01	3.4047E-04	5.6554E-04	2.0833E-07
244.	SW2D6	4.2216E-03	9.6214E-01	1.0015E+00	-1.8817E-06	3.7950E-02	2.0185E-07
245.	RPD2	3.9208E-03	1.0075E+00	9.9609E-01	5.4703E-07	3.4200E-01	1.8746E-07
246.	OSP1	3.8988E-03	5.0562E+01	9.9613E-01	2.3699E-03	7.8170E-05	1.8642E-07
247.	TB1	3.8871E-03	1.0909E+00	9.9850E-01	4.4160E-06	1.6219E-02	1.8586E-07
248.	RVD14	3.1695E-03	1.5433E+00	9.9683E-01	2.6127E-05	5.8000E-03	1.5154E-07
249.	RVD1	3.1552E-03	9.9687E-01	1.4510E+00	-2.1712E-05	9.9310E-01	1.5086E-07
250.	OSL2	3.0964E-03	1.2414E+00	9.9696E-01	1.1689E-05	1.2420E-02	1.4805E-07
251.	GH4	3.0894E-03	9.9620E-01	1.0010E+00	-2.2844E-07	2.0520E-01	1.4771E-07
252.	SDC2	3.0642E-03	1.1112E+00	9.9696E-01	5.4602E-06	2.6635E-02	1.4651E-07
253.	DGB	2.9939E-03	1.3110E+00	9.9859E-01	1.4937E-05	4.4975E-03	1.4315E-07
254.	OBCF	2.9514E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4112E-07
255.	HPI1	2.9435E-03	1.0305E+00	9.9714E-01	1.5957E-06	8.5600E-02	1.4074E-07
256.	OBD1	2.9175E-03	9.9536E-01	1.0007E+00	-2.5536E-07	1.3120E-01	1.3950E-07
257.	GG4	2.9175E-03	1.0024E+00	9.9921E-01	1.5352E-07	2.4680E-01	1.3949E-07
258.	SP1	2.7457E-03	4.4027E+00	9.9748E-01	1.6282E-04	7.4123E-04	1.3128E-07
259.	FD2	2.7072E-03	1.0829E+00	9.9867E-01	4.0282E-06	1.5830E-02	1.2944E-07
260.	RK3	2.6154E-03	9.3770E-01	1.0016E+00	-3.0530E-06	2.4290E-02	1.2505E-07
261.	SGT9	2.5596E-03	9.4042E-01	1.0019E+00	-2.9387E-06	3.0668E-02	1.2238E-07
262.	RC1	2.4473E-03	1.7119E+01	9.9768E-01	7.7080E-04	1.4420E-04	1.1702E-07
263.	RPB5	2.4082E-03	8.7131E-01	1.0017E+00	-6.2337E-06	1.2890E-02	1.1514E-07
264.	PX11	2.3130E-03	3.0607E+00	9.9836E-01	9.8608E-05	7.9450E-04	1.1059E-07

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

Sorted by Importance

Group Frequency = 4.7813E-05

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
265.	BVR1	2.2602E-03	1.0834E+00	9.9884E-01	4.0431E-06	1.3770E-02	1.0807E-07
266.	GC3	2.2596E-03	1.0127E+00	9.9795E-01	7.0356E-07	1.3910E-01	1.0804E-07
267.	HXC3	2.2053E-03	1.3955E+00	9.9782E-01	1.9012E-05	5.4880E-03	1.0544E-07
268.	DH2	2.1529E-03	8.7181E-01	1.0006E+00	-6.1564E-06	4.4485E-03	1.0294E-07
269.	DL1	2.1315E-03	7.8313E-01	1.0031E+00	-1.0517E-05	1.4010E-02	1.0192E-07
270.	DK1	2.1311E-03	7.6732E-01	1.0033E+00	-1.1281E-05	1.3840E-02	1.0190E-07
271.	RB1	2.0569E-03	1.4387E+01	9.9807E-01	6.4015E-04	1.4420E-04	9.8346E-08
272.	NPI1	2.0383E-03	7.4417E+00	9.9820E-01	3.0809E-04	2.7960E-04	9.7457E-08
273.	FC2	1.9549E-03	1.0526E+00	9.9915E-01	2.5558E-06	1.5830E-02	9.3468E-08
274.	RCL1	1.8411E-03	1.0091E+00	9.9983E-01	4.4099E-07	1.8220E-02	8.8031E-08
275.	GH7	1.8267E-03	1.0020E+00	9.9882E-01	1.5053E-07	3.7360E-01	8.7343E-08
276.	RPB1	1.6801E-03	1.1068E+00	9.9862E-01	5.1715E-06	1.2750E-02	8.0332E-08
277.	NPII2	1.6692E-03	1.0246E+00	9.9833E-01	1.2568E-06	6.3410E-02	7.9811E-08
278.	AD30	1.6653E-03	1.0015E+00	9.9833E-01	1.5009E-07	5.3050E-01	7.9625E-08
279.	HXB5	1.6170E-03	1.0034E+00	9.9838E-01	2.4011E-07	3.2200E-01	7.7315E-08
280.	HXC2	1.6167E-03	1.0521E+00	9.9840E-01	2.5676E-06	2.9810E-02	7.7300E-08
281.	HXD7	1.5395E-03	1.0011E+00	9.9846E-01	1.2495E-07	5.8910E-01	7.3609E-08
282.	ED26	1.5123E-03	9.9392E-01	1.0005E+00	-3.1542E-07	7.7650E-02	7.2306E-08
283.	DE2	1.5037E-03	7.4917E-01	1.0012E+00	-1.2049E-05	4.6501E-03	7.1898E-08
284.	RBC20	1.4461E-03	8.9444E-01	1.0019E+00	-5.1371E-06	1.7493E-02	6.9145E-08
285.	HXDF	1.4261E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.8185E-08
286.	TOR2	1.4177E-03	0.0000E+00	9.9858E-01	0.0000E+00	1.2970E-06	6.7785E-08
287.	HXAF	1.4087E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.7353E-08
288.	IVC1	1.3863E-03	1.8800E+01	9.9861E-01	8.5113E-04	7.7839E-05	6.6283E-08
289.	SP3	1.3315E-03	1.0804E+00	9.9893E-01	3.8954E-06	1.3160E-02	6.3661E-08
290.	GD5	1.3160E-03	1.0065E+00	9.9895E-01	3.6176E-07	1.3940E-01	6.2923E-08
291.	GD9	1.1982E-03	1.0048E+00	9.9910E-01	2.7310E-07	1.5790E-01	5.7289E-08
292.	RPC1	1.1532E-03	1.1105E+00	9.9902E-01	5.3310E-06	8.7460E-03	5.5138E-08
293.	HPL3	1.1273E-03	1.0013E+00	9.9888E-01	6.7582E-08	8.3410E-02	5.3898E-08
294.	DL3	1.0441E-03	9.0523E-01	1.0013E+00	-4.5949E-06	1.3840E-02	4.9922E-08
295.	HXCF	1.0419E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.9819E-08
296.	GC6	9.5714E-04	1.0053E+00	9.9913E-01	2.9253E-07	1.4180E-01	4.5764E-08
297.	SW1D9	9.4854E-04	9.9154E-01	1.0006E+00	-4.3555E-07	7.0930E-02	4.5353E-08
298.	OAD1	9.2481E-04	1.6063E+00	9.9909E-01	2.9033E-05	1.4910E-03	4.4219E-08
299.	DA1	9.1382E-04	1.0130E+00	9.9997E-01	6.2243E-07	2.0872E-03	4.3693E-08
300.	PX22	9.0390E-04	1.2318E+00	9.9910E-01	1.1126E-05	3.8810E-03	4.3219E-08
301.	NH11	8.9840E-04	4.4793E-01	1.0017E+00	-2.6477E-05	3.0330E-03	4.2956E-08
302.	HXB6	8.9699E-04	1.1593E+00	9.9912E-01	7.6609E-06	5.4880E-03	4.2888E-08
303.	PCA1	8.8610E-04	9.5427E-01	1.0002E+00	-2.1961E-06	4.4467E-03	4.2368E-08
304.	LM11	8.8233E-04	4.2743E-01	1.0012E+00	-2.7433E-05	2.0690E-03	4.2187E-08
305.	LM21	8.8226E-04	4.3202E-01	1.0012E+00	-2.7213E-05	2.0510E-03	4.2184E-08
306.	LT11	8.7137E-04	4.4810E-01	1.0016E+00	-2.6466E-05	2.9400E-03	4.1663E-08
307.	LT21	8.3379E-04	4.6687E-01	1.0014E+00	-2.5559E-05	2.6530E-03	3.9866E-08
308.	DC1	8.1031E-04	1.0093E+00	9.9998E-01	4.4328E-07	2.0467E-03	3.8744E-08

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
309.	DJF	7.9377E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.7953E-08
310.	AB5	7.6919E-04	1.6844E+00	9.9925E-01	3.2758E-05	1.0910E-03	3.6777E-08
311.	GH3	7.6286E-04	9.9647E-01	1.0008E+00	-2.0557E-07	1.7860E-01	3.6475E-08
312.	AB1	7.0964E-04	2.1698E+00	9.9943E-01	5.5961E-05	4.8320E-04	3.3930E-08
313.	HXB3	6.9567E-04	8.6240E-01	1.0007E+00	-6.6146E-06	5.3540E-03	3.3263E-08
314.	RVC5	6.4478E-04	1.0057E+00	9.9942E-01	2.9895E-07	9.2600E-02	3.0829E-08
315.	AC16	6.2527E-04	1.0096E+00	9.9937E-01	4.8802E-07	6.1260E-02	2.9896E-08
316.	DCA1	6.1024E-04	8.8735E-01	1.0005E+00	-5.4089E-06	4.1526E-03	2.9178E-08
317.	SW2D5	6.0734E-04	9.8487E-01	1.0006E+00	-7.5014E-07	3.5910E-02	2.9039E-08
318.	IVCF	5.9877E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.8629E-08
319.	EC2	5.8622E-04	5.6816E-01	1.0016E+00	-2.0725E-05	3.7120E-03	2.8029E-08
320.	LT31	5.8596E-04	4.0601E-01	1.0014E+00	-2.8469E-05	2.3830E-03	2.8017E-08
321.	OHL1	5.8526E-04	1.2917E+00	9.9957E-01	1.3969E-05	1.4740E-03	2.7983E-08
322.	LM41	5.8302E-04	2.9194E-01	1.0014E+00	-3.3923E-05	2.0200E-03	2.7876E-08
323.	LM31	5.8291E-04	2.8918E-01	1.0014E+00	-3.4056E-05	2.0350E-03	2.7871E-08
324.	OEE1	5.7051E-04	2.1230E+00	9.9944E-01	5.3723E-05	5.0050E-04	2.7278E-08
325.	GG3	5.6612E-04	9.9759E-01	1.0005E+00	-1.3951E-07	1.7470E-01	2.7068E-08
326.	LT41	5.4808E-04	4.2021E-01	1.0012E+00	-2.7780E-05	2.1120E-03	2.6206E-08
327.	IVC3	5.4514E-04	1.1872E+01	9.9946E-01	5.1988E-04	5.0102E-05	2.6065E-08
328.	DF2	5.3549E-04	8.5036E-01	1.0004E+00	-7.1736E-06	2.6116E-03	2.5604E-08
329.	GD8	5.2790E-04	1.0032E+00	9.9948E-01	1.7987E-07	1.3910E-01	2.5241E-08
330.	DJ1	5.1673E-04	1.0314E+00	9.9998E-01	1.5017E-06	5.0510E-04	2.4707E-08
331.	HXD10	5.1366E-04	1.0930E+00	9.9949E-01	4.4690E-06	5.4880E-03	2.4560E-08
332.	HPL5	5.0829E-04	1.0236E+00	9.9957E-01	1.1499E-06	1.8020E-02	2.4303E-08
333.	LVF	5.0105E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.3957E-08
334.	PX21	4.8288E-04	7.6762E-01	1.0002E+00	-1.1120E-05	7.9200E-04	2.3088E-08
335.	PCA4	4.7176E-04	9.8526E-01	1.0008E+00	-7.4301E-07	5.1329E-02	2.2556E-08
336.	SDCF	4.2796E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.0462E-08
337.	DF1	4.0920E-04	4.8368E-01	1.0017E+00	-2.4766E-05	3.1963E-03	1.9565E-08
338.	TORF	3.9453E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.8864E-08
339.	RVD21	3.7956E-04	1.0368E+00	9.9962E-01	1.7785E-06	1.0100E-02	1.8148E-08
340.	RBC17	3.7421E-04	9.4859E-01	1.0004E+00	-2.4769E-06	7.5184E-03	1.7893E-08
341.	CS1	3.4422E-04	1.1660E+00	9.9967E-01	7.9510E-06	1.9948E-03	1.6459E-08
342.	ED2	3.3572E-04	7.5452E-01	1.0009E+00	-1.1780E-05	3.6700E-03	1.6052E-08
343.	SPRF	3.3530E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6032E-08
344.	HXB7	3.2976E-04	9.9156E-01	1.0001E+00	-4.0723E-07	8.7160E-03	1.5767E-08
345.	LT42	3.2341E-04	1.0008E+00	9.9989E-01	4.4733E-08	1.1570E-01	1.5464E-08
346.	DA2	3.2215E-04	6.3371E-01	1.0006E+00	-1.7541E-05	1.5495E-03	1.5403E-08
347.	DC2	3.1335E-04	5.9553E-01	1.0006E+00	-1.9368E-05	1.5072E-03	1.4982E-08
348.	LM32	2.9940E-04	1.0285E+00	9.9972E-01	1.3777E-06	9.8830E-03	1.4315E-08
349.	LM42	2.9937E-04	1.0292E+00	9.9972E-01	1.4107E-06	9.5740E-03	1.4314E-08
350.	GF3	2.9329E-04	9.9852E-01	1.0003E+00	-8.5839E-08	1.7420E-01	1.4023E-08
351.	LT32	2.8541E-04	1.0011E+00	9.9988E-01	5.7332E-08	1.0410E-01	1.3646E-08
352.	DD2	2.7948E-04	7.2351E-01	1.0004E+00	-1.3240E-05	1.5425E-03	1.3363E-08

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

Sorted by Importance

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
353.	DB2	2.7823E-04	6.7344E-01	1.0005E+00	-1.5638E-05	1.5191E-03	1.3303E-08
354.	EA3	2.6552E-04	7.2106E-01	1.0010E+00	-1.3387E-05	3.7380E-03	1.2695E-08
355.	NPI13	2.6472E-04	1.9293E+00	9.9974E-01	4.4444E-05	2.7960E-04	1.2657E-08
356.	GH5	2.6336E-04	1.0000E+00	1.0000E+00	8.2099E-10	1.5630E-01	1.2592E-08
357.	CS5	2.6032E-04	1.1359E+00	9.9988E-01	6.5029E-06	9.0062E-04	1.2447E-08
358.	OG51	2.5698E-04	1.3604E+00	9.9986E-01	1.7238E-05	3.9230E-04	1.2287E-08
359.	CRD1	2.5496E-04	1.1714E+00	9.9977E-01	8.2077E-06	1.3351E-03	1.2190E-08
360.	LBFF	2.5277E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.2086E-08
361.	FWCF	2.5277E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.2086E-08
362.	DB1	2.3819E-04	6.2693E-01	1.0008E+00	-1.7875E-05	2.0492E-03	1.1389E-08
363.	RH1	2.3678E-04	2.0799E+00	9.9983E-01	5.1642E-05	1.6143E-04	1.1321E-08
364.	OHC1	2.2779E-04	6.3765E-01	1.0004E+00	-1.7344E-05	1.0610E-03	1.0892E-08
365.	NBOCF	2.1681E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0367E-08
366.	DD1	2.0402E-04	5.5994E-01	1.0009E+00	-2.1083E-05	2.0141E-03	9.7547E-09
367.	FWH1	2.0064E-04	1.0568E+00	9.9982E-01	2.7234E-06	3.1420E-03	9.5934E-09
368.	OAD2	1.9880E-04	1.1305E+00	9.9981E-01	6.2475E-06	1.4700E-03	9.5055E-09
369.	RVD17	1.9071E-04	1.0257E+00	9.9981E-01	1.2399E-06	7.3000E-03	9.1184E-09
370.	HRC6	1.8251E-04	1.0151E+00	9.9988E-01	7.2750E-07	7.7013E-03	8.7265E-09
371.	ODWS2	1.8099E-04	9.7988E-01	1.0006E+00	-9.8892E-07	2.7370E-02	8.6537E-09
372.	SW2C4	1.7975E-04	9.8815E-01	1.0004E+00	-5.8760E-07	3.5890E-02	8.5943E-09
373.	OSW1	1.7875E-04	2.4781E-01	1.0006E+00	-3.5992E-05	7.5160E-04	8.5467E-09
374.	DV2F	1.6751E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	8.0091E-09
375.	ISO1	1.6283E-04	1.7324E+00	9.9984E-01	3.5025E-05	2.2228E-04	7.7856E-09
376.	HPL1	1.5870E-04	9.6313E-01	1.0006E+00	-1.7929E-06	1.6800E-02	7.5880E-09
377.	OF2	1.5841E-04	1.0634E+00	9.9984E-01	3.0405E-06	2.4910E-03	7.5740E-09
378.	OHS2	1.5569E-04	2.9379E-01	1.0006E+00	-3.3793E-05	7.8720E-04	7.4442E-09
379.	RBC4	1.5532E-04	8.9730E-01	1.0002E+00	-4.9188E-06	1.7345E-03	7.4266E-09
380.	SP2	1.5529E-04	9.8553E-01	1.0004E+00	-7.0965E-07	2.5350E-02	7.4250E-09
381.	AC18	1.4777E-04	1.0120E+00	9.9999E-01	5.7550E-07	1.0910E-03	7.0655E-09
382.	ED5	1.4638E-04	8.9948E-01	1.0004E+00	-4.8239E-06	3.6740E-03	6.9987E-09
383.	OLC1	1.3796E-04	1.2809E+00	9.9987E-01	1.3437E-05	4.7900E-04	6.5964E-09
384.	RVL4	1.3758E-04	1.0236E+00	9.9986E-01	1.1359E-06	5.7910E-03	6.5783E-09
385.	EB8	1.3587E-04	9.5996E-01	1.0005E+00	-1.9378E-06	1.1970E-02	6.4965E-09
386.	RBC11	1.3499E-04	9.5948E-01	1.0005E+00	-1.9599E-06	1.1418E-02	6.4544E-09
387.	OLC2	1.3409E-04	1.1840E+00	9.9987E-01	8.8024E-06	6.9510E-04	6.4111E-09
388.	ORP3	1.2118E-04	9.9261E-01	1.0003E+00	-3.6960E-07	4.3660E-02	5.7939E-09
389.	FD3	1.1946E-04	1.0041E+00	9.9993E-01	1.9882E-07	1.5830E-02	5.7120E-09
390.	EB7	1.1843E-04	8.9326E-01	1.0004E+00	-5.1226E-06	3.6670E-03	5.6625E-09
391.	AD34	1.1751E-04	1.0016E+00	9.9990E-01	8.0283E-08	6.1260E-02	5.6184E-09
392.	RL6	1.1607E-04	9.8931E-01	1.0003E+00	-5.2384E-07	2.4290E-02	5.5498E-09
393.	HRC3	1.1217E-04	1.3182E+00	9.9990E-01	1.5218E-05	3.0573E-04	5.3632E-09
394.	FWH2	1.1197E-04	1.0039E+00	9.9990E-01	1.8875E-07	2.4606E-02	5.3538E-09
395.	OLA1	1.1009E-04	9.9828E-01	1.0001E+00	-8.9043E-08	7.7450E-02	5.2637E-09
396.	FH2	1.0592E-04	9.8631E-01	1.0002E+00	-6.6533E-07	1.5830E-02	5.0644E-09

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

Sorted by Importance

Group Frequency = 4.7813E-05

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
397.	SW1D10	1.0223E-04	9.9690E-01	1.0002E+00	-1.5877E-07	6.6980E-02	4.8881E-09
398.	CIS1	1.0054E-04	1.4753E-01	1.0006E+00	-4.0788E-05	6.8636E-04	4.8072E-09
399.	OFT1	9.4361E-05	1.0515E+00	9.9991E-01	2.4689E-06	1.8170E-03	4.5117E-09
400.	AD35	8.9657E-05	9.3754E-01	1.0001E+00	-2.9897E-06	1.0910E-03	4.2868E-09
401.	CS13	8.8796E-05	1.0789E+00	9.9991E-01	3.7747E-06	1.1226E-03	4.2457E-09
402.	SGT1	8.7639E-05	6.8386E-01	1.0005E+00	-1.5139E-05	1.5514E-03	4.1903E-09
403.	L8TRF	8.3468E-05	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.9909E-09
404.	HRC5	8.1375E-05	1.2330E+00	9.9993E-01	1.1142E-05	3.0261E-04	3.8908E-09
405.	HXD6	8.0104E-05	1.0002E+00	9.9992E-01	1.1895E-08	3.2200E-01	3.8301E-09
406.	HXB4	7.8853E-05	1.0026E+00	9.9992E-01	1.2648E-07	2.9810E-02	3.7702E-09
407.	RD1	7.8694E-05	5.5262E-01	1.0001E+00	-2.1394E-05	1.4420E-04	3.7627E-09
408.	SW1A1	7.8075E-05	9.9747E-01	1.0000E+00	-1.2250E-07	1.3430E-02	3.7330E-09
409.	CIL2	7.6453E-05	4.0720E-01	1.0003E+00	-2.8360E-05	5.5952E-04	3.6555E-09
410.	RCW1	7.4127E-05	0.0000E+00	9.9993E-01	0.0000E+00	2.5213E-05	3.5443E-09
411.	DI1	7.3980E-05	1.5092E-01	1.0004E+00	-4.0618E-05	5.0570E-04	3.5373E-09
412.	A3EC4	7.2425E-05	8.2234E-01	1.0002E+00	-8.5060E-06	1.3560E-03	3.4629E-09
413.	A3ED4	7.2178E-05	8.6521E-01	1.0002E+00	-6.4534E-06	1.3330E-03	3.4511E-09
414.	DWS1	7.0625E-05	8.3621E-01	1.0003E+00	-7.8456E-06	1.8223E-03	3.3768E-09
415.	FG2	7.0612E-05	9.9093E-01	1.0001E+00	-4.4072E-07	1.5830E-02	3.3762E-09
416.	A3EA2	6.8475E-05	7.0293E-01	1.0004E+00	-1.4224E-05	1.4090E-03	3.2740E-09
417.	SW1C4	6.7148E-05	1.0048E+00	9.9993E-01	2.3360E-07	1.3430E-02	3.2106E-09
418.	CS8	6.6684E-05	1.0022E+00	9.9994E-01	1.1036E-07	2.7924E-02	3.1884E-09
419.	A3EB2	6.5926E-05	7.5562E-01	1.0003E+00	-1.1701E-05	1.3790E-03	3.1521E-09
420.	OSD1	6.3842E-05	1.0591E+00	9.9994E-01	2.8298E-06	1.0130E-03	3.0525E-09
421.	L8H1	6.2107E-05	9.9792E-01	1.0001E+00	-1.0231E-07	2.7872E-02	2.9696E-09
422.	HXA2	6.1170E-05	9.6090E-01	1.0003E+00	-1.8861E-06	8.7390E-03	2.9248E-09
423.	ED17	6.0985E-05	9.8070E-01	1.0002E+00	-9.3171E-07	9.7680E-03	2.9159E-09
424.	AC1	5.4896E-05	8.1552E-01	1.0001E+00	-8.8249E-06	4.8330E-04	2.6248E-09
425.	CD3	5.1317E-05	1.0167E+00	9.9995E-01	8.0153E-07	3.0003E-03	2.4536E-09
426.	AD1	5.1250E-05	8.0799E-01	1.0001E+00	-9.1853E-06	4.8350E-04	2.4504E-09
427.	HXD9	5.1021E-05	1.0017E+00	9.9995E-01	8.1834E-08	2.9810E-02	2.4395E-09
428.	RPD3	4.9530E-05	1.0001E+00	9.9995E-01	9.1472E-09	2.5890E-01	2.3682E-09
429.	LPC5	4.9503E-05	1.0008E+00	1.0000E+00	3.7434E-08	6.1766E-03	2.3669E-09
430.	GG5	4.8500E-05	9.9970E-01	1.0001E+00	-1.7579E-08	1.7190E-01	2.3190E-09
431.	RI1	4.4206E-05	7.3244E-01	1.0000E+00	-1.2795E-05	1.6143E-04	2.1137E-09
432.	A3EA1	4.3110E-05	7.4847E-01	1.0002E+00	-1.2038E-05	9.1230E-04	2.0612E-09
433.	DV1F	4.1826E-05	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.9998E-09
434.	PCA3	4.1085E-05	9.9750E-01	1.0001E+00	-1.2346E-07	3.2886E-02	1.9644E-09
435.	AD32	4.0579E-05	1.0117E+00	9.9999E-01	5.6117E-07	1.0260E-03	1.9402E-09
436.	LT22	3.7762E-05	9.9951E-01	1.0001E+00	-2.6300E-08	1.0030E-01	1.8055E-09
437.	DV21	3.6391E-05	1.0077E+00	9.9996E-01	3.7038E-07	4.5200E-03	1.7400E-09
438.	NPII1	3.5765E-05	2.9662E-01	1.0002E+00	-3.3640E-05	2.6200E-04	1.7100E-09
439.	FF2	3.5302E-05	9.9489E-01	1.0001E+00	-2.4939E-07	2.0290E-02	1.6879E-09
440.	RA1	3.4645E-05	1.4339E-01	1.0002E+00	-4.0968E-05	2.5380E-04	1.6565E-09

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
441.	OAL1	3.4024E-05	9.8869E-01	1.0002E+00	-5.4998E-07	1.6490E-02	1.6268E-09
442.	A3EB1	3.3200E-05	6.8592E-01	1.0003E+00	-1.5031E-05	8.9340E-04	1.5874E-09
443.	CS2	3.3151E-05	1.0138E+00	9.9997E-01	6.6176E-07	2.1252E-03	1.5851E-09
444.	A3EC1	3.3074E-05	7.3912E-01	1.0002E+00	-1.2485E-05	8.7440E-04	1.5814E-09
445.	A3ED1	3.3014E-05	7.3991E-01	1.0002E+00	-1.2446E-05	8.5550E-04	1.5785E-09
446.	GD10	3.1116E-05	1.0002E+00	9.9997E-01	8.9265E-09	1.4180E-01	1.4878E-09
447.	EA1	3.0442E-05	7.4368E-01	1.0002E+00	-1.2265E-05	8.0190E-04	1.4555E-09
448.	EB1	3.0440E-05	7.4532E-01	1.0002E+00	-1.2187E-05	7.9080E-04	1.4554E-09
449.	MT11	2.9124E-05	7.4421E-01	1.0002E+00	-1.2239E-05	7.5428E-04	1.3925E-09
450.	SW1B1	2.9094E-05	9.9531E-01	1.0001E+00	-2.2742E-07	1.3890E-02	1.3911E-09
451.	DO3	2.7405E-05	8.8814E-01	1.0001E+00	-5.3545E-06	1.1079E-03	1.3103E-09
452.	HPI3	2.7337E-05	1.0002E+00	9.9997E-01	1.1629E-08	1.1240E-01	1.3071E-09
453.	RCI2	2.7337E-05	1.0003E+00	9.9998E-01	1.2949E-08	6.6940E-02	1.3071E-09
454.	RL4	2.7159E-05	8.5935E-01	1.0001E+00	-6.7320E-06	1.0170E-03	1.2986E-09
455.	DWS2	2.3422E-05	9.8794E-01	1.0003E+00	-5.8980E-07	2.2119E-02	1.1199E-09
456.	SW2D4	2.1930E-05	9.9097E-01	1.0001E+00	-4.3676E-07	1.1990E-02	1.0486E-09
457.	ED8	1.4731E-05	1.0000E+00	9.9999E-01	8.8976E-10	7.9160E-01	7.0433E-10
458.	EB3	1.4731E-05	1.0001E+00	9.9999E-01	4.2609E-09	1.6530E-01	7.0433E-10
459.	ISOF	1.2382E-05	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	5.9205E-10
460.	DV11	1.0876E-05	1.0022E+00	9.9999E-01	1.0418E-07	4.8650E-03	5.2000E-10
461.	CST1	1.0754E-05	0.0000E+00	1.0000E+00	0.0000E+00	3.8074E-05	5.1416E-10
462.	ISO2	1.0593E-05	1.0025E+00	9.9999E-01	1.1953E-07	4.2375E-03	5.0651E-10
463.	IVC2	1.0204E-05	0.0000E+00	9.9999E-01	0.0000E+00	4.9663E-05	4.8787E-10
464.	A3EB3	1.0134E-05	1.0004E+00	9.9999E-01	2.0801E-08	2.1620E-02	4.8455E-10
465.	OG161	8.4598E-06	7.0906E-01	1.0002E+00	-1.3919E-05	5.9198E-04	4.0449E-10
466.	CSTF	7.4288E-06	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.5520E-10
467.	SHUT11	7.0930E-06	7.6719E-01	1.0000E+00	-1.1133E-05	1.0750E-04	3.3914E-10
468.	HUM1	7.0236E-06	6.4108E-01	1.0003E+00	-1.7173E-05	7.0813E-04	3.3582E-10
469.	RPD1	6.5002E-06	9.8286E-01	1.0001E+00	-8.2643E-07	8.5010E-03	3.1080E-10
470.	LT44	5.5980E-06	1.0000E+00	9.9999E-01	2.8784E-10	9.2990E-01	2.6766E-10
471.	LM1F	5.5980E-06	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.6766E-10
472.	LM2F	5.5980E-06	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.6766E-10
473.	LT2F	5.5980E-06	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.6766E-10
474.	LT33	5.5980E-06	1.0000E+00	1.0000E+00	2.0964E-09	6.6410E-02	2.6766E-10
475.	LT1F	5.5980E-06	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.6766E-10
476.	RG1	5.3755E-06	5.2061E-01	1.0003E+00	-2.2934E-05	5.4206E-04	2.5702E-10
477.	SW1D1	4.9493E-06	9.9571E-01	1.0001E+00	-2.0797E-07	1.3070E-02	2.3664E-10
478.	OF4	4.9373E-06	9.9356E-01	1.0001E+00	-3.1035E-07	7.7770E-03	2.3607E-10
479.	AA1	4.8659E-06	7.0862E-01	1.0001E+00	-1.3939E-05	4.8300E-04	2.3265E-10
480.	SW1C1	4.7491E-06	9.9268E-01	1.0001E+00	-3.5423E-07	1.2520E-02	2.2707E-10
481.	MT31	4.5966E-06	7.1169E-01	1.0002E+00	-1.3795E-05	7.5428E-04	2.1978E-10
482.	OSP2	4.3547E-06	9.8016E-01	1.0001E+00	-9.5422E-07	5.7740E-03	2.0821E-10
483.	HXD1	3.9484E-06	9.8016E-01	1.0001E+00	-9.5368E-07	5.2080E-03	1.8879E-10
484.	HXC1	3.9483E-06	9.7810E-01	1.0001E+00	-1.0528E-06	5.3540E-03	1.8878E-10

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
485.	HXB1	3.9478E-06	9.7985E-01	1.0001E+00	-9.6844E-07	5.2700E-03	1.8876E-10
486.	LC1	3.9473E-06	9.8489E-01	1.0001E+00	-7.2663E-07	5.8080E-03	1.8873E-10
487.	RJ1	3.8307E-06	4.8233E-01	1.0001E+00	-2.4756E-05	1.6143E-04	1.8316E-10
488.	OIV1	3.2319E-06	9.2750E-01	1.0002E+00	-3.4742E-06	2.2560E-03	1.5453E-10
489.	UB42C1	3.0477E-06	7.2397E-01	1.0000E+00	-1.3199E-05	1.2844E-04	1.4572E-10
490.	RV01	2.8104E-06	0.0000E+00	1.0000E+00	0.0000E+00	1.3220E-05	1.3437E-10
491.	LPC4	2.7312E-06	1.0028E+00	1.0000E+00	1.3394E-07	2.8416E-04	1.3059E-10
492.	SHT21	2.2756E-06	7.2239E-01	1.0000E+00	-1.3275E-05	1.0750E-04	1.0880E-10
493.	DN3	0.0000E+00	9.5560E-01	1.0001E+00	-2.1269E-06	1.8957E-03	0.0000E+00
494.	DCA2	0.0000E+00	9.9751E-01	1.0001E+00	-1.2180E-07	2.4318E-02	0.0000E+00
495.	DJ2	0.0000E+00	9.9850E-01	1.0000E+00	-7.2972E-08	1.4710E-02	0.0000E+00
496.	DI3	0.0000E+00	9.9785E-01	1.0000E+00	-1.0521E-07	2.1660E-02	0.0000E+00
497.	DJ3	0.0000E+00	9.9791E-01	1.0000E+00	-1.0150E-07	1.4780E-02	0.0000E+00
498.	DI2	0.0000E+00	9.9850E-01	1.0000E+00	-7.2959E-08	1.4530E-02	0.0000E+00
499.	DN2	0.0000E+00	8.1664E-01	1.0001E+00	-8.7700E-06	3.3726E-04	0.0000E+00
500.	DN1	0.0000E+00	5.5509E-01	1.0001E+00	-2.1278E-05	2.2495E-04	0.0000E+00
501.	DL2	0.0000E+00	9.9787E-01	1.0000E+00	-1.0209E-07	1.9190E-03	0.0000E+00
502.	DJ4	0.0000E+00	9.9707E-01	1.0001E+00	-1.4331E-07	2.1630E-02	0.0000E+00
503.	DJ6	0.0000E+00	9.9993E-01	1.0000E+00	-3.5430E-09	1.6200E-03	0.0000E+00
504.	SW1AB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
505.	DV28	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
506.	DV29	0.0000E+00	1.0000E+00	1.0000E+00	-2.0712E-10	5.5550E-03	0.0000E+00
507.	RVD13	0.0000E+00	9.9989E-01	1.0000E+00	-5.1917E-09	6.9000E-03	0.0000E+00
508.	DW1	0.0000E+00	9.8129E-01	1.0000E+00	-8.9451E-07	5.2964E-05	0.0000E+00
509.	DV12	0.0000E+00	9.9999E-01	1.0000E+00	-5.9764E-10	8.4020E-03	0.0000E+00
510.	DV22	0.0000E+00	9.9999E-01	1.0000E+00	-5.5679E-10	6.6070E-02	0.0000E+00
511.	DV18	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
512.	DT21	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	4.0320E-06	0.0000E+00
513.	EB2	0.0000E+00	9.9986E-01	1.0000E+00	-6.5819E-09	6.3160E-03	0.0000E+00
514.	EB13	0.0000E+00	9.9898E-01	1.0000E+00	-4.8805E-08	2.1650E-03	0.0000E+00
515.	RPT8	0.0000E+00	9.9999E-01	1.0000E+00	-6.2686E-10	1.4739E-04	0.0000E+00
516.	DW2	0.0000E+00	9.9947E-01	1.0000E+00	-2.5619E-08	4.9566E-03	0.0000E+00
517.	DWP1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.8311E-05	0.0000E+00
518.	EB12	0.0000E+00	9.9554E-01	1.0000E+00	-2.1394E-07	3.7380E-03	0.0000E+00
519.	SHT27	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.5490E-05	0.0000E+00
520.	DN3	0.0000E+00	9.8735E-01	1.0000E+00	-6.0562E-07	1.1079E-03	0.0000E+00
521.	DN2	0.0000E+00	7.2990E-01	1.0001E+00	-1.2918E-05	2.2887E-04	0.0000E+00
522.	SGT6	0.0000E+00	9.9954E-01	1.0000E+00	-2.2791E-08	2.8724E-02	0.0000E+00
523.	SGT5	0.0000E+00	9.9622E-01	1.0001E+00	-1.8569E-07	2.6906E-02	0.0000E+00
524.	SGTOPS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
525.	DN1	0.0000E+00	6.2668E-01	1.0000E+00	-1.7852E-05	1.2147E-04	0.0000E+00
526.	DT11	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	4.0630E-06	0.0000E+00
527.	RV08	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
528.	DO2	0.0000E+00	8.1131E-01	1.0000E+00	-9.0239E-06	2.2887E-04	0.0000E+00

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
529.	RV02	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.3720E-05	0.0000E+00
530.	SGT4	0.0000E+00	9.9989E-01	1.0000E+00	-5.4329E-09	1.2845E-02	0.0000E+00
531.	SGT2	0.0000E+00	9.9492E-01	1.0001E+00	-2.4559E-07	1.1099E-02	0.0000E+00
532.	DO1	0.0000E+00	6.4735E-01	1.0000E+00	-1.6863E-05	1.2147E-04	0.0000E+00
533.	RPT5	0.0000E+00	9.9504E-01	1.0000E+00	-2.3906E-07	8.2781E-03	0.0000E+00
534.	UB41B1	0.0000E+00	7.0563E-01	1.0001E+00	-1.4078E-05	2.3330E-04	0.0000E+00
535.	UB41B3	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	3.5360E-05	0.0000E+00
536.	UB41A2	0.0000E+00	9.9558E-01	1.0000E+00	-2.1119E-07	2.2390E-04	0.0000E+00
537.	UB41A1	0.0000E+00	7.0563E-01	1.0001E+00	-1.4078E-05	2.3330E-04	0.0000E+00
538.	UB42A3	0.0000E+00	9.9561E-01	1.0000E+00	-2.0979E-07	2.2400E-04	0.0000E+00
539.	A3EC9	0.0000E+00	9.9999E-01	1.0000E+00	-4.8506E-10	1.0460E-03	0.0000E+00
540.	UB42A1	0.0000E+00	7.0560E-01	1.0001E+00	-1.4080E-05	2.3330E-04	0.0000E+00
541.	A3EC8	0.0000E+00	9.9987E-01	1.0000E+00	-6.5442E-09	1.8040E-02	0.0000E+00
542.	A3ED35	0.0000E+00	9.9879E-01	1.0000E+00	-5.8055E-08	1.4090E-03	0.0000E+00
543.	A3ED32	0.0000E+00	9.8162E-01	1.0000E+00	-8.8025E-07	1.3790E-03	0.0000E+00
544.	A3ED5	0.0000E+00	9.9990E-01	1.0000E+00	-4.8549E-09	2.2550E-02	0.0000E+00
545.	A3ED10	0.0000E+00	9.9979E-01	1.0000E+00	-1.0072E-08	1.8130E-02	0.0000E+00
546.	A3ED11	0.0000E+00	9.9999E-01	1.0000E+00	-4.8499E-10	9.0760E-04	0.0000E+00
547.	A3ED23	0.0000E+00	8.7253E-01	1.0002E+00	-6.1032E-06	1.3560E-03	0.0000E+00
548.	TBB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
549.	V2S	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
550.	V3S	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
551.	V1S	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
552.	UB43B1	0.0000E+00	7.0121E-01	1.0001E+00	-1.4289E-05	2.3311E-04	0.0000E+00
553.	WETS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
554.	A3EB5	0.0000E+00	9.9718E-01	1.0000E+00	-1.3505E-07	1.4090E-03	0.0000E+00
555.	A3EB4	0.0000E+00	9.9993E-01	1.0000E+00	-3.3496E-09	2.2560E-02	0.0000E+00
556.	UB42B1	0.0000E+00	7.0560E-01	1.0001E+00	-1.4080E-05	2.3330E-04	0.0000E+00
557.	A3EC5	0.0000E+00	9.9993E-01	1.0000E+00	-3.2355E-09	2.2070E-02	0.0000E+00
558.	UB42C2	0.0000E+00	9.9999E-01	1.0000E+00	-2.8074E-10	1.5245E-04	0.0000E+00
559.	UB42B4	0.0000E+00	9.9561E-01	1.0000E+00	-2.0979E-07	2.2410E-04	0.0000E+00
560.	A3EC14	0.0000E+00	9.0852E-01	1.0001E+00	-4.3800E-06	1.3790E-03	0.0000E+00
561.	UB43A1	0.0000E+00	7.0121E-01	1.0001E+00	-1.4289E-05	2.2316E-04	0.0000E+00
562.	A3EC18	0.0000E+00	9.9309E-01	1.0000E+00	-3.3084E-07	1.4090E-03	0.0000E+00
563.	SW1BB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
564.	SW1D8	0.0000E+00	9.9785E-01	1.0000E+00	-1.0423E-07	1.2880E-02	0.0000E+00
565.	CD2	0.0000E+00	1.0000E+00	1.0000E+00	-1.2397E-10	1.3940E-03	0.0000E+00
566.	CDA1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
567.	SW1D6	0.0000E+00	9.9702E-01	1.0000E+00	-1.4448E-07	1.3890E-02	0.0000E+00
568.	AD4	0.0000E+00	9.6270E-01	1.0000E+00	-1.7850E-06	9.7240E-04	0.0000E+00
569.	SW1DB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
570.	AD5	0.0000E+00	9.9923E-01	1.0000E+00	-3.6794E-08	1.8100E-04	0.0000E+00
571.	AD31	0.0000E+00	1.0000E+00	1.0000E+00	-1.0443E-10	4.8320E-04	0.0000E+00
572.	SW1CB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

Sorted by Importance

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......	SF.Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
573.	CRD3	0.0000E+00	1.0000E+00	1.0000E+00	-1.9426E-10	2.0415E-01	0.0000E+00
574.	CS6	0.0000E+00	9.9792E-01	1.0000E+00	-9.9355E-08	9.9380E-04	0.0000E+00
575.	SW1D5	0.0000E+00	9.9707E-01	1.0000E+00	-1.4171E-07	1.2880E-02	0.0000E+00
576.	SW1D4	0.0000E+00	9.9995E-01	1.0000E+00	-2.4009E-09	8.1210E-02	0.0000E+00
577.	CIL1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	3.6609E-06	0.0000E+00
578.	AB2	0.0000E+00	9.3107E-01	1.0001E+00	-3.2992E-06	1.0260E-03	0.0000E+00
579.	AC14	0.0000E+00	9.7348E-01	1.0000E+00	-1.2693E-06	1.0260E-03	0.0000E+00
580.	AC13	0.0000E+00	1.0000E+00	1.0000E+00	-2.3488E-10	4.8320E-04	0.0000E+00
581.	SW2D3	0.0000E+00	1.0000E+00	1.0000E+00	-2.5130E-10	7.0110E-02	0.0000E+00
582.	SW2D2	0.0000E+00	9.9573E-01	1.0000E+00	-2.0662E-07	1.1170E-02	0.0000E+00
583.	TBO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
584.	AB3	0.0000E+00	1.0000E+00	1.0000E+00	-2.3270E-10	1.8110E-04	0.0000E+00
585.	AD23	0.0000E+00	9.6719E-01	1.0000E+00	-1.5703E-06	9.9520E-04	0.0000E+00
586.	SW2C2	0.0000E+00	9.9231E-01	1.0001E+00	-3.7101E-07	8.8990E-03	0.0000E+00
587.	SW2C3	0.0000E+00	9.9992E-01	1.0000E+00	-4.0416E-09	7.6260E-02	0.0000E+00
588.	AD22	0.0000E+00	1.0000E+00	1.0000E+00	-2.3488E-10	4.8330E-04	0.0000E+00
589.	AC17	0.0000E+00	1.0000E+00	1.0000E+00	-1.0443E-10	4.8300E-04	0.0000E+00
590.	AC4	0.0000E+00	9.5922E-01	1.0000E+00	-1.9520E-06	9.9520E-04	0.0000E+00
591.	AC5	0.0000E+00	9.9929E-01	1.0000E+00	-3.4169E-08	1.8100E-04	0.0000E+00
592.	NRVO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
593.	KHS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
594.	PCA2	0.0000E+00	9.9684E-01	1.0000E+00	-1.5184E-07	4.8760E-03	0.0000E+00
595.	L8H2	0.0000E+00	9.9974E-01	1.0000E+00	-1.2760E-08	1.1184E-02	0.0000E+00
596.	OUB1	0.0000E+00	9.9997E-01	1.0000E+00	-1.3965E-09	2.8540E-03	0.0000E+00
597.	JHS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
598.	KFS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
599.	KCS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
600.	JC1	0.0000E+00	1.0000E+00	1.0000E+00	-1.9760E-10	4.4860E-02	0.0000E+00
601.	LFS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
602.	LECS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
603.	LM22	0.0000E+00	9.9912E-01	1.0000E+00	-4.2642E-08	1.0670E-02	0.0000E+00
604.	L8H3	0.0000E+00	9.9989E-01	1.0000E+00	-5.4547E-09	1.6763E-02	0.0000E+00
605.	L8TR1	0.0000E+00	9.9918E-01	1.0000E+00	-3.9455E-08	6.8250E-03	0.0000E+00
606.	OSP3	0.0000E+00	9.6653E-01	1.0000E+00	-1.6006E-06	7.2130E-05	0.0000E+00
607.	OSV1	0.0000E+00	9.8755E-01	1.0000E+00	-5.9674E-07	2.3330E-03	0.0000E+00
608.	OSD2	0.0000E+00	9.9952E-01	1.0000E+00	-2.2949E-08	1.5380E-03	0.0000E+00
609.	HXD8	0.0000E+00	9.9460E-01	1.0000E+00	-2.5936E-07	5.3540E-03	0.0000E+00
610.	HXD4	0.0000E+00	9.9949E-01	1.0000E+00	-2.5050E-08	2.0830E-02	0.0000E+00
611.	INAS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
612.	INCS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
613.	HXD11	0.0000E+00	9.9988E-01	1.0000E+00	-5.8628E-09	8.4500E-03	0.0000E+00
614.	HXD3	0.0000E+00	9.9986E-01	1.0000E+00	-6.9051E-09	1.7120E-02	0.0000E+00
615.	HXD2	0.0000E+00	9.9996E-01	1.0000E+00	-1.9700E-09	5.2700E-03	0.0000E+00
616.	JAS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

Sorted by Importance

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
617.	R480B	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
618.	INHS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
619.	IVO1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.1620E-15	0.0000E+00
620.	INDS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
621.	RBC10	0.0000E+00	9.9998E-01	1.0000E+00	-8.0261E-10	7.1009E-03	0.0000E+00
622.	INFS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
623.	RBISOS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
624.	OF1	0.0000E+00	9.9986E-01	1.0000E+00	-6.5989E-09	3.8410E-04	0.0000E+00
625.	MSVC1	0.0000E+00	9.9918E-01	1.0000E+00	-3.9189E-08	7.7830E-05	0.0000E+00
626.	MT21	0.0000E+00	7.0560E-01	1.0000E+00	-1.4078E-05	1.1271E-04	0.0000E+00
627.	OEEB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
628.	LVP1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.9975E-05	0.0000E+00
629.	LVS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
630.	LVP2	0.0000E+00	9.9999E-01	1.0000E+00	-2.6864E-10	3.6651E-03	0.0000E+00
631.	LT45	0.0000E+00	9.8251E-01	1.0000E+00	-8.3851E-07	2.6530E-03	0.0000E+00
632.	OAL2	0.0000E+00	9.9736E-01	1.0000E+00	-1.2844E-07	1.8550E-02	0.0000E+00
633.	OBC1	0.0000E+00	9.9918E-01	1.0000E+00	-3.9458E-08	7.9338E-04	0.0000E+00
634.	NRUB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
635.	NAO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
636.	NBOCB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
637.	NIEB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
638.	NH23	0.0000E+00	9.8251E-01	1.0001E+00	-8.3883E-07	3.0330E-03	0.0000E+00
639.	LM34	0.0000E+00	9.9999E-01	1.0000E+00	-2.6821E-10	2.0690E-03	0.0000E+00
640.	LPRESS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
641.	OPTR1	0.0000E+00	9.9238E-01	1.0000E+00	-3.6517E-07	1.7960E-03	0.0000E+00
642.	OJC1	0.0000E+00	1.0000E+00	1.0000E+00	-1.9498E-10	3.2040E-02	0.0000E+00
643.	OHS3	0.0000E+00	9.9108E-01	1.0000E+00	-4.2877E-07	5.2570E-03	0.0000E+00
644.	LM43	0.0000E+00	9.9970E-01	1.0000E+00	-1.4925E-08	4.0840E-02	0.0000E+00
645.	ORP1	0.0000E+00	6.0873E-01	1.0000E+00	-1.8710E-05	9.5840E-05	0.0000E+00
646.	LM45	0.0000E+00	9.9999E-01	1.0000E+00	-2.6821E-10	2.0510E-03	0.0000E+00
647.	OHC2	0.0000E+00	9.4741E-01	1.0000E+00	-2.5168E-06	9.1750E-04	0.0000E+00
648.	OHC4	0.0000E+00	9.9118E-01	1.0001E+00	-4.2596E-07	1.0350E-02	0.0000E+00
649.	OHL2	0.0000E+00	9.9997E-01	1.0000E+00	-1.3681E-09	4.4930E-03	0.0000E+00
650.	OHC3	0.0000E+00	9.5169E-01	1.0000E+00	-2.3115E-06	7.3590E-04	0.0000E+00
651.	LT34	0.0000E+00	9.8251E-01	1.0001E+00	-8.3875E-07	2.9400E-03	0.0000E+00
652.	OHS1	0.0000E+00	9.7721E-01	1.0002E+00	-1.0989E-06	8.4290E-03	0.0000E+00
653.	LT43	0.0000E+00	9.9968E-01	1.0000E+00	-1.5529E-08	4.9890E-03	0.0000E+00
654.	RPT2	0.0000E+00	9.9994E-01	1.0000E+00	-2.7672E-09	1.1123E-04	0.0000E+00
655.	FDB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
656.	FCB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
657.	FEB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
658.	FFB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
659.	EPR6B	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
660.	FBB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

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Group Frequency = 4.7813E-05

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
661.	FAB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
662.	EPR308	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
663.	FHB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
664.	RP1	0.0000E+00	3.7173E-01	1.0002E+00	-3.0048E-05	2.5662E-04	0.0000E+00
665.	RO1	0.0000E+00	3.5565E-01	1.0002E+00	-3.0817E-05	2.7103E-04	0.0000E+00
666.	RPB2	0.0000E+00	9.9670E-01	1.0001E+00	-1.6090E-07	1.9040E-02	0.0000E+00
667.	FG3	0.0000E+00	9.9996E-01	1.0000E+00	-2.2085E-09	2.3570E-01	0.0000E+00
668.	FH3	0.0000E+00	9.9989E-01	1.0000E+00	-5.1456E-09	1.5830E-02	0.0000E+00
669.	FGB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
670.	FWA1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
671.	RPS2	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.7848E-05	0.0000E+00
672.	RPS3	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.8701E-05	0.0000E+00
673.	RPS10	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.3696E-06	0.0000E+00
674.	EC3	0.0000E+00	9.4456E-01	1.0002E+00	-2.6607E-06	3.7180E-03	0.0000E+00
675.	RPT1	0.0000E+00	9.7852E-01	1.0000E+00	-1.0270E-06	1.0732E-04	0.0000E+00
676.	RPS7	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.7848E-05	0.0000E+00
677.	RPS8	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.7848E-05	0.0000E+00
678.	ED4	0.0000E+00	9.9986E-01	1.0000E+00	-6.9856E-09	9.4090E-03	0.0000E+00
679.	RPD8	0.0000E+00	9.9138E-01	1.0001E+00	-4.1762E-07	1.2750E-02	0.0000E+00
680.	ED25	0.0000E+00	9.9966E-01	1.0000E+00	-1.6272E-08	1.3670E-02	0.0000E+00
681.	ED3	0.0000E+00	9.9333E-01	1.0000E+00	-3.2020E-07	3.7070E-03	0.0000E+00
682.	RPSO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
683.	EC4	0.0000E+00	9.9963E-01	1.0000E+00	-1.7874E-08	1.2000E-02	0.0000E+00
684.	ED16	0.0000E+00	9.9481E-01	1.0000E+00	-2.4906E-07	3.7180E-03	0.0000E+00
685.	HXC4	0.0000E+00	9.9988E-01	1.0000E+00	-5.9098E-09	8.5850E-03	0.0000E+00
686.	HRLO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
687.	HR60	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
688.	HSO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
689.	RCW9	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.5659E-05	0.0000E+00
690.	RF1	0.0000E+00	5.1069E-01	1.0001E+00	-2.3402E-05	2.7103E-04	0.0000E+00
691.	RE1	0.0000E+00	5.7517E-01	1.0001E+00	-2.0318E-05	2.7103E-04	0.0000E+00
692.	HPL2	0.0000E+00	9.9997E-01	1.0000E+00	-1.4840E-09	8.2230E-02	0.0000E+00
693.	GHB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
694.	RCL2	0.0000E+00	9.9997E-01	1.0000E+00	-1.5252E-09	1.0700E-01	0.0000E+00
695.	HUM3	0.0000E+00	8.2168E-01	1.0001E+00	-8.5304E-06	5.1983E-04	0.0000E+00
696.	HXB2	0.0000E+00	9.9948E-01	1.0000E+00	-2.5481E-08	2.0830E-02	0.0000E+00
697.	RCW7	0.0000E+00	9.5203E-01	1.0001E+00	-2.2984E-06	2.0175E-03	0.0000E+00
698.	RCW2	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.4872E-05	0.0000E+00
699.	HUM2	0.0000E+00	9.9576E-01	1.0000E+00	-2.0291E-07	4.3520E-04	0.0000E+00
700.	RN1	0.0000E+00	4.5860E-01	1.0002E+00	-2.5895E-05	3.4305E-04	0.0000E+00
701.	RL5	0.0000E+00	9.9738E-01	1.0000E+00	-1.2517E-07	9.7800E-04	0.0000E+00
702.	GBB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
703.	RL1	0.0000E+00	6.2857E-01	1.0001E+00	-1.7762E-05	1.3490E-04	0.0000E+00
704.	GCB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

MODEL Name: BFNFINAL

Split Fraction Importance for Group : ALL

Sorted by Importance

Group Frequency = 4.7813E-05

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
705.	FWC1	0.0000E+00	9.9986E-01	1.0000E+00	-6.5969E-09	8.6480E-05	0.0000E+00
706.	GAB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
707.	RM1	0.0000E+00	5.7517E-01	1.0001E+00	-2.0319E-05	3.4305E-04	0.0000E+00
708.	GH8	0.0000E+00	9.9993E-01	1.0000E+00	-4.6183E-09	2.4680E-01	0.0000E+00
709.	GFB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
710.	GEB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
711.	GGB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
712.	RK2	0.0000E+00	9.8453E-01	1.0000E+00	-7.4035E-07	1.0160E-03	0.0000E+00
713.	RK1	0.0000E+00	6.2857E-01	1.0001E+00	-1.7762E-05	1.3490E-04	0.0000E+00
714.	GDB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

MODEL Name: BFNHA   Top-Ranking Sequences Contributing to Group : ALL Frequency   08:05:37 14 AUG 1992

Rank No.	Sequence Description	Guaranteed Events/Comments	End State	Frequency (per year)	Percent
1	TURBINE BUILDING FLOOD - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	MLCV	1.25E-04	6.66
2	TURBINE BUILDING FLOOD - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION	OIAV	1.12E-04	5.99

		- VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE			
3	TURBINE BUILDING FLOOD - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	1.09E-04	5.83
4	INADVERTENT OPENING OF THREE OR MORE SRVS - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 3 OR MORE VALVES STUCK OPEN - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	3.49E-05	1.86
5	TURBINE BUILDING FLOOD - OPERATOR FAILS TO ESTABLISH TORUS COOLING - SHUTDOWN COOLING HARDWARE UNAVAILABLE	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE	MLCV	3.06E-05	1.63

		- PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
6	TURBINE TRIP - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - SRV ACTUATION FAILURE WHEN FEEDWATER AVAILABLE	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - FIRE WATER UNAVAILABLE	MIAV	2.40E-05	1.28
7	TURBINE TRIP - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	2.40E-05	1.28
8	INADVERTENT (OTHER) SCRAM - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - SRV ACTUATION FAILURE WHEN FEEDWATER AVAILABLE	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - FIRE WATER UNAVAILABLE	MIAV	2.35E-05	1.25

9	INADVERTENT (OTHER) SCRAM - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	2.34E-05	1.25
10	TURBINE TRIP - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	2.34E-05	1.25
11	INADVERTENT (OTHER) SCRAM - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	2.28E-05	1.22
12	TOTAL LOSS OF OFFSITE POWER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- 500 KV OFFSITE GRID UNAVAILABLE - 161 KV OFFSITE GRID UNAVAILABLE - 4KV UNIT BD 1A UNAVAILABLE - 4KV UNIT BD 1B UNAVAILABLE	MLCV	2.01E-05	1.07

- OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING

- 4KV UNIT BD 2A UNAVAILABLE
- 4KV UNIT BD 2B UNAVAILABLE
- SHUTDOWN BUS 1 UNAVAILABLE
- SHUTDOWN BUS 2 UNAVAILABLE
- 4KV UNIT BD 2C POWER UNAVAILABLE
- 4KV UNIT BD 3A UNAVAILABLE
- 4KV UNIT BD 3B UNAVAILABLE
- VESSEL INSTRUMENT TAP I CONDITION
  STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION
  STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- HIGH VESSEL PRESSURE AT MELT-THROUGH
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC
- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
- NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT
- NOT INTACT, NO WTR TO DEBRIS, VENT
- NOT INTACT, NO WTR TO DEBRIS, NO VENT
- NOT BYPASS, WTR TO DEBRIS
- NOT BYPASS, NO WTR TO DERBIS
- NOT EARLY, WTR TO DEBRIS, DWS
- NOT EARLY, WTR TO DEBRIS, NO DWS
- NOT EARLY, NO WTR TO DEBRIS, NO DWS
- FIRE WATER UNAVAILABLE

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13 TOTAL LOSS OF OFFSITE POWER — OIAV — 1.81E-05 — .96

- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM
- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-
  STATE - PLANT DEPRESSURIZED
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT

- 500 KV OFFSITE GRID UNAVAILABLE
- 161 KV OFFSITE GRID UNAVAILABLE
- 4KV UNIT BD 1A UNAVAILABLE
- 4KV UNIT BD 1B UNAVAILABLE
- 4KV UNIT BD 2A UNAVAILABLE
- 4KV UNIT BD 2B UNAVAILABLE
- SHUTDOWN BUS 1 UNAVAILABLE
- SHUTDOWN BUS 2 UNAVAILABLE
- 4KV UNIT BD 2C POWER UNAVAILABLE
- 4KV UNIT BD 3A UNAVAILABLE
- 4KV UNIT BD 3B UNAVAILABLE
- VESSEL INSTRUMENT TAP I CONDITION
  STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION
  STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- HPCI/RCIC UNAVAILABLE FOR 24 HOURS

		- CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE			
14	RECIRC DISCHARGE LINE BREAK - OPERATOR FAILS TO INITIATE SP COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - ALTERNATE INJECTION UNAVAILABLE FOR DEBRIS BED COOLING - CONTAINMENT VENT UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE.	OLCV	1.78E-05	.95
15	MEDIUM LOCA - OPERATOR FAILS TO INITIATE SP COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - ALTERNATE INJECTION UNAVAILABLE FOR DEBRIS BED COOLING - CONTAINMENT VENT UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	1.73E-05	.92
16	TURBINE BUILDING FLOOD - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING - REACTOR BUILDING ISOLATION FAILURE	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE	MLCZ	1.68E-05	.90

		- RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VA[illegible]UCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - REACTOR BUILDING NOT ISOLATED - FIRE WATER UNAVAILABLE			
17	TURBINE BUILDING FLOOD - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - REACTOR BUILDING ISOLATION FAILURE	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - REACTOR BUILDING NOT ISOLATED - FIRE WATER UNAVAILABLE	OIAZ	1.51E-05	.81
18	TOTAL LOSS OF OFFSITE POWER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- 500 KV OFFSITE GRID UNAVAILABLE - 161 KV OFFSITE GRID UNAVAILABLE - 4KV UNIT BD 1A UNAVAILABLE - 4KV UNIT BD 1B UNAVAILABLE	OIAV	1.49E-05	.80

		- 4KV UNIT BD 2A UNAVAILABLE - 4KV UNIT BD 2B UNAVAILABLE - SHUTDOWN BUS 1 UNAVAILABLE - SHUTDOWN BUS 2 UNAVAILABLE - 4KV UNIT BD 2C POWER UNAVAILABLE - 4KV UNIT BD 3A UNAVAILABLE - 4KV UNIT BD 3B UNAVAILABLE - VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE			
19	TURBINE BUILDING FLOOD - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING - REACTOR BUILDING ISOLATION FAILURE	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - REACTOR BUILDING NOT ISOLATED - FIRE WATER UNAVAILABLE	OLCZ	1.47E-05	.79

20	TURBINE BUILDING FLOOD - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING - OPERATOR FAILS TO INITIATE DW SPRAY	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NO WATER ON DRYWELL FLOOR AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - NOT LATE, WTR TO DEBRIS, DWS - FIRE WATER UNAVAILABLE	NLFV	1.39E-05	.74
21	TURBINE BUILDING FLOOD - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED	MLCV	1.39E-05	.74

		- HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO.WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
22	TURBINE BUILDING FLOOD - OPERATOR FAILA TO PLACE MODE SWITCH IN REFUEL THEN SHUTDOWN - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	MLCV	1.39E-05	.74
23	TURBINE BUILDING FLOOD - OPERATOR FAILS TO START HPCI AND/OR RCIC - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE	MLCV	1.38E-05	.74

- DRYWELL CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- HIGH VESSEL PRESSURE AT MELT-THROUGH
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC
- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
- NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT
- NOT INTACT, NO WTR TO DEBRIS, VENT
- NOT INTACT, NO WTR TO DEBRIS, NO VENT
- NOT BYPASS, WTR TO DEBRIS
- NOT BYPASS, NO WTR TO DERBIS
- NOT EARLY, WTR TO DEBRIS, DWS
- NOT EARLY, WTR TO DEBRIS, NO DWS
- NOT EARLY, NO WTR TO DEBRIS, NO DWS
- FIRE WATER UNAVAILABLE

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24 TURBINE BUILDING FLOOD — PIDV — 1.25E-05 — .67

- OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM
- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-
  STATE - PLANT DEPRESSURIZED
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- OPERATOR FAILS TO INITIATE DW SPRAY

- VESSEL INSTRUMENT TAP I CONDITION
  STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION
  STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- RAW COOLING WATER SYSTEM UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- DRYWELL CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- HPCI/RCIC UNAVAILABLE FOR 24 HOURS
- CONDENSER UNAVAILABLE AS HEAT SINK
- CONDENSATE UNAVAILABLE FOR INJECTION
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- NO WATER ON DRYWELL FLOOR AT MELT-THROUGH
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- FIRE WATER UNAVAILABLE

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25 TURBINE BUILDING FLOOD — OLCV — 1.25E-05 — .67

- OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM
- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-
  STATE - PLANT DEPRESSURIZED

- VESSEL INSTRUMENT TAP I CONDITION
  STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION
  STATE - NO TAP FAILURE

- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING

- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- RAW COOLING WATER SYSTEM UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- DRYWELL CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- HPCI/RCIC UNAVAILABLE FOR 24 HOURS
- CONDENSER UNAVAILABLE AS HEAT SINK
- CONDENSATE UNAVAILABLE FOR INJECTION
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC
- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
- NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT
- NOT INTACT, NO WTR TO DEBRIS, VENT
- NOT INTACT, NO WTR TO DEBRIS, NO VENT
- NOT BYPASS, WTR TO DEBRIS
- NOT BYPASS, NO WTR TO DERBIS
- NOT EARLY, WTR TO DEBRIS, DWS
- NOT EARLY, WTR TO DEBRIS, NO DWS
- NOT EARLY, NO WTR TO DEBRIS, NO DWS
- FIRE WATER UNAVAILABLE

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26 TURBINE BUILDING FLOOD — MIAV 1.25E-05 .67

- OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM
- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT

- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- RAW COOLING WATER SYSTEM UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- DRYWELL CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- HPCI/RCIC UNAVAILABLE FOR 24 HOURS
- CONDENSER UNAVAILABLE AS HEAT SINK
- CONDENSATE UNAVAILABLE FOR INJECTION
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- HIGH VESSEL PRESSURE AT MELT-THROUGH
- FIRE WATER UNAVAILABLE

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27 TURBINE BUILDING FLOOD — OIAV 1.25E-05 .67

- OPERATOR FAILA TO PLACE MODE SWITCH IN REFUEL THEN SHUTDOWN
- OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM
- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED

- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE

	- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE			
28	TURBINE BUILDING FLOOD - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	1.25E-05	.67
29	TURBINE BUILDING FLOOD - OPERATOR FAILS TO START HPCI AND/OR RCIC - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	1.24E-05	.66
30	TURBINE BUILDING FLOOD	- VESSEL INSTRUMENT TAP I CONDITION	MLCV	1.22E-05	.65

- HPCI UNAVAILABLE (6 HOURS)
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING

STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION
  STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- RAW COOLING WATER SYSTEM UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- DRYWELL CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- HIGH VESSEL PRESSURE AT MELT-THROUGH
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC
- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
- NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT
- NOT INTACT, NO WTR TO DEBRIS, VENT
- NOT INTACT, NO WTR TO DEBRIS, NO VENT
- NOT BYPASS, WTR TO DEBRIS
- NOT BYPASS, NO WTR TO DERBIS
- NOT EARLY, WTR TO DEBRIS, DWS
- NOT EARLY, WTR TO DEBRIS, NO DWS
- NOT EARLY, NO WTR TO DEBRIS, NO DWS
- FIRE WATER UNAVAILABLE

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31 TURBINE BUILDING FLOOD — PLFV — 1.21E-05 — .65

- OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM
- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES-
  STATE - PLANT DEPRESSURIZED
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- OPERATOR FAILS TO INITIATE DW SPRAY

- VESSEL INSTRUMENT TAP I CONDITION
  STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION
  STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- RAW COOLING WATER SYSTEM UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- DRYWELL CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- HPCI/RCIC UNAVAILABLE FOR 24 HOURS
- CONDENSER UNAVAILABLE AS HEAT SINK
- CONDENSATE UNAVAILABLE FOR INJECTION
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- NO WATER ON DRYWELL FLOOR AT MELT-THROUGH
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT

		- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - NOT LATE, WTR TO DEBRIS, DWS - FIRE WATER UNAVAILABLE			
32	TURBINE BUILDING FLOOD - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT [illegible] CONDITION STATE - NO TAP FAILURE VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	MLCV	1.21E-05	.65
33	TURBINE BUILDING FLOOD - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO MANUALLY START RHR/CORE SPRAY - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)	OLCV	1.21E-05	.65

		STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
34	TURBINE BUILDING FLOOD - OPERATOR FAILA TO PLACE MODE SWITCH IN REFUEL THEN SHUTDOWN - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	1.21E-05	.65
35	TURBINE BUILDING FLOOD	- VESSEL INSTRUMENT TAP I CONDITION	OLCV	1.21E-05	.65

- OPERATOR FAILS TO START HPCI AND/OR RCIC
- OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM
- CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES
  STATE - PLANT DEPRESSURIZED
- OPERATOR FAILS TO ESTABLISH TORUS COOLING

  STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION
  STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- RAW COOLING WATER SYSTEM UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- DRYWELL CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- HPCI/RCIC UNAVAILABLE FOR 24 HOURS
- CONDENSER UNAVAILABLE AS HEAT SINK
- CONDENSATE UNAVAILABLE FOR INJECTION
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC
- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
- NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT
- NOT INTACT, NO WTR TO DEBRIS, VENT
- NOT INTACT, NO WTR TO DEBRIS, NO VENT
- NOT BYPASS, WTR TO DEBRIS
- NOT BYPASS, NO WTR TO DERBIS
- NOT EARLY, WTR TO DEBRIS, DWS
- NOT EARLY, WTR TO DEBRIS, NO DWS
- NOT EARLY, NO WTR TO DEBRIS, NO DWS
- FIRE WATER UNAVAILABLE

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36 TURBINE BUILDING FLOOD — MLCV — 1.14E-05 — .61

- OPERATOR FAILS TO MAINTAIN HP LVL CNTL (RCIC,HPCI)
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING

- VESSEL INSTRUMENT TAP I CONDITION
  STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION
  STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- RAW COOLING WATER SYSTEM UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- DRYWELL CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- HIGH VESSEL PRESSURE AT MELT-THROUGH
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC

		- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
37	TURBINE BUILDING FLOOD - OPERATOR FAILS TO MAINTAIN HP LVL CNTL (RCIC,HPCI) - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	1.14E-05	.61
38	TURBINE BUILDING FLOOD - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)	OLCV	1.10E-05	.59

		STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
39	TURBINE BUILDING FLOOD - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	1.09E-05	.58
40	TURBINE BUILDING FLOOD - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)	OLCV	1.07E-05	.57

		STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
41	TURBINE BUILDING FLOOD - OPERATOR FAILS TO MAINTAIN HP LVL CNTL (RCIC,HPCI) - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	1.02E-05	.55
42	TURBINE BUILDING FLOOD - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL	MIAV	9.86E-06	.53

		- FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - FIRE WATER UNAVAILABLE			
43	TURBINE BUILDING FLOOD - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	9.85E-06	.53
44	LOSS OF RAW COOLING WATER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS	MLCV	8.63E-06	.46

		- NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
45	CLOSURE OF ALL MSIVS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - OPERATOR FAILS TO MAINTAIN HP LVL CNTL (RCIC,HPCI) - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	8.61E-06	.46
46	CLOSURE OF ALL MSIVS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - OPERATOR FAILS TO INHIBIT CLOSURE OF MSIVS ON LEVEL - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	8.29E-06	.44
47	TURBINE BUILDING FLOOD - RCIC UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT	OLCV	8.17E-06	.44

		- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
48	TURBINE BUILDING FLOOD - RCIC UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	8.16E-06	.44
49	CLOSURE OF ALL MSIVS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - RFW HARDWARE UNAVAILABLE - OPERATOR FAILS TO COOLDOWN USING THE TBVS - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS	MLCV	8.07E-06	.43

		- NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
50	TURBINE BUILDING FLOOD - RCIC UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	7.95E-06	.42
51	LOSS OF RAW COOLING WATER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	7.76E-06	.41
52	TOTAL LOSS OF FEEDWATER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION	OIAV	7.31E-06	.39

	- OPERATOR FAILS TO MAINTAIN HP LVL CNTL (RCIC,HPCI) - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RFW HARDWARE UNAVAILABLE - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE			
53	LOSS OF RAW COOLING WATER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - CONDENSATE UNAVAILABLE FOR INJECTION - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	6.42E-06	.34
54	TOTAL LOSS OF FEEDWATER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RFW HARDWARE UNAVAILABLE - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	6.14E-06	.33
55	TURBINE BUILDING FLOOD - 250 V DC CONTROL POWER FOR 4KV SD BD 3ED UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- 250 RMOV BD 2A UNAVAILABLE - VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - POWER SUPPLY DIVISION II UNAVAILABLE - DIV II VESSEL LOW PRESSURE SIGNAL UNAVAILABLE - DIV II HI RX PRESS SIGNAL UNAVAILABLE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - RHRSW PUMP D1 (SWING PUMP) UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - HPCI UNAVAILABLE (6 HOURS) - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE	MLCV	6.12E-06	.33

		- SHUTDOWN COOLING HARDWARE UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
56	OTHER LARGE LOCA - OPERATOR FAILS TO INITIATE SP COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - ALTERNATE INJECTION UNAVAILABLE FOR DEBRIS BED COOLING - CONTAINMENT VENT UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	6.04E-06	.32
57	SCRAM REQUIRED (MANUAL SCRAMS) - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - SRV ACTUATION FAILURE WHEN FEEDWATER AVAILABLE	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - FIRE WATER UNAVAILABLE	MIAV	5.73E-06	.31
58	SCRAM REQUIRED (MANUAL SCRAMS) - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION	OIAV	5.73E-06	.31

	- OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE			
59	SCRAM REQUIRED (MANUAL SCRAMS) - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	5.58E-06	.30
60	RECIRC SUCTION LINE BREAK - OPERATOR FAILS TO INITIATE SP COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - ALTERNATE INJECTION UNAVAILABLE FOR DEBRIS BED COOLING - CONTAINMENT VENT UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	5.24E-06	.28
61	LOSS OF CONDENSER VACUUM - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - OPERATOR FAILS TO MAINTAIN HP LVL CNTL (RCIC,HPCI) - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MAIN CONDENSER UNAVAILABLE - RFW HARDWARE UNAVAILABLE	OIAV	4.96E-06	.27

- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT

- THE EVENT INVOLVES STUCK OPEN SRVS
- FEEDWATER UNAVAILABLE
- HPCI/RCIC UNAVAILABLE FOR 6 HOURS
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- FIRE WATER UNAVAILABLE

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62 TOTAL LOSS OF OFFSITE POWER — MLCV 4.94E-06 .26

- DG 3D UNAVAILABLE
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING

- 500 KV OFFSITE GRID UNAVAILABLE
- 161 KV OFFSITE GRID UNAVAILABLE
- 4KV UNIT BD 1A UNAVAILABLE
- 4KV UNIT BD 1B UNAVAILABLE
- 4KV UNIT BD 2A UNAVAILABLE
- 4KV UNIT BD 2B UNAVAILABLE
- SHUTDOWN BUS 1 UNAVAILABLE
- SHUTDOWN BUS 2 UNAVAILABLE
- 4KV UNIT BD 2C POWER UNAVAILABLE
- 4KV UNIT BD 3A UNAVAILABLE
- 4KV UNIT BD 3B UNAVAILABLE
- 4KV SD BD 3ED UNAVAILABLE
- VESSEL INSTRUMENT TAP I CONDITION
  STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION
  STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- RHRSW PUMP D1 (SWING PUMP) UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- HIGH VESSEL PRESSURE AT MELT-THROUGH
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC
- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
- NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT
- NOT INTACT, NO WTR TO DEBRIS, VENT
- NOT INTACT, NO WTR TO DEBRIS, NO VENT
- NOT BYPASS, WTR TO DEBRIS
- NOT BYPASS, NO WTR TO DERBIS
- NOT EARLY, WTR TO DEBRIS, DWS
- NOT EARLY, WTR TO DEBRIS, NO DWS
- NOT EARLY, NO WTR TO DEBRIS, NO DWS
- FIRE WATER UNAVAILABLE

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63 TOTAL LOSS OF OFFSITE POWER — MLCV 4.93E-06 .26

- DG 3C UNAVAILABLE
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING

- 500 KV OFFSITE GRID UNAVAILABLE
- 161 KV OFFSITE GRID UNAVAILABLE
- 4KV UNIT BD 1A UNAVAILABLE
- 4KV UNIT BD 1B UNAVAILABLE
- 4KV UNIT BD 2A UNAVAILABLE
- 4KV UNIT BD 2B UNAVAILABLE
- SHUTDOWN BUS 1 UNAVAILABLE

- SHUTDOWN BUS 2 UNAVAILABLE
- 4KV UNIT BD 2C POWER UNAVAILABLE
- 4KV UNIT BD 3A UNAVAILABLE
- 4KV UNIT BD 3B UNAVAILABLE
- 4KV SD BD 3EC AND 480V SD BD 3B UNAVAILABLE
- 480V DIESEL AUX BD 3EB POWER UNAVAILABLE
- VESSEL INSTRUMENT TAP I CONDITION
  STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION
  STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- RHRSW PUMP B1 (SWING PUMP) UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- HIGH VESSEL PRESSURE AT MELT-THROUGH
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC
- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
- NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT
- NOT INTACT, NO WTR TO DEBRIS, VENT
- NOT INTACT, NO WTR TO DEBRIS, NO VENT
- NOT BYPASS, WTR TO DEBRIS
- NOT BYPASS, NO WTR TO DERBIS
- NOT EARLY, WTR TO DEBRIS, DWS
- NOT EARLY, WTR TO DEBRIS, NO DWS
- NOT EARLY, NO WTR TO DEBRIS, NO DWS
- FIRE WATER UNAVAILABLE

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64 TOTAL LOSS OF OFFSITE POWER — MLCV — 4.93E-06 — .26

- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- SHUTDOWN COOLING HARDWARE UNAVAILABLE

- 500 KV OFFSITE GRID UNAVAILABLE
- 161 KV OFFSITE GRID UNAVAILABLE
- 4KV UNIT BD 1A UNAVAILABLE
- 4KV UNIT BD 1B UNAVAILABLE
- 4KV UNIT BD 2A UNAVAILABLE
- 4KV UNIT BD 2B UNAVAILABLE
- SHUTDOWN BUS 1 UNAVAILABLE
- SHUTDOWN BUS 2 UNAVAILABLE
- 4KV UNIT BD 2C POWER UNAVAILABLE
- 4KV UNIT BD 3A UNAVAILABLE
- 4KV UNIT BD 3B UNAVAILABLE
- VESSEL INSTRUMENT TAP I CONDITION
  STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION
  STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- CONDENSER UNAVAILABLE AS HEAT SINK

- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- HIGH VESSEL PRESSURE AT MELT-THROUGH
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC
- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
- NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT
- NOT INTACT, NO WTR TO DEBRIS, VENT
- NOT INTACT, NO WTR TO DEBRIS, NO VENT
- NOT BYPASS, WTR TO DEBRIS
- NOT BYPASS, NO WTR TO DERBIS
- NOT EARLY, WTR TO DEBRIS, DWS
- NOT EARLY, WTR TO DEBRIS, NO DWS
- NOT EARLY, NO WTR TO DEBRIS, NO DWS
- FIRE WATER UNAVAILABLE

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65 TOTAL LOSS OF OFFSITE POWER MLCV 4.90E-06 .26

- DG 3A UNAVAILABILITY
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING

- 500 KV OFFSITE GRID UNAVAILABLE
- 161 KV OFFSITE GRID UNAVAILABLE
- 4KV UNIT BD 1A UNAVAILABLE
- 4KV UNIT BD 1B UNAVAILABLE
- 4KV UNIT BD 2A UNAVAILABLE
- 4KV UNIT BD 2B UNAVAILABLE
- SHUTDOWN BUS 1 UNAVAILABLE
- SHUTDOWN BUS 2 UNAVAILABLE
- 4KV UNIT BD 2C POWER UNAVAILABLE
- 4KV UNIT BD 3A UNAVAILABLE
- 4KV SD BD 3EA AND 480V SD BD 3A POWER UNAVAILABLE
- 480V DIESEL AUX BD 3EA POWER UNAVAILABLE
- 4KV UNIT BD 3B UNAVAILABLE
- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- EECW PUMP A UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- HIGH VESSEL PRESSURE AT MELT-THROUGH
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC
- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
- NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT

		- NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
66	TOTAL LOSS OF OFFSITE POWER - DG 3B UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- 500 KV OFFSITE GRID UNAVAILABLE - 161 KV OFFSITE GRID UNAVAILABLE - 4KV UNIT BD 1A UNAVAILABLE - 4KV UNIT BD 1B UNAVAILABLE - 4KV UNIT BD 2A UNAVAILABLE - 4KV UNIT BD 2B UNAVAILABLE - SHUTDOWN BUS 1 UNAVAILABLE - SHUTDOWN BUS 2 UNAVAILABLE - 4KV UNIT BD 2C POWER UNAVAILABLE - 4KV UNIT BD 3A UNAVAILABLE - 4KV SD BD 3EB POWER UNAVAILABLE - 4KV UNIT BO 3B UNAVAILABLE - VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - EECW PUMP C UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	MLCV	4.90E-06	.26
67	CORE SPRAY LINE BREAK - OPERATOR FAILS TO INITIATE SP COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - ALTERNATE INJECTION UNAVAILABLE FOR DEBRIS BED COOLING	OLCV	4.72E-06	.25

		- CONTAINMENT VENT UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
68	INADVERTENT OPENING OF THREE OR MORE SRVS - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - REACTOR BUILDING ISOLATION FAILURE	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 3 OR MORE VALVES STUCK OPEN - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - REACTOR BUILDING NOT ISOLATED - FIRE WATER UNAVAILABLE	OIAZ	4.71E-06	.25
69	TURBINE TRIP WITHOUT BYPASS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - OPERATOR FAILS TO MAINTAIN HP LVL CNTL (RCIC,HPCI) - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - TBVS FAIL TO RELIEVE\MAINTAIN RX PRESSURE - RFW HARDWARE UNAVAILABLE - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.66E-06	.25
70	LOSS OF CONDENSER VACUUM - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MAIN CONDENSER UNAVAILABLE - RFW HARDWARE UNAVAILABLE - OPERATOR FAILS TO COOLDOWN USING THE TBVS - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	MLCV	4.65E-06	.25

		- OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO			
		- CORE DAMAGE OCCURRED			
		- CORE DAMAGE HAS OCCURRED			
		- HIGH VESSEL PRESSURE AT MELT-THROUGH			
		- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC			
		- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT			
		- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT			
		- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC			
		- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT			
		- NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT			
		- NOT INTACT, NO WTR TO DEBRIS, VENT			
		- NOT INTACT, NO WTR TO DEBRIS, NO VENT			
		- NOT BYPASS, WTR TO DEBRIS			
		- NOT BYPASS, NO WTR TO DERBIS			
		- NOT EARLY, WTR TO DEBRIS, DWS			
		- NOT EARLY, WTR TO DEBRIS, NO DWS			
		- NOT EARLY, NO WTR TO DEBRIS, NO DWS			
		- FIRE WATER UNAVAILABLE			
71	TURBINE BUILDING FLOOD	- VESSEL INSTRUMENT TAP I CONDITION	MLCV	4.61E-06	.25
	- RHRSW PUMP A2 UNAVAILABLE	STATE - NO TAP FAILURE			
	- OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP II CONDITION			
	- OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	STATE - NO TAP FAILURE			
		- DRYWELL PRESSURE SIGNAL UNAVAILABLE			
		- RAW COOLING WATER SYSTEM UNAVAILABLE			
		- PLANT CONTROL AIR SYSTEM UNAVAILABLE			
		- DRYWELL CONTROL AIR SYSTEM UNAVAILABLE			
		- MSIVS FAIL TO REMAIN OPEN			
		- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)			
		STATE - 0 RELIEF VALVES STUCK OPEN			
		- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL			
		- FEEDWATER UNAVAILABLE			
		- CONDENSER UNAVAILABLE AS HEAT SINK			
		- VESSEL INJECTION WITH CRDHS UNAVAILABLE			
		- OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC			
		- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT			
		- OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO			
		- CORE DAMAGE OCCURRED			
		- CORE DAMAGE HAS OCCURRED			
		- HIGH VESSEL PRESSURE AT MELT-THROUGH			
		- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC			
		- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT			
		- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT			
		- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC			
		- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT			
		- NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT			
		- NOT INTACT, NO WTR TO DEBRIS, VENT			
		- NOT INTACT, NO WTR TO DEBRIS, NO VENT			
		- NOT BYPASS, WTR TO DEBRIS			
		- NOT BYPASS, NO WTR TO DERBIS			
		- NOT EARLY, WTR TO DEBRIS, DWS			
		- NOT EARLY, WTR TO DEBRIS, NO DWS			
		- NOT EARLY, NO WTR TO DEBRIS, NO DWS			
		- FIRE WATER UNAVAILABLE			
72	TURBINE BUILDING FLOOD	- VESSEL INSTRUMENT TAP I CONDITION	MLCV	4.61E-06	.25
	- RHRSW PUMP B2 UNAVAILABLE	STATE - NO TAP FAILURE			
	- OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP II CONDITION			

- OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING

STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- RAW COOLING WATER SYSTEM UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- DRYWELL CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- 1 CND/CND BSTR-PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- HIGH VESSEL PRESSURE AT MELT-THROUGH
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC
- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT
- NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT
- NOT INTACT, NO WTR TO DEBRIS, VENT
- NOT INTACT, NO WTR TO DEBRIS, NO VENT
- NOT BYPASS, WTR TO DEBRIS
- NOT BYPASS, NO WTR TO DERBIS
- NOT EARLY, WTR TO DEBRIS, DWS
- NOT EARLY, WTR TO DEBRIS, NO DWS
- NOT EARLY, NO WTR TO DEBRIS, NO DWS
- FIRE WATER UNAVAILABLE

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73 TURBINE BUILDING FLOOD — MLCV — 4.61E-06 — .25

- RHRSW PUMP C2 UNAVAILABLE
- OPERATOR FAILS TO ESTABLISH TORUS COOLING
- OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING

- VESSEL INSTRUMENT TAP I CONDITION
  STATE - NO TAP FAILURE
- VESSEL INSTRUMENT TAP II CONDITION
  STATE - NO TAP FAILURE
- DRYWELL PRESSURE SIGNAL UNAVAILABLE
- RAW COOLING WATER SYSTEM UNAVAILABLE
- PLANT CONTROL AIR SYSTEM UNAVAILABLE
- DRYWELL CONTROL AIR SYSTEM UNAVAILABLE
- MSIVS FAIL TO REMAIN OPEN
- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS)
  STATE - 0 RELIEF VALVES STUCK OPEN
- 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL
- FEEDWATER UNAVAILABLE
- CONDENSER UNAVAILABLE AS HEAT SINK
- VESSEL INJECTION WITH CRDHS UNAVAILABLE
- OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC
- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT
- OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO
- CORE DAMAGE OCCURRED
- CORE DAMAGE HAS OCCURRED
- HIGH VESSEL PRESSURE AT MELT-THROUGH
- NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT
- NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT
- NOT INTACT, WTR TO DEBRIS, NO DWS, SPC

		- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
74	TURBINE BUILDING FLOOD - RHRSW PUMP D2 UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	MLCV	4.61E-06	.25
75	INADVERTENT OPENING OF TWO SRVS - OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 2 RELIEF VALVES STUCK OPEN - THE EVENT INVOLVES STUCK OPEN SRVS - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.57E-06	.24

76	TOTAL LOSS OF OFFSITE POWER - DG 3D UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- 500 KV OFFSITE GRID UNAVAILABLE - 161 KV OFFSITE GRID UNAVAILABLE - 4KV UNIT BD 1A UNAVAILABLE - 4KV UNIT BD 1B UNAVAILABLE - 4KV UNIT BD 2A UNAVAILABLE - 4KV UNIT BD 2B UNAVAILABLE - SHUTDOWN BUS 1 UNAVAILABLE - SHUTDOWN BUS 2 UNAVAILABLE - 4KV UNIT BD 2C POWER UNAVAILABLE - 4KV UNIT BD 3A UNAVAILABLE - 4KV UNIT BD 3B UNAVAILABLE - 4KV SD BD 3ED UNAVAILABLE - VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RHRSW PUMP D1 (SWING PUMP) UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.44E-06	.24
77	TOTAL LOSS OF OFFSITE POWER - DG 3C UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- 500 KV OFFSITE GRID UNAVAILABLE - 161 KV OFFSITE GRID UNAVAILABLE - 4KV UNIT BD 1A UNAVAILABLE - 4KV UNIT BD 1B UNAVAILABLE - 4KV UNIT BD 2A UNAVAILABLE - 4KV UNIT BD 2B UNAVAILABLE - SHUTDOWN BUS 1 UNAVAILABLE - SHUTDOWN BUS 2 UNAVAILABLE - 4KV UNIT BD 2C POWER UNAVAILABLE - 4KV UNIT BD 3A UNAVAILABLE - 4KV UNIT BD 3B UNAVAILABLE - 4KV SD BD 3EC AND 480V SD BD 3B UNAVAILABLE - 480V DIESEL AUX BD 3EB POWER UNAVAILABLE - VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RHRSW PUMP B1 (SWING PUMP) UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.43E-06	.24

78	TOTAL LOSS OF OFFSITE POWER - DG 3A UNAVAILABILITY - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- 500 KV OFFSITE GRID UNAVAILABLE - 161 KV OFFSITE GRID UNAVAILABLE - 4KV UNIT BD 1A UNAVAILABLE - 4KV UNIT BD 1B UNAVAILABLE - 4KV UNIT BD 2A UNAVAILABLE - 4KV UNIT BD 2B UNAVAILABLE - SHUTDOWN BUS 1 UNAVAILABLE - SHUTDOWN BUS 2 UNAVAILABLE - 4KV UNIT BD 2C POWER UNAVAILABLE - 4KV UNIT BD 3A UNAVAILABLE - 4KV SD BD 3EA AND 480V SD BD 3A POWER UNAVAILABLE - 480V DIESEL AUX BD 3EA POWER UNAVAILABLE - 4KV UNIT BD 3B UNAVAILABLE - VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - EECW PUMP A UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.41E-06	.24
79	TOTAL LOSS OF OFFSITE POWER - DG 3B UNAVAILABLE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- 500 KV OFFSITE GRID UNAVAILABLE - 161 KV OFFSITE GRID UNAVAILABLE - 4KV UNIT BD 1A UNAVAILABLE - 4KV UNIT BD 1B UNAVAILABLE - 4KV UNIT BD 2A UNAVAILABLE - 4KV UNIT BD 2B UNAVAILABLE - SHUTDOWN BUS 1 UNAVAILABLE - SHUTDOWN BUS 2 UNAVAILABLE - 4KV UNIT BD 2C POWER UNAVAILABLE - 4KV UNIT BD 3A UNAVAILABLE - 4KV SD BD 3EB POWER UNAVAILABLE - 4KV UNIT BD 3B UNAVAILABLE - VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - EECW PUMP C UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED	OIAV	4.40E-06	.24

		- FIRE WATER UNAVAILABLE			
80	TURBINE TRIP WITHOUT BYPASS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - TBVS FAIL TO RELIEVE\MAINTAIN RX PRESSURE - RFW HARDWARE UNAVAILABLE - OPERATOR FAILS TO COOLDOWN USING THE TBVS - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	MLCV	4.37E-06	.23
81	LOSS OF 500KV GRID - OPERATOR FAILS TO RESTORE POWER TO UNIT BOARDS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- 500 KV OFFSITE GRID UNAVAILABLE - 4KV UNIT BD 1A UNAVAILABLE - 4KV UNIT BD 1B UNAVAILABLE - 4KV UNIT BD 2A UNAVAILABLE - 4KV UNIT BD 2B UNAVAILABLE - SHUTDOWN BUS 1 UNAVAILABLE - SHUTDOWN BUS 2 UNAVAILABLE - 4KV UNIT BD 3A UNAVAILABLE - 4KV UNIT BD 3B UNAVAILABLE - VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE . - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - TURBINE TRIP FAILURE - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED	MLCV	4.35E-06	.23

		- HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
82	LOSS OF CONDENSER VACUUM - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MAIN CONDENSER UNAVAILABLE - RFW HARDWARE UNAVAILABLE - OPERATOR FAILS TO DEPRESSURIZE USING TBV'S - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.30E-06	.23
83	TURBINE TRIP - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - CONDENSATE UNAVAILABLE FOR INJECTION - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.24E-06	.23
84	PARTIAL LOSS OF FEEDWATER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - SRV ACTUATION FAILURE WHEN FEEDWATER AVAILABLE	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - FIRE WATER UNAVAILABLE	MIAV	4.15E-06	.22
85	TURBINE BUILDING FLOOD - RHRSW PUMP A2 UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE	OIAV	4.14E-06	.22

	- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE			
86	TURBINE BUILDING FLOOD - RHRSW PUMP B2 UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.14E-06	.22
87	TURBINE BUILDING FLOOD - RHRSW PUMP C2 UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.14E-06	.22

88	TURBINE BUILDING FLOOD - RHRSW PUMP D2 UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.14E-06	.22
89	PARTIAL LOSS OF FEEDWATER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.14E-06	.22
90	INADVERTENT (OTHER) SCRAM - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABLE - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - CONDENSATE UNAVAILABLE FOR INJECTION - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.14E-06	.22
91	TURBINE BUILDING FLOOD - OPERATOR FAILS TO ESTABLISH TORUS COOLING - SHUTDOWN COOLING HARDWARE UNAVAILABLE - REACTOR BUILDING ISOLATION FAILURE	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC	MLCZ	4.13E-06	.22

		- OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - REACTOR BUILDING NOT ISOLATED - FIRE WATER UNAVAILABLE			
92	INADVERTENT OPENING OF THREE OR MORE SRVS - OPERATOR FAILA TO PLACE MODE SWITCH IN REFUEL THEN SHUTDOWN - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 3 OR MORE VALVES STUCK OPEN - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.06E-06	.22
93	TURBINE TRIP WITHOUT BYPASS - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 1 RELIEF VALVE STUCK OPEN - RCIC UNAVAILABLE (6 HOURS) - HPCI UNAVAILABLE (6 HOURS) - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - TBVS FAIL TO RELIEVE\MAINTAIN RX PRESSURE - RFW HARDWARE UNAVAILABLE - OPERATOR FAILS TO DEPRESSURIZE USING TBV'S - THE EVENT INVOLVES STUCK OPEN SRVS - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - FIRE WATER UNAVAILABLE	OIAV	4.04E-06	.22
94	TURBINE BUILDING FLOOD - RHRSW PUMP A2 UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN	OLCV	4.03E-06	.22

		- CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN . - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
95	TURBINE BUILDING FLOOD - RHRSW PUMP B2 UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	4.03E-06	.22

96	TURBINE BUILDING FLOOD - RHRSW PUMP C2 UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	4.03E-06	.22
97	TURBINE BUILDING FLOOD - RHRSW PUMP D2 UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HP LVL CONTROL LONG TERM - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC	OLCV	4.03E-06	.22

		- NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
98	PARTIAL LOSS OF FEEDWATER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - OPERATOR FAILS TO ALIGN THE STARTUP BYPASS VALVE - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	4.03E-06	.22
99	LOSS OF UNIT 2 120V PREFERRED POWER - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES- STATE - PLANT NOT DEPRESSURIZED, MECH SRV OK - OPERATOR FAILS TO ESTABLISH TORUS COOLING - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING	- 120 V AC UNIT 2 PREFERRED POWER UNAVAILABLE - VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - MAIN CONDENSER UNAVAILABLE - RFW HARDWARE UNAVAILABLE - RCIC UNAVAILABLE (6 HOURS) - OPERATOR FAILS TO COOLDOWN USING THE TBVS - FEEDWATER UNAVAILABLE - CONDENSER UNAVAILABLE AS HEAT SINK - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO MAINTAIN HPCI/RCIC W/O SPC - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - OPERATOR FAILS TO ESTABLISH ALTRNATE LOW PRESSURE INJECTIO - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - HIGH VESSEL PRESSURE AT MELT-THROUGH - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT	MLCV	4.02E-06	.21

		- NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE			
100	TURBINE BUILDING FLOOD - OPERATOR FAILS TO MAINTAIN HP LVL CNTL (RCIC,HPCI) - FAILURE OF HPCI/RCIC LEVEL 8 TRIP - CONDITIOND RELATING TO REACTOR DEPRESSURIZATION (DEPRESS, NOT DEPRES STATE - PLANT DEPRESSURIZED - OPERATOR FAILS TO ESTABLISH TORUS COOLING	- VESSEL INSTRUMENT TAP I CONDITION STATE - NO TAP FAILURE - VESSEL INSTRUMENT TAP II CONDITION STATE - NO TAP FAILURE - DRYWELL PRESSURE SIGNAL UNAVAILABLE - RAW COOLING WATER SYSTEM UNAVAILABLE - PLANT CONTROL AIR SYSTEM UNAVAILABLE - DRYWELL CONTROL AIR SYSTEM UNAVAILABLE - MSIVS FAIL TO REMAIN OPEN - CONDITIONS RELATING TO STUCK OPEN SRVS (0, 1, 2, 3+ SORVS) STATE - 0 RELIEF VALVES STUCK OPEN - 1 CND/CND BSTR PUMP, INCLUDES SHORT CYCLE VALVE UNAVAILABL - FEEDWATER UNAVAILABLE - HPCI/RCIC UNAVAILABLE FOR 24 HOURS - HPCI/RCIC UNAVAILABLE FOR 6 HOURS - CONDENSER UNAVAILABLE AS HEAT SINK - CONDENSATE UNAVAILABLE FOR INJECTION - VESSEL INJECTION WITH CRDHS UNAVAILABLE - OPERATOR FAILS TO ESTABLISH SHUTDOWN COOLING - OPERATOR FAILS TO START CS/LPCI OR TO ESTAB TORUS VENT - CORE DAMAGE OCCURRED - CORE DAMAGE HAS OCCURRED - NOT INTACT CONTAINMENT, WTR TO DEBRIS, DWS, AND SPC - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, VENT - NOT INTACT, WTR TO DEBRIS, DWS, NO SPC, NO VENT - NOT INTACT, WTR TO DEBRIS, NO DWS, SPC - NOT INTACT, WTR TO DEBRIS, NO DWS, NO SPC, VENT - NOT INTACT, WTR TO BERBIS, NO DWS, NO SPC, NO VENT - NOT INTACT, NO WTR TO DEBRIS, VENT - NOT INTACT, NO WTR TO DEBRIS, NO VENT - NOT BYPASS, WTR TO DEBRIS - NOT BYPASS, NO WTR TO DERBIS - NOT EARLY, WTR TO DEBRIS, DWS - NOT EARLY, WTR TO DEBRIS, NO DWS - NOT EARLY, NO WTR TO DEBRIS, NO DWS - FIRE WATER UNAVAILABLE	OLCV	4.00E-06	.21

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1.	OSP	5.4062E-01	1.4877E-03	5.4211E-01	1.0148E-03
2.	RVD(DEP)	4.2876E-01	0.0000E+00	4.2876E-01	8.0261E-04
3.	OLP	3.9718E-01	3.1830E-01	7.1549E-01	1.3393E-03
4.	OHL	3.8765E-01	0.0000E+00	3.8765E-01	7.2566E-04
5.	RVC(SORV0)	2.8412E-01	5.4905E-01	8.3317E-01	1.5597E-03
6.	OSD	2.4098E-01	2.8857E-02	2.6983E-01	5.0511E-04
7.	CRD	1.8246E-01	6.8132E-01	8.6378E-01	1.6169E-03
8.	OLC	1.6633E-01	0.0000E+00	1.6633E-01	3.1135E-04
9.	HPI	1.1115E-01	3.8208E-03	1.1497E-01	2.1522E-04
10.	RVC(SORV1)	8.6457E-02	1.4285E-03	8.7885E-02	1.6452E-04
11.	OHC	8.2402E-02	0.0000E+00	8.2402E-02	1.5425E-04
12.	RCI	7.9053E-02	7.3060E-03	8.6359E-02	1.6166E-04
13.	RBI	7.1750E-02	0.0000E+00	7.1750E-02	1.3431E-04
14.	RVD(NODEP)	5.7149E-02	0.0000E+00	5.7149E-02	1.0698E-04
15.	OSW	5.5879E-02	0.0000E+00	5.5879E-02	1.0460E-04
16.	ODWS	5.5708E-02	0.0000E+00	5.5708E-02	1.0428E-04
17.	ORP	5.1590E-02	7.7309E-04	5.2363E-02	9.8021E-05
18.	RVL	5.0264E-02	0.0000E+00	5.0264E-02	9.4092E-05
19.	SDC	4.3161E-02	3.8208E-03	4.6982E-02	8.7947E-05
20.	OHS	4.3102E-02	0.0000E+00	4.3102E-02	8.0684E-05
21.	RCL	1.2146E-02	7.7309E-04	1.2919E-02	2.4184E-05
22.	OF	1.1968E-02	0.0000E+00	1.1968E-02	2.2403E-05

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......	Top................	Probabilistic..	Guar. Event....	Total..........	Frequency......
23.	OUB	8.9756E-03	0.0000E+00	8.9756E-03	1.6802E-05
24.	L8H	8.8617E-03	0.0000E+00	8.8617E-03	1.6589E-05
25.	GF	8.8381E-03	7.7309E-04	9.6112E-03	1.7992E-05
26.	RVC(SORV2)	8.4952E-03	3.3701E-03	1.1865E-02	2.2211E-05
27.	HPL	8.3422E-03	7.7309E-04	9.1153E-03	1.7063E-05
28.	GH	8.1841E-03	7.7309E-04	8.9572E-03	1.6767E-05
29.	GG	8.1714E-03	7.7309E-04	8.9445E-03	1.6744E-05
30.	GE	8.1292E-03	7.7309E-04	8.9023E-03	1.6665E-05
31.	SW2A	8.1218E-03	2.5424E-03	1.0664E-02	1.9963E-05
32.	SW2B	8.1218E-03	3.8706E-03	1.1992E-02	2.2449E-05
33.	SW2C	8.1208E-03	3.5518E-03	1.1673E-02	2.1850E-05
34.	SW2D	8.1208E-03	7.7309E-04	8.8939E-03	1.6649E-05
35.	CD	6.5931E-03	6.7768E-01	6.8427E-01	1.2809E-03
36.	OFT	6.2196E-03	0.0000E+00	6.2196E-03	1.1643E-05
37.	DH	5.3732E-03	0.0000E+00	5.3732E-03	1.0058E-05
38.	GA	4.9943E-03	0.0000E+00	4.9943E-03	9.3491E-06
39.	GC	3.8706E-03	0.0000E+00	3.8706E-03	7.2455E-06
40.	GB	3.5518E-03	0.0000E+00	3.5518E-03	6.6488E-06
41.	GD	3.2252E-03	0.0000E+00	3.2252E-03	6.0373E-06
42.	EPR30	3.1084E-03	0.0000E+00	3.1084E-03	5.8187E-06
43.	TB	3.0525E-03	8.9756E-03	1.2028E-02	2.2516E-05
44.	NH2	2.7460E-03	5.3732E-03	8.1193E-03	1.5199E-05

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45.	RVC(SORV3)	2.6597E-03	3.0854E-02	3.3514E-02	6.2736E-05
46.	L8F	2.3454E-03	2.1415E-03	4.4868E-03	8.3991E-06
47.	DK	2.3244E-03	3.5518E-03	5.8762E-03	1.1000E-05
48.	DL	2.3244E-03	7.7309E-04	3.0975E-03	5.7983E-06
49.	RVD	8.0046E-04	0.0000E+00	8.0046E-04	1.4984E-06
50.	EPR6	7.7309E-04	0.0000E+00	7.7309E-04	1.4472E-06
51.	OEE	7.1462E-04	7.7309E-04	1.4877E-03	2.7849E-06
52.	ED	7.1462E-04	7.7309E-04	1.4877E-03	2.7849E-06
53.	MCD	6.1515E-04	2.6857E-02	2.7472E-02	5.1426E-05
54.	RPA	5.8210E-04	1.4877E-03	2.0698E-03	3.8746E-06
55.	RPB	5.7670E-04	1.4877E-03	2.0644E-03	3.8645E-06
56.	EB	0.0000E+00	3.8706E-03	3.8706E-03	7.2455E-06
57.	AB	0.0000E+00	3.5518E-03	3.5518E-03	6.6488E-06
58.	BVR	0.0000E+00	1.2934E-02	1.2934E-02	2.4211E-05
59.	SW1C	0.0000E+00	3.5518E-03	3.5518E-03	6.6488E-06
60.	RH	0.0000E+00	3.5518E-03	3.5518E-03	6.6488E-06
61.	RG	0.0000E+00	3.8706E-03	3.8706E-03	7.2455E-06
62.	RF	0.0000E+00	3.8706E-03	3.8706E-03	7.2455E-06
63.	AC	0.0000E+00	3.8706E-03	3.8706E-03	7.2455E-06
64.	OBC	0.0000E+00	2.1491E-02	2.1491E-02	4.0230E-05
65.	SGTOP	0.0000E+00	1.4877E-03	1.4877E-03	2.7849E-06
66.	AD	0.0000E+00	7.7309E-04	7.7309E-04	1.4472E-06

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67.	HUM	0.0000E+00	1.4877E-03	1.4877E-03	2.7849E-06
68.	RK	0.0000E+00	7.7309E-04	7.7309E-04	1.4472E-06
69.	RL	0.0000E+00	7.7309E-04	7.7309E-04	1.4472E-06
70.	LPC	0.0000E+00	1.4877E-03	1.4877E-03	2.7849E-06
71.	SGT	0.0000E+00	1.4877E-03	1.4877E-03	2.7849E-06
72.	DWS	0.0000E+00	1.4877E-03	1.4877E-03	2.7849E-06
73.	U1	0.0000E+00	1.4877E-03	1.4877E-03	2.7849E-06
74.	DM	0.0000E+00	7.7309E-04	7.7309E-04	1.4472E-06
75.	DN	0.0000E+00	7.7309E-04	7.7309E-04	1.4472E-06
76.	RBC	0.0000E+00	7.7309E-04	7.7309E-04	1.4472E-06
77.	RI	0.0000E+00	7.7309E-04	7.7309E-04	1.4472E-06
78.	RJ	0.0000E+00	7.7309E-04	7.7309E-04	1.4472E-06
79.	DO	0.0000E+00	7.7309E-04	7.7309E-04	1.4472E-06
80.	RN	0.0000E+00	7.7309E-04	7.7309E-04	1.4472E-06
81.	A3EB	0.0000E+00	9.6112E-03	9.6112E-03	1.7992E-05
82.	SW1D	0.0000E+00	1.4330E-02	1.4330E-02	2.6826E-05
83.	NPII	0.0000E+00	5.3732E-03	5.3732E-03	1.0058E-05
84.	A3EC	0.0000E+00	8.9445E-03	8.9445E-03	1.6744E-05
85.	RP	0.0000E+00	8.9445E-03	8.9445E-03	1.6744E-05
86.	EC	0.0000E+00	9.6112E-03	9.6112E-03	1.7992E-05
87.	PX2	0.0000E+00	5.3732E-03	5.3732E-03	1.0058E-05
88.	RB	0.0000E+00	5.3732E-03	5.3732E-03	1.0058E-05

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89.	RPD	0.0000E+00	1.4877E-03	1.4877E-03	2.7849E-06
90.	RPC	0.0000E+00	1.4877E-03	1.4877E-03	2.7849E-06
91.	NRU	0.0000E+00	2.0444E-03	2.0444E-03	3.8271E-06
92.	U3	0.0000E+00	1.4877E-03	1.4877E-03	2.7849E-06
93.	SW1B	0.0000E+00	8.9445E-03	8.9445E-03	1.6744E-05
94.	A3ED	0.0000E+00	9.5082E-03	9.5082E-03	1.7799E-05
95.	NIE	0.0000E+00	2.0444E-03	2.0444E-03	3.8271E-06
96.	VT1(L1B)	0.0000E+00	5.8909E-04	5.8909E-04	1.1027E-06
97.	VT1(NOFLI)	0.0000E+00	9.9941E-01	9.9941E-01	1.8708E-03
98.	INH	0.0000E+00	5.3749E-01	5.3749E-01	1.0061E-03
99.	ING	0.0000E+00	5.3897E-01	5.3897E-01	1.0089E-03
100.	JA	0.0000E+00	5.3749E-01	5.3749E-01	1.0061E-03
101.	JH	0.0000E+00	5.3749E-01	5.3749E-01	1.0061E-03
102.	IND	0.0000E+00	5.3897E-01	5.3897E-01	1.0089E-03
103.	INF	0.0000E+00	5.3897E-01	5.3897E-01	1.0089E-03
104.	INE	0.0000E+00	5.3897E-01	5.3897E-01	1.0089E-03
105.	INC	0.0000E+00	5.6160E-01	5.6160E-01	1.0513E-03
106.	AI	0.0000E+00	3.3561E-02	3.3561E-02	6.2824E-05
107.	FIWTR	0.0000E+00	1.0000E+00	1.0000E+00	1.8719E-03
108.	VNT	0.0000E+00	3.3561E-02	3.3561E-02	6.2824E-05
109.	KC	0.0000E+00	5.3749E-01	5.3749E-01	1.0061E-03
110.	KF	0.0000E+00	5.3749E-01	5.3749E-01	1.0061E-03

MODEL Name: BFNHA

Top Event Importance for Group : ALL

Sorted by Probabilistic Importance

Group Frequency = 1.8719E-03

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......	Top...............	Probabilistic..	Guar. Event....	Total..........	Frequency......
111.	KH	0.0000E+00	5.3749E-01	5.3749E-01	1.0061E-03
112.	NRV	0.0000E+00	1.3326E-01	1.3326E-01	2.4946E-04
113.	DCA	0.0000E+00	5.6101E-01	5.6101E-01	1.0502E-03
114.	PCA	0.0000E+00	5.6178E-01	5.6178E-01	1.0516E-03
115.	IVO	0.0000E+00	6.4213E-01	6.4213E-01	1.2020E-03
116.	FWA	0.0000E+00	8.1875E-01	8.1875E-01	1.5326E-03
117.	VT2(NOFLII)	0.0000E+00	1.0000E+00	1.0000E+00	1.8719E-03
118.	RCW	0.0000E+00	5.7618E-01	5.7618E-01	1.0786E-03
119.	DW	0.0000E+00	9.3222E-01	9.3222E-01	1.7450E-03
120.	INB	0.0000E+00	5.6474E-01	5.6474E-01	1.0572E-03
121.	MELT	0.0000E+00	1.0000E+00	1.0000E+00	1.8719E-03
122.	NCD	0.0000E+00	1.0000E+00	1.0000E+00	1.8719E-03
123.	INA	0.0000E+00	5.6474E-01	5.6474E-01	1.0572E-03
124.	HRL	0.0000E+00	4.2110E-01	4.2110E-01	7.8827E-04
125.	HS	0.0000E+00	7.0692E-01	7.0692E-01	1.3233E-03
126.	CDA	0.0000E+00	4.4411E-01	4.4411E-01	8.3135E-04
127.	EA	0.0000E+00	8.9023E-03	8.9023E-03	1.6665E-05
128.	UB43A	0.0000E+00	1.0835E-01	1.0835E-01	2.0283E-04
129.	UB42C	0.0000E+00	9.9379E-02	9.9379E-02	1.8603E-04
130.	UB43B	0.0000E+00	1.0835E-01	1.0835E-01	2.0283E-04
131.	SW1A	0.0000E+00	2.5424E-03	2.5424E-03	4.7592E-06
132.	AA	0.0000E+00	2.5424E-03	2.5424E-03	4.7592E-06

MODEL Name: BFNHA

Top Event Importance for Group : ALL

Sorted by Probabilistic Importance

Group Frequency = 1.8719E-03

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......	Top...............	Probabilistic..	Guar. Event....	Total..........	Frequency......
133.	RM	0.0000E+00	2.5424E-03	2.5424E-03	4.7592E-06
134.	RE	0.0000E+00	2.5424E-03	2.5424E-03	4.7592E-06
135.	SHUT2	0.0000E+00	1.0835E-01	1.0835E-01	2.0283E-04
136.	A3EA	0.0000E+00	8.9023E-03	8.9023E-03	1.6665E-05
137.	OBD	0.0000E+00	2.2463E-02	2.2463E-02	4.2050E-05
138.	RO	0.0000E+00	8.9023E-03	8.9023E-03	1.6665E-05
139.	WET	0.0000E+00	5.5107E-02	5.5107E-02	1.0316E-04
140.	LEC	0.0000E+00	3.3079E-02	3.3079E-02	6.1923E-05
141.	DJ	0.0000E+00	7.3060E-03	7.3060E-03	1.3676E-05
142.	OAI	0.0000E+00	2.7476E-01	2.7476E-01	5.1434E-04
143.	HR6	0.0000E+00	1.7086E-01	1.7086E-01	3.1983E-04
144.	RBISO	0.0000E+00	7.1750E-02	7.1750E-02	1.3431E-04
145.	FWH	0.0000E+00	9.6473E-02	9.6473E-02	1.8059E-04
146.	OIV	0.0000E+00	1.5381E-02	1.5381E-02	2.8793E-05
147.	LPRES	0.0000E+00	3.6136E-01	3.6136E-01	6.7644E-04
148.	OHR	0.0000E+00	2.7163E-01	2.7163E-01	5.0847E-04
149.	SHUT1	0.0000E+00	1.0835E-01	1.0835E-01	2.0283E-04
150.	UB42A	0.0000E+00	1.0835E-01	1.0835E-01	2.0283E-04
151.	UB41B	0.0000E+00	1.0835E-01	1.0835E-01	2.0283E-04
152.	UB42B	0.0000E+00	1.0835E-01	1.0835E-01	2.0283E-04
153.	OG5	0.0000E+00	1.0890E-01	1.0890E-01	2.0386E-04
154.	OG16	0.0000E+00	9.9379E-02	9.9379E-02	1.8603E-04
155.	UB41A	0.0000E+00	1.0835E-01	1.0835E-01	2.0283E-04

MODEL Name: BFNHA

Split Fraction Importance for Group : ALL

Sorted by Importance

Group Frequency = 1.8719E-03

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
1.	VT2F	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.8719E-03
2.	FIWTRF	1.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.8719E-03
3.	VT1F	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.8719E-03
4.	NCDF	1.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.8719E-03
5.	MELTF	1.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.8719E-03
6.	DWF	9.3222E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.7450E-03
7.	FWAF	8.1875E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.5326E-03
8.	HSF	7.0692E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.3233E-03
9.	CRDF	6.8132E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.2754E-03
10.	CDF	6.7768E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.2686E-03
11.	IVOF	6.4213E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.2020E-03
12.	RVC9	5.8471E-01	4.1529E-01	0.0000E+00	0.0000E+00	1.0000E+00	1.0945E-03
13.	RCWF	5.7618E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0786E-03
14.	INBF	5.6474E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0572E-03
15.	INAF	5.6474E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0572E-03
16.	PCAF	5.6178E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0516E-03
17.	INCF	5.6160E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0513E-03
18.	DCAF	5.6101E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0502E-03
19.	OSP1	5.4062E-01	5.4077E+00	5.1025E-01	9.1677E-03	1.0000E-01	1.0120E-03
20.	INGF	5.3897E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0089E-03
21.	INFF	5.3897E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0089E-03
22.	INEF	5.3897E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0089E-03
23.	INDF	5.3897E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0089E-03
24.	KCF	5.3749E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0061E-03
25.	INHF	5.3749E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0061E-03
26.	JHF	5.3749E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0061E-03
27.	JAF	5.3749E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0061E-03
28.	KFF	5.3749E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0061E-03
29.	KHF	5.3749E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0061E-03
30.	CDAF	4.4411E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	8.3135E-04
31.	HRLF	4.2110E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	7.8827E-04
32.	OLP1	3.9718E-01	4.5148E+00	6.0947E-01	7.3104E-03	1.0000E-01	7.4350E-04
33.	LPRESF	3.6136E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.7644E-04
34.	OHL1	3.3635E-01	3.7737E+00	6.9181E-01	5.7692E-03	1.0000E-01	6.2962E-04
35.	RVD2	3.2609E-01	7.1018E-01	3.6054E+00	-5.4198E-03	8.9990E-01	6.1042E-04
36.	OLPF	3.1830E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	5.9585E-04
37.	RVC0	2.8412E-01	7.3690E-01	4.5554E+00	-7.1480E-03	9.3110E-01	5.3186E-04
38.	OAIF	2.7476E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	5.1434E-04
39.	OHRF	2.7163E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	5.0847E-04
40.	OSD1	2.4098E-01	2.9339E+00	7.8512E-01	4.0224E-03	1.0000E-01	4.5109E-04
41.	HR6F	1.7086E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.1983E-04
42.	CRD1	1.5771E-01	2.9459E+01	8.4230E-01	5.3568E-02	5.5109E-03	2.9522E-04
43.	OLC1	1.4769E-01	2.3292E+00	8.5231E-01	2.7647E-03	1.0000E-01	2.7647E-04
44.	NRVF	1.3326E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4946E-04

MODEL Name: BFNHA

Split Fraction Importance for Group : ALL

Sorted by Importance

Group Frequency = 1.8719E-03

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
45.	OG5F	1.0890E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.0386E-04
46.	UB41BF	1.0835E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.0283E-04
47.	UB43BF	1.0835E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.0283E-04
48.	UB43AF	1.0835E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.0283E-04
49.	UB42AF	1.0835E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.0283E-04
50.	SHUT1F	1.0835E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.0283E-04
51.	SHT2F	1.0835E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.0283E-04
52.	UB42BF	1.0835E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.0283E-04
53.	UB41AF	1.0835E-01	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.0283E-04
54.	UB42CF	9.9379E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.8603E-04
55.	OG16F	9.9379E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.8603E-04
56.	FWHF	9.6473E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.8059E-04
57.	RVC1	8.6457E-02	2.1223E+00	9.1973E-01	2.2512E-03	6.6750E-02	1.6184E-04
58.	OHC1	7.8558E-02	1.1425E+00	9.8417E-01	2.9638E-04	1.0000E-01	1.4706E-04
59.	RCI1	7.7203E-02	1.4233E+00	9.6945E-01	8.4953E-04	6.7310E-02	1.4452E-04
60.	RBI1	7.1750E-02	6.0314E-01	1.0536E+00	-8.4320E-04	1.1896E-01	1.3431E-04
61.	RBISOF	7.1750E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.3431E-04
62.	OSW1	5.5879E-02	5.9235E-01	1.0453E+00	-8.4788E-04	1.0000E-01	1.0460E-04
63.	ODWS1	5.5708E-02	5.5708E-01	1.0492E+00	-9.2123E-04	1.0000E-01	1.0428E-04
64.	WETF	5.5107E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0316E-04
65.	HPI4	5.5058E-02	1.4947E+00	9.4730E-01	1.0247E-03	9.6270E-02	1.0306E-04
66.	OHL2	5.1305E-02	1.4435E+00	9.5072E-01	9.2243E-04	1.0000E-01	9.6040E-05
67.	RVD22	5.0952E-02	1.4071E+00	9.5472E-01	8.4685E-04	1.0010E-01	9.5379E-05
68.	RVL4	5.0264E-02	1.3617E+00	9.5977E-01	7.5238E-04	1.0010E-01	9.4092E-05
69.	SDC2	4.3161E-02	2.3528E+00	9.6210E-01	2.6032E-03	2.7251E-02	8.0795E-05
70.	OHS2	4.3102E-02	6.5692E-01	1.0381E+00	-7.1359E-04	1.0000E-01	8.0684E-05
71.	ORP1	3.9325E-02	6.8270E-01	1.0353E+00	-6.5997E-04	1.0000E-01	7.3614E-05
72.	HPI2	3.8819E-02	8.0158E-01	1.0190E+00	-4.0699E-04	8.7380E-02	7.2667E-05
73.	AIF	3.3561E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.2824E-05
74.	VNTF	3.3561E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.2824E-05
75.	LECF	3.3079E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.1923E-05
76.	RVD12	3.0933E-02	9.7251E-01	1.2472E+00	-5.1413E-04	8.9990E-01	5.7905E-05
77.	RVD10	2.9854E-02	9.7347E-01	1.2385E+00	-4.9619E-04	8.9990E-01	5.5886E-05
78.	OSDF	2.8857E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	5.4019E-05
79.	RVD8	2.7249E-02	9.7578E-01	1.2177E+00	-4.5289E-04	8.9990E-01	5.1009E-05
80.	HCDF	2.6857E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	5.0275E-05
81.	OBDF	2.2463E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.2050E-05
82.	OBCF	2.1491E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.0230E-05
83.	OLC2	1.8636E-02	1.1677E+00	9.8136E-01	3.4885E-04	1.0000E-01	3.4885E-05
84.	CRD4	1.6469E-02	1.0578E+00	9.8387E-01	1.3845E-04	2.1807E-01	3.0828E-05
85.	OIVF	1.5381E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.8793E-05
86.	RVD6	1.4633E-02	9.8699E-01	1.1169E+00	-2.4321E-04	8.9990E-01	2.7392E-05
87.	SW1DF	1.4330E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.6826E-05
88.	BVRF	1.2934E-02	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.4211E-05

MODEL Name: BFNHA

Split Fraction Importance for Group : ALL

Sorted by Importance

Group Frequency = 1.8719E-03

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
89.	ORP2	1.2266E-02	8.6826E-01	1.0146E+00	-2.7402E-04	1.0000E-01	2.2960E-05
90.	OF1	1.1968E-02	9.7894E-01	1.0023E+00	-4.3800E-05	1.0000E-01	2.2403E-05
91.	HP16	1.1799E-02	1.1202E+00	9.8841E-01	2.4664E-04	8.7980E-02	2.2088E-05
92.	A3EBF	9.6112E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.7992E-05
93.	ECF	9.6112E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.7992E-05
94.	A3EDF	9.5082E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.7799E-05
95.	TBF	8.9756E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6802E-05
96.	OUB2	8.9756E-03	1.0802E+00	9.9109E-01	1.6688E-04	1.0000E-01	1.6802E-05
97.	RPF	8.9445E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6744E-05
98.	A3ECF	8.9445E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6744E-05
99.	SW1BF	8.9445E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6744E-05
100.	A3EAF	8.9023E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6665E-05
101.	ROF	8.9023E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6665E-05
102.	EAF	8.9023E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.6665E-05
103.	L8H1	8.8617E-03	1.2399E+00	9.9313E-01	4.6198E-04	2.7825E-02	1.6589E-05
104.	GF1	8.8381E-03	9.4965E-01	1.0111E+00	-1.1494E-04	1.8000E-01	1.6544E-05
105.	RVC2	8.4952E-03	5.0419E+00	9.9152E-01	7.5820E-03	2.0930E-03	1.5903E-05
106.	CRD3	8.2865E-03	1.0291E+00	9.9190E-01	6.9582E-05	2.1783E-01	1.5512E-05
107.	GH1	8.1841E-03	9.5910E-01	1.0100E+00	-9.5343E-05	1.9700E-01	1.5320E-05
108.	GG1	8.1714E-03	9.5297E-01	1.0109E+00	-1.0836E-04	1.8750E-01	1.5296E-05
109.	GE1	8.1292E-03	9.3903E-01	1.0129E+00	-1.3824E-04	1.7440E-01	1.5217E-05
110.	SW2B1	8.1218E-03	2.3349E-01	1.0281E+00	-1.4875E-03	3.5370E-02	1.5204E-05
111.	SW2A1	8.1218E-03	2.3217E-01	1.0282E+00	-1.4900E-03	3.5370E-02	1.5204E-05
112.	SW2D1	8.1208E-03	2.3670E-01	1.0286E+00	-1.4824E-03	3.6140E-02	1.5202E-05
113.	SW2C1	8.1208E-03	2.3815E-01	1.0286E+00	-1.4796E-03	3.6140E-02	1.5202E-05
114.	DJF	7.3060E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.3676E-05
115.	RCIF	7.3060E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.3676E-05
116.	CD1	6.5931E-03	5.2811E+00	9.9386E-01	8.0255E-03	1.4322E-03	1.2342E-05
117.	RCL2	6.5586E-03	9.8741E-01	1.0015E+00	-2.6403E-05	1.0760E-01	1.2277E-05
118.	OFT1	6.2196E-03	9.1002E-01	1.0100E+00	-1.8716E-04	1.0000E-01	1.1643E-05
119.	RCL1	5.5875E-03	7.2767E-01	1.0052E+00	-5.1954E-04	1.8780E-02	1.0459E-05
120.	PX2F	5.3732E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0058E-05
121.	NH2F	5.3732E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0058E-05
122.	RBF	5.3732E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0058E-05
123.	DH1	5.3732E-03	1.0840E+00	9.9958E-01	1.5804E-04	4.9731E-03	1.0058E-05
124.	NPIIF	5.3732E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.0058E-05
125.	GA1	4.9943E-03	9.2786E-01	1.0115E+00	-1.5664E-04	1.3790E-01	9.3491E-06
126.	RVD38	4.2917E-03	1.0343E+00	9.9619E-01	7.1330E-05	1.0010E-01	8.0337E-06
127.	RFF	3.8706E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	7.2455E-06
128.	SW2BF	3.8706E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	7.2455E-06
129.	RGF	3.8706E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	7.2455E-06
130.	EBF	3.8706E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	7.2455E-06
131.	ACF	3.8706E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	7.2455E-06
132.	OHC3	3.8447E-03	9.9379E-01	1.0007E+00	-1.2924E-05	1.0000E-01	7.1970E-06

MODEL Name: BFNHA

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
133.	HPIF	3.8208E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	7.1524E-06
134.	SDCF	3.8208E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	7.1524E-06
135.	HPI1	3.6253E-03	9.8675E-01	1.0013E+00	-2.7202E-05	8.8140E-02	6.7864E-06
136.	SW1CF	3.5518E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.6488E-06
137.	SW2CF	3.5518E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.6488E-06
138.	DKF	3.5518E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.6488E-06
139.	ABF	3.5518E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.6488E-06
140.	RHF	3.5518E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	6.6488E-06
141.	HPL1	3.5067E-03	6.6191E-01	1.0064E+00	-6.4489E-04	1.8620E-02	6.5644E-06
142.	GC1	3.0975E-03	9.2159E-01	1.0127E+00	-1.7061E-04	1.3970E-01	5.7983E-06
143.	TB1	3.0525E-03	4.1913E-01	1.0096E+00	-1.1053E-03	1.6248E-02	5.7141E-06
144.	GB1	2.7787E-03	9.1672E-01	1.0134E+00	-1.8094E-04	1.3840E-01	5.2016E-06
145.	NH22	2.7460E-03	1.9294E-01	1.0120E+00	-1.5332E-03	1.4640E-02	5.1404E-06
146.	RVC3	2.6597E-03	0.0000E+00	9.9734E-01	0.0000E+00	3.9220E-05	4.9789E-06
147.	SW1AF	2.5424E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.7592E-06
148.	REF	2.5424E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.7592E-06
149.	AAF	2.5424E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.7592E-06
150.	SW2AF	2.5424E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.7592E-06
151.	RMF	2.5424E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.7592E-06
152.	GD1	2.4521E-03	9.1986E-01	1.0132E+00	-1.7473E-04	1.4140E-01	4.5901E-06
153.	L8F1	2.3454E-03	1.3093E+00	9.9771E-01	5.8330E-04	7.3491E-03	4.3904E-06
154.	EPR301	2.3353E-03	9.9237E-01	1.0069E+00	-2.7217E-05	4.7500E-01	4.3715E-06
155.	DK1	2.3244E-03	1.9268E-01	1.0100E+00	-1.5301E-03	1.2290E-02	4.3512E-06
156.	DL1	2.3244E-03	1.9303E-01	1.0101E+00	-1.5296E-03	1.2420E-02	4.3511E-06
157.	L8FF	2.1415E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	4.0087E-06
158.	NIEF	2.0444E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.8271E-06
159.	NRUF	2.0444E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	3.8271E-06
160.	HPL4	2.0106E-03	1.0158E+00	9.9827E-01	3.2743E-05	9.8800E-02	3.7638E-06
161.	RVD24	1.9051E-03	1.0152E+00	9.9831E-01	3.1664E-05	1.0010E-01	3.5662E-06
162.	HPI3	1.8507E-03	1.0172E+00	9.9815E-01	3.5649E-05	9.7180E-02	3.4644E-06
163.	RCI2	1.8507E-03	9.8420E-01	1.0011E+00	-3.1723E-05	6.7780E-02	3.4644E-06
164.	HPL5	1.6478E-03	1.0640E+00	9.9877E-01	1.2213E-04	1.8780E-02	3.0846E-06
165.	SGTF	1.4877E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7849E-06
166.	RPDF	1.4877E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7849E-06
167.	SGTOPF	1.4877E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7849E-06
168.	DWSF	1.4877E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7849E-06
169.	RPBF	1.4877E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7849E-06
170.	HUMF	1.4877E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7849E-06
171.	RPAF	1.4877E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7849E-06
172.	RPCF	1.4877E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7849E-06
173.	LPCF	1.4877E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7849E-06
174.	U1F	1.4877E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7849E-06
175.	U3F	1.4877E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7849E-06
176.	OSPF	1.4877E-03	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	2.7849E-06

MODEL Name: BFNHA

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
177.	HPL2	1.1771E-03	9.4823E-01	1.0050E+00	-1.0629E-04	8.8250E-02	2.2034E-06
178.	RVD14	8.0046E-04	1.0064E+00	9.9929E-01	1.3296E-05	1.0010E-01	1.4984E-06
179.	SW2DF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
180.	EPR64	7.7309E-04	1.0021E+00	9.9923E-01	5.4000E-06	2.6800E-01	1.4472E-06
181.	ADF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
182.	ORPF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
183.	DNF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
184.	RCLF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
185.	DMF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
186.	DOF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
187.	EPR304	7.7309E-04	1.0009E+00	9.9923E-01	3.0791E-06	4.7000E-01	1.4472E-06
188.	EDF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
189.	DLF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
190.	OEEF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
191.	GGF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
192.	RJF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
193.	RNF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
194.	GEF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
195.	RBCF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
196.	HPLF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
197.	GD4	7.7309E-04	1.0018E+00	9.9923E-01	4.7857E-06	3.0240E-01	1.4472E-06
198.	RKF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
199.	GC4	7.7309E-04	1.0040E+00	9.9923E-01	8.8784E-06	1.6300E-01	1.4472E-06
200.	GB2	7.7309E-04	1.0007E+00	9.9988E-01	1.6028E-06	1.3480E-01	1.4472E-06
201.	RLF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
202.	GHF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
203.	GFF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
204.	RIF	7.7309E-04	1.0000E+00	0.0000E+00	0.0000E+00	1.0000E+00	1.4472E-06
205.	OEE1	7.1462E-04	1.0064E+00	9.9929E-01	1.3377E-05	1.0000E-01	1.3377E-06
206.	ED26	7.1462E-04	1.0016E+00	9.9929E-01	4.3817E-06	3.0530E-01	1.3377E-06
207.	MCD1	6.1515E-04	7.8997E-01	1.0068E+00	-4.0595E-04	3.1510E-02	1.1515E-06
208.	RPA1	5.8210E-04	4.5687E-02	1.0127E+00	-1.8103E-03	1.3170E-02	1.0897E-06
209.	RPB5	5.7670E-04	4.6637E-02	1.0125E+00	-1.8080E-03	1.2940E-02	1.0795E-06
210.	R4801	0.0000E+00	9.9722E-01	1.0003E+00	-5.7795E-06	1.0000E-01	0.0000E+00
211.	RBC17	0.0000E+00	4.3591E-01	1.0044E+00	-1.0641E-03	7.6774E-03	0.0000E+00
212.	RB1	0.0000E+00	5.3732E-03	1.0001E+00	-1.8621E-03	1.2721E-04	0.0000E+00
213.	PX21	0.0000E+00	5.3732E-03	1.0008E+00	-1.8634E-03	8.1130E-04	0.0000E+00
214.	R480B	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
215.	RBC11	0.0000E+00	9.0318E-01	1.0011E+00	-1.8335E-04	1.1513E-02	0.0000E+00
216.	ORP3	0.0000E+00	9.9929E-01	1.0001E+00	-1.4864E-06	1.0000E-01	0.0000E+00
217.	PCA1	0.0000E+00	5.6399E-01	1.0019E+00	-8.1976E-04	4.3635E-03	0.0000E+00
218.	PCA2	0.0000E+00	9.9779E-01	1.0000E+00	-4.1623E-06	4.8654E-03	0.0000E+00
219.	RC1	0.0000E+00	0.0000E+00	1.0001E+00	-1.8722E-03	1.2721E-04	0.0000E+00
220.	RBC20	0.0000E+00	9.8869E-01	1.0002E+00	-2.1550E-05	1.7470E-02	0.0000E+00

MODEL Name: BFNHA

Split Fraction Importance for Group : ALL

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
221.	PX11	0.0000E+00	0.0000E+00	1.0008E+00	-1.8735E-03	8.1330E-04	0.0000E+00
222.	RA1	0.0000E+00	0.0000E+00	1.0002E+00	-1.8724E-03	2.3211E-04	0.0000E+00
223.	RBC4	0.0000E+00	6.7300E-01	1.0006E+00	-6.1319E-04	1.7206E-03	0.0000E+00
224.	RBISOS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
225.	ORF1	0.0000E+00	9.9252E-01	1.0008E+00	-1.5560E-05	1.0000E-01	0.0000E+00
226.	SW2D2	0.0000E+00	9.9188E-01	1.0001E+00	-1.5372E-05	1.0960E-02	0.0000E+00
227.	SW2C4	0.0000E+00	9.9823E-01	1.0001E+00	-3.4334E-06	3.5370E-02	0.0000E+00
228.	SW2D6	0.0000E+00	9.9690E-01	1.0001E+00	-6.0223E-06	3.7200E-02	0.0000E+00
229.	SW2C2	0.0000E+00	9.9188E-01	1.0001E+00	-1.5372E-05	1.0960E-02	0.0000E+00
230.	SW1DB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
231.	TBB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
232.	TBO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
233.	TB2	0.0000E+00	9.9598E-01	1.0002E+00	-7.9919E-06	5.8344E-02	0.0000E+00
234.	TOR2	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.2980E-06	0.0000E+00
235.	SW1B1	0.0000E+00	9.9188E-01	1.0001E+00	-1.5482E-05	1.7970E-02	0.0000E+00
236.	SW1B2	0.0000E+00	9.9690E-01	1.0002E+00	-6.2104E-06	6.6360E-02	0.0000E+00
237.	SW1AB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
238.	SW1D1	0.0000E+00	9.9188E-01	1.0001E+00	-1.5428E-05	1.4690E-02	0.0000E+00
239.	SW1CB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
240.	SW1BB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
241.	SW1C1	0.0000E+00	9.9188E-01	1.0001E+00	-1.5428E-05	1.4690E-02	0.0000E+00
242.	SW1A1	0.0000E+00	9.9188E-01	1.0001E+00	-1.5482E-05	1.7970E-02	0.0000E+00
243.	UB43B1	0.0000E+00	1.0835E-01	1.0002E+00	-1.6695E-03	2.3912E-04	0.0000E+00
244.	V1S	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
245.	UB43A1	0.0000E+00	1.0835E-01	1.0002E+00	-1.6695E-03	2.3912E-04	0.0000E+00
246.	UB42C1	0.0000E+00	9.9379E-02	1.0001E+00	-1.6861E-03	1.1440E-04	0.0000E+00
247.	WETS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
248.	V2S	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
249.	V3S	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
250.	UB41A1	0.0000E+00	1.0890E-01	1.0002E+00	-1.6685E-03	2.3910E-04	0.0000E+00
251.	UB41B1	0.0000E+00	1.0890E-01	1.0002E+00	-1.6685E-03	2.3910E-04	0.0000E+00
252.	UB41B3	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.3340E-05	0.0000E+00
253.	UB41A2	0.0000E+00	9.9945E-01	1.0000E+00	-1.0280E-06	2.1920E-04	0.0000E+00
254.	UB42B4	0.0000E+00	9.9945E-01	1.0000E+00	-1.0280E-06	2.1940E-04	0.0000E+00
255.	UB42B1	0.0000E+00	1.0890E-01	1.0002E+00	-1.6685E-03	2.3910E-04	0.0000E+00
256.	UB42A1	0.0000E+00	1.0890E-01	1.0002E+00	-1.6685E-03	2.3910E-04	0.0000E+00
257.	UB42A3	0.0000E+00	9.9945E-01	1.0000E+00	-1.0280E-06	2.1930E-04	0.0000E+00
258.	RCW1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.5040E-05	0.0000E+00
259.	RK3	0.0000E+00	9.9722E-01	1.0001E+00	-5.3348E-06	2.4980E-02	0.0000E+00
260.	RL1	0.0000E+00	3.5518E-03	1.0001E+00	-1.8655E-03	1.3300E-04	0.0000E+00
261.	RK1	0.0000E+00	3.5518E-03	1.0001E+00	-1.8655E-03	1.3300E-04	0.0000E+00
262.	RJ1	0.0000E+00	7.7309E-04	1.0002E+00	-1.8708E-03	1.5053E-04	0.0000E+00
263.	RN1	0.0000E+00	7.7309E-04	1.0003E+00	-1.8711E-03	3.3077E-04	0.0000E+00
264.	RL4	0.0000E+00	9.9722E-01	1.0000E+00	-5.2067E-06	9.9410E-04	0.0000E+00

MODEL Name: BFNHA

Split Fraction Importance for Group : ALL

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
265.	RM1	0.0000E+00	2.5424E-03	1.0003E+00	-1.8678E-03	3.3077E-04	0.0000E+00
266.	RO1	0.0000E+00	8.9023E-03	1.0003E+00	-1.8557E-03	2.5539E-04	0.0000E+00
267.	RD1	0.0000E+00	0.0000E+00	1.0001E+00	-1.8722E-03	1.2721E-04	0.0000E+00
268.	RE1	0.0000E+00	2.5424E-03	1.0003E+00	-1.8677E-03	2.5539E-04	0.0000E+00
269.	RCW7	0.0000E+00	9.0373E-01	1.0002E+00	-1.8058E-04	2.0546E-03	0.0000E+00
270.	RI1	0.0000E+00	7.7309E-04	1.0002E+00	-1.8708E-03	1.5053E-04	0.0000E+00
271.	RH1	0.0000E+00	3.5518E-03	1.0002E+00	-1.8656E-03	1.5053E-04	0.0000E+00
272.	RF1	0.0000E+00	3.8706E-03	1.0003E+00	-1.8652E-03	2.5539E-04	0.0000E+00
273.	RG1	0.0000E+00	3.8706E-03	1.0005E+00	-1.8656E-03	5.1074E-04	0.0000E+00
274.	SP1	0.0000E+00	5.4211E-01	1.0003E+00	-8.5762E-04	5.5918E-04	0.0000E+00
275.	RVOB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
276.	SGT1	0.0000E+00	1.4877E-03	1.0015E+00	-1.8719E-03	1.4680E-03	0.0000E+00
277.	RVO1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.3340E-05	0.0000E+00
278.	RVLO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
279.	SHUT11	0.0000E+00	1.0835E-01	1.0001E+00	-1.6693E-03	1.1090E-04	0.0000E+00
280.	SGTOPS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
281.	SHT21	0.0000E+00	1.0835E-01	1.0001E+00	-1.6693E-03	1.1090E-04	0.0000E+00
282.	RP1	0.0000E+00	8.9445E-03	1.0003E+00	-1.8557E-03	2.5539E-04	0.0000E+00
283.	RPC2	0.0000E+00	9.9942E-01	1.0003E+00	-1.6545E-06	3.4140E-01	0.0000E+00
284.	RPD9	0.0000E+00	9.9942E-01	1.0003E+00	-1.6349E-06	3.3970E-01	0.0000E+00
285.	RPB2	0.0000E+00	9.9942E-01	1.0000E+00	-1.1105E-06	1.8800E-02	0.0000E+00
286.	RPS4	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	9.0940E-06	0.0000E+00
287.	RPS10	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.1400E-06	0.0000E+00
288.	RPSO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
289.	RPS1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	9.0940E-06	0.0000E+00
290.	A3EA1	0.0000E+00	1.0835E-01	1.0008E+00	-1.6706E-03	8.6470E-04	0.0000E+00
291.	DN2	0.0000E+00	9.9722E-01	1.0000E+00	-5.2027E-06	2.2791E-04	0.0000E+00
292.	DN1	0.0000E+00	1.1681E-02	1.0001E+00	-1.8503E-03	1.1446E-04	0.0000E+00
293.	DN3	0.0000E+00	9.9187E-01	1.0000E+00	-1.5235E-05	1.1392E-03	0.0000E+00
294.	DM2	0.0000E+00	9.9690E-01	1.0000E+00	-5.8002E-06	3.3922E-04	0.0000E+00
295.	DM3	0.0000E+00	9.9183E-01	1.0000E+00	-1.5326E-05	1.9386E-03	0.0000E+00
296.	DM1	0.0000E+00	1.2042E-02	1.0002E+00	-1.8498E-03	2.1945E-04	0.0000E+00
297.	DT21	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	4.0670E-06	0.0000E+00
298.	DT11	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	4.0670E-06	0.0000E+00
299.	DO1	0.0000E+00	3.8706E-03	1.0001E+00	-1.8649E-03	1.1446E-04	0.0000E+00
300.	DO2	0.0000E+00	9.9690E-01	1.0000E+00	-5.7996E-06	2.2791E-04	0.0000E+00
301.	DW1	0.0000E+00	9.3222E-01	1.0000E+00	-1.2690E-04	5.1413E-05	0.0000E+00
302.	DGA	0.0000E+00	8.9023E-03	1.0050E+00	-1.8645E-03	4.9731E-03	0.0000E+00
303.	DF2	0.0000E+00	9.9110E-01	1.0000E+00	-1.6709E-05	2.6587E-03	0.0000E+00
304.	DGB	0.0000E+00	9.9110E-01	1.0000E+00	-1.6741E-05	4.5649E-03	0.0000E+00
305.	DE2	0.0000E+00	9.9746E-01	1.0000E+00	-4.7810E-06	4.5649E-03	0.0000E+00
306.	DF1	0.0000E+00	8.9023E-03	1.0031E+00	-1.8611E-03	3.1418E-03	0.0000E+00
307.	DL3	0.0000E+00	9.9722E-01	1.0000E+00	-5.2663E-06	1.2290E-02	0.0000E+00
308.	DL2	0.0000E+00	9.9768E-01	1.0000E+00	-4.3592E-06	1.8260E-03	0.0000E+00

MODEL Name: BFNHA

Split Fraction Importance for Group : ALL

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
309.	DJ1	0.0000E+00	7.3060E-03	1.0005E+00	-1.8591E-03	4.7360E-04	0.0000E+00
310.	DH2	0.0000E+00	9.9645E-01	1.0000E+00	-6.6792E-06	4.5649E-03	0.0000E+00
311.	DI1	0.0000E+00	0.0000E+00	1.0005E+00	-1.8728E-03	4.7370E-04	0.0000E+00
312.	DE1	0.0000E+00	2.5424E-03	1.0050E+00	-1.8765E-03	4.9731E-03	0.0000E+00
313.	EPR68	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
314.	EPR61	0.0000E+00	9.9766E-01	1.0009E+00	-6.0048E-06	2.7200E-01	0.0000E+00
315.	FA1	0.0000E+00	8.9165E-01	1.0011E+00	-2.0492E-04	1.0210E-02	0.0000E+00
316.	ED5	0.0000E+00	9.8949E-01	1.0000E+00	-1.9751E-05	3.6810E-03	0.0000E+00
317.	EPR30B	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
318.	ED3	0.0000E+00	9.9188E-01	1.0000E+00	-1.5264E-05	3.7700E-03	0.0000E+00
319.	FC1	0.0000E+00	8.9165E-01	1.0011E+00	-2.0491E-04	1.0140E-02	0.0000E+00
320.	FBB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
321.	FAB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
322.	FB1	0.0000E+00	8.9165E-01	1.0011E+00	-2.0491E-04	1.0140E-02	0.0000E+00
323.	DWP1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.7259E-05	0.0000E+00
324.	EA3	0.0000E+00	9.0000E-01	1.0004E+00	-1.8789E-04	3.6950E-03	0.0000E+00
325.	EA1	0.0000E+00	1.0890E-01	1.0007E+00	-1.6694E-03	8.0680E-04	0.0000E+00
326.	EB1	0.0000E+00	1.0890E-01	1.0007E+00	-1.6694E-03	7.8900E-04	0.0000E+00
327.	DWS1	0.0000E+00	5.7196E-02	1.0013E+00	-1.7672E-03	1.3253E-03	0.0000E+00
328.	ED2	0.0000E+00	2.0123E-02	1.0036E+00	-1.8410E-03	3.6770E-03	0.0000E+00
329.	EC3	0.0000E+00	9.9187E-01	1.0000E+00	-1.5275E-05	3.7880E-03	0.0000E+00
330.	EC2	0.0000E+00	1.7740E-02	1.0037E+00	-1.8457E-03	3.7770E-03	0.0000E+00
331.	EB7	0.0000E+00	9.1122E-01	1.0003E+00	-1.6678E-04	3.5540E-03	0.0000E+00
332.	EB8	0.0000E+00	9.8375E-01	1.0002E+00	-3.0880E-05	1.4760E-02	0.0000E+00
333.	FCB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
334.	AB5	0.0000E+00	9.9578E-01	1.0000E+00	-7.9105E-06	1.0900E-03	0.0000E+00
335.	AB2	0.0000E+00	8.9942E-01	1.0001E+00	-1.8847E-04	1.0250E-03	0.0000E+00
336.	AC1	0.0000E+00	1.0835E-01	1.0004E+00	-1.6699E-03	4.6160E-04	0.0000E+00
337.	AA2	0.0000E+00	8.9664E-01	1.0001E+00	-1.9369E-04	1.0900E-03	0.0000E+00
338.	AB1	0.0000E+00	1.0835E-01	1.0004E+00	-1.6699E-03	4.6150E-04	0.0000E+00
339.	AA1	0.0000E+00	1.0590E-01	1.0004E+00	-1.6745E-03	4.6140E-04	0.0000E+00
340.	AD23	0.0000E+00	9.8990E-01	1.0000E+00	-1.8921E-05	9.9520E-04	0.0000E+00
341.	AD1	0.0000E+00	1.0835E-01	1.0004E+00	-1.6699E-03	4.6180E-04	0.0000E+00
342.	AC14	0.0000E+00	9.9300E-01	1.0000E+00	-1.3117E-05	1.0250E-03	0.0000E+00
343.	AC4	0.0000E+00	9.0252E-01	1.0001E+00	-1.8267E-04	9.9520E-04	0.0000E+00
344.	AD4	0.0000E+00	9.0252E-01	1.0001E+00	-1.8266E-04	9.7200E-04	0.0000E+00
345.	A3EB2	0.0000E+00	9.0939E-01	1.0001E+00	-1.6986E-04	1.4030E-03	0.0000E+00
346.	A3EB1	0.0000E+00	1.0022E-01	1.0008E+00	-1.6857E-03	8.4550E-04	0.0000E+00
347.	A3EC1	0.0000E+00	1.0835E-01	1.0007E+00	-1.6705E-03	8.2630E-04	0.0000E+00
348.	A3EA2	0.0000E+00	9.0055E-01	1.0001E+00	-1.8643E-04	1.4320E-03	0.0000E+00
349.	A3ED4	0.0000E+00	9.2629E-01	1.0001E+00	-1.3816E-04	1.3580E-03	0.0000E+00
350.	A3ED23	0.0000E+00	9.7486E-01	1.0000E+00	-4.7123E-05	1.3800E-03	0.0000E+00
351.	A3ED1	0.0000E+00	1.0835E-01	1.0007E+00	-1.6705E-03	8.0700E-04	0.0000E+00
352.	A3EC14	0.0000E+00	9.8303E-01	1.0000E+00	-3.1806E-05	1.4030E-03	0.0000E+00

MODEL Name: BFNHA

Split Fraction Importance for Group : ALL

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
353.	A3EC4	0.0000E+00	9.1756E-01	1.0001E+00	-1.5454E-04	1.3800E-03	0.0000E+00
354.	DD2	0.0000E+00	9.9923E-01	1.0000E+00	-1.4495E-06	1.5699E-03	0.0000E+00
355.	DB2	0.0000E+00	9.9613E-01	1.0000E+00	-7.2569E-06	1.5699E-03	0.0000E+00
356.	DB1	0.0000E+00	3.8706E-03	1.0020E+00	-1.8685E-03	2.0535E-03	0.0000E+00
357.	DC1	0.0000E+00	3.5518E-03	1.0021E+00	-1.8691E-03	2.0535E-03	0.0000E+00
358.	DA1	0.0000E+00	2.5424E-03	1.0021E+00	-1.8710E-03	2.0535E-03	0.0000E+00
359.	DA2	0.0000E+00	9.9746E-01	1.0000E+00	-4.7667E-06	1.5699E-03	0.0000E+00
360.	CST1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	3.6238E-05	0.0000E+00
361.	DD1	0.0000E+00	7.7309E-04	1.0021E+00	-1.8743E-03	2.0535E-03	0.0000E+00
362.	DCA2	0.0000E+00	9.9779E-01	1.0001E+00	-4.2490E-06	2.5165E-02	0.0000E+00
363.	DC2	0.0000E+00	9.9645E-01	1.0000E+00	-6.6592E-06	1.5699E-03	0.0000E+00
364.	DCA1	0.0000E+00	5.6399E-01	1.0017E+00	-8.1945E-04	3.9869E-03	0.0000E+00
365.	BVR1	0.0000E+00	7.8400E-01	1.0030E+00	-4.0995E-04	1.3680E-02	0.0000E+00
366.	CIL2	0.0000E+00	4.3822E-01	1.0003E+00	-1.0522E-03	5.6882E-04	0.0000E+00
367.	CIL1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	5.9632E-06	0.0000E+00
368.	CIS1	0.0000E+00	0.0000E+00	1.0007E+00	-1.8733E-03	7.1046E-04	0.0000E+00
369.	CDA1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
370.	CS7	0.0000E+00	9.9845E-01	1.0000E+00	-2.9857E-06	2.6706E-02	0.0000E+00
371.	CS6	0.0000E+00	9.7936E-01	1.0000E+00	-3.8673E-05	9.6245E-04	0.0000E+00
372.	CS5	0.0000E+00	5.6510E-01	1.0004E+00	-8.1481E-04	8.6971E-04	0.0000E+00
373.	CS1	0.0000E+00	9.6896E-01	1.0001E+00	-5.8217E-05	1.9509E-03	0.0000E+00
374.	CS2	0.0000E+00	9.9748E-01	1.0000E+00	-4.7300E-06	2.0586E-03	0.0000E+00
375.	OPTR1	0.0000E+00	9.9796E-01	1.0002E+00	-4.2523E-06	1.0000E-01	0.0000E+00
376.	LM41	0.0000E+00	0.0000E+00	1.0020E+00	-1.8758E-03	2.0330E-03	0.0000E+00
377.	LM31	0.0000E+00	0.0000E+00	1.0021E+00	-1.8758E-03	2.0480E-03	0.0000E+00
378.	LPC4	0.0000E+00	4.9527E-01	1.0001E+00	-9.4507E-04	2.6688E-04	0.0000E+00
379.	LM11	0.0000E+00	0.0000E+00	1.0021E+00	-1.8758E-03	2.0810E-03	0.0000E+00
380.	LM21	0.0000E+00	0.0000E+00	1.0021E+00	-1.8758E-03	2.0630E-03	0.0000E+00
381.	LFS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
382.	LT31	0.0000E+00	5.3732E-03	1.0024E+00	-1.8663E-03	2.3910E-03	0.0000E+00
383.	LT21	0.0000E+00	0.0000E+00	1.0027E+00	-1.8769E-03	2.6570E-03	0.0000E+00
384.	LPRESS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
385.	LT11	0.0000E+00	0.0000E+00	1.0029E+00	-1.8775E-03	2.9410E-03	0.0000E+00
386.	LT41	0.0000E+00	5.3732E-03	1.0021E+00	-1.8658E-03	2.1240E-03	0.0000E+00
387.	INDS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
388.	INCS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
389.	INHS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
390.	INAS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
391.	LECS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
392.	L8H3	0.0000E+00	9.9616E-01	1.0001E+00	-7.3176E-06	1.6484E-02	0.0000E+00
393.	IVO1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	6.1050E-17	0.0000E+00
394.	IVC1	0.0000E+00	9.9102E-01	1.0000E+00	-1.6803E-05	7.3812E-05	0.0000E+00
395.	IVC3	0.0000E+00	9.9695E-01	1.0000E+00	-5.7143E-06	5.0601E-05	0.0000E+00
396.	HXD8	0.0000E+00	9.9942E-01	1.0000E+00	-1.0853E-06	5.3310E-03	0.0000E+00

MODEL Name: BFNHA

Split Fraction Importance for Group : ALL

Sorted by Importance

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
397.	OF3	0.0000E+00	9.9378E-01	1.0031E+00	-1.7414E-05	3.3140E-01	0.0000E+00
398.	OEEB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
399.	OG161	0.0000E+00	9.9379E-02	1.0006E+00	-1.6869E-03	6.1657E-04	0.0000E+00
400.	NRVO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
401.	OBD1	0.0000E+00	9.8991E-01	1.0015E+00	-2.1680E-05	1.2850E-01	0.0000E+00
402.	NPII1	0.0000E+00	5.3732E-03	1.0003E+00	-1.8624E-03	2.6670E-04	0.0000E+00
403.	OIV1	0.0000E+00	9.7174E-01	1.0031E+00	-5.8789E-05	1.0000E-01	0.0000E+00
404.	OHS1	0.0000E+00	9.9336E-01	1.0007E+00	-1.3815E-05	1.0000E-01	0.0000E+00
405.	OG51	0.0000E+00	1.0890E-01	1.0003E+00	-1.6687E-03	3.8690E-04	0.0000E+00
406.	OHC2	0.0000E+00	9.7571E-01	1.0027E+00	-5.0530E-05	1.0000E-01	0.0000E+00
407.	LVP1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.8624E-05	0.0000E+00
408.	MT21	0.0000E+00	1.0890E-01	1.0001E+00	-1.6683E-03	1.1232E-04	0.0000E+00
409.	MT11	0.0000E+00	1.0890E-01	1.0007E+00	-1.6693E-03	7.4972E-04	0.0000E+00
410.	MT31	0.0000E+00	1.0890E-01	1.0007E+00	-1.6693E-03	7.4972E-04	0.0000E+00
411.	LVS	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
412.	NPI1	0.0000E+00	0.0000E+00	1.0003E+00	-1.8725E-03	2.8420E-04	0.0000E+00
413.	NIEB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
414.	NH11	0.0000E+00	0.0000E+00	1.0030E+00	-1.8776E-03	3.0370E-03	0.0000E+00
415.	NAO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
416.	NBOCB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
417.	FD1	0.0000E+00	8.9165E-01	1.0011E+00	-2.0491E-04	1.0140E-02	0.0000E+00
418.	FWH2	0.0000E+00	9.9342E-01	1.0002E+00	-1.2638E-05	2.5213E-02	0.0000E+00
419.	FWH1	0.0000E+00	8.5440E-01	1.0002E+00	-2.7288E-04	1.2000E-03	0.0000E+00
420.	GAB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
421.	FWC1	0.0000E+00	8.5404E-01	1.0000E+00	-2.7325E-04	8.5200E-05	0.0000E+00
422.	FWC2	0.0000E+00	9.9378E-01	1.0000E+00	-1.1646E-05	2.5560E-04	0.0000E+00
423.	FWA1	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
424.	GD2	0.0000E+00	9.8990E-01	1.0015E+00	-2.1716E-05	1.2960E-01	0.0000E+00
425.	GCB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
426.	GBB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
427.	GC2	0.0000E+00	9.9300E-01	1.0010E+00	-1.5068E-05	1.3040E-01	0.0000E+00
428.	GDB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
429.	FEB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
430.	FE1	0.0000E+00	8.9165E-01	1.0011E+00	-2.0492E-04	1.0210E-02	0.0000E+00
431.	FF1	0.0000E+00	8.9165E-01	1.0011E+00	-2.0491E-04	1.0140E-02	0.0000E+00
432.	FDB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
433.	FHB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
434.	FH1	0.0000E+00	8.9165E-01	1.0011E+00	-2.0491E-04	1.0140E-02	0.0000E+00
435.	FGB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
436.	FFB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
437.	FG1	0.0000E+00	8.9165E-01	1.0011E+00	-2.0491E-04	1.0140E-02	0.0000E+00
438.	HXC3	0.0000E+00	9.9942E-01	1.0000E+00	-1.0956E-06	5.4540E-03	0.0000E+00
439.	HUM1	0.0000E+00	3.5049E-02	1.0007E+00	-1.8076E-03	7.0178E-04	0.0000E+00
440.	HSO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

MODEL Name: BFNHA

Split Fraction Importance for Group : ALL

Sorted by Importance

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......	SF Name...	Importance.....	Achievement..	Reduction...	Derivative..	SF Value.......	Frequency......
441.	HUM3	0.0000E+00	9.6644E-01	1.0000E+00	-6.2855E-05	4.9058E-04	0.0000E+00
442.	HRC5	0.0000E+00	9.7571E-01	1.0000E+00	-4.5489E-05	2.6349E-04	0.0000E+00
443.	HRLO	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
444.	HRC3	0.0000E+00	9.5534E-01	1.0000E+00	-8.3623E-05	2.6349E-04	0.0000E+00
445.	HXB7	0.0000E+00	8.9313E-01	1.0009E+00	-2.0177E-04	8.5480E-03	0.0000E+00
446.	HXB3	0.0000E+00	1.0893E-01	1.0048E+00	-1.6770E-03	5.3310E-03	0.0000E+00
447.	HXA1	0.0000E+00	1.0894E-01	1.0049E+00	-1.6772E-03	5.4540E-03	0.0000E+00
448.	HXA2	0.0000E+00	8.9313E-01	1.0009E+00	-2.0181E-04	8.7440E-03	0.0000E+00
449.	GEB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
450.	GG2	0.0000E+00	9.8303E-01	1.0029E+00	-3.7174E-05	1.4560E-01	0.0000E+00
451.	GFB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
452.	GGB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
453.	GF2	0.0000E+00	9.9187E-01	1.0014E+00	-1.7859E-05	1.4790E-01	0.0000E+00
454.	HRC1	0.0000E+00	3.5691E-01	1.0003E+00	-1.2044E-03	4.8505E-04	0.0000E+00
455.	HR60	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
456.	HPL3	0.0000E+00	9.9662E-01	1.0001E+00	-6.5041E-06	2.7250E-02	0.0000E+00
457.	GH2	0.0000E+00	9.7486E-01	1.0043E+00	-5.5129E-05	1.4640E-01	0.0000E+00
458.	GHB	0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

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ALL    1 TOT   = TOTAL * 1.5187                                     $
ALL    1 TOTAL =SEQ001+SEQ002+SEQ003+SEQ004+SEQ005+SEQ006+SEQ007+X  $
ALL    1 X     =SEQ008+SEQ009+SEQ010+SEQ011+SEQ012+SEQ013+SEQ014+X  $
ALL    1 X     =SEQ015+SEQ016+SEQ017+SEQ018+SEQ019+SEQ020+SEQ021+X  $
ALL    1 X     =SEQ022+SEQ023+SEQ024+SEQ025+SEQ026+SEQ027+SEQ028+X  $
ALL    1 X     =SEQ029+SEQ030+SEQ031+SEQ032+SEQ033+SEQ034+SEQ035+X  $
ALL    1 X     =SEQ036+SEQ037+SEQ038+SEQ039+SEQ040+SEQ041+SEQ042+X  $
ALL    1 X     =SEQ043+SEQ044+SEQ045+SEQ046+SEQ047+SEQ048+SEQ049+X  $
ALL    1 X     =SEQ050+SEQ051+SEQ052+SEQ053+SEQ054+SEQ055+SEQ056+X  $
ALL    1 X     =SEQ057+SEQ058+SEQ059+SEQ060+SEQ061+SEQ062+SEQ063+X  $
ALL    1 X     =SEQ064+SEQ065+SEQ066+SEQ067+SEQ068+SEQ069+SEQ070+X  $
ALL    1 X     =SEQ071+SEQ072+SEQ073+SEQ074+SEQ075+SEQ076+SEQ077+X  $
ALL    1 X     =SEQ078+SEQ079+SEQ080+SEQ081+SEQ082+SEQ083+SEQ084+X  $
ALL    1 X     =SEQ085+SEQ086+SEQ087+SEQ088+SEQ089+SEQ090+SEQ091+X  $
ALL    1 X     =SEQ092+SEQ093+SEQ094+SEQ095+SEQ096+SEQ097+SEQ098+X  $
ALL    1 X     =SEQ099+SEQ100+SEQ101+SEQ102+SEQ103+SEQ104+SEQ105+X  $
ALL    1 X     =SEQ106+SEQ107+SEQ108+SEQ109+SEQ110+SEQ111+SEQ112+X  $
ALL    1 X     =SEQ113+SEQ114+SEQ115+SEQ116+SEQ117+SEQ118+SEQ119+X  $
ALL    1 X     =SEQ120+SEQ121+SEQ122+SEQ123+SEQ124+SEQ125+SEQ126+X  $
ALL    1 X     =SEQ127+SEQ128+SEQ129+SEQ130+SEQ131+SEQ132+SEQ133+X  $
ALL    1 X     =SEQ134+SEQ135+SEQ136+SEQ137+SEQ138+SEQ139+SEQ140+X  $
ALL    1 X     =SEQ141+SEQ142+SEQ143+SEQ144+SEQ145+SEQ146+SEQ147+X  $
ALL    1 X     =SEQ148+SEQ149+SEQ150+SEQ151+SEQ152+SEQ153+SEQ154+X  $
ALL    1 X     =SEQ155+SEQ156+SEQ157+SEQ158+SEQ159+SEQ160+SEQ161+X  $
ALL    1 X     =SEQ162+SEQ163+SEQ164+SEQ165+SEQ166+SEQ167+SEQ168+X  $
ALL    1 X     =SEQ169+SEQ170+SEQ171+SEQ172+SEQ173+SEQ174+SEQ175+X  $
ALL    1 X     =SEQ176+SEQ177+SEQ178+SEQ179+SEQ180+SEQ181+SEQ182+X  $
ALL    1 X     =SEQ183+SEQ184+SEQ185+SEQ186+SEQ187+SEQ188+SEQ189+X  $
ALL    1 X     =SEQ190+SEQ191+SEQ192+SEQ193+SEQ194+SEQ195+SEQ196+X  $
ALL    1 X     =SEQ197+SEQ198+SEQ199+SEQ200+SEQ201+SEQ202+SEQ203+X  $
ALL    1 X     =SEQ204+SEQ205+SEQ206+SEQ207+SEQ208+SEQ209+SEQ210+X  $
ALL    1 X     =SEQ211+SEQ212+SEQ213+SEQ214+SEQ215+SEQ216+SEQ217+X  $
ALL    1 X     =SEQ218+SEQ219+SEQ220+SEQ221+SEQ222+SEQ223+SEQ224+X  $
ALL    1 X     =SEQ225+SEQ226+SEQ227+SEQ228+SEQ229+SEQ230+SEQ231+X  $
ALL    1 X     =SEQ232+SEQ233+SEQ234+SEQ235+SEQ236+SEQ237+SEQ238+X  $
ALL    1 X     =SEQ239+SEQ240+SEQ241+SEQ242+SEQ243+SEQ244+SEQ245+X  $
ALL    1 X     =SEQ246+SEQ247+SEQ248+SEQ249+SEQ250+SEQ251+SEQ252+X  $
ALL    1 X     =SEQ253+SEQ254+SEQ255+SEQ256+SEQ257+SEQ258+SEQ259+X  $
ALL    1 X     =SEQ260+SEQ261+SEQ262+SEQ263+SEQ264+SEQ265+SEQ266+X  $
ALL    1 X     =SEQ267+SEQ268+SEQ269+SEQ270+SEQ271+SEQ272+SEQ273+X  $
ALL    1 X     =SEQ274+SEQ275+SEQ276+SEQ277+SEQ278+SEQ279+SEQ280+X  $
ALL    1 X     =SEQ281+SEQ282+SEQ283+SEQ284+SEQ285+SEQ286+SEQ287+X  $
ALL    1 X     =SEQ288+SEQ289+SEQ290+SEQ291+SEQ292+SEQ293+SEQ294+X  $
ALL    1 X     =SEQ295+SEQ296+SEQ297+SEQ298+SEQ299+SEQ300+SEQ301+X  $
ALL    1 X     =SEQ302+SEQ303+SEQ304+SEQ305+SEQ306+SEQ307+SEQ308+X  $
ALL    1 X     =SEQ309+SEQ310+SEQ311+SEQ312+SEQ313+SEQ314+SEQ315+X  $
ALL    1 X     =SEQ316+SEQ317+SEQ318+SEQ319+SEQ320+SEQ321+SEQ322+X  $
ALL    1 X     =SEQ323+SEQ324+SEQ325+SEQ326+SEQ327+SEQ328+SEQ329+X  $
ALL    1 X     =SEQ330+SEQ331+SEQ332+SEQ333+SEQ334+SEQ335+SEQ336+X  $
ALL    1 X     =SEQ337+SEQ338+SEQ339+SEQ340+SEQ341+SEQ342+SEQ343+X  $
ALL    1 X     =SEQ344+SEQ345+SEQ346+SEQ347+SEQ348+SEQ349+SEQ350+X  $
ALL    1 X     =SEQ351+SEQ352+SEQ353+SEQ354+SEQ355+SEQ356+SEQ357+X  $
ALL    1 X     =SEQ358+SEQ359+SEQ360+SEQ361+SEQ362+SEQ363+SEQ364+X  $
ALL    1 X     =SEQ365+SEQ366+SEQ367+SEQ368+SEQ369+SEQ370          $
ALL    2 SEQ001=LOSP*REC6H4*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL    2 X     =RVD2*(1-RBI1)                          $
ALL    3 SEQ002=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X     $
ALL    3 X     =HRSSY1*RVD22*(1-ORP2)*(1-RBI1)                      $
ALL    4 SEQ003=LOSP*REC6H3*(1-RK3)*(1-GE1)*X        $
ALL    4 X     =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVCO*X  $
ALL    4 X     =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)    $
ALL    5 SEQ004=LOSP*REC6H3*(1-GE1)*(1-GF1)*X        $
ALL    5 X     =(1-GG1)*(1-GH1)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*X $
ALL    5 X     =(1-HPI2)*RVD2*RPX1*(1-RBI1)            $
ALL    6 SEQ005=LOSP*REC6H4*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL    6 X     =RVD2*RBI1                              $
ALL    7 SEQ006=FLTB*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL    7 X     =RVD9*(1-ORP2)*(1-RBI1)                $
ALL    8 SEQ007=LOSP*REC6H4*RVCO*(1-RCI1)*HRSHP1*X  $
ALL    8 X     =RVD2*(1-RBI1)                                       $
ALL    9 SEQ008=CIV*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL    9 X     =RVC1*RVD5*(1-ORP2)*(1-RBI1)                         $
ALL   10 SEQ009=LOSP*REC6H4*RVCO*HRSRC1*(1-HPI4)*X  $
ALL   10 X     =RVD2*(1-RBI1)                                       $
ALL   11 SEQ010=LOSP*REC6H4*RVC1*(1-RCI1)*(1-HPI2)*X    $
ALL   11 X     =(1-RBI1)                               $
ALL   12 SEQ011=LOSP*REC6H4*FOT1/DG1*RVCO*(1-RCI1)*(1-HPI2)*X    $
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ALL   12 X      =RVD2*(1-RBI1)                                              $
ALL   13 SEQ012=LOSP*REC6H4*FOT1/DG1*RVCO*(1-RCI1)*X      $
ALL   13 X      =(1-HPI2)*RVD2*(1-RBI1)                                     $
ALL   14 SEQ013=LOFW*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   14 X      =(1-HCD1)*RVC1*(1-OBD1)*(1-ORP2)*(1-RBI1)          $
ALL   15 SEQ014=LOSP*REC6H3*(1-RK3)*(1-GE1)*X          $
ALL   15 X      =(1-GF1)*DG31*(1-GH2)*(1-SW2D5)*RVCO*(1-RCI1)*(1-HPI2)*X $
ALL   15 X      =RVD2*RPX1*(1-RBI1)                                  $
ALL   16 SEQ015=LOSP*REC6H3*(1-RK3)*(1-GE1)*X          $
ALL   16 X      =(1-GF1)*(1-GG1)*DG31*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X$
ALL   16 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)                         $
ALL   17 SEQ016=LOCV*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   17 X      =RVC1*RVD5*(1-ORP2)*(1-RBI1)                         $
ALL   18 SEQ017=TTWB*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   18 X      =(1-HCD1)*RVC1*RVD5*(1-ORP2)*(1-RBI1)                       $
ALL   19 SEQ018=LOSP*REC6H3*(1-RK3)*DG31*(1-GF2)*X    $
ALL   19 X      =(1-GG2)*(1-GH2)*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X      $
ALL   19 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)         $
ALL   20 SEQ019=LOSP*REC6H3*(1-GE1)*(1-GF1)*X          $
ALL   20 X      =(1-GG1)*DG31*(1-SW2B1)*RVCO*(1-RCI1)*(1-HPI2)*X     $
ALL   20 X      =RVD2*RPX1*(1-RBI1)                                         $
ALL   21 SEQ020=LOSP*REC6H3*(1-RK3)*(1-GE1)*DG31*X    $
ALL   21 X      =(1-GG2)*(1-GH2)*(1-ED26)*(1-SW1B2)*(1-SW2D6)*RVCO*X      $
ALL   21 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)    $
ALL   22 SEQ021=LOSP*REC6H3*(1-GE1)*(1-GF1)*DG31*X   $
ALL   22 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL   22 X      =RVD2*RPX1*(1-RBI1)                                  $
ALL   23 SEQ022=LOSP*REC6H3*DG31*(1-GF2)*(1-GG2)*X    $
ALL   23 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL   23 X      =RVD2*RPX1*(1-RBI1)                                  $
ALL   24 SEQ023=LOSP*REC6H3*(1-GE1)*DG31*(1-GG2)*X    $
ALL   24 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL   24 X      =RVD2*RPX1*(1-RBI1)                                  $
ALL   25 SEQ024=IOTM*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-HCD1)*X $
ALL   25 X      =(1-ORP2)*OLP1*(1-RBI1)                                     $
ALL   26 SEQ025=LOSP*REC6H4*FOT1/DG1*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL   26 X      =RVD2*(1-RBI1)                                       $
ALL   27 SEQ026=LOSP*REC6H4*FOT1/DG1*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL   27 X      =RVD2*(1-RBI1)                                       $
ALL   28 SEQ027=LOAC*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RVCO*X     $
ALL   28 X      =HRSSY1*RVD22*CRD4*(1-ORP2)*(1-RBI1)                  $
ALL   29 SEQ028=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*(1-GE1)*(1-GF1)*X  $
ALL   29 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X           $
ALL   29 X      =(1-SW2D1)*RVCO*HRSSY1*RVD22*(1-ORP2)*(1-RBI1)      $
ALL   30 SEQ029=LOSP*REC6H3*(1-GE1)*(1-GF1)*X          $
ALL   30 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW1D9)*RVCO*X     $
ALL   30 X      =(1-RCI1)*(1-HPI2)*SPR1*(1-RBI1)*(1-SGT9)         $
ALL   31 SEQ030=LOSP*REC6H4*FOT4/DG4*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL   31 X      =RVD2*(1-RBI1)                                       $
ALL   32 SEQ031=TT*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-HCD1)*X   $
ALL   32 X      =RVC3*(1-ORP2)*OLP1*(1-RBI1)                                $
ALL   33 SEQ032=ISCRAM*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X         $
ALL   33 X      =(1-HCD1)*RVC3*(1-ORP2)*OLP1*(1-RBI1)                       $
ALL   34 SEQ033=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X    $
ALL   34 X      =HRSSY1*RVD22*(1-ORP2)*RBI1                                 $
ALL   35 SEQ034=LOSP*REC6H3*(1-RK3)*(1-GE1)*X          $
ALL   35 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVCO*X        $
ALL   35 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*RBI1*(1-SGT9)         $
ALL   36 SEQ035=LOSP*REC6H3*FOT1/DG1*(1-RK3)*(1-GE1)*X       $
ALL   36 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVCO*X        $
ALL   36 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)     $
ALL   37 SEQ036=LOSP*REC6H3*FOT1/DG1*(1-RK3)*X          $
ALL   37 X      =(1-GE1)*(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*X   $
ALL   37 X      =RVCO*(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*X      $
ALL   37 X      =(1-SGT9)                                                   $
ALL   38 SEQ037=LOSP*REC6H3*(1-GE1)*(1-GF1)*X          $
ALL   38 X      =(1-GG1)*(1-GH1)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*X      $
ALL   38 X      =(1-HPI2)*RVD2*RPX1*RBI1                             $
ALL   39 SEQ038=LOSP*REC6H1*(1-GE1)*X         $
ALL   39 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW2C1)*X $
ALL   39 X      =(1-SW2D6)*RVCO*(1-RCI1)*(1-HPI2)*RPX3*X  $
ALL   39 X      =(1-RBI1)                                  $
ALL   40 SEQ039=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-RCI1)*X $
ALL   40 X      =(1-HPI2)*RPX4*U11*(1-RBI1)                $
ALL   41 SEQ040=FWRU*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   41 X      =(1-HCD1)*RVC1*(1-OBD1)*(1-ORP2)*(1-RBI1)          $
ALL   42 SEQ041=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*(1-GE1)*(1-GF1)*X  $
ALL   42 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X           $
ALL   42 X      =(1-SW2D1)*RVC1*(1-RCI1)*(1-HPI2)*OLP1*(1-RBI1)            $
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ALL   43 SEQ042=LOSP*REC6H3*(1-RK3)*(1-GE1)*X        $
ALL   43 X     =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVCO*X        $
ALL   43 X     =(1-RCI1)*HRSHP1*RVD2*RPX1*(1-RBI1)*(1-SGT9)        $
ALL   44 SEQ043=LOSP*REC3H4*RVC2*(1-HPI6)*(1-ORP2)*X     $
ALL   44 X     =(1-RBI1)                                             $
ALL   45 SEQ044=LOAC*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL   45 X     =RVCO*RVD9*CRD4*(1-ORP2)*(1-RBI1)                 $
ALL   46 SEQ045=FLTB*DGA*PXI*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL   46 X     =RVD10*(1-ORP2)*(1-RBI1)                              $
ALL   47 SEQ046=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*DH1*(1-GE1)*DGA*X $
ALL   47 X     =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X $
ALL   47 X     =(1-SW2D1)*RVCO*RVD9*(1-ORP2)*(1-RBI1)                $
ALL   48 SEQ047=LOSP*REC6H3*(1-GE1)*(1-GF1)*X        $
ALL   48 X     =(1-GG1)*(1-GH1)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*X     $
ALL   48 X     =HRSHP1*RVD2*RPX1*(1-RBI1)                  $
ALL   49 SEQ048=LOSP*REC6H4*FIT1*RVCO*(1-RCI1)*X        $
ALL   49 X     =(1-HPI2)*RVD2*(1-RBI1)                    $
ALL   50 SEQ049=LOSP*REC6H4*FIT1*RVCO*(1-RCI1)*X        $
ALL   50 X     =(1-HPI2)*RVD2*(1-RBI1)                    $
ALL   51 SEQ050=LOSP*REC6H4*FIT1*RVCO*(1-RCI1)*X        $
ALL   51 X     =(1-HPI2)*RVD2*(1-RBI1)                    $
ALL   52 SEQ051=LOSP*REC6H4*FIT1*(1-FF2)*RVCO*(1-RCI1)*X $
ALL   52 X     =(1-HPI2)*RVD2*(1-RBI1)                    $
ALL   53 SEQ052=MLOCA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*HRSHP1*X  $
ALL   53 X     =RVD14*(1-RBI1)                                       $
ALL   54 SEQ053=LOSP*REC6H3*FOT1/DG1*(1-RK3)*(1-GE1)*X       $
ALL   54 X     =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVCO*X      $
ALL   54 X     =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)    $
ALL   55 SEQ054=LOSP*REC6H4*NHI*RVCO*(1-RCI1)*X       $
ALL   55 X     =(1-HPI2)*RVD2*(1-RBI1)                    $
ALL   56 SEQ055=LRCW*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-HCD1)*X $
ALL   56 X     =RVCO*HRSSY1*RVD22*(1-ORP2)*(1-RBI1)                $
ALL   57 SEQ056=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X      $
ALL   57 X     =HRSSY1*RVD10*(1-ORP2)*OLP1*(1-RBI1)                  $
ALL   58 SEQ057=LOSP*REC6H3*(1-RK3)*(1-GE1)*X        $
ALL   58 X     =(1-GF1)*(1-GG1)*(1-GH1)*SW1B2*RVCO*(1-RCI1)*(1-HPI2)*X  $
ALL   58 X     =RVD2*RPX1*(1-RBI1)*(1-SGT9)               $
ALL   59 SEQ058=LOSP*REC6H2*(1-RK3)*(1-GE1)*X   $
ALL   59 X     =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2B1)*(1-SW2D1)*RVCO*X      $
ALL   59 X     =(1-RCI1)*(1-HPI2)*RVD2*RPX2AC*U11*(1-RBI1)*X  $
ALL   59 X     =(1-SGT9)                                             $
ALL   60 SEQ059=LOSP*REC6H3*FOT1/DG1*(1-GE1)*(1-GF1)*X       $
ALL   60 X     =(1-GG1)*(1-GH1)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*X     $
ALL   60 X     =(1-HPI2)*RVD2*RPX1*(1-RBI1)               $
ALL   61 SEQ060=ISCRAM*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X       $
ALL   61 X     =(1-SW2D1)*TB2*RVC1*RVD5*(1-ORP2)*(1-RBI1)            $
ALL   62 SEQ061=FLTB*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL   62 X     =RVD9*(1-ORP2)*RBI1                        $
ALL   63 SEQ062=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-RCI1)*X $
ALL   63 X     =(1-HPI2)*HRC1*(1-LBH1)*RVD22*(1-ORP2)*(1-RBI1)       $
ALL   64 SEQ063=LOSP*REC6H3*(1-RK3)*(1-GE1)*X        $
ALL   64 X     =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVCO*X $
ALL   64 X     =HRSRC1*(1-HPI4)*RVD2*RPX1*(1-RBI1)*(1-SGT9)          $
ALL   65 SEQ064=LOSP*REC6H3*(1-GE1)*(1-GF1)*X        $
ALL   65 X     =(1-GG1)*(1-GH1)*(1-SW2B1)*SC*RVCO*(1-RCI1)*X        $
ALL   65 X     =(1-HPI2)*RVD2*RPX1*(1-RBI1)               $
ALL   66 SEQ065=CIV*DGA*PXI*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   66 X     =RVC1*RVD6*(1-ORP2)*(1-RBI1)                          $
ALL   67 SEQ066=LOSP*REC6H3*(1-RK3)*(1-GE1)*X        $
ALL   67 X     =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVC1*X      $
ALL   67 X     =(1-RCI1)*(1-HPI2)*RPX1*(1-RBI1)*(1-SGT9)        $
ALL   68 SEQ067=FLTB*DE1*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL   68 X     =HRSHP1*RVD22*(1-ORP2)*(1-RBI1)                $
ALL   69 SEQ068=LOSP*REC6H3*(1-GE1)*(1-GF1)*X        $
ALL   69 X     =(1-GG1)*(1-GH1)*(1-SW2B1)*(1-SW1D7)*RVCO*HRSRC1*X       $
ALL   69 X     =(1-HPI4)*RVD2*RPX1*(1-RBI1)               $
ALL   70 SEQ069=LOSP*REC6H4*RVCO*(1-RCI1)*HRSHP1*X  $
ALL   70 X     =RVD2*RBI1                                            $
ALL   71 SEQ070=FLTB*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL   71 X     =HRSHP1*RVD22*(1-ORP2)*(1-CS7)*(1-RBI1)               $
ALL   72 SEQ071=LOSP*REC6H3*FOT1/DG1*(1-GE1)*(1-GF1)*X       $
ALL   72 X     =(1-GG1)*(1-GH1)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*X     $
ALL   72 X     =(1-HPI2)*RVD2*RPX1*(1-RBI1)               $
ALL   73 SEQ072=LOSP*REC6H3*FOT1/DG1*(1-GE1)*X       $
ALL   73 X     =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2B1)*(1-SW1D7)*RVCO*X      $
ALL   73 X     =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)      $
ALL   74 SEQ073=LOSP*REC6H3*(1-GE1)*(1-GF1)*X        $
ALL   74 X     =(1-GG1)*(1-GH1)*(1-SW2B1)*(1-SW1D7)*RVC1*(1-RCI1)*X     $
ALL   74 X     =(1-HPI2)*RPX1*(1-RBI1)                    $
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ALL  75 SEQ074=TT*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*X       $
ALL  75 X      =(1-MCD1)*SL1*RVC4*(1-ORP2)*(1-SP2)*(1-OOWS2)*(1-RBI1)  $
ALL  76 SEQ075=CIV*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RVC1*X $
ALL  76 X      =HRSSY1*RVD6*(1-ORP2)*OLP1*(1-RBI1)                    $
ALL  77 SEQ076=CIV*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL  77 X      =RVC1*RVD5*(1-ORP2)*RBI1                               $
ALL  78 SEQ077=CIV*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RVC3*X     $
ALL  78 X      =(1-ORP2)*OLP1*(1-RBI1)                                $
ALL  79 SEQ078=LOPA*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL  79 X      =RVC1*RVD5*(1-ORP2)*(1-RBI1)                 $
ALL  80 SEQ079=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*S404*X  $
ALL  80 X      =(1-GE1)*(1-GF1)*(1-GG1)*(1-GH1)*RCW15*RVCO*X     $
ALL  80 X      =(1-RCI1)*(1-HPI2)*(1-ORP3)*(1-RBI1)                   $
ALL  81 SEQ080=L500*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL  81 X      =RVC1*RVD5*(1-ORP2)*(1-RBI1)                 $
ALL  82 SEQ081=L500*OUB2*REC6H4*RVCO*(1-RCI1)*X        $
ALL  82 X      =(1-HPI2)*(1-RBI1)                               $
ALL  83 SEQ082=TT*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*X      $
ALL  83 X      =(1-MCD1)*OSL1*(1-ORP2)*(1-SP2)*(1-OOWS2)*X     $
ALL  83 X      =(1-RBI1)                                              $
ALL  84 SEQ083=TT*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS4*X  $
ALL  84 X      =(1-MCD1)*RVC4*(1-ORP2)*(1-SP2)*(1-OOWS2)*(1-RBI1)     $
ALL  85 SEQ084=LOSP*REC6H2*(1-RK3)*(1-GE1)*X   $
ALL  85 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW2D6)*X $
ALL  85 X      =RVCO*(1-RCI1)*(1-HPI2)*R4801*RPX1*(1-RBI1)        $
ALL  86 SEQ085=LOSP*REC6H2*(1-GE1)*DGA*X           $
ALL  86 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*(1-SW1D7)*X $
ALL  86 X      =RVCO*(1-HPI6)*RVD2*(1-RBI1)*(1-SGT9)          $
ALL  87 SEQ086=LOSP*REC6H2*(1-RK3)*(1-GE1)*X   $
ALL  87 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW2D6)*X $
ALL  87 X      =RVCO*(1-RCI1)*(1-HPI2)*RPX2AB*(1-RBI1)       $
ALL  88 SEQ087=LOFW*DGA*PXI*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL  88 X      =(1-MCD1)*RVC1*(1-OBD1)*(1-ORP2)*(1-RBI1)              $
ALL  89 SEQ088=LOSP*REC6H4*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL  89 X      =RVD2*OOWS1*(1-RBI1)                             $
ALL  90 SEQ089=LOFW*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X $
ALL  90 X      =RVC3*(1-ORP2)*OLP1*(1-RBI1)                           $
ALL  91 SEQ090=LOSP*REC6H4*RVCO*HRSRC1*(1-HPI4)*X  $
ALL  91 X      =RVD2*RBI1                                             $
ALL  92 SEQ091=CIV*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RVC2*X $
ALL  92 X      =HRSHP1*RVD2*(1-ORP2)*OLP1*(1-RBI1)                    $
ALL  93 SEQ092=FLTB*DH1*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X     $
ALL  93 X      =HRSRC1*RVD22*(1-ORP2)*(1-CS7)*(1-RBI1)          $
ALL  94 SEQ093=LOSP*REC6H2*(1-GE1)*(1-GF1)*X   $
ALL  94 X      =(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2C4)*(1-SW2D6)*RVCO*X  $
ALL  94 X      =(1-RCI1)*(1-HPI2)*(1-HPL3)*RVD2*RPX2AB*X     $
ALL  94 X      =(1-RBI1)*(1-SGT9)                                     $
ALL  95 SEQ094=LOSP*REC6H4*RVC1*(1-RCI1)*(1-HPI2)*X    $
ALL  95 X      =RBI1                                            $
ALL  96 SEQ095=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*S404*X   $
ALL  96 X      =(1-GE1)*(1-GF1)*(1-GG1)*(1-GH1)*X      $
ALL  96 X      =RVCO*(1-RCI1)*(1-HPI2)*(1-ORP3)*(1-RBI1)      $
ALL  97 SEQ096=LOFW*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL  97 X      =(1-MCD1)*RVC1*OBD1*RVD5*(1-ORP2)*(1-RBI1)       $
ALL  98 SEQ097=CIV*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*OSL2*X $
ALL  98 X      =(1-ORP2)*(1-SP2)*(1-OOWS2)*(1-RBI1)           $
ALL  99 SEQ098=LOSP*REC6H3*(1-RK3)*(1-GE1)*X        $
ALL  99 X      =(1-GF1)*DG32*(1-SW2D5)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL  99 X      =RVD2*RPX1*(1-RBI1)                           $
ALL 100 SEQ099=LOSP*REC6H2*(1-GE1)*(1-GF1)*X   $
ALL 100 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*(1-SW1D7)*RVCO*X  $
ALL 100 X      =(1-RCI1)*(1-HPI2)*RPX2AB*(1-RBI1)*(1-SGT9)      $
ALL 101 SEQ100=LOSP*REC6H3*(1-RK3)*DG32*(1-GF2)*X   $
ALL 101 X      =(1-GH4)*(1-SW2D5)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL 101 X      =RVD2*RPX1*(1-RBI1)                                   $
ALL 102 SEQ101=LOSP*REC6H4*RVCO*HRSSY1*X      $
ALL 102 X      =RVD10*(1-RBI1)                                       $
ALL 103 SEQ102=LOSP*REC6H4*FOT1/DG1*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL 103 X      =RVD2*RBI1                                      $
ALL 104 SEQ103=LOSP*REC6H4*FOT1/DG1*RVCO*(1-RCI1)*X      $
ALL 104 X      =(1-HPI2)*RVD2*RBI1                             $
ALL 105 SEQ104=LOFW*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X $
ALL 105 X      =RVC1*HRSSY1*(1-OBD1)*(1-ORP2)*OLP1*(1-RBI1)        $
ALL 106 SEQ105=LOSP*REC6H3*(1-GE1)*(1-GF1)*X        $
ALL 106 X      =(1-GG1)*DG31*(1-SW2A1)*(1-SW1B2)*RVCO*(1-RCI1)*X      $
ALL 106 X      =(1-HPI2)*SPR1*(1-RBI1)                         $
ALL 107 SEQ106=LRCW*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X $
ALL 107 X      =RVC1*(1-RCI1)*(1-HPI2)*OLP1*(1-RBI1)                  $
ALL 108 SEQ107=FLTB*NA*(1-SW2B1)*(1-SW2D1)*HRSSY1*RVD22*X       $
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ALL   108 X      =(1-ORP2)*(1-RBI1)                                               $
ALL   109 SEQ108=FLTB*(1-SW2A1)*(1-SW2B1)*NA*(1-SW2D1)*HRSSY1*X      $
ALL   109 X      =RVD22*(1-ORP2)*(1-RBI1)                                         $
ALL   110 SEQ109=LOSP*REC6H3*(1-GE1)*(1-GF1)*DG31*X   $
ALL   110 X      =(1-GH2)*(1-SW2A1)*(1-SW1D10)*RVCO*(1-RCI1)*(1-HPI2)*X   $
ALL   110 X      =SPR1*(1-RBI1)*(1-SGT9)                                        $
ALL   111 SEQ110=LOSP*REC6H3*(1-RK3)*DG31*(1-GF2)*X   $
ALL   111 X      =(1-GG2)*GH2*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X                 $
ALL   111 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)                                  $
ALL   112 SEQ111=FLTB*(1-SW2A1)*SA*(1-SW2C1)*HRSSY1*RVD22*X            $
ALL   112 X      =(1-ORP2)*(1-RBI1)                                               $
ALL   113 SEQ112=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*SA*HRSSY1*X      $
ALL   113 X      =RVD22*(1-ORP2)*(1-RBI1)                                         $
ALL   114 SEQ113=LOSP*REC6H3*(1-RK3)*(1-GE1)*DG32*X   $
ALL   114 X      =(1-GH4)*(1-ED26)*(1-SW2D5)*RVCO*(1-RCI1)*(1-HPI2)*X $
ALL   114 X      =RVD2*RPX1*(1-RBI1)                                           $
ALL   115 SEQ114=LOFW*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   115 X      =(1-MCD1)*RVC1*(1-OBD1)*(1-ORP2)*RBI1                        $
ALL   116 SEQ115=LOSP*REC6H3*(1-RK3)*DG32*X       $
ALL   116 X      =(1-GG4)*(1-GH4)*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X      $
ALL   116 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)                         $
ALL   117 SEQ116=LOSP*REC6H2*(1-RL6)*(1-GE1)*X   $
ALL   117 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2B1)*(1-SW2C4)*(1-SW1D7)*X $
ALL   117 X      =RVCO*(1-RCI1)*(1-HPI2)*(1-HPL3)*RVD2*RPX2AB*X  $
ALL   117 X      =(1-RBI1)                                                        $
ALL   118 SEQ117=LOSP*REC6H3*DG31*(1-GF2)*(1-GG2)*X   $
ALL   118 X      =(1-GH2)*(1-SW2A1)*(1-SW1B2)*(1-SW1D9)*RVCO*(1-RCI1)*X   $
ALL   118 X      =(1-HPI2)*EPR63*SPR1*(1-RBI1)                                    $
ALL   119 SEQ118=LOSP*REC6H3*(1-GE1)*(1-GF1)*DG32*X  ·$
ALL   119 X      =(1-SW2B1)*RVCO*(1-RCI1)*(1-HPI2)*RVD2*RPX1*X  $
ALL   119 X      =(1-RBI1)                                                        $
ALL   120 SEQ119=LOSP*REC6H3*DG32*(1-GF2)*(1-GG2)*X   $
ALL   120 X      =(1-SW2B1)*RVCO*(1-RCI1)*(1-HPI2)*RVD2*RPX1*X  $
ALL   120 X      =(1-RBI1)                                                        $
ALL   121 SEQ120=LOSP*REC6H3*(1-GE1)*DG32*(1-GG2)*X   $
ALL   121 X      =(1-SW2B1)*RVCO*(1-RCI1)*(1-HPI2)*RVD2*RPX1*X  $
ALL   121 X      =(1-RBI1)                                                        $
ALL   122 SEQ121=LOSP*REC6H3*(1-RK3)*(1-GE1)*X       $
ALL   122 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*SW2D6*RVCO*(1-RCI1)*X $
ALL   122 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)                         $
ALL   123 SEQ122=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*(1-GE1)*(1-GF1)*X  $
ALL   123 X      =(1-GG1)*DG31*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   123 X      =RVCO*HRSSY1*RVD22*(1-ORP2)*(1-RBI1)                          $
ALL   124 SEQ123=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*(1-GE1)*(1-GF1)*X  $
ALL   124 X      =DG31*(1-GH2)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   124 X      =RVCO*HRSSY1*RVD22*(1-ORP2)*(1-RBI1)                          $
ALL   125 SEQ124=LOCV*DGA*PXI*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL   125 X      =RVC1*RVD6*(1-ORP2)*(1-RBI1)                                     $
ALL   126 SEQ125=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*DG31*(1-GF2)*X        $
ALL   126 X      =(1-GG2)*(1-GH2)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X                $
ALL   126 X      =(1-SW2D1)*RVCO*HRSSY1*RVD22*(1-ORP2)*(1-RBI1)          $
ALL   127 SEQ126=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*(1-GE1)*DG31*X        $
ALL   127 X      =(1-GG2)*(1-GH2)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X                $
ALL   127 X      =(1-SW2D1)*RVCO*HRSSY1*RVD22*(1-ORP2)*(1-RBI1)          $
ALL   128 SEQ127=LOSP*REC6H3*(1-GE1)*DG31*(1-GG2)*X   $
ALL   128 X      =(1-GH2)*(1-SW2A1)*(1-SW1B2)*(1-SW1D9)*RVCO*(1-RCI1)*X   $
ALL   128 X      =(1-HPI2)*SPR1*(1-RBI1)*(1-SGT9)                               $
ALL   129 SEQ128=LOSP*REC6H3*(1-RK3)*(1-GE1)*DG32*X   $
ALL   129 X      =(1-GG2)*(1-ED26)*(1-SW1B2)*(1-SW2D6)*RVCO*X              $
ALL   129 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)                      $
ALL   130 SEQ129=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-RCI1)*X $
ALL   130 X      =(1-HPI2)*OSP1*SDC2*(1-RBI1)                                     $
ALL   131 SEQ130=TT*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X    $
ALL   131 X      =MCD1*RVC1*RVD5*(1-ORP2)*(1-RBI1)                                $
ALL   132 SEQ131=SCRAMR*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X          $
ALL   132 X      =(1-MCD1)*RVC3*(1-ORP2)*OLP1*(1-RBI1)                            $
ALL   133 SEQ132=LOSP*REC6H3*DG32*(1-GG4)*X        $
ALL   133 X      =(1-GH4)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL   133 X      =RVD2*RPX1*(1-RBI1)                                           $
ALL   134 SEQ133=TTWB*DGA*PXI*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL   134 X      =(1-MCD1)*RVC1*RVD6*(1-ORP2)*(1-RBI1)                            $
ALL   135 SEQ134=LOSP*REC6H3*DG32*(1-GF2)*X        $
ALL   135 X      =(1-GH4)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL   135 X      =RVD2*RPX1*(1-RBI1)                                           $
ALL   136 SEQ135=ISLOCA                                                           $
ALL   137 SEQ136=LOSP*REC6H3*(1-GE1)*DG32*X        $
ALL   137 X      =(1-GH4)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL   137 X      =RVD2*RPX1*(1-RBI1)                                           $
ALL   138 SEQ137=LRCW*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
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ALL   138 X      =(1-MCD1)*RVCO*RVD9*(1-ORP2)*(1-RBI1)              $
ALL   139 SEQ138=LOSP*REC6H2*(1-RL6)*(1-GE1)*X    $
ALL   139 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW2C1)*X $
ALL   139 X      =(1-SW1D9)*RVCO*(1-RCI1)*(1-HPI2)*RPX2AC*X  $
ALL   139 X      =(1-RBI1)*(1-SGT9)                                   $
ALL   140 SEQ139=LOSP*REC6H3*(1-GE1)*(1-GF1)*X        $
ALL   140 X      =(1-GG1)*(1-GH1)*SA*RVCO*(1-RCI1)*(1-HPI2)*X     $
ALL   140 X      =RVD2*RPX1*(1-RBI1)                                      $
ALL   141 SEQ140=LOSP*REC6H4*RVCO*(1-RCI1)*(1-HPI2)*X     $
ALL   141 X      =RVD22*(1-RBI1)                                   $
ALL   142 SEQ141=ISCRAM*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X         $
ALL   142 X      =(1-SW2D1)*MCD1*RVC1*RVD5*(1-ORP2)*(1-RBI1)      $
ALL   143 SEQ142=LOFW*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X $
ALL   143 X      =RVC2*HRSHP1*(1-OBD1)*(1-ORP2)*OLP1*(1-RBI1)             $
ALL   144 SEQ143=LOSP*REC6H1*(1-GE1)*X       $
ALL   144 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW2C1)*X $
ALL   144 X      =(1-SW2D6)*RVC1*(1-RCI1)*(1-HPI2)*RPX1*X  $
ALL   144 X      =CS7*(1-DWS2)*(1-RBI1)                                   $
ALL   145 SEQ144=LOSP*REC6H3*(1-RK3)*(1-GE1)*X       $
ALL   145 X      =(1-GF1)*DG31*(1-GH2)*(1-SW2D5)*RVCO*(1-RCI1)*(1-HPI2)*X $
ALL   145 X      =RVD2*RPX1*RBI1                                   $
ALL   146 SEQ145=FLTB*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   146 X      =TB2*RVD9*(1-ORP2)*(1-RBI1)                              $
ALL   147 SEQ146=LOSP*REC6H3*FOT1/DG1*(1-RK3)*(1-GE1)*X      $
ALL   147 X      =(1-GF1)*DG31*(1-GH2)*(1-SW2D5)*RVCO*(1-RCI1)*(1-HPI2)*X $
ALL   147 X      =RVD2*RPX1*(1-RBI1)                               $
ALL   148 SEQ147=LOSP*REC6H3*FOT1/DG1*(1-RK3)*X        $
ALL   148 X      =(1-GE1)*(1-GF1)*DG31*(1-GH2)*(1-SW2D5)*RVCO*(1-RCI1)*X  $
ALL   148 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)                      $
ALL   149 SEQ148=LOCV*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RVC1*X     $
ALL   149 X      =HRSSY1*RVD6*(1-ORP2)*OLP1*(1-RBI1)                  $
ALL   150 SEQ149=LOCV*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RVC3*X     $
ALL   150 X      =(1-ORP2)*OLP1*(1-RBI1)                                  $
ALL   151 SEQ150=LOSP*REC6H3*(1-GE1)*(1-GF1)*X       $
ALL   151 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW1D9)*RVCO*X     $
ALL   151 X      =(1-RCI1)*(1-HPI2)*RPX1*(1-RBI1)*(1-SGT9)        $
ALL   152 SEQ151=LOSP*REC6H3*(1-RK3)*(1-GE1)*X       $
ALL   152 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVCO*X       $
ALL   152 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*SGT9       $
ALL   153 SEQ152=LOSP*REC6H4*RVC1*(1-RCI1)*HRSHP1*X  $
ALL   153 X      =(1-RBI1)                                                $
ALL   154 SEQ153=LOSP*REC6H3*(1-RK3)*(1-GE1)*X       $
ALL   154 X      =(1-GF1)*(1-GG1)*DG31*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X$
ALL   154 X      =(1-HPI2)*RVD2*RPX1*RBI1                          $
ALL   155 SEQ154=LOCV*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   155 X      =RVC1*RVD5*(1-ORP2)*RBI1                        $
ALL   156 SEQ155=TTWB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X $
ALL   156 X      =RVC1*HRSSY1*RVD6*(1-ORP2)*OLP1*(1-RBI1)             $
ALL   157 SEQ156=LOSP*REC6H3*FOT1/DG1*(1-RK3)*(1-GE1)*X      $
ALL   157 X      =(1-GF1)*(1-GG1)*DG31*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X$
ALL   157 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)                      $
ALL   158 SEQ157=LOSP*REC6H3*FOT1/DG1*(1-RK3)*X        $
ALL   158 X      =(1-GE1)*(1-GF1)*(1-GG1)*DG31*(1-SW1B2)*(1-SW2D6)*RVCO*X $
ALL   158 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)             $
ALL   159 SEQ158=TTWB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X $
ALL   159 X      =RVC3*(1-ORP2)*OLP1*(1-RBI1)                             $
ALL   160 SEQ159=TTWB*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   160 X      =(1-MCD1)*RVC1*RVD5*(1-ORP2)*RBI1                        $
ALL   161 SEQ160=IOOV*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   161 X      =TB2*RVD5*(1-ORP2)*(1-RBI1)                              $
ALL   162 SEQ161=LOSP*REC6H3*(1-RK3)*DG31*(1-GF2)*X   $
ALL   162 X      =(1-GG2)*(1-GH2)*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X      $
ALL   162 X      =(1-HPI2)*RVD2*RPX1*RBI1*(1-SGT9)                 $
ALL   163 SEQ162=LOSP*REC6H3*(1-GE1)*(1-GF1)*X       $
ALL   163 X      =(1-GG1)*DG31*(1-SW2B1)*RVCO*(1-RCI1)*(1-HPI2)*X     $
ALL   163 X      =RVD2*RPX1*RBI1                                          $
ALL   164 SEQ163=LOSP*REC6H3*FOT1/DG1*(1-RK3)*DG31*(1-GF2)*X   $
ALL   164 X      =(1-GG2)*(1-GH2)*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X      $
ALL   164 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)             $
ALL   165 SEQ164=LOSP*REC6H3*FOT1/DG1*(1-RK3)*DG31*X   $
ALL   165 X      =(1-GF2)*(1-GG2)*(1-GH2)*(1-SW1B2)*(1-SW2D6)*RVCO*X       $
ALL   165 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)    $
ALL   166 SEQ165=LOSP*REC6H4*FOT1/DG1*RVCO*(1-RCI1)*HRSHP1*X  $
ALL   166 X      =RVD2*(1-RBI1)                                           $
ALL   167 SEQ166=LOSP*REC6H4*FOT1/DG1*RVCO*(1-RCI1)*X      $
ALL   167 X      =HRSHP1*RVD2*(1-RBI1)                              $
ALL   168 SEQ167=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-RCI1)*X $
ALL   168 X      =(1-HPI2)*HX4*U11*(1-RBI1)                  $
ALL   169 SEQ168=CIV*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X   $
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ALL  169 X      =RVC2*RVD1*(1-ORP2)*(1-RBI1)                                     $
ALL  170 SEQ169=LOSP*REC6H3*(1-RL6)*(1-GE1)*X       $
ALL  170 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2C4)*(1-SW1D9)*X $
ALL  170 X      =RVCO*(1-RCI1)*(1-HPI2)*(1-HPL3)*RVD2*RPX1*X         $
ALL  170 X      =(1-RBI1)                                                          $
ALL  171 SEQ170=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X      $
ALL  171 X      =HRSSY1*RVD22*ORP2*(1-RBI1)                                      $
ALL  172 SEQ171=LOAC*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL  172 X      =RVC1*RVD5*(1-ORP2)*(1-RBI1)                     $
ALL  173 SEQ172=LOSP*REC6H3*(1-RK3)*(1-GE1)*DG31*X    $
ALL  173 X      =(1-GG2)*(1-GH2)*(1-ED26)*(1-SW1B2)*(1-SW2D6)*RVCO*X      $
ALL  173 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*RBI1*(1-SGT9)        $
ALL  174 SEQ173=LOSP*REC6H3*(1-GE1)*(1-GF1)*DG31*X    $
ALL  174 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X     $
ALL  174 X      =RVD2*RPX1*RBI1                                    $
ALL  175 SEQ174=LOSP*REC6H3*DG31*(1-GF2)*(1-GG2)*X    $
ALL  175 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X     $
ALL  175 X      =RVD2*RPX1*RBI1                                    $
ALL  176 SEQ175=LOSP*REC6H3*(1-GE1)*DG31*(1-GG2)*X    $
ALL  176 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X     $
ALL  176 X      =RVD2*RPX1*RBI1                                    $
ALL  177 SEQ176=LOSP*REC6H3*FOT1/DG1*(1-RK3)*(1-GE1)*DG31*X   $
ALL  177 X      =(1-GG2)*(1-GH2)*(1-ED26)*(1-SW1B2)*(1-SW2D6)*RVCO*X      $
ALL  177 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)    $
ALL  178 SEQ177=LOSP*REC6H3*FOT1/DG1*(1-RK3)*X       $
ALL  178 X      =(1-GE1)*DG31*(1-GG2)*(1-GH2)*(1-ED26)*(1-SW1B2)*X        $
ALL  178 X      =(1-SW2D6)*RVCO*(1-RCI1)*(1-HPI2)*RVD2*RPX1*X     $
ALL  178 X      =(1-RBI1)*(1-SGT9)                                                 $
ALL  179 SEQ178=PLFW*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X $
ALL  179 X      =RVC3*(1-ORP2)*OLP1*(1-RBI1)                                     $
ALL  180 SEQ179=SLOCA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*X   $
ALL  180 X      =(1-MCD1)*(1-OLA1)*(1-ORP2)*(1-SP2)*(1-ODWS2)*(1-RBI1)   $
ALL  181 SEQ180=LOCV*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RVC2*X    $
ALL  181 X      =HRSHP1*RVD2*(1-ORP2)*OLP1*(1-RBI1)                             $
ALL  182 SEQ181=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*TOR2*X    $
ALL  182 X      =(1-RCI1)*RVD2*(1-RBI1)                                          $
ALL  183 SEQ182=LOSP*(1-GA1)*(1-GB1)*DG1*(1-GD2)*(1-EPR301)*(1-GE1)*X  $
ALL  183 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW2C1)*X $
ALL  183 X      =(1-SW2D6)*RVCO*(1-RCI1)*(1-HPI2)*RPX4*X  $
ALL  183 X      =(1-RBI1)                                                          $
ALL  184 SEQ183=TT*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X   $
ALL  184 X      =RVC1*CD1*(1-RCI1)*(1-HPI2)*OLP1*(1-RBI1)                      $
ALL  185 SEQ184=LOSP*REC6H1*(1-GE1)*X          $
ALL  185 X      =(1-GF1)*DG31*(1-GH2)*(1-SW2A1)*(1-SW2C1)*(1-SW2D5)*X     $
ALL  185 X      =RVCO*(1-RCI1)*(1-HPI2)*RPX3*X $
ALL  185 X      =(1-RBI1)                                                          $
ALL  186 SEQ185=ISCRAM*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X        $
ALL  186 X      =(1-MCD1)*RVC1*CD1*(1-RCI1)*(1-HPI2)*OLP1*(1-RBI1)        $
ALL  187 SEQ186=IOTM*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X $
ALL  187 X      =(1-ORP2)*OLP1*RBI1                                               $
ALL  188 SEQ187=LOSP*REC6H4*RVCO*(1-RCI1)*(1-HPI2)*X      $
ALL  188 X      =RVD2*RBI1                                           $
ALL  189 SEQ188=LOSP*REC6H4*RVCO*(1-RCI1)*(1-HPI2)*X      $
ALL  189 X      =RVD2*RBI1                                           $
ALL  190 SEQ189=TTWB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X $
ALL  190 X      =RVC2*HRSHP1*RVD2*(1-ORP2)*OLP1*(1-RBI1)                       $
ALL  191 SEQ190=IOOV*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*TB1*IVC1*X $
ALL  191 X      =(1-ORP2)*(1-RBI1)                                                 $
ALL  192 SEQ191=LOSP*REC6H1*DG31*(1-GF2)*X   $
ALL  192 X      =(1-GG2)*(1-GH2)*(1-SW2A1)*(1-SW1B2)*(1-SW2C1)*X           $
ALL  192 X      =(1-SW2D6)*RVCO*(1-RCI1)*(1-HPI2)*RPX3*X  $
ALL  192 X      =(1-RBI1)                                      $
ALL  193 SEQ192=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-RCI1)*X $
ALL  193 X      =(1-HPI2)*SP1*SPR1*SDC2*(1-RBI1)                                  $
ALL  194 SEQ193=LOSP*REC6H3*MOV1B*(1-GE1)*(1-GF1)*X   $
ALL  194 X      =(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X      $
ALL  194 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)          $
ALL  195 SEQ194=LOSP*REC6H4*DE2*RVCO*(1-HPI6)*X    $
ALL  195 X      =RVD2*(1-RBI1)                                                     $
ALL  196 SEQ195=LOSP*REC6H4*DH2*(1-DI3)*RVCO*(1-RCI1)*X $
ALL  196 X      =RVD2*(1-RBI1)                                       $
ALL  197 SEQ196=LOSP*REC6H4*DG8*(1-DJ4)*RVCO*(1-HPI6)*X $
ALL  197 X      =RVD2*(1-RBI1)                                       $
ALL  198 SEQ197=LOAC*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RVCO*X     $
ALL  198 X      =HRSSY1*RVD22*CRD4*(1-ORP2)*RBI1                         $
ALL  199 SEQ198=LOSP*REC6H1*(1-GE1)*X          $
ALL  199 X      =(1-GF1)*(1-GG1)*DG31*(1-SW2A1)*(1-SW1B2)*(1-SW2C1)*X      $
ALL  199 X      =(1-SW2D6)*RVCO*(1-RCI1)*(1-HPI2)*RPX3*X  $
ALL  199 X      =(1-RBI1)*(1-SGT5)                             $
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ALL  200 SEQ199=TTWB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*X       $
ALL  200 X      =(1-MCD1)*OSL2*(1-ORP2)*(1-SP2)*(1-ODWS2)*X     $
ALL  200 X      =(1-RBI1)                                                $
ALL  201 SEQ200=LOSP*REC6H3*(1-RK3)*(1-GE1)*X       $
ALL  201 X      =(1-GF1)*DG31*(1-GH2)*(1-SW2D5)*RVCO*(1-RCI1)*HRSHP1*X  $
ALL  201 X      = RVD2*RPX1*(1-RBI1)                              $
ALL  202 SEQ201=LOSP*REC6H4*RVC1*HRSRC1*(1-HPI4)*X  $
ALL  202 X      =(1-RBI1)                                                $
ALL  203 SEQ202=LOFW*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL  203 X      =TB2*RVC1*RVD5*(1-ORP2)*(1-RBI1)                         $
ALL  204 SEQ203=LOSP*REC6H1*(1-GE1)*DG31*X   $
ALL  204 X      =(1-GG2)*(1-GH2)*(1-ED26)*(1-SW2A1)*(1-SW1B2)*X          $
ALL  204 X      =(1-SW2C1)*(1-SW2D6)*RVCO*(1-RCI1)*(1-HPI2)*X   $
ALL  204 X      =RPX3*(1-RBI1)                   $
ALL  205 SEQ204=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*(1-GE1)*(1-GF1)*X  $
ALL  205 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X         $
ALL  205 X      =(1-SW2D1)*RVCO*HRSSY1*RVD22*(1-ORP2)*RBI1          $
ALL  206 SEQ205=LOSP*REC6H3*(1-GE1)*(1-GF1)*X       $
ALL  206 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW1D9)*RVCO*X    $
ALL  206 X      =(1-RCI1)*(1-HPI2)* SPR1*RBI1*(1-SGT9)             $
ALL  207 SEQ206=LOSP*REC6H4*FOT1/DG1*RVCO*HRSRC1*(1-HPI4)*X  $
ALL  207 X      =RVD2*(1-RBI1)                                           $
ALL  208 SEQ207=LOSP*REC6H4*FOT1/DG1*RVCO*HRSRC1*X          $
ALL  208 X      =(1-HPI4)*RVD2*(1-RBI1)                          $
ALL  209 SEQ208=LOSP*REC6H3*(1-RK3)*(1-GE1)*X       $
ALL  209 X      =(1-GF1)*FIT1*(1-GH3)*(1-SW2D5)*RVCO*(1-RCI1)*(1-HPI2)*X $
ALL  209 X      = RVD2*RPX1*(1-RBI1)                              $
ALL  210 SEQ209=LOSP*REC6H3*(1-RK3)*(1-GE1)*X       $
ALL  210 X      =(1-GF1)*(1-GG1)*DG31*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X$
ALL  210 X      =HRSHP1*RVD2*RPX1*(1-RBI1)                         $
ALL  211 SEQ210=LOSP*REC6H4*FOT4/DG4*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL  211 X      =RVD2*RBI1                                        $
ALL  212 SEQ211=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*(1-GE1)*(1-GF1)*X  $
ALL  212 X      =(1-GG1)*DG31*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL  212 X      =RVC1*(1-RCI1)*(1-HPI2)*OLP1*(1-RBI1)                    $
ALL  213 SEQ212=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*(1-GE1)*(1-GF1)*X  $
ALL  213 X      =DG31*(1-GH2)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL  213 X      =RVC1*(1-RCI1)*(1-HPI2)*OLP1*(1-RBI1)                    $
ALL  214 SEQ213=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*DG31*(1-GF2)*X      $
ALL  214 X      =(1-GG2)*(1-GH2)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X         $
ALL  214 X      =(1-SW2D1)*RVC1*(1-RCI1)*(1-HPI2)*OLP1*(1-RBI1)          $
ALL  215 SEQ214=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*(1-GE1)*DG31*X      $
ALL  215 X      =(1-GG2)*(1-GH2)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X         $
ALL  215 X      =(1-SW2D1)*RVC1*(1-RCI1)*(1-HPI2)*OLP1*(1-RBI1)          $
ALL  216 SEQ215=LOSP*REC6H4*FOT1/DG1*RVC1*(1-RCI1)*(1-HPI2)*X    $
ALL  216 X      =(1-RBI1)                                         $
ALL  217 SEQ216=LOSP*REC6H4*FOT1/DG1*RVC1*(1-RCI1)*X     $
ALL  217 X      =(1-HPI2)*(1-RBI1)                                $
ALL  218 SEQ217=LOSP*REC6H3*(1-RK3)*DG31*(1-GF2)*X   $
ALL  218 X      =(1-GG2)*(1-GH2)*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X     $
ALL  218 X      =HRSHP1* RVD2*RPX1*(1-RBI1)*(1-SGT9)                $
ALL  219 SEQ218=LOSP*REC6H3*(1-GE1)*(1-GF1)*X       $
ALL  219 X      =(1-GG1)*DG31*(1-SW2B1)*RVCO*(1-RCI1)*HRSHP1* RVD2*X   $
ALL  219 X      =RPX1*(1-RBI1)                                           $
ALL  220 SEQ219=TT*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X    $
ALL  220 X      =RVC3*(1-ORP2)*OLP1*RBI1                                 $
ALL  221 SEQ220=LOFW*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL  221 X      =(1-MCD1)*RVC2*(1-OBD1)*(1-ORP2)*(1-RBI1)        $
ALL  222 SEQ221=LOSP*REC6H3*(1-RK3)*(1-GE1)*X       $
ALL  222 X      =(1-GF1)*(1-GG1)*FIT1*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X$
ALL  222 X      =(1-HPI2)* RVD2*RPX1*(1-RBI1)                     $
ALL  223 SEQ222=ISCRAM*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X          $
ALL  223 X      =(1-MCD1)*RVC3*(1-ORP2)*OLP1*RBI1                         $
ALL  224 SEQ223=FLTB*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*SA*X     $
ALL  224 X      =RVD9*(1-ORP2)*(1-RBI1)                          $
ALL  225 SEQ224=FLTB*DH1*DGA*NA*(1-SW2B1)*(1-SW2D1)*RVD9*X   $
ALL  225 X      =(1-ORP2)*(1-RBI1)                                       $
ALL  226 SEQ225=FLTB*DH1*DGA*(1-SW2A1)*(1-SW2B1)*NA*(1-SW2D1)*X     $
ALL  226 X      =RVD9*(1-ORP2)*(1-RBI1)                          $
ALL  227 SEQ226=LOSP*REC6H3*(1-RK3)*FIT1*(1-FF2)*X   $
ALL  227 X      =(1-GF3)*(1-GG3)*(1-GH3)*(1-SW1B2)*(1-SW2D6)*RVCO*X      $
ALL  227 X      =(1-RCI1)*(1-HPI2)* RVD2*RPX1*(1-RBI1)*(1-SGT9)    $
ALL  228 SEQ227=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*DH1*(1-GE1)*DGA*X  $
ALL  228 X      =(1-GF1)*DG31*(1-GH2)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X    $
ALL  228 X      =(1-SW2D1)*RVCO*RVD9*(1-ORP2)*(1-RBI1)                   $
ALL  229 SEQ228=FLTB*DH1*DGA*(1-SW2A1)*SA*(1-SW2C1)*RVD9*X   $
ALL  229 X      =(1-ORP2)*(1-RBI1)                                       $
ALL  230 SEQ229=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*DH1*(1-GE1)*DGA*X  $
ALL  230 X      =(1-GF1)*(1-GG1)*DG31*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X    $
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ALL  230 X      =(1-SW2D1)*RVCO*RVD9*(1-ORP2)*(1-RBI1)                          $
ALL  231 SEQ230=LOSP*REC6H3*FOT1/DG1*(1-RK3)*(1-GE1)*X          $
ALL  231 X      =(1-GF1)*DG31*(1-GH2)*(1-SW2D5)*RVCO*(1-RCI1)*(1-HPI2)*X $
ALL  231 X      =RVD2*RPX1*(1-RBI1)                                     $
ALL  232 SEQ231=LOSP*REC6H3*(1-RK3)*(1-GE1)*DG31*X     $
ALL  232 X      =(1-GG2)*(1-GH2)*(1-ED26)*(1-SW1B2)*(1-SW2D6)*RVCO*X     $
ALL  232 X      =(1-RCI1)*HRSHP1*RVD2*RPX1*(1-RBI1)*(1-SGT9)          $
ALL  233 SEQ232=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*DH1*(1-GE1)*DGA*X  $
ALL  233 X      =DG31*(1-GG2)*(1-GH2)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X    $
ALL  233 X      =(1-SW2D1)*RVCO*RVD9*(1-ORP2)*(1-RBI1)                   $
ALL  234 SEQ233=LOSP*REC6H3*(1-GE1)*(1-GF1)*X        $
ALL  234 X      =(1-GG1)*FIT1*(1-SW2B1)*RVCO*(1-RCI1)*(1-HPI2)*X     $
ALL  234 X      =RVD2*RPX1*(1-RBI1)                                      $
ALL  235 SEQ234=LOSP*REC6H3*(1-GE1)*(1-GF1)*DG31*X    $
ALL  235 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*HRSHP1*X  $
ALL  235 X      =RVD2*RPX1*(1-RBI1)                                      $
ALL  236 SEQ235=LOSP*REC6H3*DG31*(1-GF2)*(1-GG2)*X    $
ALL  236 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*HRSHP1*X  $
ALL  236 X      =RVD2*RPX1*(1-RBI1)                                      $
ALL  237 SEQ236=LOSP*REC6H3*(1-GE1)*DG31*(1-GG2)*X    $
ALL  237 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*HRSHP1*X  $
ALL  237 X      =RVD2*RPX1*(1-RBI1)                                      $
ALL  238 SEQ237=LOSP*REC6H4*FOT2/DG2*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL  238 X      =RVD2*(1-RBI1)                                         $
ALL  239 SEQ238=LOSP*REC6H4*FOT2/DG2*RVCO*(1-RCI1)*X      $
ALL  239 X      =(1-HPI2)*RVD2*(1-RBI1)                                $
ALL  240 SEQ239=LOSP*REC6H3*(1-RK3)*(1-GE1)*FIT1*X    $
ALL  240 X      =(1-GG3)*(1-GH3)*(1-ED26)*(1-SW1B2)*(1-SW2D6)*RVCO*X     $
ALL  240 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)    $
ALL  241 SEQ240=LOSP*REC6H3*FOT1/DG1*(1-RK3)*(1-GE1)*X         $
ALL  241 X      =(1-GF1)*(1-GG1)*DG31*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X$
ALL  241 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)                          $
ALL  242 SEQ241=LOSP*REC6H3*(1-GE1)*(1-GF1)*DG31*X    $
ALL  242 X      =(1-GH3)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL  242 X      =RVD2*RPX1*(1-RBI1)                                    $
ALL  243 SEQ242=LOSP*REC6H3*FIT1*(1-FF2)*(1-GF3)*X    $
ALL  243 X      =(1-GG3)*(1-GH3)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*X     $
ALL  243 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)                          $
ALL  244 SEQ243=LOSP*REC6H3*(1-GE1)*FIT1*(1-GG3)*X    $
ALL  244 X      =(1-GH3)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL  244 X      =RVD2*RPX1*(1-RBI1)                                   $
ALL  245 SEQ244=CIV*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*SL1*X  $
ALL  245 X      =RVC4*RVD10*(1-ORP2)*(1-SP2)*(1-COWS2)*X        $
ALL  245 X      =(1-RBI1)                                                $
ALL  246 SEQ245=LOSP*REC6H3*(1-RK3)*(1-GE1)*DG31*X    $
ALL  246 X      =(1-GG2)*(1-GH2)*ED26*(1-SW1B2)*(1-SW2D6)*RVCO*X         $
ALL  246 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)    $
ALL  247 SEQ246=LOSP*REC6H3*DG34*X          $
ALL  247 X      =(1-SW2B1)*RVCO*(1-RCI1)*(1-HPI2)*RVD2*(1-RBI1)     $
ALL  248 SEQ247=LOSP*REC6H3*(1-RK3)*(1-GE1)*X       $
ALL  248 X      =(1-GF1)*(1-GG1)*(1-GH1)*RBC20*(1-SW1B2)*(1-SW2D6)*X     $
ALL  248 X      =RVCO*(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*X      $
ALL  248 X      =(1-SGT9)                                                $
ALL  249 SEQ248=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*TB1*X $
ALL  249 X      =HRSSY1*RVD22*(1-ORP2)*(1-RBI1)                          $
ALL  250 SEQ249=LOSP*REC6H3*FOT1/DG1*(1-RK3)*DG31*(1-GF2)*X   $
ALL  250 X      =(1-GG2)*(1-GH2)*(1-SW1B2)*(1-SW2D6)*RVCO*(1-RCI1)*X     $
ALL  250 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)             $
ALL  251 SEQ250=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*TB1*IVC3*X $
ALL  251 X      =(1-ORP2)*(1-RBI1)                                       $
ALL  252 SEQ251=LOSP*REC6H3*FOT1/DG1*(1-GE1)*(1-GF1)*X        $
ALL  252 X      =(1-GG1)*DG31*(1-SW2B1)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL  252 X      =RVD2*RPX1*(1-RBI1)                                      $
ALL  253 SEQ252=LOSP*REC6H3*FOT1/DG1*(1-RK3)*(1-GE1)*X        $
ALL  253 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVCO*X      $
ALL  253 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*RBI1*(1-SGT9)        $
ALL  254 SEQ253=LOSP*REC6H3*FOT1/DG1*(1-RK3)*X       $
ALL  254 X      =(1-GE1)*(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*X   $
ALL  254 X      =RVCO*(1-RCI1)*(1-HPI2)*RVD2*RPX1*RBI1*(1-SGT9)   $
ALL  255 SEQ254=LOSP*REC6H4*FOT1/DG1*RVCO*(1-RCI1)*HRSHP1*X  $
ALL  255 X      =RVD2*(1-RBI1)                                           $
ALL  256 SEQ255=LOSP*REC6H4*FOT1/DG1*RVCO*(1-RCI1)*HRSHP1*X  $
ALL  256 X      =RVD2*(1-RBI1)                                           $
ALL  257 SEQ256=LOSP*REC3H3*(1-RK3)*(1-GE1)*X       $
ALL  257 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVC2*X      $
ALL  257 X      =(1-HPI6)*(1-ORP2)*RPX1*(1-RBI1)*(1-SGT9)               $
ALL  258 SEQ257=SCRAMR*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X           $
ALL  258 X      =(1-SW2D1)*TB2*RVC1*RVD5*(1-ORP2)*(1-RBI1)               $
ALL  259 SEQ258=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*DH1*DG31*DGB*X      $
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ALL  259 X       =(1-DJ4)*(1-GF2)*(1-GG2)*(1-GH2)*(1-SW2A1)*(1-SW2B1)*X   $
ALL  259 X       =(1-SW2C1)*(1-SW2D1)*RVCO*RVD9*(1-ORP2)*(1-RBI1)          $
ALL  260 SEQ259=LOSP*REC6H3*(1-RK3)*(1-GE1)*X          $
ALL  260 X       =(1-GF1)*DG31*(1-GH2)*(1-SW2D5)*RVCO*HRSRC1*(1-HPI4)*X   $
ALL  260 X       =RVD2*RPX1*(1-RBI1)                          $
ALL  261 SEQ260=LOSP*REC6H3*(1-RK3)*(1-GE1)*X         $
ALL  261 X       =(1-GF1)*(1-GG1)*DG31*SW1B2*RVCO*(1-RCI1)*(1-HPI2)*X     $
ALL  261 X       =RVD2*RPX1*(1-RBI1)                          $
ALL  262 SEQ261=LUPS*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RVC1*X       $
ALL  262 X       =HRSHP1*RVD6*(1-ORP2)*OLP1*(1-RBI1)                      $
ALL  263 SEQ262=LOSP*REC6H2*(1-RK3)*(1-GE1)*X    $
ALL  263 X       =(1-GF1)*(1-GG1)*DG31*(1-SW2B1)*(1-SW2D1)*RVCO*(1-RCI1)*X$
ALL  263 X       =(1-HPI2)*RVD2*RPX2AC*U11*(1-RBI1)          $
ALL  264 SEQ263=LOSP*REC6H2*(1-GE1)*(1-GF1)*X    $
ALL  264 X       =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*(1-SW1D7)*RVCO*X    $
ALL  264 X       =HRSRC1*(1-HPI4)*RVD2*CS7*(1-RBI1)*(1-SGT9)        $
ALL  265 SEQ264=LOFW*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*X       $
ALL  265 X       =(1-MCD1)*SL1*RVC4*(1-HPI6)*RVD2*(1-SP2)*(1-ODWS2)*X     $
ALL  265 X       =(1-RBI1)                                                 $
ALL  266 SEQ265=LOSP*REC6H2*(1-RK3)*(1-GE1)*X    $
ALL  266 X       =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW2D6)*X $
ALL  266 X       =RVCO*(1-RCI1)*(1-HPI2)*HXA1*RPX1*(1-RBI1)        $
ALL  267 SEQ266=LOSP*REC6H3*(1-RK3)*DG34*X   $
ALL  267 X       =(1-SW2D5)*RVCO*(1-RCI1)*(1-HPI2)*RVD2*X       $
ALL  267 X       =(1-RBI1)                                                 $
ALL  268 SEQ267=LOSP*REC6H3*(1-RK3)*DG31*(1-GF2)*X   $
ALL  268 X       =(1-GG2)*(1-GH2)*SW1B2*RVCO*(1-RCI1)*(1-HPI2)*X     $
ALL  268 X       =RVD2*RPX1*(1-RBI1)*(1-SGT9)                            $
ALL  269 SEQ268=LOSP*REC6H3*(1-RK3)*(1-GE1)*X         $
ALL  269 X       =(1-GF1)*DG31*(1-GH2)*(1-SW2D5)*RVC1*(1-RCI1)*(1-HPI2)*X$
ALL  269 X       =RPX1*(1-RBI1)                                  $
ALL  270 SEQ269=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*(1-GE1)*(1-GF1)*X   $
ALL  270 X       =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X         $
ALL  270 X       =(1-SW2D1)*RVCO*(1-RCI1)*(1-HPI2)*RPX4*X   $
ALL  270 X       =U11*(1-RBI1)                                             $
ALL  271 SEQ270=LLD*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPX4*X $
ALL  271 X       =(1-RBI1)                                     $
ALL  272 SEQ271=LOSP*REC6H2*(1-RK3)*(1-GE1)*X    $
ALL  272 X       =(1-GF1)*DG31*(1-GH2)*(1-SW2B1)*(1-SW2D1)*RVCO*(1-RCI1)*X$
ALL  272 X       =(1-HPI2)*RVD2*RPX2AC*U11*(1-RBI1)*(1-SGT9)    $
ALL  273 SEQ272=LOSP*REC6H2*(1-RK3)*DG31*X       $
ALL  273 X       =(1-GF2)*(1-GG2)*(1-GH2)*(1-SW2B1)*(1-SW2D1)*RVCO*X      $
ALL  273 X       =(1-RCI1)*(1-HPI2)*RVD2*RPX2AC*U11*(1-RBI1)*X  $
ALL  273 X       =(1-SGT9)                                                 $
ALL  274 SEQ273=LOSP*REC3H1*(1-GE1)*X          $
ALL  274 X       =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW2C1)*X $
ALL  274 X       =(1-SW2D6)*RVCO*(1-RCI1)*(1-HPI2)*(1-EPR61)*X   $
ALL  274 X       =RPX4*(1-RBI1)                           $
ALL  275 SEQ274=LOSP*REC6H2*(1-RK3)*(1-GE1)*X    $
ALL  275 X       =DG31*(1-GG2)*(1-GH2)*(1-SW2B1)*(1-SW2D1)*RVCO*(1-RCI1)*X$
ALL  275 X       =(1-HPI2)*RVD2*RPX2AC*U11*(1-RBI1)*(1-SGT9)    $
ALL  276 SEQ275=LOFW*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*X       $
ALL  276 X       =(1-MCD1)*OSL1*(1-ORP2)*(1-SP2)*(1-ODWS2)*X    $
ALL  276 X       =(1-RBI1)                                                 $
ALL  277 SEQ276=LOSP*REC3H1*(1-RL6)*X          $
ALL  277 X       =(1-GE1)*(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*X   $
ALL  277 X       =(1-SW2C1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X   $
ALL  277 X       =(1-EPR61)*RPX4*(1-RBI1)                 $
ALL  278 SEQ277=LOSP*REC6H2*(1-GE1)*(1-GF1)*X    $
ALL  278 X       =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*(1-SW1D7)*RVC1*X    $
ALL  278 X       =(1-RCI1)*(1-HPI2)*CS7*(1-RBI1)*(1-SGT9)       $
ALL  279 SEQ278=LOSP*REC6H3*FOT1/DG1*(1-RK3)*(1-GE1)*DG31*X    $
ALL  279 X       =(1-GG2)*(1-GH2)*(1-ED26)*(1-SW1B2)*(1-SW2D6)*RVCO*X     $
ALL  279 X       =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)   $
ALL  280 SEQ279=LOSP*REC6H3*FOT1/DG1*(1-GE1)*(1-GF1)*DG31*X   $
ALL  280 X       =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL  280 X       =RVD2*RPX1*(1-RBI1)                            $
ALL  281 SEQ280=LOSP*REC6H3*FOT1/DG1*DG31*(1-GF2)*(1-GG2)*X    $
ALL  281 X       =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL  281 X       =RVD2*RPX1*(1-RBI1)                            $
ALL  282 SEQ281=LOSP*REC6H3*FOT1/DG1*(1-GE1)*DG31*(1-GG2)*X    $
ALL  282 X       =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL  282 X       =RVD2*RPX1*(1-RBI1)                            $
ALL  283 SEQ282=LOSP*REC3H3*(1-GE1)*(1-GF1)*X        $
ALL  283 X       =(1-GG1)*(1-GH1)*(1-SW2B1)*(1-SW1D7)*RVC2*(1-HPI6)*X     $
ALL  283 X       =(1-ORP2)*RPX1*(1-RBI1)                                   $
ALL  284 SEQ283=CIV*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*SA*RVC1*X  $
ALL  284 X       =RVD5*(1-ORP2)*(1-RBI1)                                   $
ALL  285 SEQ284=LOSP*REC6H3*(1-RK3)*(1-GE1)*X        $
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ALL   285 X       =(1-GF1)*(1-GG1)*DG31*(1-SW1B2)*(1-SW2D6)*RVCO*HRSRC1*X  $
ALL   285 X       =(1-HPI4)*RVD2*RPX1*(1-RBI1)                            $
ALL   286 SEQ285=CIV*DH1*DGA*NA*(1-SW2B1)*(1-SW2D1)*RVC1*RVD5*X          $
ALL   286 X       =(1-ORP2)*(1-RBI1)                                        $
ALL   287 SEQ286=CIV*DH1*DGA*(1-SW2A1)*(1-SW2B1)*NA*(1-SW2D1)*RVC1*X  $
ALL   287 X       =RVD5*(1-ORP2)*(1-RBI1)                                   $
ALL   288 SEQ287=TT*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X    $
ALL   288 X       =(1-MCD1)*BVR1*RVC1*RVD5*(1-ORP2)*(1-RBI1)                $
ALL   289 SEQ288=CIV*DH1*DGA*(1-SW2A1)*SA*(1-SW2C1)*RVC1*RVD5*X          $
ALL   289 X       =(1-ORP2)*(1-RBI1)                                        $
ALL   290 SEQ289=LOCV*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   290 X       =RVC2*RVD1*(1-ORP2)*(1-RBI1)                        $
ALL   291 SEQ290=FLTB*NHI*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X     $
ALL   291 X       =HRSSY1*RVD22*(1-ORP2)*(1-RBI1)                          $
ALL   292 SEQ291=LICA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RVCO*X     $
ALL   292 X       =HRSSY1*RVD22*CRD4*(1-ORP2)*(1-RBI1)                     $
ALL   293 SEQ292=LOSP*REC6H3*(1-GE1)*(1-GF1)*DG31*X   $
ALL   293 X       =(1-GH2)*SA*RVCO*(1-RCI1)*(1-HPI2)*RVD2*X        $
ALL   293 X       =(1-RPB6)*(1-RBI1)                                        $
ALL   294 SEQ293=LOSP*REC6H2*(1-GE1)*(1-GF1)*X   $
ALL   294 X       =(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2C4)*(1-SW2D6)*RVCO*X    $
ALL   294 X       =(1-RCI1)*(1-HPI2)*(1-HPL3)*RVD2*HX1*RPX1*X       $
ALL   294 X       =(1-RBI1)*(1-SGT9)                                        $
ALL   295 SEQ294=TTWB*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   295 X       =(1-MCD1)*RVC2*RVD1*(1-ORP2)*(1-RBI1)                    $
ALL   296 SEQ295=FWRU*DGA*PXI*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL   296 X       =(1-MCD1)*RVC1*(1-OBD1)*(1-ORP2)*(1-RBI1)                $
ALL   297 SEQ296=LOSP*REC6H3*(1-RK3)*DG31*(1-GF2)*X   $
ALL   297 X       =(1-GG2)*(1-GH2)*(1-SW1B2)*(1-SW2D6)*RVCO*HRSRC1*X       $
ALL   297 X       =(1-HPI4)*RVD2*RPX1*(1-RBI1)*(1-SGT9)             $
ALL   298 SEQ297=FLTB*RB1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   298 X       =RVD9*(1-ORP2)*(1-RBI1)                                   $
ALL   299 SEQ298=CIV*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS4*X  $
ALL   299 X       =RVC4*RVD10*(1-ORP2)*(1-SP2)*(1-ODWS2)*X          $
ALL   299 X       =(1-RBI1)                                                 $
ALL   300 SEQ299=LOSP*REC6H3*(1-GE1)*(1-GF1)*X        $
ALL   300 X       =(1-GG1)*DG31*(1-SW2B1)*RVCO*HRSRC1*(1-HPI4)*RVD2*X   $
ALL   300 X       =RPX1*(1-RBI1)                                            $
ALL   301 SEQ300=LOSP*REC6H3*(1-RK3)*(1-GE1)*X        $
ALL   301 X       =(1-GF1)*(1-GG1)*DG31*(1-SW1B2)*(1-SW2D6)*RVC1*(1-RCI1)*X$
ALL   301 X       =(1-HPI2)*RPX1*(1-RBI1)                          $
ALL   302 SEQ301=LOSP*REC6H3*(1-RK3)*(1-GE1)*DG31*X   $
ALL   302 X       =(1-GG2)*(1-GH2)*(1-ED26)*SW1B2*RVCO*(1-RCI1)*(1-HPI2)*X $
ALL   302 X       =RVD2*RPX1*(1-RBI1)*(1-SGT9)                     $
ALL   303 SEQ302=LOSP*REC6H3*(1-GE1)*(1-GF1)*DG31*X   $
ALL   303 X       =(1-GH2)*(1-SW2B1)*SC*RVCO*(1-RCI1)*(1-HPI2)*X  $
ALL   303 X       =RVD2*RPX1*(1-RBI1)                                       $
ALL   304 SEQ303=LOSP*REC6H3*DG31*(1-GF2)*(1-GG2)*X   $
ALL   304 X       =(1-GH2)*(1-SW2B1)*SC*RVCO*(1-RCI1)*(1-HPI2)*X  $
ALL   304 X       =RVD2*RPX1*(1-RBI1)                                       $
ALL   305 SEQ304=LOSP*REC6H4*NHI*RVCO*(1-RCI1)*X          $
ALL   305 X       =(1-HPI2)*RVD2*(1-RBI1)                            $
ALL   306 SEQ305=LOSP*REC6H3*(1-GE1)*DG31*(1-GG2)*X   $
ALL   306 X       =(1-GH2)*(1-SW2B1)*SC*RVCO*(1-RCI1)*(1-HPI2)*X  $
ALL   306 X       =RVD2*RPX1*(1-RBI1)                                       $
ALL   307 SEQ306=LOSP*REC6H3*(1-GE1)*(1-GF1)*X        $
ALL   307 X       =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW1D9)*RVCO*X    $
ALL   307 X       =(1-RCI1)*HRSHP1*SPR1*(1-RBI1)*(1-SGT9)              $
ALL   308 SEQ307=LOSP*REC6H3*FOT1/DG1*(1-GE1)*(1-GF1)*X       $
ALL   308 X       =(1-GG1)*DG31*(1-SW2B1)*RVCO*(1-RCI1)*(1-HPI2)*X    $
ALL   308 X       =RVD2*RPX1*(1-RBI1)                                       $
ALL   309 SEQ308=LOSP*REC6H3*FOT1/DG1*(1-GE1)*X       $
ALL   309 X       =(1-GF1)*(1-GG1)*DG31*(1-SW2B1)*RVCO*(1-RCI1)*(1-HPI2)*X $
ALL   309 X       =RVD2*RPX1*(1-RBI1)                               $
ALL   310 SEQ309=FLTB*DL1*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL   310 X       =HRSSY1*RVD22*(1-ORP2)*(1-RBI1)                           $
ALL   311 SEQ310=FLTB*DK1*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL   311 X       =HRSSY1*RVD22*(1-ORP2)*(1-RBI1)                           $
ALL   312 SEQ311=FWRU*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X $
ALL   312 X       =RVC3*(1-ORP2)*OLP1*(1-RBI1)                              $
ALL   313 SEQ312=FLTB*DH1*RC1*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL   313 X       =RVD9*(1-ORP2)*(1-RBI1)                          $
ALL   314 SEQ313=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-RCI1)*X $
ALL   314 X       =HRSHP1*HRXRC1*RVD2*OLP1*(1-RBI1)                         $
ALL   315 SEQ314=LOSP*REC6H3*(1-RK3)*DG31*(1-GF2)*X   $
ALL   315 X       =(1-GG2)*(1-GH2)*(1-SW1B2)*(1-SW2D6)*RVC1*(1-RCI1)*X     $
ALL   315 X       =(1-HPI2)*RPX1*(1-RBI1)*(1-SGT9)                 $
ALL   316 SEQ315=LOSP*REC6H4*FOT4/DG4*RVCO*(1-RCI1)*HRSHP1*X  $
ALL   316 X       =RVD2*(1-RBI1)                                            $
```

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ALL  317 SEQ316=LOSP*REC6H3*(1-GE1)*(1-GF1)*X        $
ALL  317 X      =(1-GG1)*DG31*(1-SW2B1)*RVC1*(1-RCI1)*(1-HPI2)*X    $
ALL  317 X      =(1-RBI1)                                            $
ALL  318 SEQ317=IOOV*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL  318 X      =MCD1*RVD5*(1-ORP2)*(1-RBI1)                    $
ALL  319 SEQ318=ISCRAM*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X          $
ALL  319 X      =(1-SW2D1)*(1-MCD1)*BVR1*RVC1*RVD5*(1-ORP2)*X    $
ALL  319 X      =(1-RBI1)                                               $
ALL  320 SEQ319=LOCV*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL  320 X      =TB2*RVC1*RVD5*(1-ORP2)*(1-RBI1)                        $
ALL  321 SEQ320=LOSP*REC6H3*(1-RK3)*(1-GE1)*X        $
ALL  321 X      =(1-GF1)*(1-GG1)*(1-GH1)*MHI*(1-SW1B2)*(1-SW2D6)*RVCO*X $
ALL  321 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)    $
ALL  322 SEQ321=LOSP*DG1*(1-GB2)*(1-GC2)*(1-GD2)*(1-EPR301)*(1-GE1)*X   $
ALL  322 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X $
ALL  322 X      =(1-SW2D1)*RVCO*HRSSY1*RVD22*(1-ORP2)*(1-RBI1)        $
ALL  323 SEQ322=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*DG1*(1-EPR301)*(1-GE1)*X   $
ALL  323 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*X $
ALL  323 X      =(1-SW2D1)*RVCO*HRSSY1*RVD22*(1-ORP2)*(1-RBI1)        $
ALL  324 SEQ323=LOFW*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS4*X $
ALL  324 X      =(1-MCD1)*RVC4*(1-HPI6)*RVD2*(1-SP2)*(1-ODWS2)*X        $
ALL  324 X      =(1-RBI1)                                               $
ALL  325 SEQ324=LOSP*(1-GA1)*DG1*(1-GC2)*(1-GD2)*(1-EPR301)*(1-RK3)*X   $
ALL  325 X      =(1-GE1)*(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW2B1)*X  $
ALL  325 X      =(1-SW2D1)*(1-DCA2)*RVCO*HRSSY1*RVD22*(1-ORP2)*X      $
ALL  325 X      =(1-RBI1)                                               $
ALL  326 SEQ325=LOSP*REC6H3*(1-RK3)*(1-GE1)*DG31*X    $
ALL  326 X      =(1-GG2)*(1-GH2)*(1-ED26)*(1-SW1B2)*(1-SW2D6)*RVCO*X    $
ALL  326 X      =HRSRC1*(1-HPI4)*RVD2*RPX1*(1-RBI1)*(1-SGT9)      $
ALL  327 SEQ326=LOSP*REC6H1*(1-GE1)*X        $
ALL  327 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW2C1)*X $
ALL  327 X      =(1-SW2D6)*RVCO*(1-RCI1)*(1-HPI2)*RPX3*X  $
ALL  327 X      =RBI1                          $
ALL  328 SEQ327=CIV*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*RVC4*X $
ALL  328 X      =(1-RCI1)*(1-HPI2)*RPX2AC*(1-ODWS2)*(1-DWS2)*X        $
ALL  328 X      =(1-RBI1)                                               $
ALL  329 SEQ328=LOSP*REC6H3*(1-GE1)*(1-GF1)*DG31*X   $
ALL  329 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*HRSRC1*(1-HPI4)*X  $
ALL  329 X      =RVD2*RPX1*(1-RBI1)                                     $
ALL  330 SEQ329=LOSP*REC6H3*DG31*(1-GF2)*(1-GG2)*X   $
ALL  330 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*HRSRC1*(1-HPI4)*X  $
ALL  330 X      =RVD2*RPX1*(1-RBI1)                                     $
ALL  331 SEQ330=LOSP*REC6H3*(1-GE1)*DG31*(1-GG2)*X   $
ALL  331 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*HRSRC1*(1-HPI4)*X  $
ALL  331 X      =RVD2*RPX1*(1-RBI1)                                     $
ALL  332 SEQ331=LOAC*DGA*PXI*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X $
ALL  332 X      =RVCO*RVD10*CRD4*(1-ORP2)*(1-RBI1)                      $
ALL  333 SEQ332=SCRAMR*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*X   $
ALL  333 X      =(1-MCD1)*SL1*RVC4*(1-ORP2)*(1-SP2)*(1-ODWS2)*(1-RBI1)  $
ALL  334 SEQ333=LOSP*(1-GA1)*(1-GB1)*DG1*(1-GD2)*(1-EPR301)*(1-GE1)*X   $
ALL  334 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW2C1)*X $
ALL  334 X      =(1-SW2D6)*RVCO*HRSSY1*RVD22*(1-ORP2)*(1-RBI1)        $
ALL  335 SEQ334=LOSP*REC6H3*FOT1/DG1*(1-GE1)*(1-GF1)*DG31*X   $
ALL  335 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X   $
ALL  335 X      =RVD2*RPX1*(1-RBI1)                            $
ALL  336 SEQ335=LOSP*REC6H3*FOT1/DG1*(1-GE1)*X        $
ALL  336 X      =(1-GF1)*DG31*(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*X$
ALL  336 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)                   $
ALL  337 SEQ336=LOSP*REC6H3*FOT1/DG1*DG31*(1-GF2)*(1-GG2)*X   $
ALL  337 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X   $
ALL  337 X      =RVD2*RPX1*(1-RBI1)                            $
ALL  338 SEQ337=LOSP*REC6H3*FOT1/DG1*DG31*(1-GF2)*X   $
ALL  338 X      =(1-GG2)*(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*X    $
ALL  338 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)                   $
ALL  339 SEQ338=FWRU*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL  339 X      =(1-MCD1)*RVC1*OBD1*RVD5*(1-ORP2)*(1-RBI1)    $
ALL  340 SEQ339=LOSP*REC6H3*FOT1/DG1*(1-GE1)*DG31*(1-GG2)*X   $
ALL  340 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*(1-HPI2)*X   $
ALL  340 X      =RVD2*RPX1*(1-RBI1)                            $
ALL  341 SEQ340=LOSP*REC6H3*FOT1/DG1*(1-GE1)*DG31*X   $
ALL  341 X      =(1-GG2)*(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVCO*(1-RCI1)*X    $
ALL  341 X      =(1-HPI2)*RVD2*RPX1*(1-RBI1)                   $
ALL  342 SEQ341=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-RCI1)*X $
ALL  342 X      =(1-HPI2)*RPX4*U11*RBI1                 $
ALL  343 SEQ342=LOSP*REC6H3*(1-RK3)*(1-GE1)*DG31*X   $
ALL  343 X      =(1-GG2)*(1-GH2)*(1-ED26)*(1-SW1B2)*(1-SW2D6)*RVC1*X    $
ALL  343 X      =(1-RCI1)*(1-HPI2)*RPX1*(1-RBI1)*(1-SGT9)      $
ALL  344 SEQ343=LOSP*REC6H3*(1-RK3)*DL3*(1-GE1)*X   $
ALL  344 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVCO*X     $
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ALL  344 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)*(1-SGT9)    $
ALL  345 SEQ344=LOSP*REC6H3*(1-GE1)*(1-GF1)*DG31*X   $
ALL  345 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVC1*(1-RCI1)*(1-HPI2)*X    $
ALL  345 X      =RPX1*(1-RBI1)                                       $
ALL  346 SEQ345=LOSP*REC6H3*DG31*(1-GF2)*(1-GG2)*X   $
ALL  346 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVC1*(1-RCI1)*(1-HPI2)*X    $
ALL  346 X      =RPX1*(1-RBI1)                                       $
ALL  347 SEQ346=LOSP*REC6H3*(1-GE1)*DG31*(1-GG2)*X   $
ALL  347 X      =(1-GH2)*(1-SW2B1)*(1-SW1D7)*RVC1*(1-RCI1)*(1-HPI2)*X    $
ALL  347 X      =RPX1*(1-RBI1)                                       $
ALL  348 SEQ347=TT*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*X        $
ALL  348 X      =(1-MCD1)*OAD1*(1-RCI1)*(1-HPI2)*(1-OLA1)*(1-SP2)*X      $
ALL  348 X      =(1-OOWS2)*(1-RBI1)                                      $
ALL  349 SEQ348=LOSP*REC6H3*(1-GE1)*(1-GF1)*X       $
ALL  349 X      =(1-GG1)*(1-GH1)*NHI*(1-SW2B1)*(1-SW1D7)*RVCO*X        $
ALL  349 X      =(1-RCI1)*(1-HPI2)*RVD2*RPX1*(1-RBI1)            $
ALL  350 SEQ349=LOSP*(1-GA1)*(1-GB1)*(1-GC1)*(1-GD1)*(1-GE1)*DGA*X       $
ALL  350 X      =(1-GF1)*(1-GG1)*(1-GH1)*PXI*(1-SW2A1)*(1-SW2B1)*X     $
ALL  350 X      =(1-SW2C1)*(1-SW2D1)*RVCO*RVD10*(1-ORP2)*(1-RBI1)        $
ALL  351 SEQ350=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-RCI1)*X $
ALL  351 X      =(1-HPI2)*HRXSY1*RVD2*OLP1*(1-RBI1)                 $
ALL  352 SEQ351=FWRU*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-MCD1)*X $
ALL  352 X      =RVC1*HRSSY1*(1-OBD1)*(1-ORP2)*OLP1*(1-RBI1)          $
ALL  353 SEQ352=FLTB*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL  353 X      =RVD9*ORP2*(1-U11)*(1-RBI1)                         $
ALL  354 SEQ353=TT*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*X        $
ALL  354 X      =(1-MCD1)*OSL1*CRD4*(1-ORP2)*(1-SP2)*(1-OOWS2)*X         $
ALL  354 X      =(1-RBI1)                                                $
ALL  355 SEQ354=LOSP*REC6H4*DF2*RVCO*(1-RCI1)*X          $
ALL  355 X      =(1-HPI2)*RVD2*(1-RBI1)                              $
ALL  356 SEQ355=LOSP*REC6H3*(1-RK3)*(1-GE1)*X       $
ALL  356 X      =(1-GF1)*(1-GG1)*DG31*(1-SW1B2)*SW2D6*RVCO*(1-RCI1)*X    $
ALL  356 X      =(1-HPI2)*RVD2*(1-RPD10)*(1-RBI1)                    $
ALL  357 SEQ356=LOSP*REC6H3*(1-RK3)*(1-GE1)*X       $
ALL  357 X      =(1-GF1)*(1-GG1)*(1-GH1)*(1-SW1B2)*(1-SW2D6)*RVCO*X      $
ALL  357 X      =(1-RCI1)*(1-HPI2)*RVD2*R4801*RPX1*(1-RBI1)*X     $
ALL  357 X      =(1-SGT9)                                                $
ALL  358 SEQ357=LOSP*REC6H4*FOT1/DG1*RVCO*HRSRC1*(1-HPI4)*X  $
ALL  358 X      =RVD2*(1-RBI1)                                           $
ALL  359 SEQ358=LOSP*REC6H4*FOT1/DG1*RVCO*HRSRC1*(1-HPI4)*X  $
ALL  359 X      =RVD2*(1-RBI1)                                           $
ALL  360 SEQ359=LOSP*REC6H3*(1-GE1)*(1-GF1)*X       $
ALL  360 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW1D9)*RVCO*X    $
ALL  360 X      =(1-RCI1)*(1-HPI2)*HXA1*(1-RBI1)*(1-SGT9)            $
ALL  361 SEQ360=PLFW*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL  361 X      =TB2*RVC1*RVD5*(1-ORP2)*(1-RBI1)                         $
ALL  362 SEQ361=LOSP*REC6H3*FOT1/DG1*(1-GE1)*(1-GF1)*X       $
ALL  362 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW1D9)*RVCO*X    $
ALL  362 X      =(1-RCI1)*(1-HPI2)*SPR1*(1-RBI1)*(1-SGT9)            $
ALL  363 SEQ362=LOSP*REC6H3*FOT1/DG1*(1-GE1)*(1-GF1)*X       $
ALL  363 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW1D9)*RVCO*X    $
ALL  363 X      =(1-RCI1)*(1-HPI2)*SPR1*(1-RBI1)*(1-SGT9)            $
ALL  364 SEQ363=LOSP*REC6H3*FOT1/DG1*(1-GE1)*(1-GF1)*X       $
ALL  364 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*(1-SW1D9)*RVCO*X    $
ALL  364 X      =(1-RCI1)*(1-HPI2)*SPR1*(1-RBI1)*(1-SGT9)            $
ALL  365 SEQ364=FWRU*DH1*DGA*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*X  $
ALL  365 X      =(1-MCD1)*RVC1*(1-OBD1)*(1-ORP2)*RBI1             $
ALL  366 SEQ365=FLTB*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*(1-RCI1)*X $
ALL  366 X      =(1-HPI2)*OHL1*RVD2*OLP1*(1-RBI1)                        $
ALL  367 SEQ366=LOSP*REC6H2*(1-GE1)*DGA*X       $
ALL  367 X      =(1-GF1)*(1-GG1)*DG31*(1-SW2A1)*(1-SW2B1)*RVCO*(1-HPI6)*X$
ALL  367 X      =RVD2*(1-RBI1)                                       $
ALL  368 SEQ367=LOSP*REC6H3*(1-GE1)*(1-GF1)*X       $
ALL  368 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1B2)*SW1D9*RVCO*X        $
ALL  368 X      =(1-RCI1)*(1-HPI2)*SPR1*(1-RBI1)*(1-SGT9)            $
ALL  369 SEQ368=LOSP*REC6H3*(1-GE1)*DGA*(1-GF1)*X   $
ALL  369 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*(1-SW1D10)*RVCO*(1-HPI6)*X    $
ALL  369 X      =RVD2*(1-SPR1)*(1-DWS2)*(1-RBI1)*(1-SGT9)            $
ALL  370 SEQ369=LOSP*REC6H3*(1-GE1)*(1-GF1)*X       $
ALL  370 X      =(1-GG1)*(1-GH1)*(1-SW2A1)*SW1B2*RVCO*(1-RCI1)*X         $
ALL  370 X      =(1-HPI2)*SPR1*(1-RBI1)*(1-SGT9)                     $
ALL  371 SEQ370=SCRAMR*(1-SW2A1)*(1-SW2B1)*(1-SW2C1)*(1-SW2D1)*RPS1*X    $
ALL  371 X      =(1-MCD1)*OSL1*(1-ORP2)*(1-SP2)*(1-OOWS2)*X     $
ALL  371 X      =(1-RBI1)                                                $
       0 L500   =0.8*ZESWYD  $
       0 LOSP   =0.8*BELOSP  $
```

E. GENERIC ISSUES

E.1 BROWNS FERRY INTERNAL FLOODS ANALYSIS

E.1.1 INTRODUCTION AND SUMMARY

An analysis has been completed to identify accident sequences involving internal floods at Browns Ferry Units 1, 2, and 3. The analysis identifies internal flooding initiating events and their associated frequencies and impacts on plant equipment. The flood scenarios are treated as initiating events and are included in the overall individual plant examination (IPE) risk model. The results from quantifying these initiating events in the IPE risk model are summarized in Section 3.

The flood scenarios identified in this analysis are summarized in Table E.1-1 with their estimated frequency and impact on the plant model. Quantification of these scenarios is based on industry experience events (internal flood database) and a plant-specific screening of this database. Figure E.1-1 summarizes the results of this plant-specific screening and identifies the applicable flood scenarios in Table E.1-1. The following provides additional qualitative results and insights from the analysis:

- The reactor buildings are separated from each other by flood doors to Elevation 565' so that floods in one reactor unit will not impact equipment in another unit. Therefore, shutdown events in the database are not used to develop flood frequencies for the reactor building of the operating Unit 2.

- Floods in the reactor building propagate to the lowest elevation (519'); however, it takes several hundred thousand gallons to impact safety pumps at this location. Large bounding floods are postulated to assess the potential risk of floods in the reactor building. This risk is not significant.

- The service, radwaste, off-gas, and turbine buildings contain a limited amount of equipment desirable for safe shutdown of the plant. These buildings are equipped with sumps and high-level alarms. Turbine building floods have a relatively high frequency based on industry experience but are not generally risk important since few accident mitigation equipment are located in this building. The plant design precludes propagation to the vital electrical and safeguards areas in the reactor building, as penetrations below Elevation 572.5' are sealed watertight. This elevation is 7.5 feet above plant grade; therefore, a flood in the turbine building would drain outside before entering the reactor building. A scenario that causes loss of feedwater, condenser, station air, raw cooling water, and raw service water is included but is not significant.

- The intake pumping station houses the residual heat removal (RHR) service water (RHRSW) and the emergency equipment cooling water (EECW) pumps. RHRSW supplies river water to the RHR heat exchangers, and the EECW system supplies the safety-related equipment cooling loads in the reactor building. EECW floods have occurred in industry experience, and even a partial loss of EECW (i.e., a header or pumps) impacts many other systems due to functional dependencies.

This analysis postulates EECW/RHRSW flood scenarios in the intake pumping station and reactor building.

- Fire water floods were evaluated, but no specific scenarios were postulated. The frequency and impact of fire water floods are assumed to be enveloped by the turbine building and reactor building flood scenarios already postulated. The preaction fire water system used throughout vital areas appears to be reliable, and the flow capacity of these systems is considered to be an insignificant amount due to small pipe size.

- The suppression pool and the condensate storage tank (CST) are major flood sources, and flood scenarios are postulated where they empty into the reactor building and either fail the RHR, core spray, high pressure coolant injection (HPCI), and reactor core isolation cooling (RCIC) pumps or impact the water source of them on Elevation 519' of Unit 2.

- The standby diesel generator buildings are also important areas as they house the diesels, relays, and controls for the plant. There are fire water sprinklers in rooms and a stand pipe supply to hose reels in the stairwells. In addition, EECW supplies unit coolers. However, both buildings have been provided with adequate drainage to mitigate even an EECW header break; therefore, no flood events are postulated.

- The frequency of a flood in the control bay is assessed to be reasonably low. There are limited flood sources, personnel are present in this area, and the likelihood of the operators not maintaining safety functions (i.e., to prevent core damage) is judged to be unlikely. No flood events that involve the control bay are postulated.

Figures E.1-2 through E.1-11 provide a description of the general buildings and locations discussed throughout this report. These figures are general arrangement drawings derived from Reference E.1-1. Additional detailed drawings are available in the Final Safety Analysis Report (FSAR).

E.1.2 METHODOLOGY

The basic approach is a conservative screening analysis that first establishes potential major flood sources and PRA equipment locations. Flood scenarios are postulated in terms of the flooding source, the extent of propagation to adjacent locations, and the equipment impacted. The frequencies of these scenarios are then quantified as initiating events and combined with independent failures in the overall risk model. The methodology is summarized below:

- **Plant Familiarization.** Key plant design information that provides details of the plant systems and layout is reviewed. This includes the FSAR, flow diagrams, arrangement drawings, internal flood studies, and fire analysis reports (References E.1-1 through E.1-6). The PRA models are reviewed to ensure familiarity with important intersystem dependencies, success criteria, and plant response models to initiating events.

- **Flood Experience Review.** Flood data collected from *Nuclear Power Experience* (Reference E.1-7) through September 1987 are reviewed to ensure familiarization with actual flood events, their locations within the plant, and causes. These data are used in the quantification of internal flood scenario initiating event frequencies. In addition, any events at Browns Ferry are reviewed carefully for their potential impact on risk.

- **Evaluation of Flood Sources.** Using the plant design information and a general knowledge of plant layout, major flood sources and their locations are identified. For example, Wheeler Reservoir supplies the EECW system, which supplies cooling to several plant locations. EECW is identified as a major flood source, and its locations within buildings are identified.

- **Evaluation of Plant Locations.** Using plant design information such as arrangement drawings and internal flood studies and information from the evaluation of flood sources, the buildings where floods can have major impact on systems are identified. Then, each building is evaluated further with regard to equipment housed at each elevation/room, flood source, propagation path, and means of flood detection and isolation. Flood scenarios are identified for further evaluation when a potential flood that can impact more than one PRA-evaluated system is identified.

- **Plant Walk-Through.** A plant walk-through was conducted to collect additional information and to confirm previous documentation and judgments on flood sources, and their potential impact, propagation paths, and detection.

- **Scenarios and Screening.** The potential for an initiating event, propagation to other locations including drainage, detection and isolation potential, and system impact is considered in judging whether a flood scenario should be postulated and quantitatively evaluated. Initial flood scenarios are based on conservative assumptions about flood size and system impacts.

  A flood source in a location (propagation included) must cause either an initiating event and impact at least an additional important system, or cause sufficient system failures. For example, a flood that causes loss of feedwater but no other failures is insignificant because the probabilistic risk assessment (PRA) model already contains loss of main feedwater due to other causes at a much higher frequency. Similarly, a flood that fails one RHR pump division but does not cause an initiating event was not considered further. The relatively low frequency of the flood, combined with additional failures required to cause core damage, makes it a highly unlikely event.

- **Quantification.** A point estimate screening quantification is performed where conservative assumptions about flood size, impact, and operator response are made. The flood scenario is then combined with independent failures in the PRA model, and the resulting core damage frequency is compared with other core damage sequences. The important flood scenarios are evaluated further to include more realistic flood frequencies as well as detection and operator recovery actions. An uncertainty analysis is performed on dominant scenarios in the PRA model.

  The initial point estimate quantification of the flood initiating event was conducted with one of two methods. The first method uses historical data on the total annual frequency of floods (Reference E.1-7). The total frequency can be apportioned to plant systems and locations on a plant-specific basis. The apportionment is based on a screening of the database for its size, applicability to specific types of systems, and their locations at Browns Ferry. The second method sums rupture failure rates for pipes, valves, tanks, and expansion joints in a location. This requires detailed information of the number of valves, type of valves, and piping sections. This method is effective when only a few pipe sections are in a particular location.

E.1.3 EVALUATION OF FLOOD SOURCES

This section describes major flood sources and their locations in the plant based on a review of the plant design, system flow diagrams, and a plant walk-through. The following were identified as potential major flood sources and are described further in the subsections below (drawing series are in parenthesis):

- RHR Service Water (47E858)
- Emergency Equipment Cooling Water (47E859)
- Condenser Circulating Water (47E831)
- Fire Water System (47E850)
- Raw Service Water (47E836)
- Raw Cooling Water (47E844)
- Condensate Storage Tanks 1 through 5 (47E818)
- Demineralized Water Storage Tank (47E856)
- Suppression Pool (47E626)

Other sources such as smaller tanks and reactor building closed cooling water have a limited flood source and are considered to be less significant than the above sources. In Section E.1.4, building locations are evaluated with regard to equipment housed in the building, flood sources, propagation, and detection. Therefore, there is another check against the judgment for important plant locations.

E.1.3.1 RHR Service Water

RHRSW supplies the RHR heat exchangers on Elevation 565' of the reactor building. The system has 12 pumps located in the pumping station that take suction directly from Wheeler Reservoir. Four of the pumps can also be used to supply EECW loads. (Eight of the pumps can be aligned to EECW.) This system is in standby during normal operation, although the heat exchangers and the discharge lines are kept full of water to prevent water hammer upon pump startup and corrosion in the heat exchangers. A break in the RHR heat exchangers or the RHRSW supply line would empty the volume of water stored in the pipe and heat exchanger into the reactor building. This volume is not sufficient to flood reactor building Elevation 519' to a depth of 4 feet, which would disable the RHR, core spray, RCIC, and HPCI pumps. Floods from this source in the reactor building are included with EECW flood scenarios postulated in the following sections. Flooding events in the pump room could potentially affect three pumps: an EECW pump, an RHRSW pump, and a swing pump. This scenario, which has been observed at Browns Ferry, is included in the quantification of EECW pump room floods presented in Section E.1.5.

E.1.3.2 Emergency Equipment Cooling Water

EECW is a potentially large flood source due to large pipe diameters and flow rates, and it is virtually an infinite source when unisolated. The water source is Wheeler Reservoir via the pumping station through four pumps. EECW provides cooling water to the following locations and components:

- **Diesel Generator Building Units 1 and 2.** EECW is supplied to the four diesels. The two main headers run through this building with normally open valves.
- **Diesel Generator Building Unit 3.** EECW is supplied to the four diesels and the shutdown board room AC chillers.
- **Turbine Building.** EECW from the north header is supplied to the station air compressors as a backup to raw cooling water (RCW).
- **Control Bay.** EECW is supplied to the following areas in the control bay:
  - 4-inch line to emergency condensing units on Elevation 606′ with normally closed manual isolation valves.
  - 4-inch and 6-inch EECW and RCW lines to AC chillers on Elevation 617′ with normally open manual isolation valves.
  - 1.5-inch lines to shutdown boardroom condenser on Elevation 617′ (relay room) with normally open manual isolation valves.
- **Reactor Building.** EECW is supplied to the following components and locations within the reactor building:

Component	Elevation
Core Spray Environmental Coolers	519′
RHR Environmental Coolers	519′
RHR Pump Seal Water Heat Exchangers	519′
Reactor Building Component Cooling Water (RBCCW) Heat Exchangers	593′

Flood events involving EECW are postulated to occur in the intake pumping station and the reactor buildings. Floods that occur in the shutdown unit(s) reactor building(s) are assumed to disable the affected EECW header for all three units. Floods that occur in an operating unit reactor building has the added impact of flooding Elevation 519′ of the operating unit reactor building.

E.1.3.3 Condenser Circulating Water

Very large floods in the turbine building have been postulated to be associated with the circulating water system. This piping is very large (78-inch diameter in the turbine building), and the water source is very large. The condenser circulating water pumps take suction from Wheeler Reservoir at the pumping station and discharge to the condensers. From the condenser, circulating water flows either back to the river or to the cooling tower. It also supplies the RCW system and the raw service water (RSW) system. Because of the existence of an electrical tunnel connecting the intake pumping station to the turbine building, some circulating water flood events in the pumping station are included in the turbine building flood frequency. The impact of a very large flood in the turbine building and the potential propagation and impact to other plant locations are evaluated in Section E.1.4.

E.1.3.4 Fire Water

Fire protection water is supplied throughout the plant and is supplied from Wheeler Reservoir via the pumping station. This is a potentially important flood source due to the very large source of water. Fire water is supplied to the turbine building, service building, and practically all other buildings onsite. The following summarizes key fire water locations in the plant:

- **Diesel Generator Building Units 1 and 2.** Automatic preaction sprinklers are used. Hose stations are located in the stairwells.
- **Control Bay.** Automatic preaction sprinklers are used on Elevation 617′ in the mechanical equipment rooms, technical support rooms, offices, etc. Manual preaction is used in the battery and battery board rooms. Hose stations are located in the stairwells.
- **Reactor Building.** Automatic preaction is used in areas of the reactor building on Elevations 565′, 593′, and 621′, including the RHR pump rooms and heat exchanger. Fixed water spray is used in areas on Elevations 565′ and 593′, including cable trays and the HPCI pump turbine oil tanks.

Preaction systems use fusible link sprinkler heads. Actuation of preaction systems is alarmed, and the flow rates are relatively low. In some areas, such as the reactor building, there is air supervision (alarms) in the dry piping downstream of FCV 2-26-77 to ensure integrity. For these reasons, the frequency of a flood occurring that remains unisolated long enough to flood Elevation 519′ is assumed to be very low, and therefore no flood events that involve the fire protection system are postulated.

E.1.3.5 Raw Service Water

The RSW system supplies water for yard-watering, cooling for miscellaneous plant equipment with small loads, washdown services, and fire protection pressurization. The RSW system is supplied through the condenser circulating water inlet conduit from the main raw cooling water pump suction header. There are four RSW pumps (375 gpm) located in the turbine building that service the plant (two for Units 1 and 2, and two for Unit 3). The water is distributed from two 10,000-gallon-capacity storage tanks on the roof of the reactor building through a system shared by RCW and the fire protection system. Operation of the RCW pumps is controlled by level indicators on the tanks, except when the high pressure fire pumps are operating, in which case the RCW pumps are stopped and the tanks are isolated. The RSW pumps can provide 120 gpm of river water to fight fires below Elevation 617'. This system's pipe diameters and tank capacities are small. No flood events that involve this system are postulated.

E.1.3.6 Raw Cooling Water

The RCW system is supplied from the circulating water system, the pumps are located in the turbine building, and the system provides cooling to balance-of-plant equipment mostly located in the turbine building. Raw cooling water is interconnected to the EECW and serves as a backup system for the RHR pump seals and room coolers and the control room AC chillers. It supplies the following major loads in the reactor building:

Component	Elevation
RCW Booster Pumps	593'
Reactor Water Cleanup (RWCU) Pump Coolers	593'
RBCCW Heat Exchanger	593'
Motor Generator Set Oil Coolers	639'

The RCW system is not normally isolated from the EECW system because the system with the highest pressure will supply the load; therefore, RCW floods in the reactor building are included with EECW floods and are not treated separately.

E.1.3.7 Condensate Storage Tanks

The CSTs are located in the yard at grade Elevation 577' with a capacity of tanks 1 through 3 at approximately 375,000 gallons each and tanks 4 and 5 with a capacity of approximately 500,000 gallons each. Water is supplied to the turbine building from two lines from each tank. The 20-inch line supplies the control rod drive pumps in the reactor building and the condensate transfer pumps in the turbine building. The 24-inch line supplies the reactor building headers, which enter on Elevation 541' and supply the HPCI and RCIC pumps.

An expression has been developed in Reference E.1-8 that relates volume of water to flood height in the reactor building. The relationship explicitly takes into account the volume of the room displaced by the torus. 375,000 gallons corresponds to approximately 3 feet, 3 inches of water in the reactor building. Failure of the CST such that its contents drain into the reactor building will not result in direct failure of the core spray, RHR, HPCI, and RCIC pumps. However, the CST does provide the initial water source for HPCI and RCIC and the backup supply for core spray and RHR. Therefore, a flood event involving the CST is postulated.

E.1.3.8 Demineralized Water Storage Tank

The demineralized water storage tank (DWST) with a capacity of approximately 375,000 gallons is located in the yard at grade Elevation 578'. This system supplies high purity water to the plant through small-diameter piping; i.e., sample sinks, eye wash, etc. It is also used for makeup to the primary coolant system (pumped to the condensate storage tanks) and the RBCCW system. Water is supplied to the DWST from the water treatment plant, which has a capacity of 120,000 gallons per day. The distribution system from the DWST consists of two transfer pumps and three 10,000-gallon head tanks located on the roof of the reactor building. Level controls on the head tanks actuate the transfer pumps. A low level signal (LS 2-159B) actuates one pump, and a low-low level alarm (LS 2-159C) actuates the second pump. Because of small pipe diameters and head tank capacity, the amount of water emptied into the reactor building due to a pipe break is considered negligible. The operators are assumed to have enough time to locate and isolate the break or to turn off the DWST pumps before the DWST is emptied. This system also serves no essential or safety functions. For these reasons, no flood events involving the DWST are postulated.

E.1.3.9 Suppression Pool

The suppression pool (torus) is located on Elevation 537′ of the reactor building. The maximum suppression pool water volume is 127,800 cubic feet (Reference E.1-9), or 956,000 gallons of water. It is normally aligned to the RHR and core spray suction through normally open motor-operated valves (MOV) and is used as a backup supply for the RCIC and HPCI pumps through lines with normally closed MOVs. A flood event is postulated in which the suppression pool is emptied into Unit 2 reactor building, resulting in a flooded level of 8 feet to 12.7 feet, which disables the RHR, core spray, HPCI, and RCIC pumps on Elevation 519′.

E.1.4 EVALUATION OF PLANT LOCATIONS

This section evaluates building locations, equipment housed in the location, flood sources, propagation paths, and means of flood detection and isolation. Based on the review of major flood sources in Section E.1.3, plant design and layout drawings, and the location of PRA equipment, the following buildings are identified as potentially important buildings and are considered in this section:

- Reactor Building
- Control Bay
- Turbine Building
- Pumping Station
- Diesel Generator Buildings

Scenarios are postulated where flood frequency and its consequences were evaluated to be important. These scenarios are subsequently analyzed and quantified in Section E.1.5.

E.1.4.1 Reactor Building

The reactor building houses PRA (electrical, and mechanical) equipment. The upper elevations (Elevations 593′ and 621′) contain emergency AC and DC power systems. There are limited flood sources on these floors. The lower elevations (Elevations 565′, 541′, and 519′) contain mostly mechanical equipment. There are more significant flood sources on these floors, but there are open stairwells and large floor openings such that floods will propagate to the lowest elevation (Elevation 519′).

- **Reactor Building Elevation 639′ (Figure E.1-3).** This elevation houses the recirculation motor generator sets and the standby liquid control system. The motor generator sets are cooled by raw cooling water. Flood sources include raw cooling water and high pressure fire protection sprinklers. No flood scenarios are postulated that affect this elevation for the following reasons:

- Although raw cooling water and fire water have virtually infinite sources, the presence of open stairwells and drains is sufficient flood protection for this elevation. The presence of RCW and propagation to lower elevations is considered below for Elevation 519′.

- Most fire water lines are dry preaction systems. Operation of the preaction system requires a deluge valve to open, which floods the dry portion of the system. A water flow alarm is generated on a fire protection panel and in the control room. Fusible links prevent sprinklers from spraying a room, and most of the systems are under air supervision. Loss of system integrity results in a low air pressure alarm at the fire protection panel and in the control room. In addition, the flow rate through the sprinklers in a room is low such that floor areas and drains are sufficient.

- **Reactor Building Elevation 621′ (Figure E.1-4).** PRA equipment on this elevation includes:

  - 4-kV Shutdown Board C (Control Bay)*
  - 250V DC Reactor MOV Board 2A (Control Bay)*
  - 480V Reactor MOV Board 2A (Control Bay)*
  - 480V Shutdown Boards 2A and 2B (Control Bay)*
  - Backup Control Panel (Control Bay)*
  - 250V Battery Panel SB-C, D
  - 480V MOV Reactor Board 2E
  - 4-kV Transformers

The general arrangement can be seen in Figure E.1-4. The vital electrical rooms do not communicate directly with the general floor area. The 480V MOV board 2E and the 4-kV transformers are located in the general floor area of the reactor building. The other electrical equipment is located in separate board rooms, which are only accessible from the control bay Elevation 617′, which is 4 feet below the board room elevation. Flood sources in the board rooms include an 8-inch RBCCW line in the 4-kV shutdown board room and roof drains in the 4-kV and 480V board rooms. The only fire suppression equipment in these rooms are manual fire extinguishers. The propagation path is under doors to the reactor building general floor area and then down to lower elevations. The frequency of rupturing one section of RBCCW pipe is low (6×10^{-6} per year), the RBCCW water volume is small, and even if electrical equipment were affected, the impact would be to one division of power. Therefore, this source is neglected.

The reactor building general floor area houses the fuel pool cooling and RWCU equipment. Flood sources include high pressure fire water, which is dry and

*Normal access for this equipment is via the 617′ level of the control bay.

supplies preaction sprinklers and raw cooling water. No flood scenarios are postulated that affect this elevation for the following reasons:

- Water from the control bay areas would not propagate to the electrical board rooms as they are higher than the control bay floor, and water would propagate to the lower elevations of the control bay.

- Most fire water lines are dry preaction systems. Operation of the preaction system requires a deluge valve to open, which floods the dry portion of the system. A water flow alarm is generated on a fire protection panel and in the control room. Fusible links prevent sprinklers from spraying a room, and most of the systems are under air supervision. Loss of system integrity results in a low air pressure alarm at the fire protection panel and in the control room.

- Although raw cooling water and fire water have virtually infinite sources, the presence of open stairwells and drains are sufficient flood protection for this elevation. The presence of RCW and propagation to lower elevations is considered below Elevation 519'.

- **Reactor Building Elevation 593' (Figure E.1-5).** PRA equipment on this elevation includes:

  - 4-kV Shutdown Board D (Control Bay)*
  - 250V Reactor MOV Board 2B (Control Bay)*
  - 480V Reactor MOV Board 2B (Control Bay)*
  - 480V Reactor MOV Board 2D
  - RBCCW Pumps A and B

  The general arrangement can be seen in Figure E.1-5. The vital electrical rooms do not communicate with the RBCCW or RWCU equipment areas in the reactor building except for one door leading to the general floor area that is not used. The 480V MOV board 2D is located in the general floor area of the reactor building. The other electrical equipment is located in separate board rooms, which are only accessible from the control bay Elevation 593'. Flood sources in the board rooms include an 8-inch RBCCW line in the 4-kV shutdown board room and roof drains in the 4-kV and 480V board rooms. The only fire suppression equipment in these rooms are manual fire extinguishers. The propagation path is under doors to the reactor building general floor area and the control bay. The frequency of rupturing one section of RBCCW pipe is low (6×10^{-6} per year), the RBCCW water volume is small, and even if electrical equipment were affected, the impact would be to one division of power. Therefore, this source is neglected.

  Water sources in the control bay on this elevation include RCW for the air handling units and dry fire water lines. Flood sources also include EECW from control bay Elevation 606' [mechanical equipment rooms; heating, ventilating, and air conditioning (HVAC)].

*Normal access for this equipment is via the 617' level of the control bay.

Equipment in the reactor building on this elevation includes the RBCCW heat exchangers, RWCU pumps and backwash tank, RHR heat exchangers, and the RCW booster pump. Flood sources include fire water, RHRSW, RCW, and the EECW main headers. Most fire water is dry and supplies preaction sprinklers in the general floor area. There are limited wet fire water lines that supply hose reels. No flood scenarios that affect this elevation are postulated for the following reasons:

- Significant water from the control bay areas would not propagate to the shutdown board rooms due to the airtight doors between these two areas and the doors open into the control bay (Figure E.1-11). Any leakage would pass under a door into the reactor building general area.

- Most fire water lines are dry preaction systems. Operation of the preaction system requires a deluge valve to open, which floods the dry portion of the system. A water flow alarm is generated on a fire protection panel and in the control room. Fusible links prevent sprinklers from spraying a room, and most of the systems are under air supervision. Loss of system integrity results in a low air pressure alarm at the fire protection panel and in the control room. In addition, the flow rate through the sprinklers in a room is low such that floor areas and drains are sufficient.

- Floods from the reactor building, including EECW, RHRSW, fire water, and RCW, would propagate down open stairways and equipment hatches to lower elevations. These sources are considered for lower elevations.

- **Reactor Building Elevation 565' (Figure E.1-6).** This elevation houses the control rod drive hydraulic units. PRA equipment includes the 250V reactor MOV board 2C and the 480V reactor MOV board 2C. There is an equipment and personnel access lock leading to the turbine building at Elevation 565'. As described in Section E.1.4.3, significant propagation from the turbine building is not expected. Flood sources within the reactor building include fire water, EECW, and RCW. There are four open stairwells as well as open hatches leading to Elevations 541.5' and 519'. Therefore, propagation into this area from above and floods at this elevation will propagate to the Elevation 519' pump rooms. For these reasons, no flood scenarios are postulated. However, flood scenarios at the lower elevations consider flood sources on this elevation.

- **Reactor Building Elevation 541.5' (Figure E.1-7).** This elevation contains the control rod drive pumps located in rooms only accessible from a stairwell from Elevation 565'. The central floor area of this elevation is the location of the suppression pool. Flood sources include propagation from above floors as well as raw cooling water and condensate storage. However, there are four open stairwells in Unit 2 and three each in Unit 1 and 3, and a large, grated floor opening to the Elevation 519' pump rooms. Since propagation is to the lower elevation, no flood scenarios are postulated. However, flood scenarios at Elevation 519' considers flood sources on this elevation.

- **Reactor Building Elevation 519' (Figure E.1-8).** This elevation contains a total floor area of 17,750 square feet (Reference E.1-8). It contains the RHR pumps (four per unit) and the core spray pumps (four per unit) as well as the turbine-driven HPCI pump (one per unit) and RCIC pump (one per unit). The most significant flood sources are the 24-inch header from the CSTs, high pressure fire water, the suppression pool ring header, and the suppression pool. Critical flooding levels for RCIC and HPCI are assumed to be 524 feet, 2 inches and 524 feet, 6 inches, respectively. These values were conservatively based on pump/turbine centerline elevations from Reference E.1-10. The critical flooding level for the core spray and RHR pumps is determined to be 523 feet and is based on the interpolation of data presented in Reference E.1-10.

There are bulkhead doors leading to the other units in pump rooms in Unit 2, in pump rooms B and D in Unit 1, and in pump rooms A and C of Unit 3. Open stairwells lead down from upper elevations into all four pump rooms in Unit 2 and into three pump rooms in Units 1 and 3. RHR pump rooms B and D in Unit 1 and pump rooms A and C in Unit 3 have an elevator. Core spray pump room B and D in each unit has an equipment drain sump. RHR pumps A and C of each unit has a floor drain sump.

Six flood level switches are provided (one in each room and one on the general floor) that would actuate alarms in the main control room when the flood water reached a height of 2 inches above Elevation 519'. There are 12-inch curbs between the suppression pool room and the RHR pump rooms and an 18-inch curb to protect the HPCI room from external propagation. Floor drain sumps are equipped with high level alarms at Elevation 516' 6" that transmit a trouble alarm to the main control room, which gives operators time to correct the problem, if possible, prior to the water level reaching Elevation 519'. The actions to be taken are listed in 2-EOI-3 for a flood on Elevation 519'. RHR crossties between Units 1 and 2. Units 2 and 3 are available. The crosstie to Unit 1 is modeled; the crosstie to Unit 3 is not.

Floods in the upper elevations of the reactor building as well as flood sources located on Elevation 519' would flood Elevation 519'. For this reason, flood scenarios that flood all RHR and core spray pumps as well as HPCI and RCIC are postulated and evaluated in Section E.1.5 to investigate the potential significance of a large flood in the reactor building. Postulated potential scenarios include EECW/RHRSW, the suppression pool, and the CSTs as possible flood sources. In comparison, fire water events are low in frequency and are considered to be insignificant risk contributors.

E.1.4.2 Control Bay

The control bay houses the control room, relay rooms, cable spreading room, computer room, auxiliary instrument rooms, communication room, battery rooms, and mechanical equipment rooms. It provides access to the diesel generator buildings, reactor building vital electrical board rooms, and the turbine building. Flood sources are limited, and there is constant personnel surveillance.

- **Control Bay Elevation 617' (Figure E.1-9).** This area houses the control room, relay room, air handling units, and HVAC equipment room. There are no water sources in the control room.

On one side of the control room (Units 1 and 2) are offices, a relay room, the Unit 3 control room, and the air handling units. The flood source on this side is fire protection water.

On the other side of the control room are offices, toilets, a kitchen, lockers, and HVAC equipment room. The flood sources are fire protection water and small (2- to 4-inch) RCW lines in the HVAC equipment room.

Most fire water piping is dry preaction systems that are not considered to be significant sources due to alarms, low flow rates, and the presence of personnel in the area. Since this side includes an entrance to the control room, offices, toilets, lockers, and kitchen, there should be significant traffic here, ensuring early detection of floods. It is considered to be very unlikely that a flood in this area could progress for very long and lead to core damage. Floods would propagate to the lowest control bay elevation (593') and go out to the yard. Key electrical and mechanical systems required for injection and heat removal are located in the reactor building, higher elevation of control bay and the EECW pump rooms. Therefore, floods in the control building are judged to be unlikely causes of core damage.

- **Control Bay Elevation 606' (Figure E.1-10).** This area houses the cable spreading room and the mechanical equipment rooms. The water source is limited fire water piping, RCW, and EECW in the equipment rooms. Since propagation is to the lower elevation, no flood scenarios are postulated. However, flood scenarios at the lower elevations should consider flood sources on this elevation.

- **Control Bay Elevation 593' (Figure E.1-11).** This area houses the battery rooms, battery board rooms, DC equipment room, and the auxiliary instrument room for each unit. Yard access is through a door at the Unit 3 end of the building and up a flight of stairs (approximately 3 feet up). Access to the reactor and the turbine buildings is available through the airtight doors. One door is provided in each unit that leads to the reactor building via the electrical board room. One door opens into turbine building at Elevation 586' from the corridor just outside the Unit 3 battery board room. Another set of doors opens into the turbine building from the corridor next to the control bay elevator.

Flood sources on this elevation include propagation from upper floors. Once a flood reached control bay at Elevation 593', water could relieve out to the yard when it reached a depth of 3 feet, through a door at the end of the building on the Unit 3 side. There are also drains in the equipment rooms that relieve to the yard at Elevation 591'. Water through the airtight doors to the reactor (door opens in control bay) and turbine buildings is deemed to be insignificant. Leakage into the reactor building would continue to pass under doors in the electrical room, into the reactor building general area, and then down to Elevation 519' (see Section E.1.4.2) with insignificant impact. Leakage into the turbine building would also tend to end up in the basement as discussed in the next section. The flood would be confined to the hallway and any open rooms. The electrical equipment on this elevation is required to support balance-of-plant equipment in the turbine building. Therefore, floods in this area could cause a turbine trip but would not impact PRA equipment in the PRA model. However, it is likely that the flood would be detected and isolated before reaching levels that causes equipment damage due to the constant presence of personnel in the control bay.

E.1.4.3 Turbine Building

The turbine building is very large, housing the turbine, generators, service water pumps, and balance-of-plant equipment for all three units. The turbine building is an important area because the frequency of floods is relatively high, and it is important to understand the impact of such floods including the potential propagation into adjacent buildings. The turbine building interfaces with the reactor and control buildings as well as the pumping station via a cable tunnel. The interfaces with the reactor and control buildings are discussed in the following paragraphs. Floods at the pumping station which are external to the RHRSW/EECW pump rooms are postulated to propagate to the turbine building. A flood in the turbine building impacts more equipment than a flood localized at the pumping station. The frequency of pumping station flood events is therefore included in the frequency developed for turbine building floods.

There are doors that open into the turbine building Elevation 586' from the control building at Elevation 593'. Floods in the turbine building would propagate down to the basement (lower elevations) as there is significant floor grating and open stairs. If the building filled to Elevation 565', there are several doors to the outside yard at Elevation 565'. The building volume below Elevation 586' is very large; therefore, there is an opportunity to isolate a flood before it reaches this level.

Penetrations between the turbine and reactor buildings below Elevation 572.5' are sealed. Significant leakage through the equipment access lock to the reactor building at Elevation 565' is not expected due to door tightness (turbine building side of access opens into turbine building) and paths to other buildings and the outside. Any flood in the turbine building would propagate outside to the yard before it challenged the reactor or control buildings.

The electrical boards (4-kV common boards and unit boards) containing offsite power feeds are located above Elevation 565' in the turbine building and are safe from flooding. Floods in the turbine building would only impact mechanical equipment below Elevation 586', including the RSW and RCW pumps, condensate pumps, condensate booster pumps, condensers, and the station air compressors.

A large turbine building flood scenario that causes loss of station air, condensate, raw cooling water, raw service water, and the condenser is postulated.

E.1.4.4 RHRSW/EECW Pumping Station

The RHRSW and EECW pumps, located in the pumping station, are important, critical components in the PRA model. Therefore, potential flood events in the pumping station that could fail multiple pumps are investigated.

The pumps are located on top of the pumping station building at Elevation 565'. Nine CCW pumps are located on the deck of the pumping station building, open to the air. No flood events are postulated for these pumps, as water would not accumulate on the deck but would drain downward. There are four RHRSW/EECW pump rooms on the north side of the pumping station building. Each room contains two RHRSW pumps, one capable of supplying flow to EECW, one EECW pump, and two sump pumps. The sump and sump pumps, however, are not designed to handle a major pipe break. These submersible pumps are designed to be operable under flood conditions up to Elevation 578'. Also, the north wall of each pump room is 1 foot lower than the other walls, so that water would flow over this wall rather than into any of the other pump compartments. There are no penetrations between compartments. The lower elevations of the pumping station are not required to remain dry, as the pump electrical circuits are protected in case of a flood. A flood in the lower elevations would either relieve up the stairs to the roof or propagate through the cable tunnel toward the turbine building at Elevation 565' (included in the turbine flood scenario). Floods in the RHRSW pump rooms have occurred in the past, and a flood that removes one pump vault (two RHRSW pumps and one EECW pump) from operation is postulated.

E.1.4.5 Diesel Generator Buildings

- **Diesel Generator Building Units 1 and 2.** This building is accessible on Elevation 583' from a ladder from the 4-kV shutdown board room, Unit 1, Elevation 593'. Elevation 593' contains the diesel auxiliary boards that affect standby gas treatment and EECW header MOVs. There is a door to a stairway that leads to Elevation 565'. This elevation contains the CO_2 tank and the diesel generator rooms. Doors to the yard are flood tight. Flood sources are fire water and 18-inch EECW main headers (north and south). There is a sump equipped with two sump pumps with a 400-gpm capacity and a high-level alarm. There is also a 24-inch emergency drain in the wall that empties into a culvert in the yard and that is capable of handling an EECW header break. For these reasons, no flood events are postulated.

- **Diesel Generator Building Unit 3.** This building is accessible from Elevation 593' of the control bay near Unit 3. A wall separates the stairs leading to the 4-kV shutdown boards and the stairs leading down to the diesels. There are no flood sources in the shutdown board rooms. The diesels are located on Elevation 565', and are in flood-tight rooms similar to those in the Units 1 and 2 diesel building. Flood sources in the corridor include fire water and a small EECW line. The corridor is equipped with a sump and two sump pumps with a 400-gpm capacity and a high-level alarm. There are also two 18-inch emergency drains in the floor that empty into culverts in the yard. For these reasons, no flood events are postulated.

E.1.4.6 Other Buildings

Other buildings do not contain PRA modeled equipment, and it is unlikely that floods in these buildings would cause an initiating event and propagate to other critical locations. Since LOCAs have been analyzed in detail for breaks inside the primary containment building, it is unlikely that flood sources would jeopardize safety before detection.

E.1.5 SCENARIO EVALUATION AND QUANTIFICATION

Floods and their potential impacts are characterized in the prior sections. This characterization includes flood sources, potential propagation, isolation capability, detection, and impact on plant systems. This section evaluates and quantifies those scenarios that are judged to have the most significant risk to the plant. Table E.1-1 summarizes the results in terms of initiating events and impacts on the plant model. The estimated frequency of core damage from these events is quantified in the plant model.

E.1.5.1 Data

The primary source of data used in this analysis is derived from the database (Reference E.1-7), which classifies internal flood events in U.S. nuclear power plants. This database is used to estimate the frequency of internal floods in plant locations from major flood sources. The database covers a total of 740 years of reactor power operation (1,081 calendar years). The number of reactor-years was calculated by summing the plant data years (operation only) listed on pages A-4 and A-5 of Reference E.1-7.

Table E.1-2 summarizes the database events from Reference E.1-7 and presents initial screening results. The initial screening assigns the event to one of the following categories:

- Turbine Building (includes feedwater, condensate, circulating water, RCW, etc.)
- Service Water System (EECW, RHRSW)
- Fire Water System
- ECCS Related (includes HPCI, RCIC, RHR, and core spray, and events that are associated with the condensate storage tank and the suppression pool)
- Not Included (pertains to primary containment, outside, circulating water pumping station, etc.)

The above categories were chosen because they represent major flood sources. Based on plant-specific equipment locations, plant layout, design, and operation and maintenance practices, the above events are further screened and partitioned to develop flood frequencies. The following summarizes the results of this additional screening:

- **Turbine Building.** The 25 events in the database, as identified in Table E.1-2, were screened further with regard to size. Only the large events were retained (Events 1, 2, 4, 5, 22, 23, 53, 57, 58, 93, and 94). Because the turbine building is common to Browns Ferry Units 1, 2, and 3, shutdown-related events are assumed to be applicable to the operating unit. Events at one unit during shutdown could impact the other operating plant. The frequency of a large turbine building flood leading to an initiating event at each plant is conservatively estimated as follows:

  FLTB = (11 events/1,081 calendar years) × 3 units

The following distribution was substituted (Reference E.1-11) for the term "11 events in 1,081 years" to account for plant-to-plant variability, plant-specific experience, and uncertainty.

Frequency of Turbine Building Floods — Large	
Mean	1.5×10^{-2}
5th Percentile	1.7×10^{-3}
95th Percentile	3.4×10^{-2}

FLTB = 4.5×10^{-2} per reactor-year where station air, feedwater, RCW, RSW, and condenser are assumed to be unavailable.

- **Service Water (EECW and RHRSW).** The 15 events in the database are evaluated further from a plant-specific basis, as described in Section E.1.5.2 and Table E.1-3. RHRSW/EECW floods are postulated in the RHRSW/EECW pumping station and the reactor building.

- **Fire Water.** The 17 events in the database are evaluated further from a plant-specific basis, as described in Section E.1.5.3 and Table E.1-4. No fire water floods were postulated due to low frequency and insignificant impact relative to other flood scenarios already postulated.

- **ECCS Related.** The 27 events in the database are evaluated further from a plant-specific basis, as described in Section E.1.5.4 and Table E.1-5. EECW floods are postulated in the RHRSW pump rooms at the intake pumping station and the reactor building.

Several key buildings (turbine, control, and pumping station) are common to Browns Ferry Units 1, 2, and 3, while the reactor buildings are separate. In addition, the EECW system is common to all units. This means that an event that involves the turbine building or EECW and that occurs at one unit while it is shut down could impact the other operating unit. Events that occur in a reactor building during shutdown, however, are not likely to impact the operating unit. EECW header breaks in the reactor buildings of a shutdown unit will be assumed to disable one EECW header for the operating unit. Maintenance-related events that are expected to be more likely during plant shutdown are not easily screened out or reduced in frequency for the turbine building and pumping station. However, shutdown events are not included in scenarios that flood the operating unit, such as ECCS floods.

Plant-specific screening considered the following:

1. Size of the leak and the potential for propagation to equipment of interest. For example, EECW seal leaks would be small and would flow to drains and sumps. It is unlikely that sufficient water would collect and fail the leaking pump, let alone the other two pumps in the room.

2. Design precludes the event. Event 8 in Table E.1-2 is an example of an event that occurred at Browns Ferry due to poor initial design. The CST ring header has since

been redesigned to prevent the same type of failure from reoccurring. Plant design is also considered in determining the potential for maintenance events in item 3.

3. The potential for a maintenance event during power operation is considered. However, as described above, shutdown events associated with one unit can impact another operating unit at Browns Ferry. One of the most likely ways to have a large flood may be from maintenance events when valves and equipment are disassembled. Where there are isolation valves that can be opened remotely (human error or spurious) and initiate a flood is considered, as well as the system design, technical specifications, and maintenance practices.

The mean frequency of pipe rupture, database designators ZTP1B and ZTPP2B in Reference E.1-4, is used when there are only a few pipe sections and the potential for maintenance and human contributors is considered to be unlikely:

Pipe > 3 inch = 8.6×10^{-10} per section-hour = 7.5×10^{-6} per section-year.

Pipe < 3 inch = 8.6×10^{-9} per section-hour = 7.5×10^{-5} per section-year.

Using 80% availability for plant operation:

Pipe > 3 inch = 6.0×10^{-6} per section-reactor-year.

Pipe < 3 inch = 6.0×10^{-5} per section-reactor-year.

E.1.5.2 Service Water Events and Scenarios

The service water (EECW and RHRSW at Browns Ferry) events from industry data (Reference E.1-7) were screened to determine their applicability to Browns Ferry. The service water-related events and the screening results are summarized in Table E.1-3. A total of 15 events are separated into three groups: (1) pump related; (2) not pump related (valves and coolers); and (3) outside (underground).

As shown in Table E.1-3, 11 of the 15 events are known to have occurred when the plant was shut down. This is not surprising since most major maintenance actions are scheduled for shutdown conditions, when practical. However, at Browns Ferry, all three units share pumps located in the RHRSW pump rooms at the intake pumping station. Thus, shutdown events can impact the operating unit. In the reactor building, cooling loads for all units are usually on the same elevation but not in a common building. For this reason, events at shutdown may affect the availability of a header, but flood impact should not affect the operating unit.

E.1.5.2.1 RHRSW/EECW — Intake Pumping Station

Six of the seven pump-related events in Table E.1-3 would apply to the intake pumping station at Browns Ferry. Two of the events are classified as small or not applicable. Events 11, 14, 17, and 62 would apply to the pump rooms on Elevation 565' of the intake pumping station. Event 14 occurred at Browns Ferry during refueling. Components in the rooms are pumps, check valves (one per pump), manual valves (one per pump), manual valves for the crosstie between pumps 1 and 2 (one per room), manual hand control valve for crosstie between pumps 1 and 3 in rooms A and B (one per room), motor-operated flow control valve for crosstie between pumps 1 and 3 in rooms C and D (one per room), and limited piping. From the system design, it appears that maintenance on the pump and check valve would be performed by isolating the system with the manual valve in the same room. Opening the manual valve after maintenance requires personnel in the area such that leaks on the discharge side of the check valve would be detected. Testing the pump division after maintenance requires personnel to be present in the pump room.

Based on the above, a flood initiating event in a pump room is postulated.

FLPH = 4 events/1,081 calendar years

The following distribution was substituted (Reference E.1-11) for the term "4 events in 1,081 years" to account for plant-to-plant variability, plant-specific experience, and uncertainty.

Frequency of Pump Room Floods — Large	
Mean	8.4×10^{-3}
5th Percentile	5.6×10^{-3}
95th Percentile	2.3×10^{-2}

FLPH = 8.4×10^{-3} per reactor-year where the impact is assumed to be loss of one RHRSW/EECW pump vault (two RHRSW pumps and one EECW pump).

The following flood initiating event is included in the model:

FLPH1 = FLPH $\times$ 3 units

FLPH1 = 2.5×10^{-2} per reactor-year where the impact is assumed to be loss of one running EECW pump and two RHRSW pumps from any one of the four pump rooms.

E.1.5.2.2 Service Water (RHRSW/EECW) Reactor and Control Buildings

The six events that are not pump related but are associated with valves and coolers are applicable to the Browns Ferry reactor buildings. Three events (10, 31, and 47) are considered small, and, given the reactor building design, it would take several hours before flooding would impact the RHR, HPCI, RCIC, and core spray pumps on Elevation 519'. Therefore, these events were considered to be insignificant. The other three events are discussed below:

- Event 16 occurred during shutdown due to a disassembled valve. Service water was started and then stopped. At Browns Ferry, there are sufficient manual valves to isolate equipment for maintenance, and these valves are located near the equipment in most cases. Therefore, human errors should be detected immediately at the source, and spurious opening of a valve is unlikely.

- Event 36 occurred because a service water valve to component cooling was removed for maintenance during shutdown. This event is similar to Event 16 in that they both have the potential to be large floods; i.e., the system is open. On the other hand, they are expected to occur with personnel present during local realignment.
- Event 107 occurred when service water to the primary containment unit coolers leaked with both primary containment sumps unavailable. This event would appear to apply to the primary containment unit coolers, except it could also be applied to air conditioning units in the reactor and control buildings. Note that the primary containment unit coolers at Browns Ferry are cooled by RBCCW.

It appears that Events 16 and 36 could have resulted in large floods since they were maintenance events where equipment was disassembled. Therefore, these two events are applied to the reactor building shutdown service water flood initiating frequency. The frequency of a large service water flood (10,000 gpm is assumed) in the reactor building is estimated as follows:

EECW-RB = (2 events/341 calendar years) × 2 plants in shutdown

E-RB = 1.2×10^{-2} per reactor-year

If the operators isolate the flood to the shutdown unit in 20 to 30 minutes, the initial impact would be the loss of one pump supply to the operating unit EECW header. If the flood is not due to a main header pipe rupture, then the equipment-related event may be isolatable without affecting other equipment. Given successful isolation of the flood, it is conservatively assumed that one pump supply to the operating header of EECW is unavailable. The following flood initiating event in the reactor building that causes the loss of one EECW header is included in the model:

FLRB1 = 1.2×10^{-2} per reactor-year

The above shutdown events do not apply to scenarios involving loss of PRA equipment in the operating unit due to flooding. If the operators fail to isolate this break in the operating unit within 20 to 30 minutes (OP1), then the RHR, HPCI, RCIC, and core spray pumps on Elevation 519' are assumed to become flooded. The following flood initiating event in the reactor building that causes loss of one EECW header and all RHR, HPCI, RCIC, and core spray pumps is included in the model:

FLRB2 = (0 events/1,081 plant-years) × OP1

The following distribution was substituted (Reference E.1-11) for the term "0 events in 1,081 years" to account for plant-to-plant variability, plant-specific experience, and uncertainty.

Frequency of Reactor Building Floods — Source	
Mean	5.7×10^{-4}
5th Percentile	1.2×10^{-5}
95th Percentile	1.8×10^{-3}

FLRB2 = 1.7×10^{-6} per reactor-year where OP1 is 3×10^{-3} (see Section 3.3.3 of the main report for human recovery action OFLRB1).

It is assumed that the flood would be isolated prior to reaching higher elevations that would cause further damage.

It should be pointed out that the RHR systems are cross-connected between units such that heat removal can be performed from other units. RHR crosstie valves 74-101 and 74-100 are located on Elevation 578′, and valves 74-96 and 74-97 are located approximately 15 feet above Elevation 519′ and should provide an opportunity for successful RHR operation using the other units.

The unit cooler leakage event (107) occurred during operation and could be applicable to the control building and the reactor building where there are normally operating unit coolers or air conditioning units. The frequency and impact of the above reactor building floods are assumed to envelope this event. However, the frequency of a relatively large flood at specific plant locations that contain unit coolers could be estimated as follows:

FLUC = 1 event/1,081 calendar years

FLUC = 9.3×10^{-4} per reactor-year total for all unit coolers per reactor unit

The frequency of an event at a specific location that contains a unit cooler would be estimated as follows:

FLUC1 = FLUC/10 unit coolers = 9.3×10^{-5}

Thus, if the frequency of a flood initiating in the control building mechanical equipment room were of interest, the above would be used. However, as described in Section E.1.4, the likelihood of not isolating the event or not recovering manual control of the plant from the auxiliary control room is considered to be small.

E.1.5.2.3 EECW — Outside/Underground

The two EECW events in Table E.1-3 that occurred outside appear to be relatively small leaks. At Browns Ferry, this would be a minor impact if the operators identified and isolated the affected supply header and opened a zonal isolation valve to an unaffected header. These events are neglected since the above scenarios are believed to envelope risk.

E.1.5.3 Fire Water Events and Scenarios

The fire water events from industry data (Reference E.1-7) were screened to determine their applicability to Browns Ferry. The fire water-related events and the screening results are summarized in Table E.1-4. A total of 17 events are separated into 2 groups: (1) inadvertent actuation and (2) leaks/breaks.

The 11 inadvertent actuations are not considered to be significant flooding sources because the capacity of the sprinkler systems in the areas of interest (i.e., the control building and reactor building) is relatively small. In addition, the preaction systems at Browns Ferry require fusible links to melt or fail and alarms alert the operators of actuation. The local impact from inadvertent actuation should be the only concern since floor areas and drains handle spray flows. Thus, the frequency and impact of actuation are considered to be insignificant.

Two of the six leaks/breaks events (102 and 105) are applicable to the inside of buildings. Event 102 occurred in the turbine building, and Event 105 appears to be a small leak (although not clear). Therefore, fire water pipe breaks or large floods from the fire water system are judged to be unlikely. In addition, the areas of largest concentration of fire water system components, in particular, large piping, are the pumping station, underground, turbine building, and the lower portions of the reactor building. Turbine building floods and reactor building floods from EECW, CST, and suppression pool are judged to envelope fire water contributions to risk based on frequency and impact. There is limited smaller fire water piping in the control bay and the upper electrical portion of the auxiliary building. These sources are judged to be insignificant since only a small portion of the total fire water system is expected to be located in these areas.

E.1.5.4 ECCS Events and Scenarios

The emergency core cooling system (ECCS) related events from industry data (Reference E.1-7) were screened to determine their applicability to Browns Ferry. The ECCS-related events and the screening results are summarized in Table E.1-5. ECCS-related events include HPCI, RCIC, core spray, and RHR. These systems are located in the reactor building at Browns Ferry, and are connected to the CSTs and the suppression pool. A total of 27 events are categorized into the following 4 groups:

- **Pump Related (except for high pressure pumps in operation).** These events are potentially applicable to the RHR, core spray, HPCI, and RCIC. These pumps are located in the reactor building.

- **Valve/Cooler Related.** These events are more appropriately applied to areas that contain heat exchangers or cooling units. These events apply to the reactor building at Browns Ferry.

- **Inadvertent Spray or Actuation.** These events apply to inside primary containment at Browns Ferry.

- **High Pressure Pumps during Operation.** These events apply to the HPCI and RCIC pumps located in the reactor building at Elevation 519′ and the control rod drive and RWCU systems.

As described in Table E.1-5, some of the events do not apply to Browns Ferry, many of the events were small (seals, vents, drains, and leaks), inadvertent actuations mostly apply to the primary containment of PWRs, and personnel are expected to be present when many events occurred during testing. It (where, for example, automatic initiation of containment spray is possible) is unlikely that the small events would cause significant damage based on the reactor building design.

Among these events, Events 92, 8, and 78 appear to be potentially larger than the other small events as they involved piping and/or weld failures. Event 8, in which the condensate ring header weld failed, occurred at Browns Ferry in 1978. Since this event, the ring header was completely redesigned, and it is assumed that this event is no longer applicable to the current design. Event 92 occurred during cold shutdown and therefore may not apply to an operating unit. It is assumed that events occurring in the other units during shutdown are not likely to affect the unit in operation. Event 78 involved a test return line rupture in the HPCI system. To establish a bounding frequency for scenarios associated with CST in the reactor building, it is assumed that the remaining event is applicable and is a large flood (10,000 gpm). If this were the case, the following flood frequency would be derived for ECCS-related events:

ECCS-CST = 1 events/1,081 calendar years

The following distribution was substituted (Reference E.1-11) for the term "1 event in 1,081 years" to account for plant-to-plant variability, plant-specific experience, and uncertainty.

Frequency of Reactor Building Floods — CST	
Mean	9.8×10^{-4}
5th Percentile	1.7×10^{-5}
95th Percentile	3.0×10^{-3}

ECCS-CST = 9.8×10^{-4} per reactor-year in reactor building

The CST is equipped with level instrumentations that provide low tank level indications and alarms in the control room. Flood alarms would help to determine which pump room is flooded, if applicable, and there are motor-operated isolation valves in the RHR, HPCI, RCIC, and core spray pump suction lines and isolation valve at outlet of the CST.

In addition, the flood must continue to be unisolated for 20 to 30 minutes to drain the tank. Therefore, the following CST-related flood initiating events are included in the model:

FLRB3C = ECCS-CST X OP2

FLRB3C = 9.8×10^{-5} per reactor-year

where OP2 is set equal to 0.1 and is the human error associated with failure to isolate the flood prior to losing approximately 200,000 gallons (20 minutes) at which time it is assumed that the CST is fully drained and unavailable. The 0.1 value is a conservative screening value.

Note that there is no impact from draining a CST to reactor building as the floor will not reach the PRA equipment.

For flood scenarios involving the suppression pool, no applicable events are identified in the flood event database. The suppression pool is a steel pressure vessel in the shape of a torus and is designed to perform pressure suppression and heat removal functions during emergency operations. The suppression pool also provides suction through a ring header (connected to the suppression pool by four 30-inch tees) for the RHR, CS, HPCI, and RCIC systems. During normal plant operation, the suppression pool serves as a reservoir and is not subjected to any significant dynamic loading. Therefore, water lost from the suppression pool due to vessel rupture during normal operation or during a normal transient response is deemed to be highly unlikely. This assessment does not consider scenarios including failure to isolate such breaks. Isolation failure scenarios would not contribute significantly to the frequency of suppression pool ring leader failure. However, ring header failure has the potential to drain the torus water to the reactor building. To quantify the suppression pool ring header scenario, the pipe rupture frequency in the component failure database is used. The mean frequency of pipe rupture is 8.6×10^{-10} per section-hour (i.e., 7.5×10^{-6} per section-year) for pipe > 3". Using the 80% availability for plant operation, the frequency becomes 6.0×10^{-6} per section-reactor year.

In Unit 2, 16 pipe sections are connected to the suppression pool or the ring header. The pipe sections downstream of the RHR and core spray pump suction isolation valves are not accounted for since failure to isolate such a flood (by closing the suction isolation valve) is deemed to be unlikely. This assessment does not consider scenarios involving failure to isolate such breaks. Isolation failure scenarios would not contribute significantly to the frequency of suppression pool ring header failure. Therefore, the frequency of a suppression pool flood scenario is estimated as:

$$FLRB3S = 6.0 \times 10^{-6} \text{ per section-reactor year} \times 16 \text{ pipe sections}$$

$$FLRB3S = 9.6 \times 10^{-5} \text{ per reactor-year}$$

where it is assumed that the suppression pool is drained and unavailable. In addition, it is assumed that the RHR, HPCI, RCIC, and core spray pumps became flooded and unavailable.

E.1.6 REFERENCES

E.1-1. Browns Ferry Nuclear Plant Architectural Drawings:

47E200 1-17	Powerhouse
47W4220	Standby Diesel Generator Building

E.1-2. Design Basis Evaluation Report — Moderate Energy Line Break (MELB)-Flood Evaluation Requirements for Browns Ferry Unit 2 Restart, TVA, March 31, 1988.

E.1-3. Browns Ferry Nuclear Plant Flow Diagrams:

1-47E859-1 (R23)	Emergency Equipment Cooling Water
2-47E859-1 (R16)	"
1-47E858-1 (R12)	RHR Service Water
2-47E858-1 (R8)	"
3-47E858-1 (R7)	"
1-47E850-1 (R13)	Fire Water and Raw Service Water
2-47E850-1 (R14)	"
3-47E850-1 (R15)	"
1-47E850-2 (R9)	"
2-47E850-2 (R10)	"
3-47E850-2 (R10)	"
0-47E850-4 (R7)	"
3-47E850-4 (R8)	"
1-47E850-5 (R5)	"
2-47E850-5 (R10)	"
3-47E850-5 (R5)	"
1-47E850-6 (R5)	"
2-47E850-6 (R8)	"
2-47E850-7 (R6)	"
0-47E850-9 (RF)	"
0-47E851-1 (R7)	Floor and Equipment Drains
0-47E851-2 (R7)	"
0-47E851-3 (R9)	"
0-47E851-4 (R7)	"
1-47E844-1 (R7)	Raw Cooling Water
1-47E844-2 (R12)	"
2-47E844-1 (R6)	"
2-47E844-2 (R11)	"
3-47E844-1 (R3)	"
3-47E844-2 (R9)	"
3-47E844-3 (R7)	"
1-47E831-1 (R1)	Condenser Circulating Water
2-47E831-1 (R2)	"
2-47E803-1 (R9)	Feedwater
2-47E803-5 (R15)	"
0-47E856-1 (R14)	Demineralized Water
2-47E804-1 (R14)	Condensate
2-47E814-1 (R25)	Core Spray
2-47E822-1 (R18)	Reactor Building Closed Cooling Water
2-47E811-1 (R29)	Residual Heat Removal System

E.1-4. Engineering Evaluations in Support of the 10CFR50 Appendix R Submittal for Browns Ferry Nuclear Plant, Volume 1, TVA.

E.1-5. Browns Ferry Nuclear Plant Updated FSAR, Amendment 8.

E.1-6. Tennessee Valley Authority Browns Ferry Nuclear Plant PRA, September 1987.

E.1-7. PLG, Inc., "Database for Probabilistic Risk Assessment of Light Water Nuclear Power Plants, Flood Data," Volume 9, PLG-0500, Revision 0, March 1990.

E.1-8. Primary Containment Maximum Flood Level, B22 91 0907 101 (R3), TVA, September 6, 1991.

E.1-9. TVA Calculation, ND-Q2999-880163, R0 (B22 89 0377 1091).

E.1-10. Browns Ferry Nuclear Plant Mechanical Drawings

2-47W455-7 (R0)	High Pressure Coolant Injection System
0-47W456-4 (R0)	Reactor Core Isolation Cooling System
0-47W483-2 (R0)	Core Spray System
0-47W452-4 (RA)	Residual Heat Removal System
0-47W452-5 (RB)	Residual Heat Removal System

E.1-11. Johnson, D. H., PLG, Inc., letter to R. J. Mc Mahon, TVA, Browns Ferry Flood Frequency Calculation, TVA-1418-PLG-21, August 21, 1992.

Table E.1-1. Summary of Results for Browns Ferry Internal Floods Analysis

Flood	Annual Frequency (point estimate)	Description	Cause of Plant Trip	Plant Model Impact
FLTB	4.5-2	Turbine Building	Loss of Condenser Feedwater or Plant Control Air	Loss of Feedwater, Condenser, RCW, RSW, and Station Air
FLPH1	2.5-2	EECW Pump Room	Manual Reactor Trip Loss of EECW Header	Loss of One EECW and Two RHRSW Pumps
FLRB1	1.2-2	EECW in Reactor Building - Shutdown Units	Manual Reactor Trip Loss of EECW Header	Loss of One Pump Supply to One EECW Header
FLRB2	1.7-6	EECW in Reactor Building - Operation	Manual Reactor Trip Loss of an EECW Header	Loss of an EECW Header RHR, HPCI, RCIC, and Core Spray Unavailable
FLRB3C	9.8-5	CST Drained to Reactor Building	Manual Reactor Trip	CST, CRD Unavailable; Water Source for HPCI, RCIC, and Core Spray Impacted
FLRB3S	9.6-5	Suppression Pool Drained to Reactor Building	Manual Reactor Trip	Suppression Pool, RHR, HPCI, RCIC, and Core Spray Unavailable

Note: Exponential notation is indicated in abbreviated form; e.g., 3.6-2 = 3.6×10^{-2}.

Table E.1-2 (Page 1 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
1	Quad Cities 2 B.VI.E.26	Turbine	6/74	Feedwater	Feedwater flow regulating valve.	70,000 gallons	Feedwater break and fire deluge actuation.	Caused plant trip.	Included in turbine building flood frequency.
2	Duane Arnold B.VI.E.31	Turbine	7/74	Condensate	Backwash valve would not close.	123,000 gallons	While at-power, maintenance resulted in flooding.	"Cold" water. Plant trip not reported; unclear if it did.	Included in turbine building flood events.
3	Dresden 2 B.VI.E.33	Turbine	9/74	Condensate	Condensate booster pump vent line.	20 inches in pump room	Occurred at-power, ruptured vent line.	Unit manually scrammed.	Included in turbine building flood events.
4	Quad Cities B.VI.F.2	Turbine	6/72	Circulating Water	Water box expansion joint.	15 feet	Ruptured following a design change.	Prior to commercial operation.	Included in turbine building flood frequency.
5	Monticello B.VI.F.25	Outside	5/76	Circulating Water	Cooling tower expansion joint failed.	Flooded discharge structure	Failed during shutdown.	--	Included in turbine building flood frequency.
6	Browns Ferry 2 B.VII.E.44	Reactor	9/74	HPCI	Gasket for HPCI turbine gland steam condenser blew.	The Gland Steam condenser hotwell pump flooded	Following a plant trip, the gasket blew. There was no level alarm.	Occurred when high pressure system operated; i.e., after plant trip.	Included in ECCS flood events, HP pumps. See Table E.1-5.
7	Browns Ferry 2 B.VII.E.46	Reactor	10/74	HPCI	Gasket for HPCI turbine gland steam condenser blew.	The Gland Steam condenser hotwell pump flooded	Occurred 1 month after event 6.	Occurred when high pressure system operated; i.e., after plant trip.	Included in ECCS flood events, HP pumps. See Table E.1-5.
8	Browns Ferry 3 B.VII.E.147	Reactor	4/78	Condensate (ECCS)	Welded joint in ring header.	80,000 gallons	Ring header failed after plant trip as RCIC and HPCI operated.	High pressure systems were operating.	Included in ECCS flood events, HP pumps. See Table E.1-5.
9	Quad Cities 1 B.VIII.C.26	Outside	4/74	RHR Service Water	Underground piping.	50 gpm	Construction debris pierced pipe to RHR heat exchanger.	Revealed when RHR placed in service; i.e., shut down.	Included in Service Water flood events, outside. See Table E.1-3.

Table E.1-2 (Page 2 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
10	Brunswick 1 B.VIII.C.110	Reactor	7/77	Service Water	RHR service water heat exchanger outlet valve.	Unclear	Gasket for valve ruptured (flange).	Revealed when RHR placed in service; i.e., shut down.	Included in Service Water flood events, valve. See Table E.1-3.
11	Hatch 1 B.VIII.C.153	Service Water Pump House	10/78	Service Water	Strainer backwash line valve body blew out.	3 Feet of water	Valve closed to permit maintenance ruptured.	May affect only pump out for maintenance.	Included in Service Water flood events, pump. See Table E.1-3.
12	Brunswick 1 B.VIII.C.169	Reactor	11/77	HPCI	Floor drains inadequately.	Enough to flood auxiliary oil pump	Sump pumps from other ECCS cubicles flooded sump if transferred water to; i.e., HPCI pump room.	Peculiar to floor drain interconnections arrangement.	Not included in detailed screening - drains.
13	Browns Ferry B.VIII.C.178	Outside/ Turbine	1/79	Drainage System for ground water	Design inadequacy.	Small, no equipment effected	Drainage system could not keep up with water level, dewatering pumps failed.	Peculiar to plant design. Additional redundancy added.	Not included in detailed screening - drains.
14	Browns Ferry 1 B.VIII.C.255	RHRSW/ EECW Pump Vault	8/81	RHR Service Water	Air/vacuum valve failed to seal, RHRSW pump.	Pump room flooded	Valve failed during refueling.	Revealed during shutdown.	Included in Service Water flood events, pump. See Table 3.36-3.
15	Fitzpatrick B.IX.E.756	Reactor	3/82	RCIC	Failed sump pump	Small	A RCIC valve flooded when the sump pump did not work.	Leak source not identified.	Not included in detailed screening - source was not identified.
16	Dresden B.XVI.C.377	Auxiliary	11/77	Service Water/LPCI	Heat exchanger outlet valve.	3.5 Feet flooded	Valve disassembled but not isolated when river pump started (shutdown).	Heat exchanger maintenance permitted at-power also.	Included in Service Water flood events, valve. See Table E.1-3.
17	Quad Cities B.VIII.C.361	Auxiliary	6/85	Service Water/RHR	Pump vent line.	Pump vault filled, sprayed two other pumps	Vent line failure during RHR cooling.	Location of pump vent lines is of interest.	Included in Service Water flood events, pump. See Table E.1-3.

Table E.1-2 (Page 3 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
18	Hatch 1 B.XVI.C.1633 B.XVI.C.1547	Reactor	5/85	Deluge System for CR Filters	Pressure gauge bumped.	Small (20 gallons)	The pressure gauge actuated the system, a plugged drain caused leakage into a control room panel.	Spurious valve actuation and instrument readings resulted.	Included in Fire Water flood events, inadvertent act. See Table E.1-4.
19	Cooper B.XVI.C.1215 B.VII.F.341	Reactor	4/84	Fire Protection System	Deluge valve failed.	Unclear	Inadvertent fire protection actuation.	--	Included in Fire Water flood events, inadvertent act. See Table E.1-4.
20	Point Beach 2 P.VD.133	Auxiliary	4/77	Steam Generator Blowdown	Blowdown tank overflowed.	Small	Leaking blowdown line did not isolate blowdown.	Could associate with a tank.	Not included in detailed screening - steam generator related.
21	TMI 2 P.VI.E.200	Auxiliary	3/79	Liquid Waste System	Holdup tanks overflowed.	50,000 gallons	TMI 2 accident. Tanks overflowed due to transfer of containment sump water.	Could associate with a tank. Happened during accident.	Not included in detailed screening - radwaste related.
22	Crystal River 3 P.VI.E.214	Turbine	1/79	Circulating Water	Secondary services heat exchanger block valve.	65,000 gpm medium	AOV valve opened during heat exchanger cleaning. Circulating water pumped into open service water pipe; plant was at 100% power.	Caused condensate and MFW pumps to trip due to flood.	Included in turbine building flood frequency.
23	TMI 1 P.VI.F.52	Circulating Water Pump House	4/77	Circulating Water	Circulating water pump casing.	Large	Casing split during refueling, flooding pump house.	Separate pump house for circulating water for this plant.	Included in turbine building flood frequency.
24	Trojan P.VIII.A.216	Auxiliary	5/77	Spent Fuel Pool Demineralizer	Head gasket in demineralizer (manhole cover).	10,000 Gallons (20 to 30 gpm)	Gasket blew during purification of RWST inventory, during shutdown.	Could associate with a tank.	Not included in detailed screening - spent fuel pool.

Table E.1-2 (Page 4 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
25	TMI 2 P.VIII.A.410	Auxiliary	2/80	HHSI	Test connection valve separated.	550 gallons	Leak occurred during pump test.	Leak was isolated rather quickly.	Included in ECCS flood events, HP pumps. See Table E.1-5.
26	Surry 2 P.VIII.B.54	Service Water Pump House	6/75	Service Water	Pump seal.	Small	Valve motor in pit below pump shorted.	Seal leak size not reported.	Included in Service Water flood events, pump. See Table E.1-3.
27	Trojan P.VIII.B.134 (Duplicate of Event #24)	Auxiliary	5/77	Spent Fuel Pool Demineralizer	Head gasket in demineralizer (manhole cover).	10,000 gallons (20 to 30 gpm)	Gasket blew during purification of RWST inventory, during shutdown.	Could associate with a tank.	Not included in detailed screening - spent fuel pool.
28	Oconee 1 P.VIII.C.6	Auxiliary	10/74	LPI/DHR	Drain valves left open for cooler and piping.	3 feet (small)	During maintenance to inspect a valve, the system was not isolated properly for draining.	Drain valves could be associated with the valve or the cooler.	Included in ECCS flood events, valve. See Table E.1-5.
29	Oconee 3 P.XI.B.163.196	Turbine	10/76	Main Condenser	Solenoid butterfly valve failed open	Large (for 30 minutes) (turbine building flooded 2 ft)	Valves designed to fail open. During refueling, lake drained into turbine building via circulating water. Condenser, circulating water valve (outlet) solenoids.	Not applicable to power operation. Relative elevations peculiar to this plant.	Not included in detailed screening - site elevations.
30	Zion 1 & 2 P.XII.53	Auxiliary	4/73, 11/75	Radwaste	Design error, inadequate capacity.	15 gpm	Numerous instances of small flooding.	No events were significant enough to report separately.	Not included in detailed screening - radwaste related.
31	Surry 2 P.XVI.C.518	Service Water Valve Pit	10/77	Service Water	2" Service Water drain valves left open	Unclear	During shutdown, flooded when header returned to service.	1 header maybe in maintenance while at power.	Included Service Water flood events, valve. See Table E.1-3.

Table E.1-2 (Page 5 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
32	Surry 2 P.XVI.C.679	Turbine	10/78	Main condenser	Drain line insufficient capacity	Unclear	Service water valve pit in turbine building flooded, due to shutdown maintenance.	Affected service water but flood source in turbine building.	Included in turbine building flood events.
33	Surry 1 P.XVI.C.1543	Turbine/ Service Water Valve pit	11/81	Unclear	Not specified.	Valve pit flooded	Service water valve pit in turbine building flooded from unknown source.	Numerous instances of this at Surry, all due to main condenser maintenance.	Not included in detailed screening - source unknown.
34	San Onofre 1 P.XVI.C.1774	Service Water Pump House	3/82	Service Water	Operator error.	Unclear	Circulating water pump not started to depress service water intake water level before maintenance.	Peculiar to ocean site at San Onofre (during shutdown).	Included in Service Water flood events, pump. See Table E.1-3.
35	Turkey Point 3 P.XVIC.1849	Auxiliary	11/82	Liquid waste	Waste holdup tank overflowed	600 gallons (small)	Laundry water spilled.	Occurred at power.	Not included in detailed screening - liquid waste related.
36	Indian Point 2 P.VIII.B.639	Auxiliary	8/84	Service Water	Service water valve removed for maintenance in CCW pump room	Medium	In shutdown with fuel removed, header not completely isolated for maintenance, CCW pumps were flooded.	Maintenance could occur in header while at power. One CCW pump cleaned and started in 3 hours.	Included in Service Water flood events, valve. See Table E.1-3.
37	Brunswick 1 B.VI.C.86	Turbine	9/86	Main Condenser	Main condenser cleaning system leak.	Medium	During startup, led to high main condenser pit water level.	Circulating water pumps tripped.	Included in turbine building flood events.
38	Pilgrim 1 B.VI.E.53	Turbine	1/76	Feedwater	Feedwater regulating valve broken	5,000 gallons (medium)	Valve broke, line isolated by operators.	Plant was then shut down.	Included in turbine building flood events.
39	Quad Cities 1 B.VII.C.32	Reactor	2/75	Core Spray	Relief valve lifted during test.	20,000 gallons (1,000 gpm)	Relief valve lifted and diverted flow during the spray pump test.	Could occur for any pump test. This test, the pump ran on mini flow.	Included in ECCS flood events, pump. See Table E.1-5.

Table E.1-2 (Page 6 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
40	Oyster Creek B.VII.C.48	Reactor	4/76	Core Spray	Pump seal leak	3 gpm (small) (1,375 gal.)	The seal leakage occurred but was not associated with a test.	This leak rate may be within capacity of the sump pumps.	Included in ECCS flood events, pump. See Table E.1-5.
41	Peach Bottom 2 B.VII.E.135	Reactor	2/78	HPCI	Pump flange gasket leak.	Unclear	The flange leak was associated with a test; closing suction valve stopped the leak.	Leak rate not reported but was enough to cause flood alarm.	Included in ECCS flood events, HP pump. See Table E.1-5.
42	Susquehanna 2 B.VII.E.420	Reactor	10/86	HPCI	Drain line left open in steam supply line.	750 gallons	HPCI pump test sprayed steam.	Procedure problem concerning valve checklist.	Included in ECCS flood events, HP pump. See Table E.1-5.
43	Browns Ferry B.VII.F.304	Containment	4/86	Spray	Pressure switches.	Large	Shorting of pressure switches led to inadvertent spray actuation.	Plant was in cold shutdown.	Included in ECCS flood events, inadvertent act. See Table E.1-5.
43(a)	Browns Ferry B.VII.F.304	Containment	4/86	Fire Protection System	Cable tray deluge valves failed when system repressurized.	Large	A yard break depressurized the fire protection system, the valves then failed.	This event is documented with event 43.	Included in Fire Water flood events, inadvertent act. See Table E.1-4.
44	Vermont Yankee B.VIII.A.31	Reactor Building	10/76	RWCU	Flow switch.	Several hundred gallons	RCS leaked into reactor building before leak isolated.	Flow switches later replaced with blank flanges; small LOCA.	Not included in detailed screening - reactor water clean up.
45	LaSalle 1 B.VIII.A.165	Reactor	8/84	RWCU	Manual valve left open.	Small	Tank overflowed due to leak from RWCU system.	Occurred when RWCU filters rearranged.	Not included in detailed screening - reactor water clean up.
46	Millstone 1 B.VIII.A.212	Reactor	7/86	RWCU	1" relief line failed for regenerative heat exchanger	Unclear (Small)	Pipe line failure led to leak, line was then isolated.	–	Included in ECCS flood events, valve. See Table E.1-5.

Table E.1-2 (Page 7 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
47	Millstone 1 B.VIII.B.1	Reactor	5/71	Service Water	RBCCW heat exchanger discharge line on service water side.	Small (failed MCC below)	Service water leakage near heat exchanger during plant cooldown.	Revealed during shutdown.	Included in Service Water flood events, valve. See Table E.1-3.
48	Dresden 1 B.VIII.C.105	Reactor	4/77	Fuel Pool Cooling	Heat exchanger inlet vent line.	3,500 gallons	Nipple corroded, caused a leak.	Occurred at power.	Included in ECCS flood events, valve. See Table E.1-5.
49	Quad Cities 1 B.VIII.C.224	Reactor	10/80	Service Water/RHR	Pump packing leakage.	Small	Pump leakage and sump pump design inadequacy.	Revealed when RHR operated for shutdown cooling.	Included in Service Water flood events, pump. See Table E.1-3.
50	Quad Cities 1 B.VIII.C.270	Under-ground Piping	11/81	Service Water	Design error (see event 9) RHR service water line.	Unclear	Leakage under turbine building.	Revealed when RHR operated for shutdown cooling.	Included in Service Water flood events, outside. See Table E.1-3.
51	Hatch 2 B.X.56	Reactor	12/86	Fuel Pool	Inflatable seals failed.	140,000 gallons	Inflatable seals failed, permitting flood.	Could only have occurred during shutdown.	Not included in detailed screening - spent fuel pool.
52	Millstone 1 B.XII.28	Turbine	3/75	Condensate	Condensate return overflowed.	Small	While at power, condensate overflowed.	Did not cause a plant trip.	Included in turbine building flood events.
53	Browns Ferry 1 B.XVI.C.75	Turbine	5/74	Condensate	Blank flange loosened.	Large (85,000 gallons)	U1 and U2 crosstie to be connected, but condensate system not isolated.	Operations error prior to commercial operation.	Included in turbine building flood frequency.
54	Brunswick 1 B.XVI.C.1634	Contain-ment	7/85	Containment Spray	Maintenance error.	25,000 gallons (secured in 3 minutes)	Inadvertent containment spray actuation during refueling.	Cause is related to the refueling outage maintenance.	Included in ECCS flood events, inadvertent act. See Table E.1-5.
55	Hatch 1 B.XVI.C.1845; VII.D.412	Reactor	12/85	RHR	Air-operated butterfly valve used for pump isolation.	14 feet (large)	Isolation valve opened in response to a loss of offsite power test.	Occurred during refueling; may occur during any maintenance.	Included in ECCS flood events, pump. See Table E.1-5.

Table E.1-2 (Page 8 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
56	Arkansas Nuclear One 1 P.V.F.50	Auxiliary	8/85	Letdown	3/4" drain line valve.	500 gallons (several inches)	Valve opened, later isolated locally.	Isolable small LOCA.	Not included in detailed screening - letdown line.
57	Trojan P.VI.E.559	Turbine	3/85	Feedwater	Heat drain pump discharge piping ruptured.	Large	Ruptured, caused loss of condenser vacuum and actuation of fire suppression.	Occurred in response to turbine trip with partial FWI.	Included in turbine building flood frequency.
58	Surry P.VI.E.786, 736,749, 756	Turbine	12/86	Feedwater	Elbow of MFW pump suction ruptured.	Large	Ruptured led to loss of MFW and numerous fire suppression actuation all over the plant.	In response to one MSIV closure and partial FWI.	Included in turbine building flood frequency.
59	Catawba 1 P.VI.F.89	Turbine	8/86	Feedwater	MFW pump turbine condenser valve.	Medium	Valve leaked, then failed open.	Circulating water secured. Plant was at hot standby.	Included in turbine building flood events.
60	San Onofre P.VII.E.210	Outside	6/84	Fire Protection	Fire water pipe underground.	Not reported	Break in a fire main weakened by construction equipment.	May wish to consider as external flood.	Included in Fire Water flood event, leak. See Table E.1-4.
61	Surry 2 P.VIII.B.421, 567	Turbine	8/81	Unclear	Not specified.	Small	Leak flooded service water valve pit.	Service water valve pit normally not in the turbine building.	Included in turbine building flood events.
62	Salem 2 P.VIII.B.571	Service Water Pump House	6/83	Service Water	Check valve flange gasket.	6 Feet	When in cold shutdown, leak occurred when service water restored after header cleaning.	Service water pumps may be in maintenance when at power.	Included in Service Water flood events, pump. See Table E.1-3.
63	Rancho Seco P.IX.C.317	Auxiliary	12/85	HHSI	HHSI pump seal.	450 gallons (small)	Pump seal leaked when started with suction valve closed.	Occurred in response to an safety injection.	Included in ECCS flood events, HP pump. See Table E.1-5.

Table E.1-2 (Page 9 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
64	San Onofre 1 P.XII.147	Auxiliary	8/85	Post-Accident Sampling	Relief valve diaphragm failed, valve opened.	Not reported.	Valve spuriously opened, post-accident sampling lost.	--	Not included in detailed screening - post-accident sampling.
65	Surry 2 P.XVI.C.174	Turbine	1/75	Drainage of Sumps	Operator error.	Valve pit flooded (small)	Operators started sump test, then left; sump overflowed.	Service water valve pit not normally in the turbine building.	Not included in detailed screening - sump drainage.
66	Surry 2 P.XVI.C.1904	Turbine	7/82	Main Condenser	Main condenser inlet water box.	Valve pit flooded (small)	While cleaning a water box, leakage flooded a nearby valve pit.	Service water valve pit not normally in the turbine building.	Included in turbine building flood events.
67	Surry 2 P.XVI.C.1910	Turbine	9/82	Main Condenser	Main condenser water box.	Valve pit flooded (small)	Portable sump pump left unattended, misdirected flow into valve pit.	Service water valve pit not normally in the turbine building.	Included in turbine building flood events.
68	Indian Point 2 P.VI.E.34	Inside Contain-ment	11/73	MFW	Feedwater line to steam generator 22 only.	Unspecified Containment sump level rose	Feedwater linebreak inside containment safety injection occurred on delta-P between steam generators 180-degree crack with maximum width 5/32".	Power at 7%, turbine not yet synched.	Not included in detailed screening - containment.
69	Maine Yankee P.VI.E.435	Inside Containment	1/83	MFW	Feedwater line/ nozzle at No. 2 steam generator inlet nozzle.	Severe, but Containment was entered for inspection	Feedwater linebreak inside containment. MFW was not available after trip. Water hammer occurred due to AFW startup.	Full power, water hammer when steam collapsed due to rising steam generator water level.	Not included in detailed screening - containment.
70	Arkansas Nuclear One 1 P.VIII.B.96	Auxiliary	8/76	DHR	Flow instrument valve weld.	Minor (~2 gpm)	Cold shutdown, minor leaks due to excessive vibrations.	Similar problem in same material of spray system.	Included in ECCS flood event, valve. See Table E.1-5.

Table E.1-2 (Page 10 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
71	Salem 2 P.VIII.A.538	Containment	6/81	CVCS	Letdown isolation valve transferred closed.	3,000 gallons before isolation	A letdown isolation valve closed, safety valve lifted venting to containment.	Vent valve on isolation valve had failed at a weld.	Not included in detailed screening - containment, CVCS.
72	Ft. Calhoun P.V.A.61	Containment	10/76	RCS RCP seals	RCP controlled bleed-off line.	<0.2 gpm	Weld leak on bleed-off line discovered during shutdown.	Insignificant size.	Not included in detailed screening - containment, small RCP seal leak.
73	Indian Point 2 P.V.A.69	Containment	7/77	RCS	RCP seal.	<75 gpm, 90,000 gallons total	RCP seal package failed while at 2% power. No safety injection, but manual shutdown required. Rapid cooldown; plant had to be depressurized and drained to stop the leak. Charging pumps worked.	Second charging pump controlled level, pressurizer pressure also fell. Recirculation not required.	Not included in detailed screening - containment, RCP seal leak.
74	Arkansas Nuclear One 1 P.V.A.84	Containment	5/80	RCS	RCP seal.	>20 gpm, totaled 64,000 gal.	RCP seal leak from 86% power, manual reactor trip and safety injection.	Building pressure increases 0.5 psid. Took 7 hours to get on RHR.	Not included in detailed screening - containment, RCP seal leak.
75	Oconee 2 P.V.A.32	Auxiliary	1/74	CVCS	RCP seal injection line outside containment.	Unclear, 1.5" CVCS line	Leak in seal injection line led to isolation of injection flow to all four RCPs.	Cool down took 75 hours once started.	Included in ECCS flood events, HP pump. See Table E.1-5.
75(a)	Oconee 2 P.V.A.32	Containment	1/74	RCS	RCP seal.	Averaged 90 gpm, 50,000 gallons total	Manual trip and cool-down. Did not go on recirculation.	Seal that failed was for different pump than one which lost injection.	Not included in detailed screening - containment, RCP seal leak.

Table E.1-2 (Page 11 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
76	Robinson 2 P.V.A.40	Containment	4/75	RCS	RCP seal	400 gpm max. (130,000 gallons total)	RCP seal leak, started at full power and increased 6 hours later after trip. Containment pressure increased 3 psig. Safety injection indicated.	Took 3.5 hours for depressurization on RHR. Very little operating history.	Not included in detailed screening - containment, RCP seal leak.
77	Oyster Creek B.VI.E.157	Turbine	6/82	Condensate	1/2" pressure gauge connecting pipe.	9,700 gallons in <1.25 hours.	Sheared small connecting pipe off due to pump vibration.	At 78% power.	Included in turbine building flood events.
78	Dresden 1 B.VII.E.9	Auxiliary	5/71	HPCI	Test return line to condensate.	Not specified	Line ruptured during test.	--	Included in ECCS flood events, HP pumps. See Table E.1-5.
79	Dresden 2 B.VII.E.93	Auxiliary	9/76	HPCI	Test return line.	Very small <1/4" diameter <5 gpm	Small hole in HPCI test return line.	Reactor at 97% power. May not have been a test in progress.	Included in ECCS flood events, HP pumps. See Table E.1-5.
80	Quad Cities 2 B.VI.E.45	Turbine	8/75	MFW	Low flow MFW line.	8,500 gallons and 4,000 from SW deluge	At 170 MW, the low flow line severed as the plant switched from the low flow to the main feedwater regulating valve.	Pump trip and isolation of valves limited the leakage.	Included in turbine building flood events.
80(a)	Quad Cities 2 B.VI.E.45	Turbine	8/75	MFW	Feedwater low flow drain lines.	3-3/4" lines	At 410 MW, feedwater regulating valve failed open; 3-3/4" lines broke due to excessive vibration.	Similar vibration causes as with event 80.	Included in turbine building flood events.

Table E.1-2 (Page 12 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
81	Salem 1 P.V.A.90	Containment	10/78	RCS	RCP seal.	15,000 gallons rate not specified (believe >75 gpm)	At hot shutdown, RCP seal leakage, makeup required shifting to RWST.	Plant was already tripped at time of leakage.	Not included in detailed screening - containment, RCP seal leak.
82	Oconee 3 P.V.C.8	Containment	6/75	RCS	Pressurizer PORV stuck open.	1,500 gallons	From low power, during power reduction, transient caused PORV challenge, stuck open.	Pre-TMI B&W plant transient.	Not included in detailed screening - containment, RCS.
83	Calvert Cliffs 2 P.V.A.77	Containment	11/78	RCS	RCP seal pressure sensing line.	Technical Specification (~25 gpm)	Seal pressure sensing line weld cracked; reactor remained critical while operators isolated the line.	Plant at full power.	Not included in detailed screening - containment, RCS.
84	Trojan P.VIII.A.308	Auxiliary	9/77	CVCS	Common suction line for charging pumps.	11 gpm	Small leak detected when plant at 80% power.	--	Included in ECCS flood events, HP pump. See Table E.1-5.
85	Davis-Besse 1 P.IX.D.95	Containment	9/77	RCS	Pressurizer PORV stuck open.	11,000 gallons, operator isolated in 21 minutes	At 9% power, spurious 1/2 FWI caused RCS pressure transient, which challenged PORV. Valve failed open.	Valve closed at open rather than closing setpoint so it cycled nine times.	Not included in detailed screening - containment, RCS.
86	Zion 1	Containment	1975	RCS	RCS drain valves mispositioned.	(750 gpm) 15,000 gallons	Valve alignment error revealed when another valve operated as part of routine operation.	Occurred at hot shutdown isolated in 20 minutes.	Not included in detailed screening - containment, RCS.
87	Surry 1 P.V.B.2	Containment	11/72	RCS	Hotleg RTD.	3/8" diameter 30,000 gallons	RTD blew out soon after pressurizer pressurized.	Failure pressure was less than earlier hydrotest.	Not included in detailed screening - containment, RCS.

Table E.1-2 (Page 13 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
88	Salem 2 LER 311/84016	Auxiliary	7/84	Charging	Weld of vent valve to header.	Unspecified	3"-long crack in charging pump suction header where vent valve attaches to schedule 10 pipe. Reactor was at 100% power.	Operability of charging pumps questionable.	Included in ECCS flood events, HP pump. See Table E.1-5.
89	Maine Yankee LER 309/83003	Auxiliary/ Containment	1/83	ECCS	Pump vent lines.	Small, via pump casing vent lines	While at power, inadvertent actuation of automatic switchover to recirculation of train A during RWST level testing.	Small drainage of RWST through LPSI and QSS pump vent lines to sump.	Included in ECCS flood events, inadvertent act. See Table E.1-5.
90	Indian Point 2 LER 247/78032	Auxiliary	11/78	Charging	Weld of drain valve to seal injection header.	8.0 gpm	While at power, small leak in seal injection header, where drain valve welded to header.	Leak increased from original 0.5 gphr.	Included in ECCS flood events, HP pump. See Table E.1-5.
91	Indian Point 2 LER 247/77000	Auxiliary	3/77	Charging	Seal injection line.	Unspecified	Weld leaking elbow connection of seal injection line during power operation.	Unit shut down for repairing similar events mentioned on 7/75 and 2/77.	Included in ECCS flood events, HP pump. See Table E.1-5.
92	McGuire 2 LER 370/84017	Auxiliary	8/84	RHR	Weld on letdown line from RHR to CVCS.	3,000 to 7,000 gallons spraying	During cold shutdown with RHR in operation, weld in small pipe and sprayed from stem of valve.	Leaking line was isolated.	Included in ECCS flood events, pump. See Table E.1-5.
93	LaSalle 1 & 2 INPO(SOER)85-5 LER 373/85045	Turbine	5/85	Circulating water	Expansion joint between circulating pump and discharge valve.	2,000 gpm	At 85% power, transient caused joint to rupture, flooded basement to 15 feet, stopped when equilibrated to river.	All circulating water and nonemergency service water lost. Fire water rigged for cooling in <3 hours.	Included in turbine building flood frequency.

Table E.1-2 (Page 14 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
94	Peach Bottom 3 INPO(SOER)85-5 (SER) 50-84	Turbine	1/84	Circulating Water	Water box vent valve left open for maintenance.	1-hour flooded pump room 6-8 ft	60% power, restoring from maintenance, pump room flooded, operators attended other problem.	Condensate pump bearings failed when water displaced oil in bearings, motors not flooded.	Included in turbine building flood frequency.
95	Not Used								
96	Surry 2 P.XVI.C.679	Turbine	10/78	Main Condenser	Drain line insufficient capacity.	Unclear	Service water valve pit in turbine building flooded due to shutdown maintenance.	Affected service water but flood source in turbine building.	Included in turbine building flood events.
97	North Anna P.VII.E.222	Outside	11/84	Fire Protection	Fire protection system main header	Not reported	12 foot crack found in piping	May wish to consider as external flood	Included in Fire Water flood events, leak. See Table E.1-4.
98	Dresden 1 B.VI.E.9	Turbine	5/63	Condensate	Condensate pump.	2" on Condensate room floor	Lube oil supply pump to condensate pump failed. Condensate pump shaft seized, casing cracked at power.	Oil-lubricated condensate pump; no temperature alarm.	Included in turbine building flood events.
99	Turkey Point 3 P.XIV.B.12	4-kV switchgear	11/72	Floor Drain	Drain discharge channel.	1" to 4" on floor	Heavy rains and incomplete discharge canal caused floor drains to back up.	–	Not included in detailed screening - drain related.
100	Beaver Valley 1 P.V.B.10	Containment	6/76	RCS	RCS pressure sensing line.	5,300 gallons	Failure of flexible hose in sensing line, improper choice of hose, 28% power.	Engineering error in hose choice.	Not included in detailed screening - containment, RCS.

Table E.1-2 (Page 15 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
101	Arkansas Nuclear One 1 and 2 P.VI.D.176	Containment	9/78	Containment Spray	ESF relay.	50,000 gallons	MSIV air solenoid created plant transient. Improper set relays caused containment spray actuation and gravity feed as recirculation valves repositioned. 100% power.	–	Included in ECCS flood events, inadvertent act. See Table E.1-5.
102	Peach Bottom B.VII.F.238	Turbine	6/84	Fire Water	Piping	Unknown	Pipe break at elbow during fire system testing.	–	Included in Fire Water flood events, leak. See Table E.1-4.
103	Pilgrim 1 B.VII.F.58	Outside	11/78	Fire Water	Shutoff valve.	Medium	During hydrant repair, shutoff valve blew off, 100% power.	Improper valve reinstallation is cause.	Included in Fire Water flood events, leak. See Table E.1-4.
104	Dresden 2 B.XII.67	Radwaste Auxiliary	6/79	Demineralized water	Hose.	Medium	Demineralized hose ruptured, flooding containment floor.	91% Power	Not included in detailed screening - radwaste.
105	Dresden 2 B.XIV.A.77	Diesel Generator Room	10/79	Fire Water	Careless while performing maintenance activity	Small	While modifying fire system water ran down into diesel generator control cabinet.	Maintenance activity, 98% power.	Included in Fire Water flood events, leak. See Table E.1-4.
106	Crystal River 3 P.VII.A.262	Outside	7/80	Core Flood Tanks	Check valve.	20 gallons	Core flood check valve failed, 500 gallons enter N_2 system, 20 gallons to environment via N_2 R.V.	Shutdown.	Not included in detailed screening - outside.
107	Indian Point 2 P.VII.C.55	Containment	10/81	Service Water	Fan cooler unit coil leak.	100,000 gallons	Leaking fan cooler unit, 100% power.	Both containment sump pumps out of order.	Included in Service Water flood events, valve. See Table E.1-3..

Table E.1-2 (Page 16 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
108	Peach Bottom 3 INPO (SER) 46-83 LER 278/83007	Reactor	3/83	RHR/LPCI	RHR/LPCI pumps	60,000 gallons	Inadvertent LPCI actuation during instrument calibration.	Refueling	Included in ECCS flood events, inadvertent act. See Table E.1-5.
109	Oyster Creek NRC IE Information Notice #83-41	Unclear	11/9/80	Fire Water	Automatic fire suppression system was left on while trouble shooting electrical fault	Unclear	While trouble shooting an electrical fault in an automatic fire suppression system, sprinkler actuation occurred because operators did not de-activate automatic feature.	Caused one train of a redundant safety feature actuation system to fail.	Included in Fire Water flood events, inadvertent act. See Table E.1-4.
110	Oyster Creek NRC IE Information Notice #83-41	Unclear	1/82	Fire Water	Pump motor	Unclear	Pump motor overheated causing actuation of fire suppression sprinkler system.	Some safety-related equipment suffered water damage.	Included in Fire Water flood events, inadvertent act. See Table E.1-4.
111	Dresden Unit 3 NRC IE Information Notice #83-41	Reactor	11/81	Fire water	Smoke Detector caused actuation of sprinkler system.	Unclear	Ionization-type smoke detector in an HPCI room reacted to high temperature and humidity, actuating an automatic sprinkler system.	This lead to loss of HPCI system.	Included in Fire Water flood events, inadvertent act. See Table E.1-4.
112	Dresden Unit 2 NRC IE Information Notice #83-41	Reactor	12/81	Fire Water	High temperature caused actuation of sprinkler system	Unclear	High temperature and humidity caused actuation of sprinkler system in HPCI room. This event is similar to event 111.	Caused HPCI and redundant automatic depressurization system to fail.	Included in Fire Water flood events, inadvertent act. See Table E.1-4.

Table E.1-2 (Page 17 of 17). Categorization of Flooding Events from Industry Data through September 1987 (Reference E.1-7) (References are from NPE unless otherwise noted.)

Event	Plant and Reference	Building	Date	System	Component	Size of Leak	Event Description	Comments	Detailed Screening Information
113/ 114	Farley Unit 1 NRC IE Information Notice #83-41	Cooling Towers	6/10/ 81 and 7/21/ 82	Fire Water	Inadvertent actuation of deluge system due to a maintenance activity	Unclear	These two events resulted in unnecessary actuation of the deluge system for the main cooling towers because control system had been taken out of service for maintenance.	Led to actuation of deluge system and drawdown of two water storage tanks below tech spec. limit.	Included in Fire Water flood events, inadvertent act. See Table E.1-4.
115	Trojan NRC IE Information Notice #83-41	Containment	7/26/ 81	Fire Water	Fire suppression system	Unclear	Smoke from welding caused actuation of fire suppression system.	Caused inoperability of one train of the redundant containment atmosphere hydrogen recombiner system.	Included in Fire Water flood events, inadvertent act. See Table E.1-4.
116	Surry Unit 2 NRC IE Information Notice #83-41	Diesel Generator Room	5/28/ 81	Fire Water	Valve was left slightly open	Unclear	A foam distributor system was installed in the fuel oil tank. Water leaked through open valve.	The diesel generators were technically inoperable until the water was removed.	Included in Fire Water flood events, leak. See Table E.1-4.
117	Ginna NRC IE Information Notice #83-41	Auxiliary	11/14/ 81	Fire Water System	Satellite Station A (provides power to smoke detector circuits)	Unclear	While performing lamp test, actuation of several fire water suppression or sprinklers occurred.	Resulted in the trip of one RPS motor generator set and a small amount of water entering the control rod drive switchgear cabinet. Two rods dropped.	Included in Fire Water flood events, inadvertent act. See Table E.1-4.

Table E.1-3 (Sheet 1 of 2). Plant-Specific Screening Service Water Flood Events			
Class of Events	**Event**	**Description**	**Plant-Specific Screening**
Pump Related	11	During maintenance, strainer backwash isolation valve body blew.	Applies to RHRSW/pump vault.
	14	Air/vacuum valve failed to seal, shut down.	Applicable to flooding RHRSW/pump vault.
	17	Pump vent line failed and flooded vault.	Applicable to flooding RHRSW/pump vault.
	26	Pump seal leak, valve motor below shorted.	Small; leakage within drain capacity of pump room.
	34	CWS not started to depress level before maintenance, shut down.	Not applicable to intake pump station.
	49	Pump packing leak, sump pump inadequate, shut down.	Small; leakage within drain capacity of pump room.
	62	Check valve flange gasket, 6 feet of water when header restored, shut down.	Large; applicable to maintenance in pump vault.
Valves, Coolers	10	RHR heat exchanger outlet valve flange gasket ruptured when operated, booster pump, shut down.	Small leak; applies to reactor building.
	16	Maintenance on heat exchanger outlet valve, service water started and stopped, valve disassembled, shut down.	Medium; applies to reactor building.
	31	Drain valve left open in valve pit after maintenance, shut down.	Small leak.
	36	Service water valve in CCW pump room removed for maintenance, shut down.	Medium, maintenance event; applies to reactor building.
	47	Service water CCW heat exchanger discharge leakage, shut down.	Small leak; applies to reactor building.

Table E.1-3 (Sheet 2 of 2). Plant-Specific Screening Service Water Flood Events			
Class of Events	**Event**	**Description**	**Plant-Specific Screening**
	107	Service water to containment unit coolers leaked, both primary containment sumps unavailable (100,000 gallons).	Inside primary containment. Could apply to air conditioning units in reactor building and control building. Included in service water flood events.
Outside (underground)	9	Construction debris pierced underground pipe, 50 gpm, shut down.	Could affect one EECW header. Included in service water flood events.
	50	Service water to RHR underground leakage, shut down.	Could affect one EECW header. Included in service water flood events.

Table E.1-4 (Sheet 1 of 2). Plant-Specific Screening of Fire Water Flood Events			
Class of Events	**Event**	**Description**	**Plant-Specific Screening**
Inadvertent Actuation	18	Inadvertent actuation of deluge system when a pressure gauge was bumped. This caused a small leak of approximately 20 gallons.	Applicable to areas that have a deluge system.
	19	Inadvertent startup of fire protection system led to a water hammer event that forced open a deluge valve. Occurred when bulldozer sheared off a fire hydrant. This resulted in an insignificant leak.	Applicable to areas that have a deluge system.
	43(a)	Cable tray deluge inadvertently opened due to faulty deluge valves that opened when system repressurized. Occurred during shutdown. This resulted in a very large leak of approximately 28,000 to 30,000 gallons.	Applicable to areas that have a deluge system. BFN event, small in comparison to other flood sources.
	109	While troubleshooting an electrical fault in an automatic fire suppression system, inadvertent actuation of the fire suppression system caused one division of a redundant safety feature actuation system to fail.	Applicable to areas that have a deluge system.
	110	Pump motor overheated, causing inadvertent actuation of fire suppression system. Some safety-related equipment suffered water damages.	Applicable to areas that have a deluge system.
	111	Ionization-type smoke detector in an HPCI room reacted to high temperature and humidity, inadvertently actuating an automatic sprinkler system. This caused a loss in HPCI system.	Applicable to HPCI pump room.
	112	Similar to event 111.	Applicable to HPCI pump room.

Table E.1-4 (Sheet 2 of 2). Plant-Specific Screening of Fire Water Flood Events

Class of Events	Event	Description	Plant-Specific Screening
	113/ 114	Two events resulted in unnecessary actuation of the deluge system for the main cooling towers due to the deactivation of the control system for maintenance work.	Applicable to areas that have a deluge system.
	115	Smoke from welding caused an inadvertent actuation of fire suppression system. Water damage caused inoperability of one division of the redundant primary containment atmosphere hydrogen recombiner system.	Applicable to areas that have a deluge system.
	117	During tests, actuation of several fire water suppression or sprinklers occurred. Tripped one RPS motor generator set and caused two dropped control rods.	Applicable to area that have a deluge system.
Leaks/Breaks	60	Underground fire main leak during construction. Potential cause due to large construction equipment.	Applicable but does not affect equipment inside buildings.
	97	Underground pipe ruptured with plant at power.	Applicable but does not affect equipment inside buildings.
	102	Pipe break (turbine building) at elbow during motor pump testing. Break detected when second pump auto started.	Applicable; is actually a small leak but has the potential to become very large.
	103	During fire hydrant repair of shutoff valve, it blew off. Occurred outside and at 100% power.	Applicable but does not affect equipment inside buildings.
	105	While modifying fire water system, water ran down into diesel generator control cabinet. Plant at power.	Applicable.
	116	A foam distributor system leaked water into the diesel fuel oil tank through an open valve.	Not applicable.

Table E.1-5 (Sheet 1 of 3). Plant-Specific Screening ECCS Flood Events			
Class of Events	**Event**	**Description**	**Plant-Specific Screening**
Pump Related (except for high pressure pumps in operation)	39	Core spray relief valve lifted during test shutdown, 20,000 gallons diverted (1,000 gpm).	BFN relief valve capacity is 93 gpm. Small event, detectable by sump alarms.
	40	Core spray pump seal leak, power (3 gpm).	Small; applies to reactor building.
	55	AOV opened (RHR) during LOSP test, refueling (14 feet of water).	No fail-open AOVs. Not applicable design.
	92	Weld on RHR to CVCS letdown small line (3,000 to 7,000 gallons). Shutdown.	Medium; applies to RHR connection to RWCU or RCIC in reactor building.
Valve/Cooler Related (except for high pressure pump in operation)	28	LPI/DHR drain valve left open during maintenance, power (3 feet of water).	Small (1 inch or less); pump rooms have flood alarms.
	46	RWCU 1-inch relief line for regenerator heat exchanger failed, power continued, isolated.	Small; normal operating system.
	48	Fuel pool heat exchanger inlet vent line nipple ruptured from corrosion, power, 3,500 gallons.	Small; applies to reactor building.
	70	DHR flow instrument valve weld, 2 gpm.	Small; applies to reactor building.
Inadvertent (spray) Actuation or Automatic Recirculation Alignment	43	Pressure switch shorted and actuated sprays and pumps shut down (30,000 gallons in drywell).	Water was inadvertently sprayed in primary containment. Not applicable to flooding equipment outside.
	54	Spray actuation due to maintenance error during refueling. 25,000 gallons in 3 minutes.	Inside primary containment. Not applicable to flooding equipment.
	89	One division auto recirculation actuation during RWST level test.	Small; not applicable to flooding equipment unless it happens when equipment disassembled and unisolated.

Table E.1-5 (Sheet 2 of 3). Plant-Specific Screening ECCS Flood Events			
Class of Events	Event	Description	Plant-Specific Screening
	101	Loss of power and improper relay set idle to spray actuation/recirculation valve reposition.	Inside primary containment. Not applicable to flooding equipment outside.
	108	Inadvertent actuation in RHR during refueling due to low level false signal, overflowed to lower elevations.	Refueling event; not enough water in reactor cavity to cause significant flooding in reactor building.
High Pressure Pumps during Operation	6	HPCI gland steam condenser gasket blew after plant trip (power escalation testing).	Small BFN event in HPCI pump room.
	7	Same as event 6 one month later.	Small BFN event in HPCI pump room.
	8	RCIC/HPCI condenser ring header weld joint fail in the torus room after trip 80,000 gallons.	Large BFN event; design modification has remedied problem.
	25	HHSI test connection valve separated during test, pump secured (550 gallons), shut down.	Small; applies to reactor building.
	41	HPCI pump flange leak during test, detected by flood alarm, isolated, power.	Small; applies to HPCI and RCIC.
	42	HPCI steam supply drain line left open, sprayed during test, startup (750 gallons).	Small; applies to reactor building.
	63	HHSI pump seal leak during response to safety injection, suction valve close (450 gallons).	Small; system must be operating. Operator should be locally at the pump during test.
	75	Charging seal injection line leak, 1.5-inch line lost flow to all RCP seals.	Small; applies to RWCU or CRD in reactor building.
	78	HPCI test return line rupture.	Size not indicated. Applies, but operator should be locally at pump during test.
	79	HPCI test return line leak, < 5 gpm, power.	Small. Applies, but operator should be locally at pump during test.

Table E.1-5 (Sheet 3 of 3). Plant-Specific Screening ECCS Flood Events			
Class of Events	Event	Description	Plant-Specific Screening
	84	Charging common suction line, 11 gpm at 80% power.	Small. Applies to normally operating systems (RWCU or CRD) in reactor building.
	88	3-inch crack in charging pump suction header vent valve, pumps unavailable.	Applies to normal operating systems (RWCU or CRD) in reactor building.
	90	Seal injection header drain valve leak, < 8 gpm.	Small; applies to normal operating systems in reactor building or inside primary containment.
	91	Seal injection line elbow weld leak at power.	Small; applies to normal operating systems in reactor building or inside primary containment.

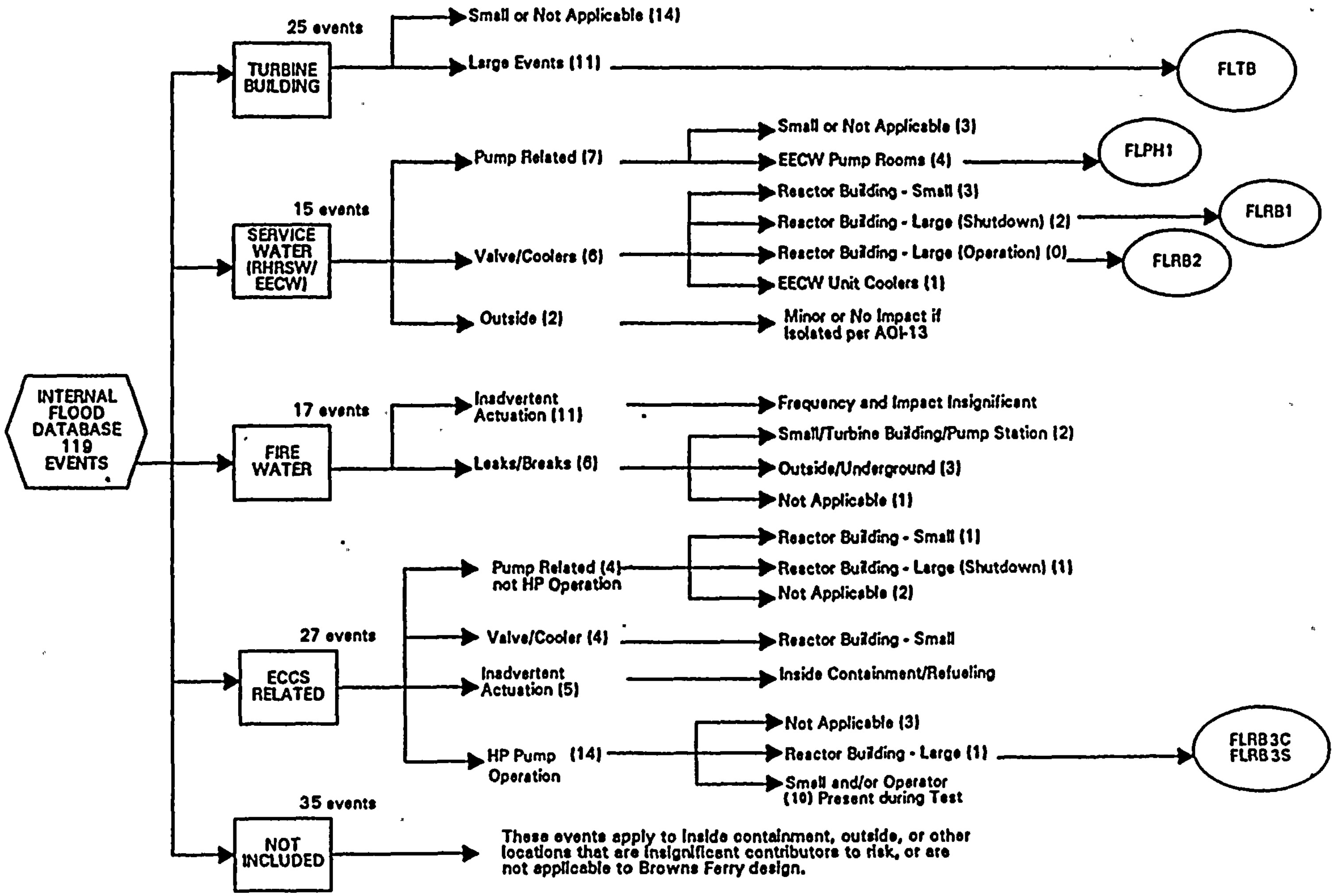

Figure E.1-1 (Page 1 of 2). Screening and Partitioning of Flood Events at Browns Ferry

Description	Number of Events	Events
Turbine Building	25	1, 2, 3, 4, 5, 22, 23, 32, 37, 38, 52, 53, 57, 58, 59, 61, 66, 67, 77, 80, 80(a), 93, 94, 96, 98
Service Water (EECW)	15	9, 10, 11, 14, 16, 17, 26, 31, 34, 36, 47, 49, 50, 62, 107
Fire Water	17	18, 19, 43(a), 60, 97, 102, 103, 105, 109, 110, 111, 112, 113, 114, 115, 116, 117
ECCS Related	27	6, 7, 8, 25, 28, 39, 40, 41, 42, 43, 46, 48, 54, 55, 63, 70, 75, 78, 79, 84, 88, 89, 90, 91, 92, 101, 108

Figure E.1-1 (Page 2 of 2). Screening and Partitioning of Flood Events at Browns Ferry

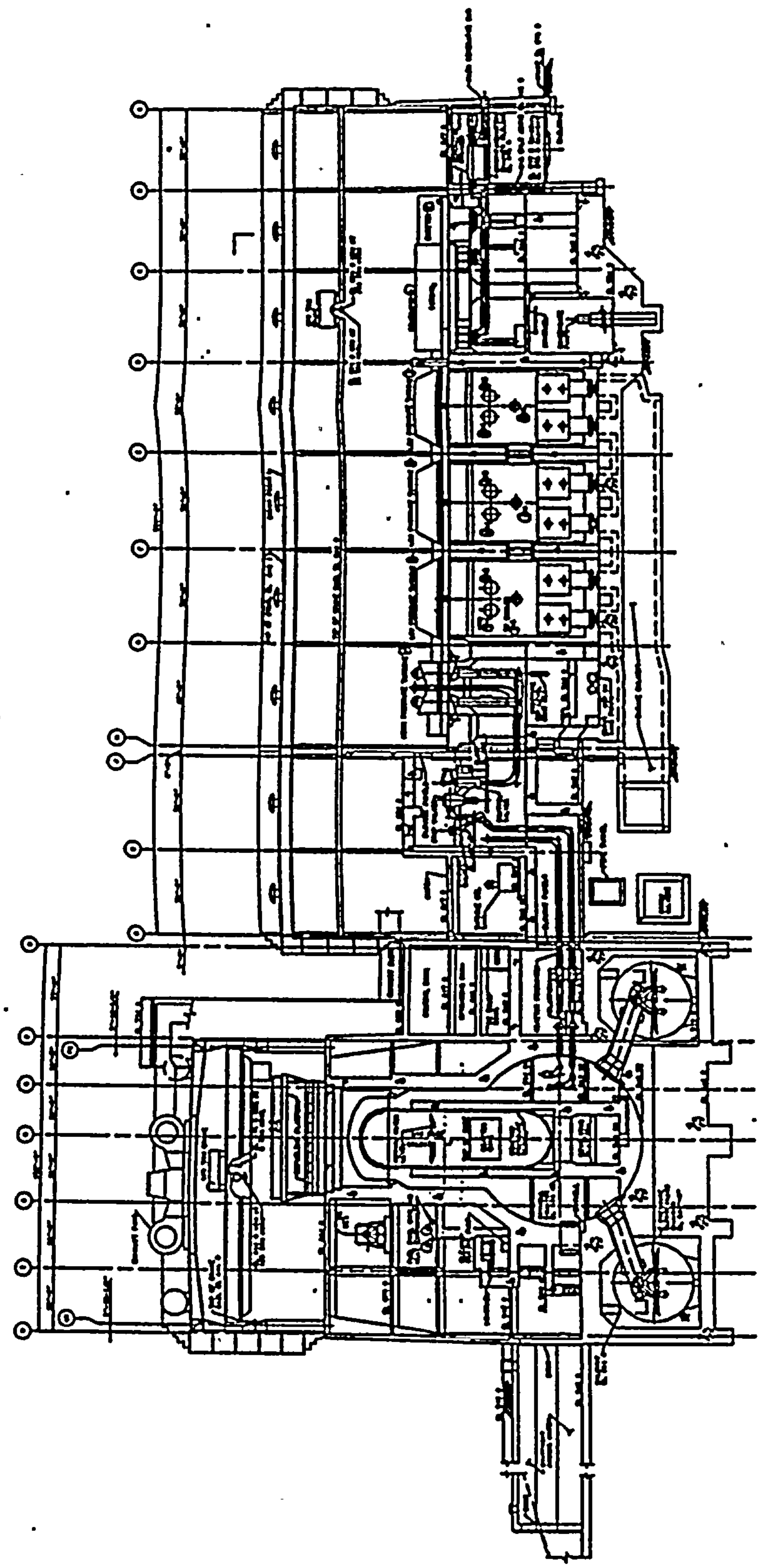

Figure E.1-2. Equipment Longitudinal Section

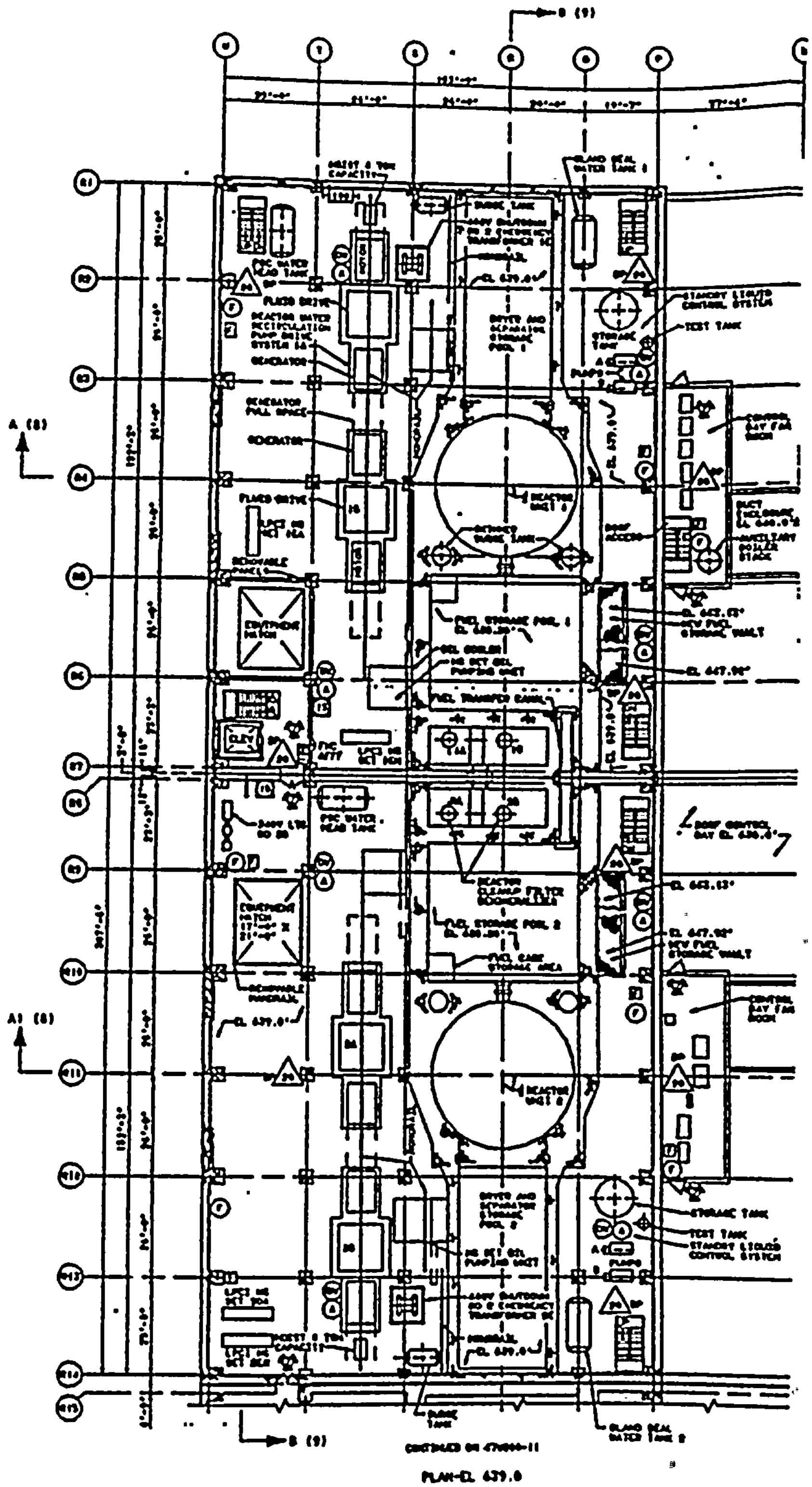

Figure E.1-3 (Page 1 of 2). Reactor Building, Elevation 639'

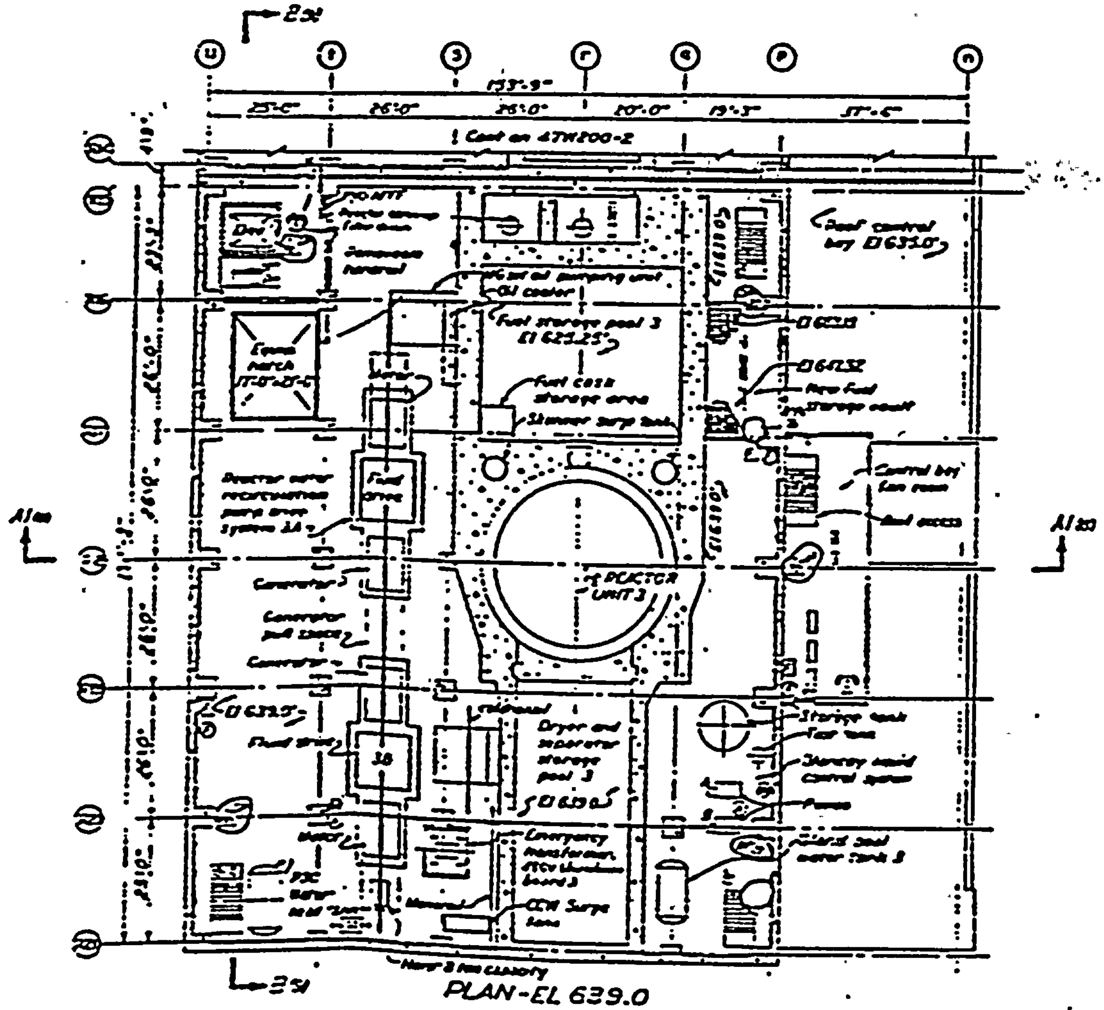

Figure E.1-3 (Page 2 of 2). Reactor Building, Elevation 639'

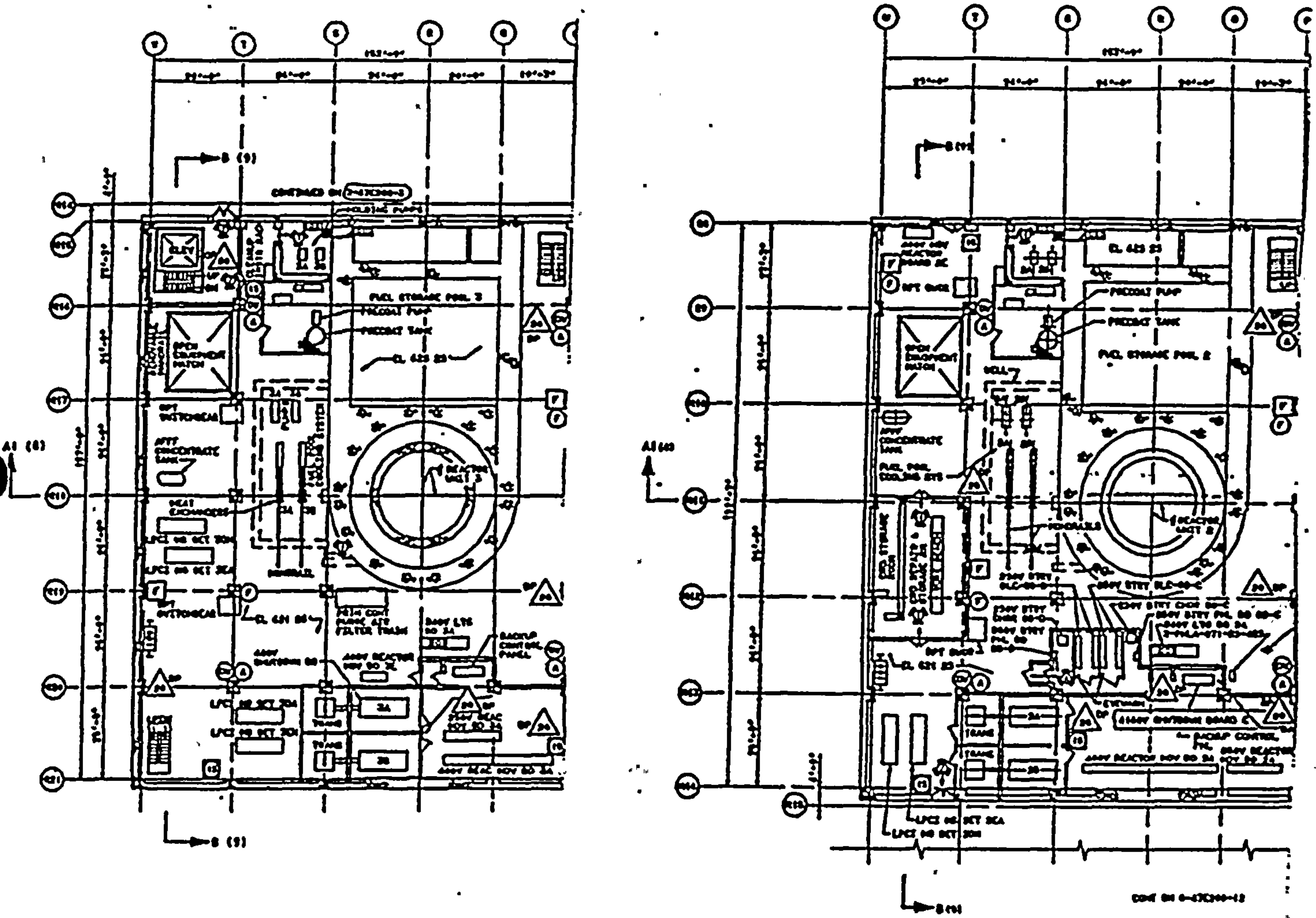

Figure E.1-4 (Page 1 of 2). Reactor Building, Elevation 621'

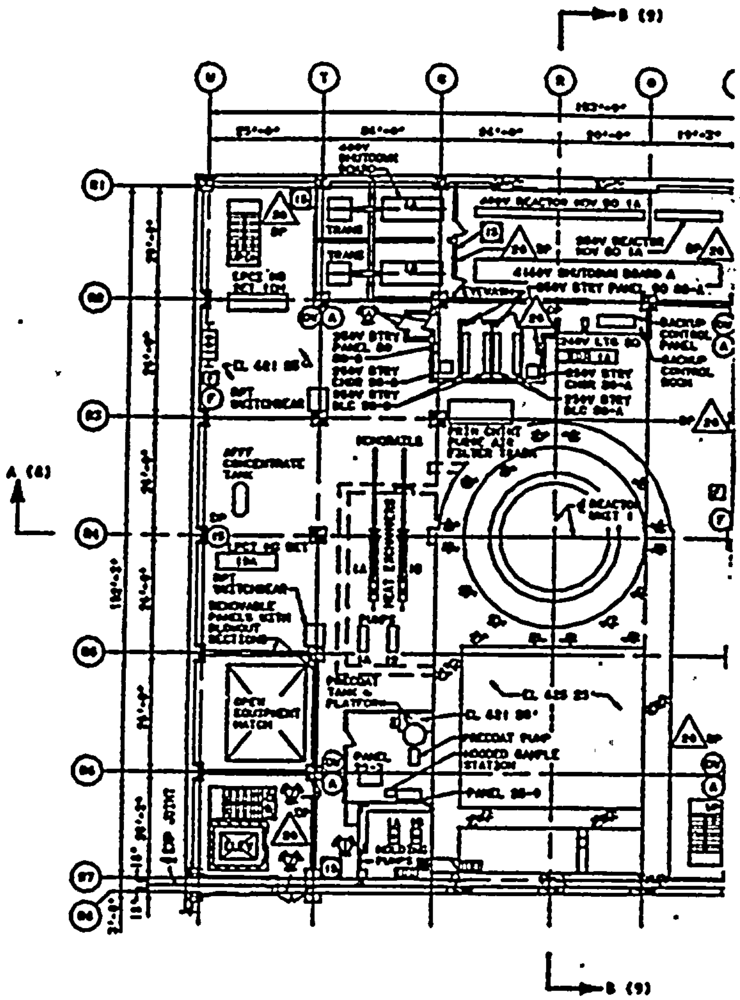

Figure E.1-4 (Page 2 of 2). Reactor Building, Elevation 621'

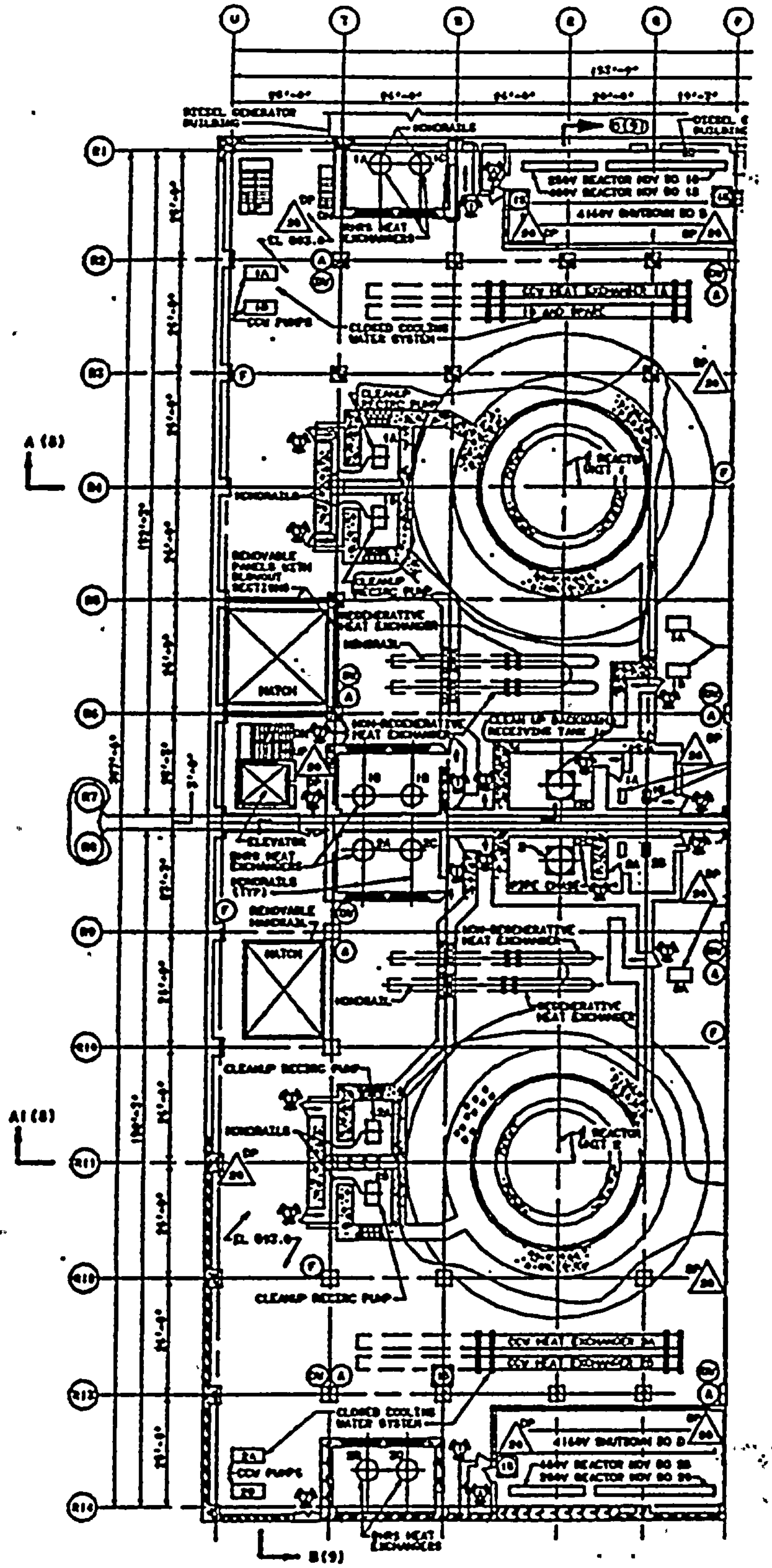

Figure E.1-5 (Page 1 of 2). Reactor Building, Elevation 593'

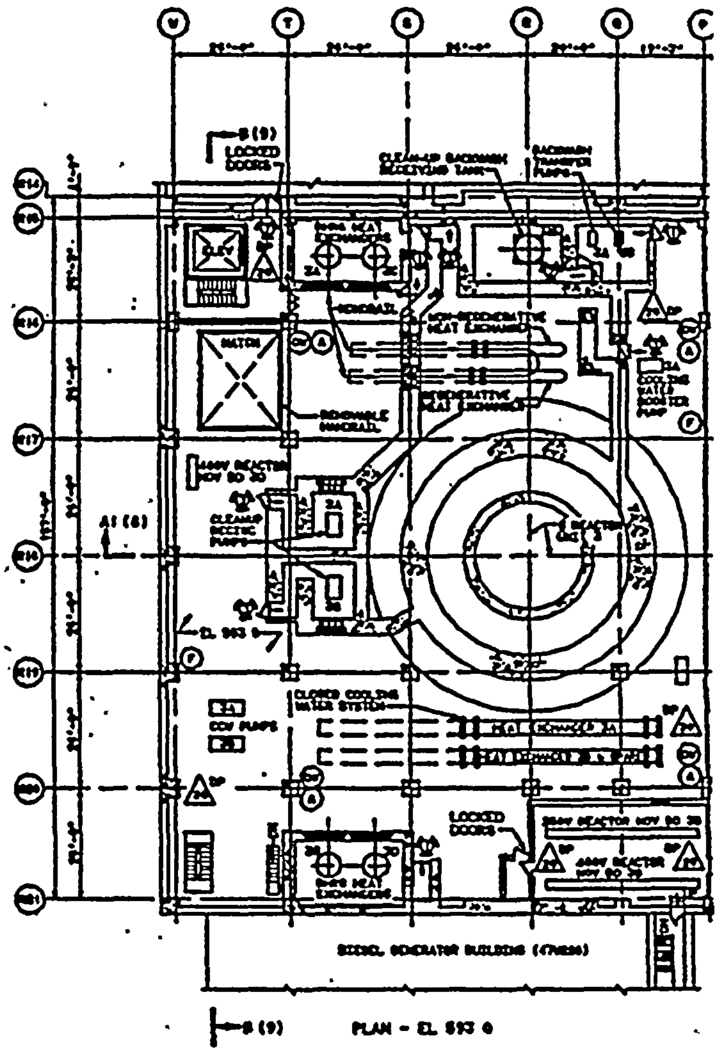

Figure E.1-5 (Page 2 of 2). Reactor Building, Elevation 593'

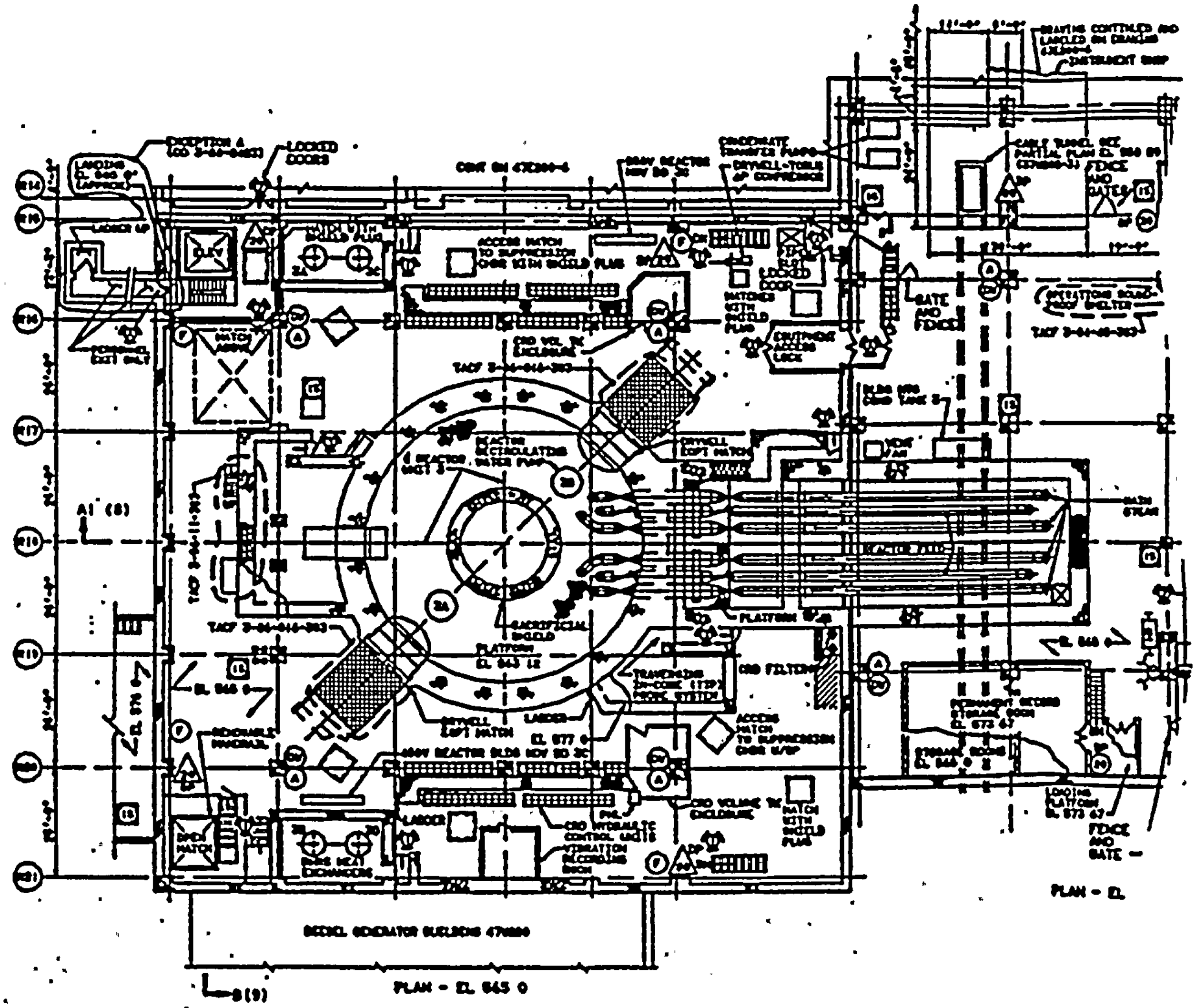

Figure E.1-6 (Page 1 of 2). Reactor Building, Elevation 565'

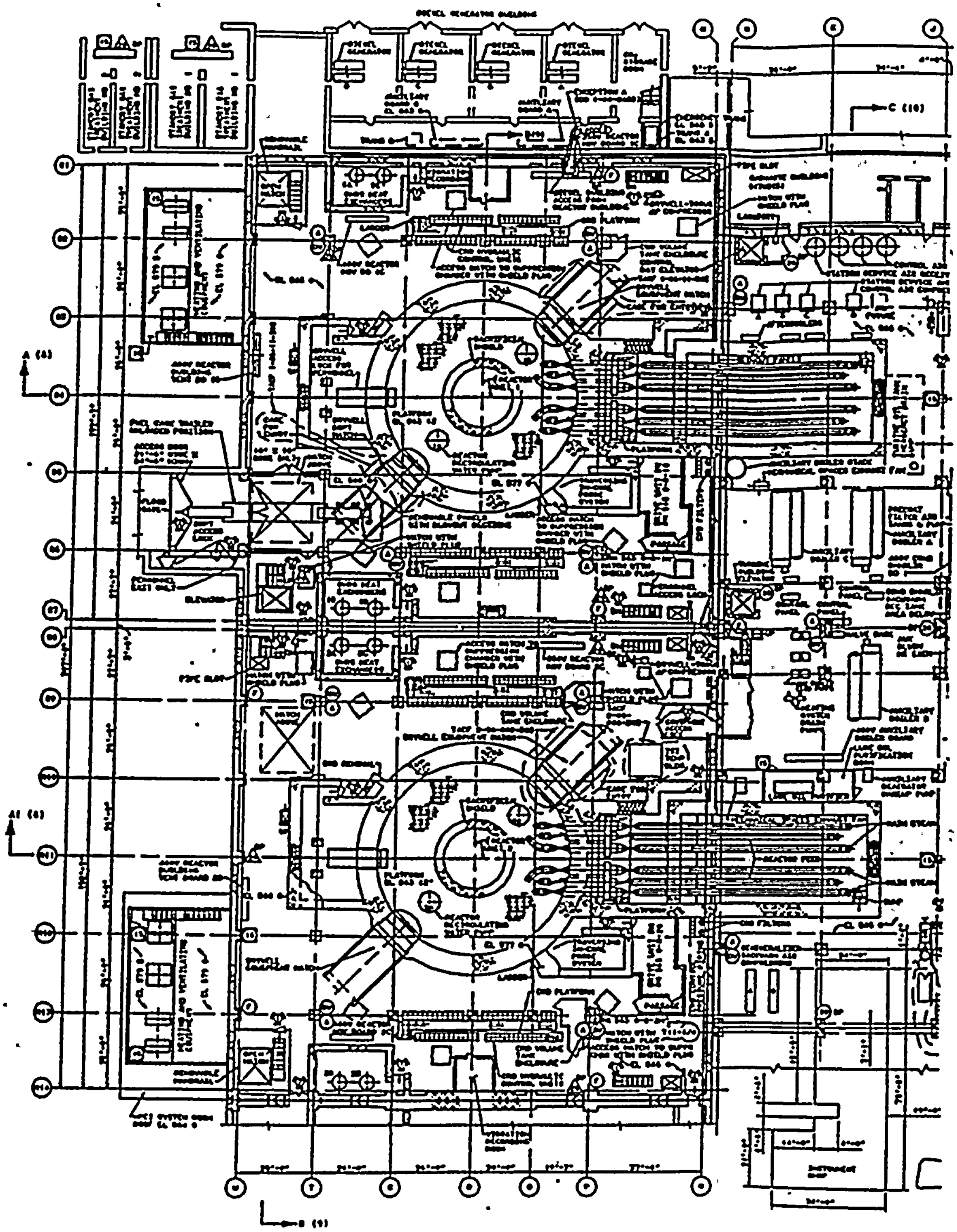

Figure E.1-6 (Page 2 of 2). Reactor Building, Elevation 565'

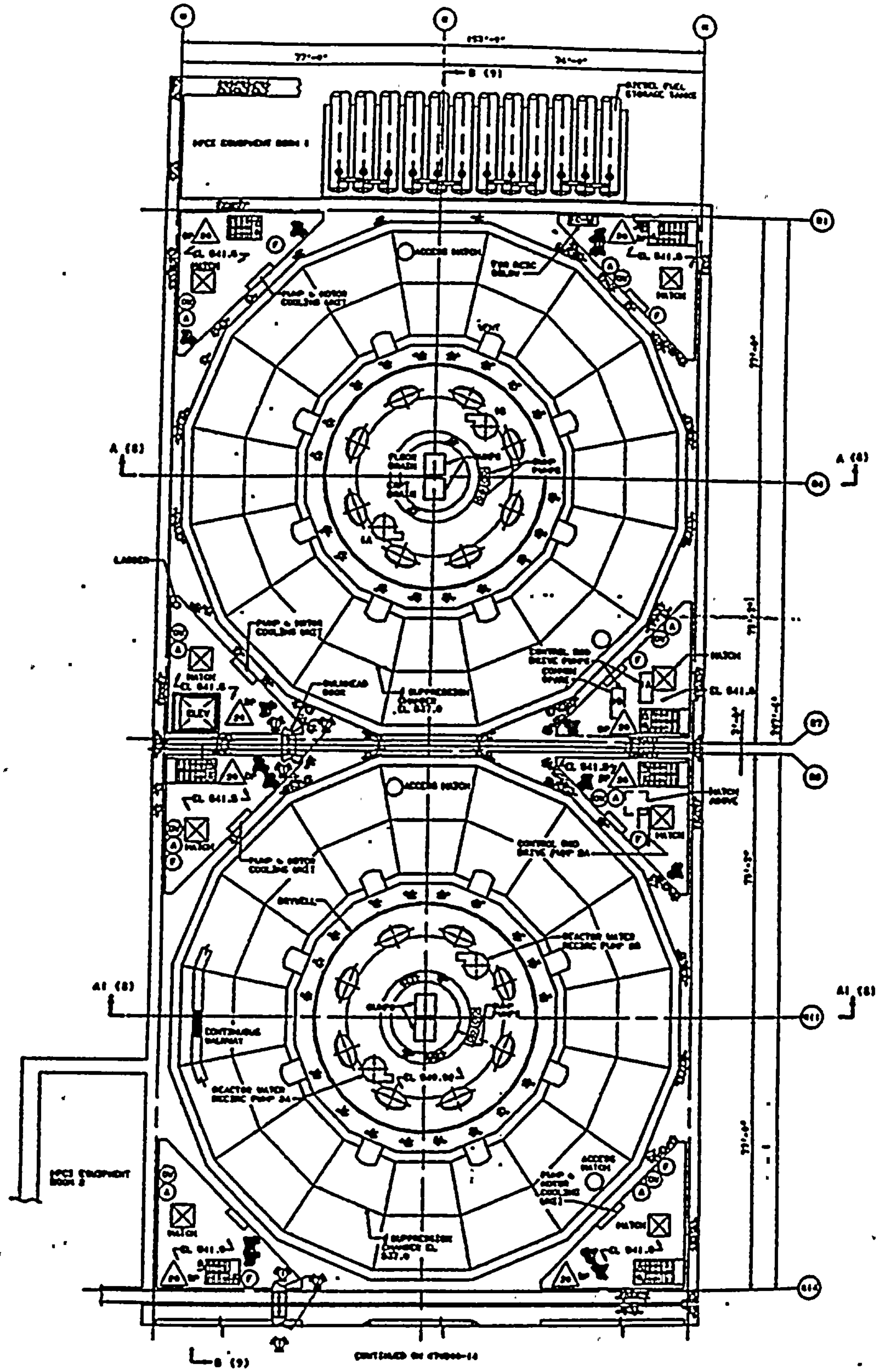

Figure E.1-7 (Page 1 of 2). Reactor Building, Elevation 541'

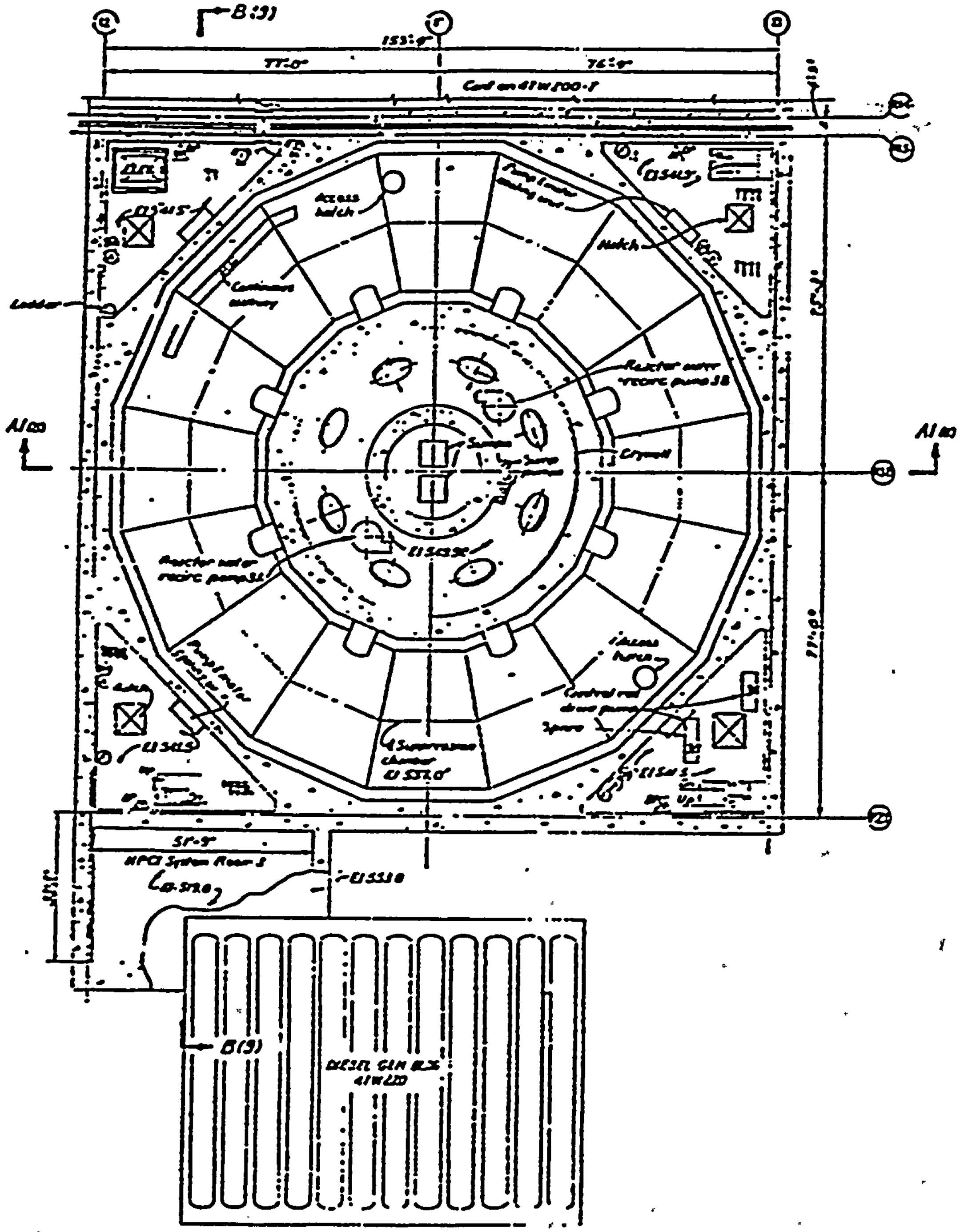

Figure E.1-7 (Page 2 of 2). Reactor Building, Elevation 541'

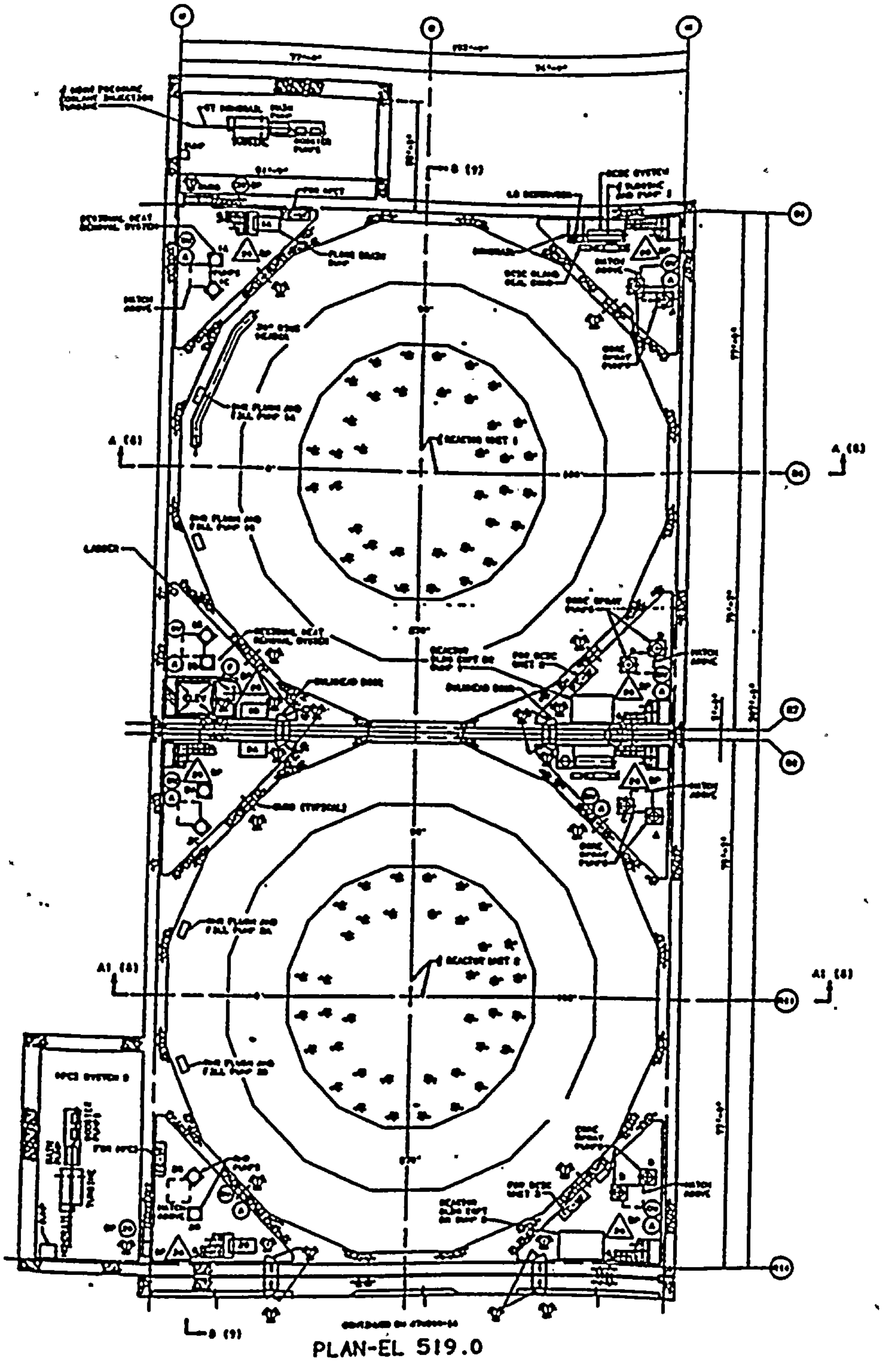

Figure E.1-8 (Page 1 of 2). Reactor Building, Elevation 519'

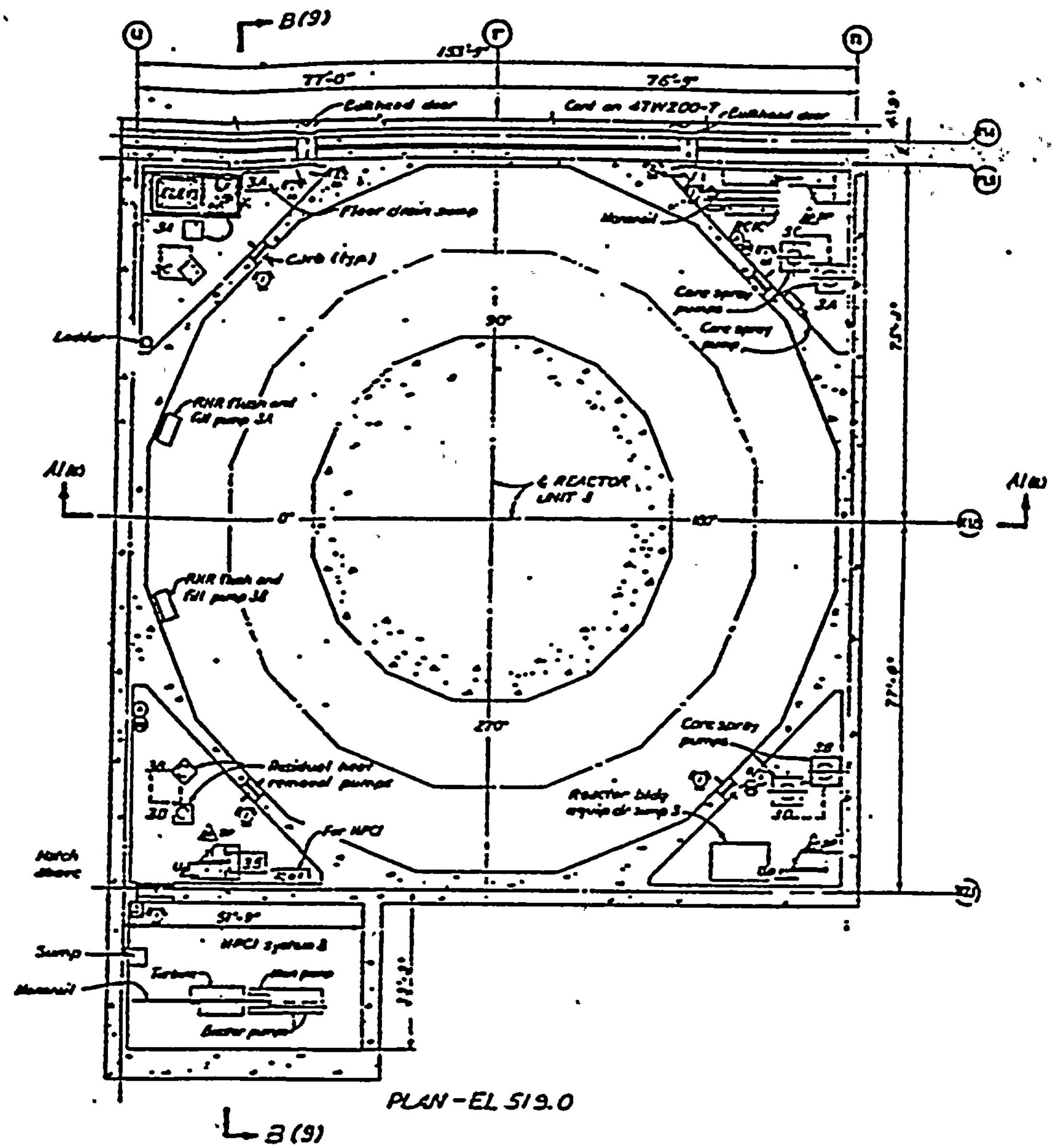

Figure E.1-8 (Page 2 of 2). Reactor Building, Elevation 519'

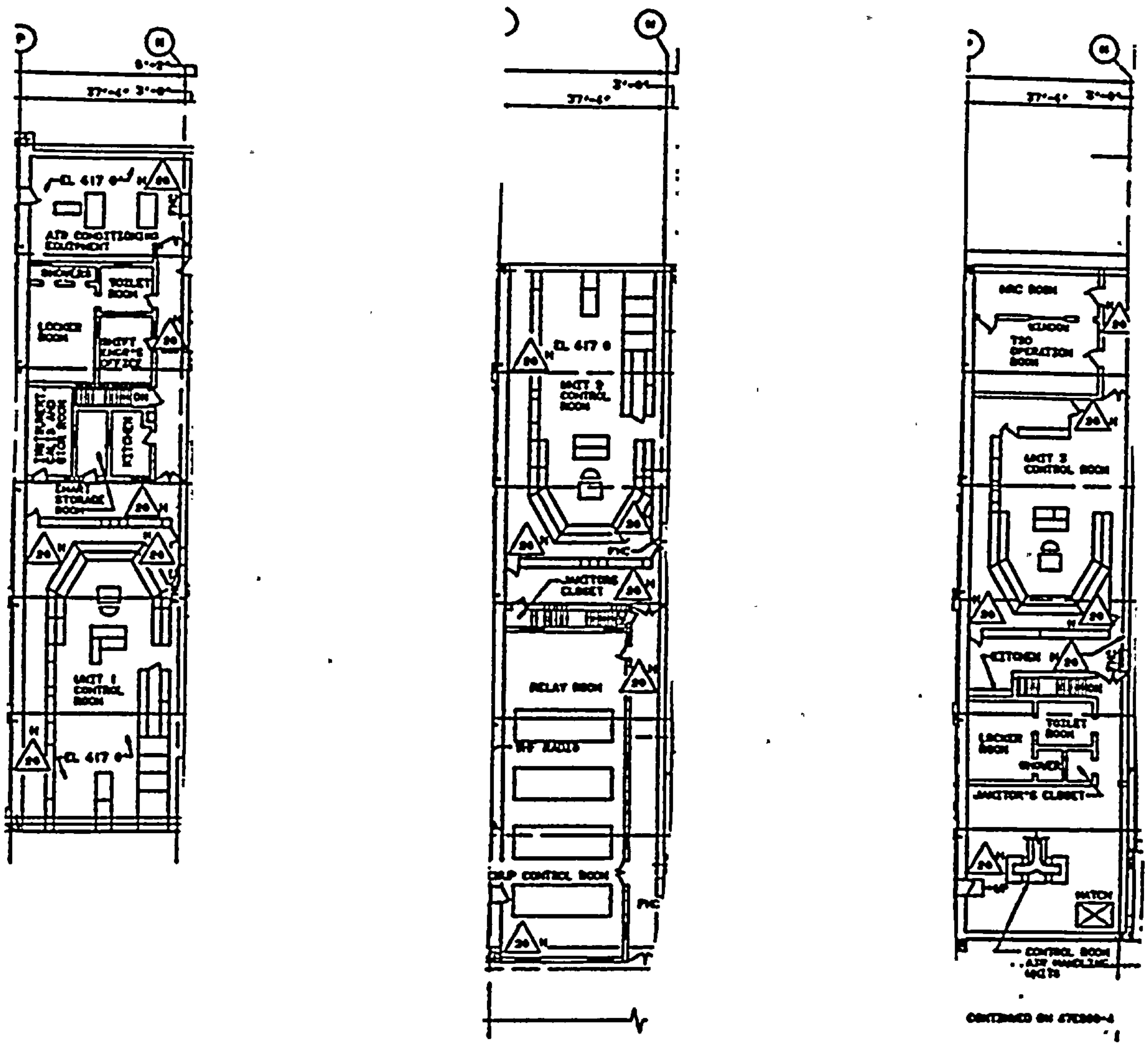

Figure E.1-9. Control Bay, Elevation 617'

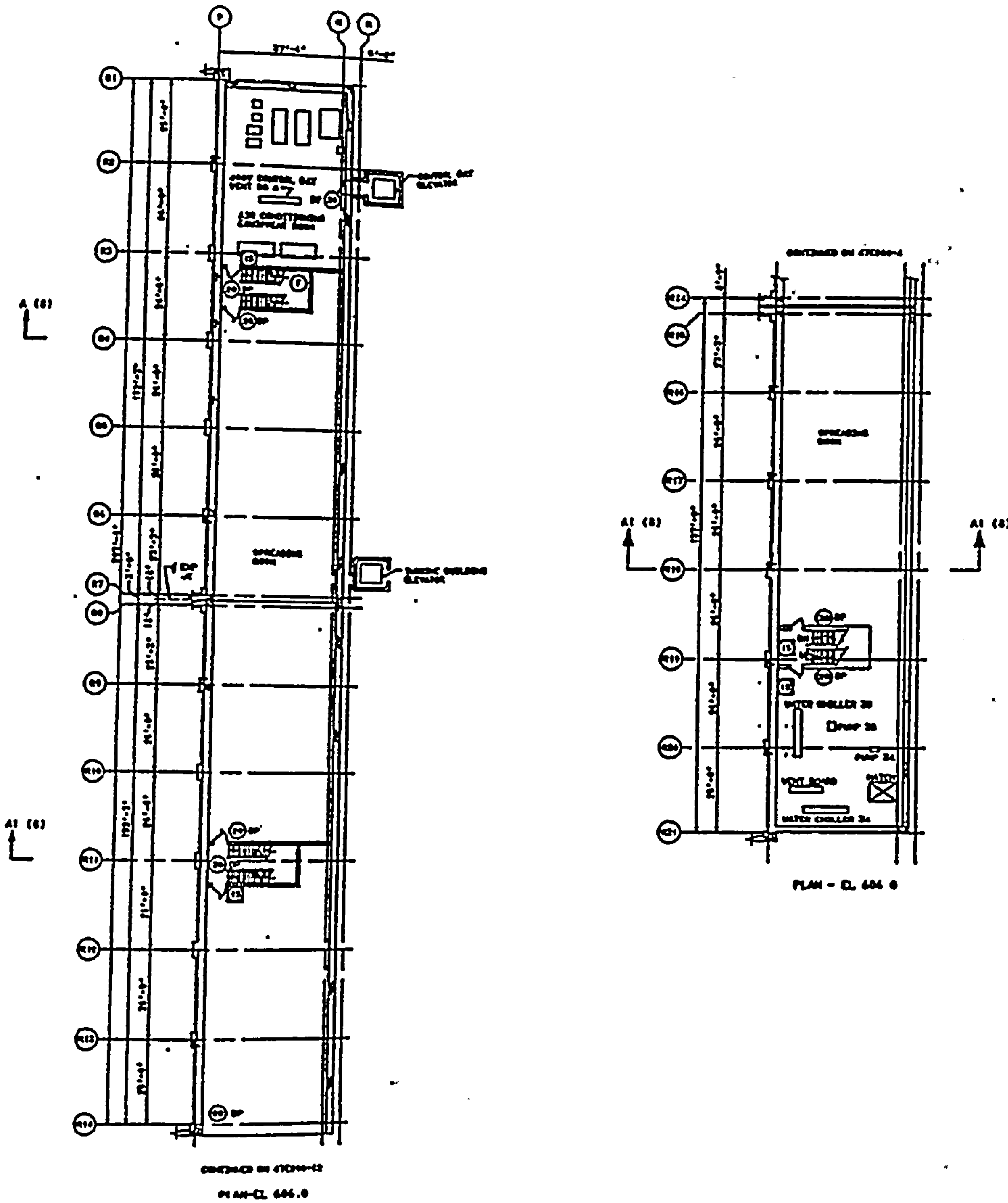

Figure E.1-10. Control Bay, Elevation 606'

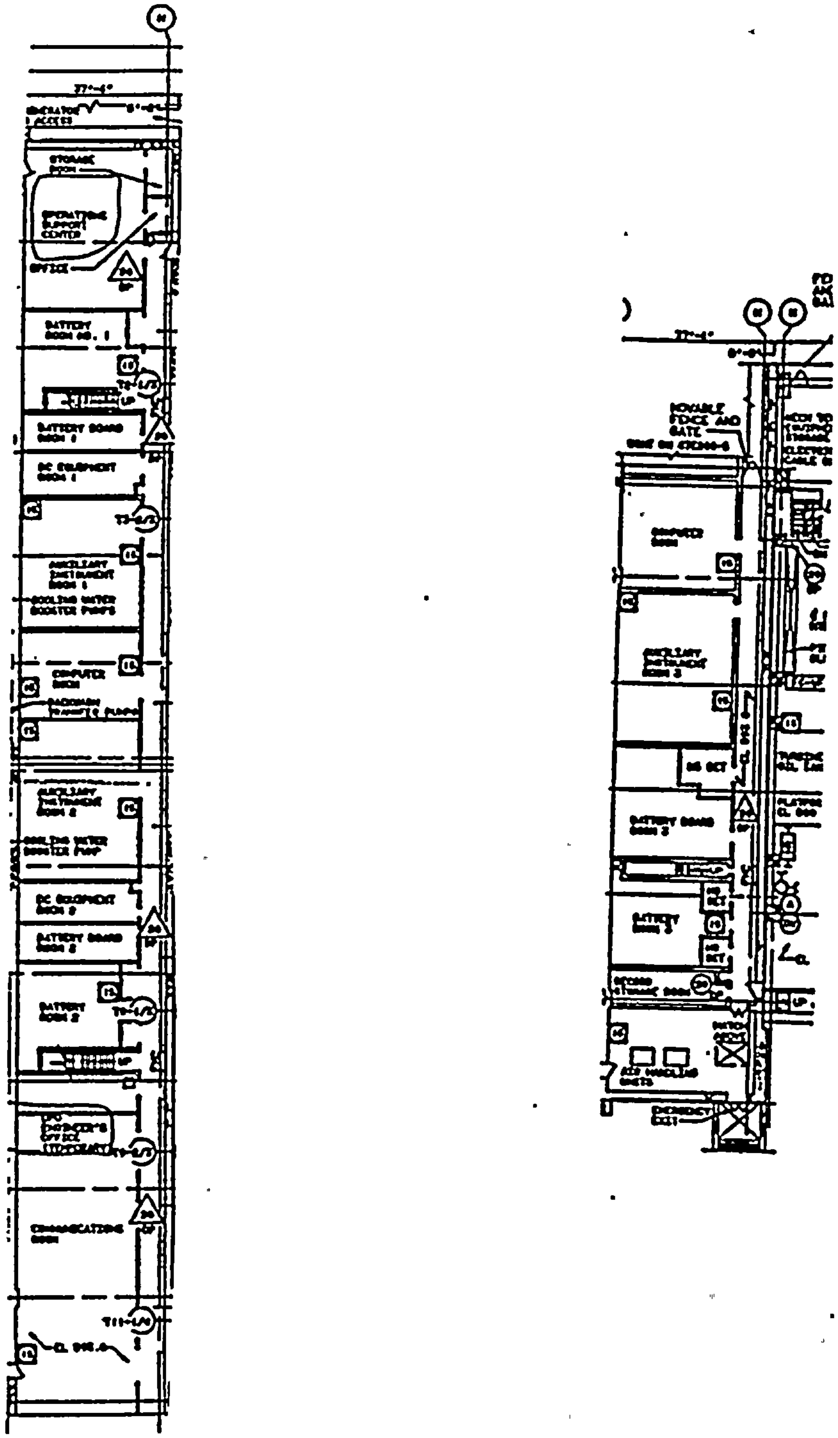

Figure E.1-11. Control Bay, Elevation 593'

E.2 BROWNS FERRY INTERFACING SYSTEMS LOCA EVALUATION

E.2.1 INTRODUCTION AND SUMMARY

An interfacing system loss of coolant accident (LOCA) is potentially initiated by the failure of the pressure boundary separating the reactor vessel from system components of lower design pressures. These interfaces are potentially important to risk because the low pressure system rupture results in the unavailability of the same systems that are used to mitigate the event. In addition, primary containment is bypassed and if core damage occurs, radioactive releases bypass the primary containment.

This interfacing LOCA evaluation includes the identification and quantification of interfacing system LOCA initiating events, an assessment of low pressure system failure modes and their probabilities, and an accident sequence analysis, which considers operator and equipment response to these failures.

The following summarizes the procedure used to conduct this evaluation:

- Interfacing LOCA initiating event paths were identified. Primary containment penetrations that connect to the reactor vessel were screened to identify low pressure system interfaces. This screening and the identification of interfacing LOCA initiating event paths are described in Section E.2.2.

- Initiating event models were developed and quantified for each interfacing LOCA path. Section E.2.3 describes the development of these models, and Section E.2.6 describes their quantification.

- For each interfacing LOCA path, an overpressurization analysis of the interfacing low pressure system is performed. Component materials, thickness, and their design pressures and temperatures are determined to evaluate failure modes in the low pressure system and their probabilities. Relief valves are identified, and their setpoints, capacities, and discharge paths are determined. The results of this analysis are used in the accident sequence and plant response analysis. The evaluation of low pressure systems design is presented in Section E.2.4.

- An accident sequence analysis incorporates the above evaluations and further evaluates operator response and systems that can be used to recover from an interfacing LOCA initiating event. This analysis includes consideration of plant response for a spectrum of interfacing LOCAs and the operator interface with procedures. The accident sequence analysis is provided in Section E.2.5.

- Accident sequence quantification and results are described in Section E.2.6.

NRC guidance states that bypass scenarios with frequency greater than 1×10^{-8} be identified.

E.2.2 IDENTIFICATION OF INTERFACING SYSTEMS LOCA PATHS

As described previously, an interfacing LOCA is initiated by failures of the pressure boundary separating the nuclear boiler from low pressure systems, which, in turn, are partially located outside the primary containment. Therefore, by definition, an interfacing LOCA path must penetrate the primary containment and connect to the reactor vessel. Penetrations are identified by reviewing the Final Safety Analysis Report (FSAR) listing of primary containment penetrations (Reference E.2-1) and the systems flow diagrams, which are also identified in Reference E.2-1. The primary containment penetrations that connect to the reactor vessel and that are greater than 1 inch in diameter are listed in Table E.2-1. Although the control rod drive inlets and outlets are 1 inch and ¾ inch in diameter, respectively, these penetrations are considered as possible interfacing LOCA initiators because there are 185 inlet and outlet lines each. Section E.2.2.1 discusses the potential importance of these paths.

E.2.2.1 Scram Discharge Header LOCA

Scram inlet penetrations (X-37, 185 one-inch lines) (Reference E.2-2) are downstream of the control rod drive (CRD) pumps, which normally continue to operate and inject to the RPV through the CRD seals after a scram. This piping is high pressure design and relatively small diameter. In addition, each of the 185 inlet paths has a check valve prior to its scram inlet valve outside primary containment. The scram inlet valves close after the scram is reset by the operators (if the scram signal can be reset). For a LOCA outside containment to occur, the high pressure piping in the CRD pump discharge header would have to fail and several of the 185 one-inch check valves would have to fail to close to cause a significant leak outside primary containment. The frequency and consequences of the LOCA are judged to be enveloped by the scram outlet paths described below.

Scram outlet penetrations (X-38, 185 3/4" lines) discharge to the east and west discharge headers on Elevation 565' in the reactor building. There is one scram outlet valve in each line outside primary containment that closes after the scram is reset by the operators. There are vents on the scram discharge headers and drains on the instrument volumes. These vent and drain paths have redundant isolation valves to prevent leakage from the reactor protection vessel (RPV) after a scram. The system is designed to reactor operating pressure up to and including the isolation valves. Two types of scenarios can be postulated to address a LOCA outside primary containment:

- Pipe break in the scram discharge volume after a scram. Note that, during normal operation prior to scram, the scram discharge volume is at atmospheric pressure.
- One of four vent and drain paths fails to isolate after a scram.

The first scenario appears to be unlikely because of the low frequency of pipe rupture on demand and during the short duration after scram when the reactor is still at high pressure. This scenario was evaluated by the U.S. Nuclear Regulatory Commission (NRC) in NUREG/CR-2672 and NUREG-0803 (References E.2-3 and E.2-4). The Tennessee Valley Authority (TVA) performed a plant-specific analysis (Reference E.2-5) based on NUREG-0803 (Reference E.2-4) and General Electric NEDO-24342 (Reference E.2.6). These analyses considered environmental impacts on equipment in the reactor building, alarms and indications associated with operators diagnosing the LOCA outside primary containment, and operator responses to mitigate the accident. The TVA analysis estimated the probability of core damage at approximately 1.5×10^{-9} per year, and the NRC conservatively estimated the frequency at less than 1×10^{-6} per year. After these analyses were performed, Emergency Operating Instructions for secondary containment control (2-EOI-3, Reference E.2-7) were developed; they require the operators to emergency depressurize the RPV based on high temperature, level, or radiation in the reactor building. Thus, if a normal shutdown after scram does not reduce the leak significantly and in time, the reactor building temperature alarms and/or flood alarms would provide another requirement to depressurize (emergency depressurization) the RPV and to reduce the leakage outside primary containment. The present procedures provide an improvement from what was available when these earlier analyses were performed.

The following summarizes the analyses:

- Initiating event frequency is less than 1×10^{-4} per year.

- The possibility of scram reset closing the scram outlet valves and eliminating the LOCA was considered. The analyses recognized that some scrams cannot be reset easily.

- A total leakage of 550 gpm from 185 seals was used. Reactor building environmental response was considered. The environmental effects are bounded by the maximum reactor building temperature postulated for the environmental qualification program. Flooding takes significant time to jeopardize operation of core spray, residual heat removal (RHR), high pressure coolant injection (HPCI), or reactor core isolation cooling (RCIC) pumps at Elevation 519'.

- Manual isolation at the CRD mechanisms was considered, but little credit was given due to environmental conditions (operator accessibility).

- Cooldown and depressurization is the most likely action after a scram, which reduces the LOCA (leakage) and consequences outside primary containment.

Based on these earlier analyses and today's improved Emergency Operating Instructions, the risk from pipe rupture in the scram discharge volume is judged to be very low. An initiating event frequency of 1×10^{-4} per year in combination with a conservative estimate of the unreliability of the operators or equipment at 1×10^{-3} would set core damage frequency at approximately 1×10^{-7} per year. This is considered to be a conservative estimate.

It appears that the second scenario (scram discharge volume isolation failure) has not previously been evaluated. The frequency and consequences of this scenario are investigated to determine its relative importance to the pipe rupture scenario.

The east and west scram discharge headers in the reactor building are cross connected (1-inch line), and each header vents to clean radwaste (CRW) drains through redundant air-operated valves (AOV). These valves that fail closed on loss of air and isolation signals are from the reactor protection system, which is fail safe position. The following summarizes the discharge volume vent isolation valves:

Discharge Header	Redundant Valves	Line Size
East Vent	FCV 85-83 and FCV 85-83A	2 inches
West Vent	FCV 85-82 and FCV 85-82A	2 inches

The scram discharge headers drain to the east and west instrument volumes, which drain to CRW through redundant AOVs. These valves fail closed on loss of air and isolation signals are from the reactor protection system, which is the fail safe position. The following summarizes the instrument volume drain isolation valves:

Instrument Volume	Redundant Valves	Line Size
East Drain	FCV 85-37E and FCV 85-37F	1.5 inches
West Drain	FCV 85-37C and FCV 85-37D	1.5 inches

Failure of any one of the above vent and drain paths from the discharge headers and instrument volumes results in reactor coolant leakage to the reactor building equipment drain sump 2, which is located in the reactor building northeast corner room on Elevation 519′. Core spray pumps B and D are located in this corner room.

The following summarizes the location of core spray, RHR, HPCI, and RCIC, all located at Elevation 519′:

Reactor Building Corner Room	Equipment
Northeast	Core Spray B and D, and Equipment Drain Sump 2
Northwest	Core Spray A and C, and RCIC
Southeast	RHR B and D, and HPCI and Floor Drain Sump 2B
Southwest	RHR A and C, and Floor Drain Sump 2A

Indications to the operators that a discharge header or an instrument volume is unisolated include high room temperature alarms, sump alarms, and flood alarms at Elevation 519′. The response is very similar to a pipe break on Elevation 565′ except that the LOCA is to the equipment drain sump on Elevation 519′ rather than to the floor drain sumps. The temperatures should be slightly higher on Elevation 519′ compared with the pipe break scenario, and the opportunity for manual isolation at the CRD mechanisms should be better as the environmental conditions are less severe at the CRDs.

The frequency of a LOCA outside primary containment due to scram discharge volume isolation failure can be estimated as follows:

ISOL = SCRAM*(4*AOV*AOV)

where "SCRAM" is the frequency of scrams per year, and "4*AOV*AOV" is the four combinations of isolation valve failures on demand that cause a LOCA to the CRW.

If three scrams per year are assumed (see Section 3.1.1; the generic number of scrams per year is on the order of 2.5) and if AOV = 2.66×10^{-4} (data variable ZTVAOF), ISOL is calculated to be 8.5×10^{-7} per year if common cause failure of the valves is neglected. Common cause data for the failure mode "air-operated valves failing to transfer the failed position" are not available. If a common cause beta factor of 0.07 is used (data variable ZBVAOD, representing air-operated valves failing on demand), ISOL is calculated to be 2.2×10^{-4} per year.

The above indicates that the initiating event frequency is low, there is sufficient time for operator response with minor consequences, and operator response procedures adequately address these scenarios. Thus, the risk from these scenarios is judged to be small compared with other scenarios considered in the PRA.

E.2.2.2 Other Potential LOCAs

A screening evaluation of the remaining penetrations in Table E.2-1 determines the paths to include as initiating events in the interfacing LOCA model. This screening evaluation is also documented in Table E.2-1. The purpose of the screening is to identify the most risk-significant paths to the model, recognizing that the other paths would not contribute significantly to risk. To make this judgment, the paths chosen will be the more likely initiating event paths and have the more significant impact on mitigating systems located outside primary containment, i.e., RHR and core spray system failures. The following summarizes the design features considered in the screening evaluation:

- Design and operating pressure of systems and components outside primary containment.
- The number, type, and normal position of isolation valves between the reactor vessel and the lines leading outside primary containment.
- Pipe diameter of path.
- Potential consequences from failure of valves in the path and/or from pipe failure outside primary containment.

A positive combination of two or more of the above design features will usually justify a judgment of low risk. For example, a small line outside primary containment would only lead to a small LOCA, and the consequences on mitigating systems would be minimal. Clearly, the penetrations chosen as most important interfacing LOCA paths do not satisfy positive aspects of the above design features. For example, the low pressure injection paths have large pipe diameters, there are two isolation valves in series that isolate the low pressure design outside primary containment, and the potential consequences include failure of equipment in the reactor building due to degraded environmental conditions.

Based on the above evaluation, the following interfacing LOCA paths are identified and analyzed further:

- **Core Spray Injection Lines.** There are two interfacing LOCA paths. Each path has one check valve and one motor-operated (MOV) in series (FCVs 75-26 and 75-25, and FCVs 75-54 and 75-53, respectively). Figure E.2-1 shows only one of the paths (division B). Except for valve numbers, the other core spray path (division A) is identical to that shown in Figure E.2-1.

- **Residual Heat Removal Injection Lines.** There are two interfacing LOCA paths; each path has one check valve and one MOV in series (FCVs 74-54 and 74-53, and FCVs 74-68 and 74-67, respectively). Figure E.2-2 shows only one of the paths (division B). Except for valve numbers, the other RHR injection path (division A) is identical to that shown in Figure E.2-2.

- **Residual Heat Removal Shutdown Cooling Suction Line.** As shown in Figure E.2-3, there are two normally closed, motor-operated valves (FCVs 74-47 and 74-48) in this path.

The following interfacing LOCA initiating events are defined to represent the above paths:

- VI. An interfacing LOCA initiated by one of the two core spray injection paths due to equipment failure.

- VITM. An interfacing LOCA initiated by one of the two core spray injection paths due to test and/or maintenance activities.

- VR. An interfacing LOCA initiated by one of the two RHR injection paths due to equipment failure.

- VRTM. An interfacing LOCA initiated by one of the two RHR injection paths due to test and/or maintenance activities.

- VS. An interfacing LOCA initiated by the RHR suction path. Since testing and/or maintenance is not conducted on the RHR suction valves during operation, only a LOCA due to equipment failure is considered.

Because of actual precursor events described in the next section, VITM and VRTM are explicitly modeled rather than combined with VI and VR.

Given the identification of interfacing LOCA initiating event paths, the next steps are to establish failure modes for each initiating event and to collect more detailed design information on each low pressure system path outside primary containment. This is described further in Sections E.2.3 and E.2.4. The failure models and data developed in Section E.2.3 establish the initiating event portion of the model. The more detailed design information and overpressure analysis described in Section E.2.4 support the event sequence analysis tasks.

E.2.3 INITIATING EVENT MODELS AND DATA

E.2.3.1 Valve Leakage Events

An interfacing LOCA can be initiated by a spectrum of leakage events that range from a small leak that exceeds the capacity of the relief valves in the low pressure system to the catastrophic failure of a valve, which structurally challenges the interfacing low pressure system.

Figure E.2-4 presents the frequency of exceeding check valve leakage rates from industry experience. These experience data were developed from a review of check valve failure events in U.S. light water reactors during the period 1972 through 1984 as reported in *Nuclear Power Experience* (Reference E.2-8 as described in Reference E.2-12). Among the several hundred check valve failures identified, only those that are initially seated and testable were considered to be the most relevant for the valves considered here. No disc rupture event was identified, and the maximum leak rate observed was 200 gpm.

Table E.2-2 contains nine boiling water reactor (BWR) events (Reference E.2-9) that could be considered as precursors to an interfacing LOCA. These events are considered in developing the test and maintenance contribution to the interfacing LOCA initiating events.

A total exposure time of 1×10^8 check valve hours was estimated by counting the number of check valves in power plants in the database of the low pressure systems (Reference E.2-10). A best line fit to the data was obtained using Bayesian regression techniques (Reference E.2-11), and it is presented along with the calculated bounds at 90% confidence in Figure E.2-4 (see Reference E.2-12).

From the data in Figure E.2-4, the frequency of random valve disc failures resulting in different leakage rates can be obtained as input to the initiating event quantification.

E.2.3.2 Initiating Event Failure Models

As described in Section E.2.2, interfacing LOCA initiating events are caused by failure of two valves in series, allowing the nuclear boiler to pressurize the lower pressure system outside primary containment. In general, the frequency of failure of two valves, V_1 and V_2, in series can be expressed as (Reference E.2-12):

$$\lambda_{V\text{-}V} = \lambda(V_1)^*P(V_2|V_1) + \lambda(V_2)^*P(V_1|V_2) \qquad \text{(E.2.1)}$$

where

$\lambda_{V\text{-}V}$ = the failure frequency of two valves in series.
$\lambda(V_1)$ = the independent failure frequency of V_1.
$\lambda(V_2)$ = the independent failure frequency of V_2.
$P(V_2|V_1)$ = the conditional failure frequency of V_2, given that V_1 has failed.
$P(V_1|V_2)$ = the conditional failure frequency of V_1, given that V_2 has failed.

$\lambda(V_1)$ is not necessarily the same as $\lambda(V_2)$, as the valves experience different operating conditions; for example, valve V_1 experiences a higher differential pressure as it is closer to the reactor vessel. When valve V_1 leaks, the space between the valves, V_1 and V_2, becomes pressurized. If the probability that the space that is between the valves is pressurized to reactor vessel operating pressure is called P_l, Equation (E.2.1) becomes

$$\lambda_{V\text{-}V} = \lambda(V_1)*P(V_2|V_1)*(1-P_l) + \lambda'(V_1)*P'(V_2|V_1)*P_l + \lambda(V_2)*P(V_1|V_2)*(1-P_l) + \lambda'(V_2)*P'(V_1|V_2)*P_l \quad \text{(E.2.2)}$$

where the primes indicate failure probabilities with a pressurized space between the valves. With leakage of valve V_1, the higher differential pressure exists across valve V_2 instead of V_1. Given this fact, the following assumptions are made to simplify Equation (E.2.2):

(a) $\lambda'(V_2) \simeq \lambda(V_1)$

(b) $\lambda'(V_1) << \lambda(V_1)$

(c) $\lambda(V_2) << \lambda'(V_2)$

(d) $P'(V_1|V_2) \sim P(V_2|V_1)$

Assumption (a) states that the failure probability of either valve, given high differential pressure, is approximately equal. Assumptions (b) and (c) state that the failure probability of either valve under low pressure loading is smaller than the failure probability under high pressure loading. Assumption (d) states that the conditional probability of one valve under low pressure loading, given the failure of a valve under high pressure loading, is approximately the same for the pressurized and nonpressurized conditions. Under these assumptions, Equation (E.2.2) becomes:

$$\lambda V\text{-}V = \lambda(V_1)*P(V_2|V_1) + \lambda'(V_1)*P'(V_2|V_1)*P_l + \lambda(V_2)*P(V_1|V_2)*(1-P_l) \quad \text{(E.2.3)}$$

To further simplify Equation (E.2.3), the following assumptions are made:

(e) $\lambda(V_1) >> \lambda(V_2)$

(f) $P(V_2|V_1) \geq P(V_1|V_2)$

(g) $\lambda(V_1)*P(V_2|V_1) > \lambda'(V_1)*P'(V_2|V_1)$

Assumption (e) is the same as assumptions (b) and (c) above; a valve with high differential pressure loading has a higher probability of failure than a valve with low differential pressure loading. Assumption (f) states that the probability of random failure of V_1 contained in $P(V_1|V_2)$ is less than or equal to $P(V_2|V_1)$, which contains the probability of failure of V_2 due to shock impact after V_1 fails as well as the random failure of V_2.

Combining assumptions (e) and (f) results in assumption (g). From the latter assumption, it is a conservative estimate that

$$\lambda(V_1)*P(V_2|V_1) = \lambda'(V_1)*P'(V_2|V_1) \quad \text{(E.2.4)}$$

Following assumptions (e), (f), and (g) and Equation (E.2.4), Equation (E.2.3) can be rewritten as

$$\lambda V\text{-}V = \lambda(V_1)*P(V_2|V_1)*(1+P_l) \qquad (E.2.5)$$

Because only a small amount of leakage is required to pressurize the space between the valves, P_l is conservatively assumed to be equal to 1, and Equation (E.2.5) becomes

$$\lambda_{V\text{-}V} = 2*\lambda(V_1)*P(V_2|V_1) \qquad (E.2.6)$$

Therefore, a conservative expression for the probability of failure of two valves in series is twice the product of the failure probability of a single valve (under high differential pressure) and the conditional failure probability of the second valve, given that the first has failed.

E.2.3.2.1 Failure of One Check Valve and One MOV in Series due to Equipment Failure

Initiating events VI and VR represent failure of one testable check valve and one MOV in any injection line. In these events, V_1 is the check valve, and V_2 is the MOV. The following failure modes apply to the failure of one check valve and one MOV in series due to equipment failure:

1. Rupture of V_1, which goes undetected, and then V_2 ruptures between tests.
2. Rupture of V_1, and then rupture of V_2 on demand.
3. V_1 ruptures, and V_2 spuriously opens.
4. V_1 ruptures, and V_2 position status indicates closed, but V_2 is actually left open after maintenance and/or testing.

The failure mode "check valve stuck open after test" is not considered in this analysis because the testable check valves (75-26, 75-54, 74-54, and 74-68) are seal leak tested during refueling or cold shutdown. The air operator is made inoperable (air removed) during power operation, and relief in testing the check valves from a quarterly time interval to periods of cold shutdown has been granted (Reference E.2-13). The core spray and RHR MOVs are tested quarterly per Surveillance Instructions 2-SI-4.5.A.1.C(I)/(II) and 2-SI-4.5.B.1.C(I)/(II).

A spurious actuation failure mode is not considered for the testable check valves because they cannot open under reactor pressure and air is normally disconnected from these valves, and can only be reconnected when primary containment is deinerted (Reference E.2-14). The spurious actuation failure mode for the MOVs includes spurious signals as well as operator error during testing. The expression for the probability of failure of two valves in series was given in Equation (E.2.6). The term $P(V_2|V_1)$ in this equation contains four components: failure modes 1 through 4 above. To derive an expression for Equation (E.2.6) in terms of known failure frequencies, the frequency of failure mode 1, random valve failure, will be determined first.

As shown in Section 6.6 of the Seabrook Station Probability Safety Assessment (Reference E.2-15), the determination of the frequency of occurrence of random failures may be accomplished by assuming that the two series valves in each path represent a standby redundant system and that failure of the downstream valve cannot occur until failure of the valve with the high differential pressure loading has occurred. The probability of random failure (unreliability) for a single injection path is given by

$$Q_{path} = 1 - e^{-\lambda(V1)t}(1 + \lambda(V_1)t) \tag{E.2.7}$$

In this analysis, $\lambda(V_1)$ is the failure frequency of exceeding leakages greater than or equal to the relief valve capacity. This expression is then used to derive a failure (hazard) rate for the path:

$$\lambda_{path}(t) = -1/(1 - Q_{path}) * d/dt[1 - Q_{path}] \tag{E.2.8}$$

or, substituting using Equation (E.2.7)

$$\lambda_{path}(t) = \lambda(V_1)/(1 + 1/\lambda(V_1)t) \tag{E.2.9}$$

Since the MOVs are tested quarterly, the check valves are tested at cold shutdown (18 months), and RHR check valve leakage is not detected during MOV testing, the time-dependent failure rate, Equation (E.2.9), is bounded by an 18-month exposure time T_e (hours). Therefore, Equation (E.2.9) is integrated over a time T (18 months) to obtain the average failure rate over 18 months.

$$\lambda_{path}(\text{per 18 months}) = [\lambda(V_1)T_e - \ln(1 + \lambda(V_1)T_e)]/T_e$$

where T_e = 18 months. (E.2.10)

When $\lambda(V_1)T_e << 1$, this result can be expanded using a limiting procedure to obtain

$$\lambda_{path}(\text{per year}) = \lambda^2(V_1)T_e^2/(2 * T_e) \tag{E.2.11}$$

The rupture on demand component of the path failure frequency, failure mode 2 above, is merely the product of $\lambda(V_1)$ and the rupture on demand failure rate λ_d. This is multiplied by two because of two possible combinations of valve failures. Thus, Equation (E.2.11) can be expanded to include the rupture on demand failure

$$\lambda_{path}(\text{per 18 months}) = \lambda(V1)\left\{\frac{\lambda(V1)T_e}{2} + 2\lambda_d\right\} \tag{E.2.12}$$

The next component of the path failure frequency, failure mode 3, is similar to failure mode 2, but it involves the failure frequency λ_s, which represents "MOV spuriously opens." Thus, the expression for one check valve and one MOV in series is

$$\lambda_{path}(\text{per 18 months}) = \lambda(V1)\left\{\frac{\lambda(V1)T_e}{2} + 2\lambda_d\right\} + \lambda_s T_e \tag{E.2.13}$$

MOVs are equipped with stem-mounted limit switches, and closure of these valves is verified once a month per Technical Specification 4.5.B. However, a slight possibility exists that the "MOV indicates closed but is open after test." To reflect this failure mode and the fact that there are two paths for initiators VI and VR, the expression becomes

$$\lambda_{2paths}(\text{per 18 months}) = 2*\lambda(V1)\left\{\frac{\lambda(V1)T_e}{2} + 2\lambda_d + \lambda_s T_e\right\} \quad (E.2.14)$$

The contribution from failure modes 3 and 4 does not include the factor of 2 from Equation (E.2.6) because these failure modes do not apply to the check valve. The initiator frequencies for VR and VI over a 1-year period can be obtained by having Equation (E.2.14) multiplied by 8,760 hours.

E.2.3.2.2 Failure of One Check Valve and One MOV in Series due to Test and/or Maintenance Activities

Initiating events VITM and VRTM represent failure of one testable check valve and one MOV in any injection line due to test and/or maintenance activities, failure frequency $\lambda_{T\&M}$. As in the above events, V_1 is the check valve, and V_2 is the MOV.

A review and an evaluation of operational events involving actual and potential overpressurization of low pressure safety systems in BWRs have been conducted (References E.2-9 and E.2-16). As a result of that review, Table E.2-2 lists nine events identified as BWR precursors to an interfacing system LOCA. The Hatch event and two of the LaSalle events did not cause low pressure safety system overpressurization because the associated MOV remained closed. The LaSalle event was conducted while the plant was in cold shutdown. Therefore, five of the nine events led to actual overpressurization of the low pressure safety systems while the plant was at power. The 1986 Pilgrim incident resulted in a leak rate within the relief valve capacity. As a result, the event frequency, measured by the 4 events in 250 reactor-years that produced a leak rate beyond the relief valve capacity and led to low pressure safety system overpressurization, is represented by the following expression:

$$\lambda_{T\&M} = \lambda(CV) * P(MOV/CV) \quad (E.2.15)$$

where

$\lambda(CV)$ = the failure frequency of a check valve.

P(MOV/CV) = the conditional failure probability of the MOV, given that the check valve has failed.

According to the above discussion, the point estimate values of $\lambda(CV)$ and P(MOV/CV) are 9/250 and 4/9, respectively. The events in Table E.2-2 occurred in both high pressure (HPCI) and low pressure (RHR and core spray) systems. The fraction of applicable events in low pressure interfaces is 4/9 precursors, and the fraction of applicable overpressure events in low pressure systems is 2/4. At Browns Ferry, there are 4/6 applicable low pressure paths (2 RHR injection, 2 core spray injection, 1 HPCI, and 1 RCIC that contain a testable check valve and MOV configuration. This is similar to other BWRs. The 4/6 fraction is used because it provides slightly more conservative results. The reported overpressurization events applicable to low pressure emergency core cooling and the point estimate value are calculated by

$$\lambda_{T\&M} = 9/250 * 4/9 * 4/6 = 1.1 \times 10^{-2} \text{ (events per reactor-year)} \quad (E.2.16)$$

Based on the above point estimate result and using that as an estimate of the median frequency, the distribution for pressurization initiators attributed to test or maintenance activities can be developed based on past experience. Assuming a lognormal distribution for this frequency with a range factor of 2, the distribution of this frequency, $\lambda_{T\&M}$, has the following characteristics:

Frequency Distribution for $\lambda_{T\&M}$	
Parameter	**Frequency (events per reactor-year)**
Mean	1.1×10^{-2}
5th Percentile	5.6×10^{-3}
95th Percentile	2.2×10^{-2}

The above estimate of $\lambda_{T\&M}$, based on past operational experience, provides a total frequency of the event at Browns Ferry. This frequency can be split evenly between core spray and RHR as they both contain two injection paths. Thus, the mean frequency of VITM and VRTM from operational experience is $0.5*\lambda_{T\&M} = 5.5 \times 10^{-3}$ per year.

The above is believed to be conservative. The frequency of these events today is expected to be less likely due to differences in testing practices, improved procedures, and configuration changes that require additional failures. The event at Browns Ferry is discussed below:

- The inboard air-operated testable check valve was partially open, indicating closed due to maintenance error on the solenoid. Leakage past the check valve was relatively small, and the check valve would have to fail to reseat under higher flows to be classified as a large LOCA outside primary containment. These check valves now have air removed during power operation, and are only tested during cold shutdown (Technical Specification relief per Reference E.2-13). Valve and actuator maintenance and return to service procedures were revised to be more descriptive. The check valve is leak tested during shutdown to ensure leak tightness after tests.

- A second error was associated with surveillance logic testing of the core spray loop, which allowed the inboard MOV to open (failure to open valve breaker) while the outboard MOV was not closed. Improved procedures and training have been implemented.

Based on the above, a more realistic frequency for VITM and VRTM was developed and summarized in Section E.2.6.1. The 4 events in 250 reactor operating years are retained as the frequency of inadvertent opening of the inboard MOV with the outboard valve open (similar to the Browns Ferry event). Also, the factor of 4/6 for low pressure systems and the factor of 1/2 to split this into VITM and VRTM are appropriate. However, the frequency of check valve failure is based on the gross leakage model (Figure E.2-4), rupture on demand, and failure to reseat on demand. The following model is used:

$$VI_{TM} = VR_{TM} = \lambda_{T\&M} * [\lambda(V_1)\, T_e + \lambda_d + \lambda_r] \qquad (E.2.17)$$

As described above, the check valve is designed to close on flow; therefore, the valve may fail to reseat (λ_r) or it can rupture on demand (λ_d) or it may grossly leak ($\lambda(V_1)$) between outages.

E.2.3.2.3 Failure of Two Motor-Operated Valves in Series

Initiating event VS represents failure of two series motor-operated valves in the RHR suction path from the recirculation loop. The following failure modes apply to the failure of two motor-operated valves in series:

1. Rupture of V_1, which goes undetected, and V_2 ruptures between tests.
2. Rupture of V_1, and then rupture of V_2 on demand.
3. V_1 spuriously opens, and V_2 ruptures.
4. V_1 ruptures and V_2 position status indicates closed, but V_2 is actually left open after maintenance and/or testing.

A spurious actuation failure mode is not considered for MOV 74-47 because the power is normally removed from the control circuits (Reference E.2-14). The spurious actuation failure mode for MOV 74-48 includes spurious signals. In addition, testing and/or maintenance activities are not performed on these MOVs during power operation. Therefore, the $\lambda_{T\&M}$ term is omitted from the failure frequency equation.

The expression for the failure modes for two series motor-operated valves is the same as Equation (E.2.14) developed above. There is no factor of 2 because this initiating event contains only one RHR suction line. Failure mode 4, λ_g, does contain a factor of 2 since either MOV can be left open. Thus, the failure rate equation for two series MOVs is as follows:

$$\lambda(VS)(\text{per 18 months}) = \lambda(V_1)\left\{\frac{\lambda(V_1)T_e}{2} + 2\lambda_d + \lambda_s\, T_e + 2\lambda_g\right\} \qquad (E.2.18)$$

The failure frequency for VS over 1 year is a product of Equation (E.2.18) and the period (8,760 hours).

E.2.4 OVERPRESSURIZATION ANALYSIS

E.2.4.1 Core Spray System Design

The core spray system has two injection paths (division B is shown in Figure E.2-1) to supply the required cooling water to the reactor core. The portion of the system covered in this study includes the piping system from the primary containment isolation valves to the core spray pump. It includes one testable check valve and one normally closed MOV

(FCVs 75-26 and 75-25 for pumps A and C; FCVs 75-54 and 75-53 for pumps B and D, respectively). There is a check valve (75-537A through 75-537D, respectively) at each pump discharge.

Relief valves are provided to accommodate MOV leakage. The core spray system is equipped with the following relief valves that are installed on 1-inch lines and discharge to the clean radwaste (CRW):

Core Spray System Relief Valve Capacity (Reference E.2-17)		
Relief Valve	Location	Capacity
75-543A	Between FCV 75-25 and Core Spray Pumps B and D Discharge Lines	93 gpm at 500 psig
75-543B	Between FCV 75-53 and Core Spray Pumps A and C Discharge Lines	93 gpm at 500 psig
75-507A	Core Spray Pump A Suction Line	52 gpm at 150 psig
75-507B	Core Spray Pump B Suction Line	52 gpm at 150 psig
75-507C	Core Spray Pump C Suction Line	52 gpm at 150 psig
75-507D	Core Spray Pump D Suction Line	52 gpm at 150 psig

Consideration is not given for the core spray pump suction relief valves in this analysis because leakage into the pump will be directed to the suppression pool via normally open FCV 75-9 for pumps A and C or FCV 75-37 for pumps B and D (miniflow path). Also, the pump suction is normally open to the suppression pool.

E.2.4.2 RHR System Design

Three RHR piping lines are included in the interfacing LOCA analysis, the RHR suction line, and the two independent RHR injection lines.

The RHR injection line (division B is shown in Figure E.2-2) includes the piping system from the recirculation line (discharge side)/RHR system interface to the individual RHR pumps. There are two separate low pressure injection paths at Browns Ferry supplied by the four RHR pumps. Each injection path has one testable check valve and one normally closed MOV at the RHR/RCS interface (FCVs 74-53 and 74-54 for division A; FCVs 74-67 and 74-68 for division B, respectively).

The RHR injection lines are equipped with the following relief valves that are installed on 1-inch lines and discharge to the CRW:

RHR Line Relief Valve Capacity (Reference E.2-18)		
Relief Valve	Location	Capacity
74-587A	Upstream of FCV 74-53	89 gpm at 450 psig
74-587B	Upstream of FCV 74-67	89 gpm at 450 psig

RHR Line Relief Valve Capacity (Reference E.2-18)		
Relief Valve	Location	Capacity
74-578A	Shell-Side Heat Exchanger A	89 gpm at 450 psig
74-578B	Shell-Side Heat Exchanger B	89 gpm at 450 psig
74-578C	Shell-Side Heat Exchanger C	89 gpm at 450 psig
74-578D	Shell-Side Heat Exchanger D	89 gpm at 450 psig
74-509A	RHR Pump A Suction Line	52 gpm at 150 psig
74-509B	RHR Pump B Suction Line	52 gpm at 150 psig
74-509C	RHR Pump C Suction Line	52 gpm at 150 psig
74-509D	RHR pump D Suction line	52 gpm at 150 psig

The total relief valve capacity for the RHR injection path is determined by adding the inline relief valve and the two associated heat exchanger relief valves. Consideration is not given for the RHR pump suction relief valves when the initiating event is from the injection side because leakage into the pump will be directed to the suppression pool via normally open FCV 74-7 or FCV 74-30 for pumps B and D (miniflow path). Also, the pump suction is normally open to the suppression pool.

The RHR suction line (shown in Figure E.2-3) includes piping from the recirculation line/RHR system interface to the individual RHR pump suction side. It has two normally closed, motor-operated valves (FCV 74-48 and FCV 74-47) at the reactor coolant system/residual heat removal interface and a normally closed, motor-operated valve at each RHR pump suction side (FCVs 74-2, 74-25, 74-13, and 74-36 for pumps A, B, C, and D, respectively).

In addition to the RHR pump suction relief valves 74-509A through D discussed above, the RHR suction line is equipped with relief valve 74-659 (downstream of FCV 74-47), which is installed on 1-inch lines and discharges to the CRW.

Again, consideration is not given to the RHR pump suction relief valves (74-509A through 74-509D) because leakage past the individual pump suction motor-operated valves would be directed to the suppression pool.

E.2.4.3 Overpressure Evaluation

The overpressure analysis described below has been taken from Reference E.2-19. The failure pressures developed here are based on the material strengths and methods outlined in Reference E.2-20.

A range of temperature from ambient temperature to 600°F is considered. Temperatures are assumed to be material temperatures rather than fluid temperatures. Unless leak areas are presented for a given component and failure mode, failure pressure is considered to result in a large, uncontrolled leak area.

It is assumed that the pressure capacities have a lognormal distribution. This assumption is made because a lognormal distribution has been shown to be a valid description of the variability in material strengths (see, for example, Reference E.2-21). In addition, for a random variable that can be expressed as the product and quotient of several random variables, the distribution of the dependent variable tends to be lognormal regardless of the distributions of the independent base variables.

With the pressure capacity assumed to be a lognormal random variable and denoting it as P, the probability of failure occurring at a pressure less than or equal to a specific value p is expressed as:

$$P_f = \text{Prob}\ (P \leq p) = \Phi \qquad \text{(E.2.19)}$$

where

P_f = probability that failure occurs at a pressure $P \leq p$.

P = random pressure capacity.

β_c = logarithmic standard deviation of P.

$\hat{P}$ = median pressure capacity.

Φ (.) = cumulative distribution function for a standard normal random variable.

In Equation (E.2.19), the pressure capacity for a given failure mode is probabilistically described by the following expression:

$$P = \hat{P} \bullet M \bullet S \qquad \text{(E.2.20)}$$

in which $\hat{P}$ is the median pressure capacity, M is a lognormally distributed random variable having a unit median and a logarithmic standard deviation, β_M, representing the uncertainty in modeling, and S is also a lognormally distributed random variable with a unit median value and a logarithmic standard deviation, β_S, representing the uncertainty in the material properties. The overall uncertainty in the median capacity is obtained by taking the square root of the sum of the squares of β_M and β_S.

The median pressure capacity represents the internal pressure level for which there is a 50% probability of failure (leakage or burst) for a given failure mode. The median values are evaluated from limit state analyses for the different failure modes. The uncertainties, β_M and β_S, are associated with variability due to a lack of knowledge related to differences between the analytical model and the real structure. Modeling uncertainties are associated with the assumptions used to develop analytical models and their ability to represent properly the failure condition. The strength uncertainties are associated with variabilities related to the material resistance. Examples of the sources of strength uncertainties include variability in steel yield and ultimate strengths, stress-strain relationships, and the influence of elevated temperatures on material strength.

Uncertainties will exist in the estimated pressure capacities due to differences between the analytical idealization of the structure and the real conditions. There are numerous possible sources of modeling uncertainties. Examples of the sources of modeling uncertainties include assumptions used to develop the internal force distributions, failure criteria, some detail dimensions, and the use of empirical formulae. Moreover, since the uncertainties are dependent on the particular failure mode under consideration, they must be evaluated on a case-by-case basis. However, in many instances, the evaluation of these uncertainties would require very detailed analysis and/or extensive data, which may not be available. As a result, it was necessary to use subjective evaluation and engineering judgment to estimate these uncertainties.

E.2.4.3.1 Pipe

The RHR and core spray piping of interest includes various diameters up to 20 inches. Various pipe schedules, including standard, extra strong, Schedule 30, and Schedule 40, are used in various locations in the two systems.

Table E.2-3 shows median failure pressures for the pipe sizes of importance in the core spray and RHR systems. Pipes with diameters less than 4 inches have capacities above the range of interest. Pressure capacities for a temperature range from room temperature to 600°F are given. In addition to the base condition of no corrosion shown in Table E.2-3, pressure capacities for 0.02-inch and 0.04-inch corrosion are also shown in Tables E.2-4 and E.2-5.

Temperature-dependent variabilities for the above failure pressures are shown in Table E.2-6. The variabilities include estimates of the variation in material strength, stress strain relations, biaxial strain effects, the possibility of large pipe bending stresses due to thermal expansion of pipes designed for lower temperature service, and the possibility of partial through-wall flaws. Although the possibility of a major partial through-wall flaw probably increases with the number of pipe segments and welds in a given piping run, the relatively large variability associated with piping failure should at least initially permit treating a given pipe run as a single element in the risk analysis, regardless of the number of segments and welds in the line.

E.2.4.3.2 Gasketed Flange Connections

Most of the piping joints in the Brown's Ferry RHR and core spray systems are full penetration butt welds. However, both 10-inch 300-pound and 14-inch 150-pound flanges are specified for use in the core spray system (Reference E.2-22). No flanges were identified for the RHR system (Reference E.2-23).

The behavior of gasketed flanges under pressure and temperature conditions is quite complex. The variables affecting the leak pressure and the methodology used to develop the gross leak pressure (GLP) and leak rates and leak areas for bolted flanges are discussed in Reference E.2-20. The definition of the onset of gross leakage, or gross leak pressure, as the point at which the gasket stress is equal to the pressure being retained, is used quite generally in the gasket industry. For pressures less than GLP, the mass leak rate is calculated from the results of gasket leakage tests with water reported in Reference E.2-24. Leakage of this form is related to the presence of the seams and crevasses in the flange/seal joint rather than to any apparent leak area. For pressures above the GLP, it was judged that the leakage is no longer due to seams and crevasses in the flange/seal joint but primarily due to actual separation of the flange and gasket. Thus, a leak area is calculated that is intended to be in addition to the leak rate calculated at GLP. The leak area is calculated as the mean gasket perimeter times the separation distance at the gasket. The separation distance is affected by bolt extension, gasket recovery, and flange flexibility. Of these, the contribution of the bolt extension is by far the most dominant.

Gross leak pressures, leak rates, and leak areas for 10-inch 300-pound and 14-inch 150-pound flanges are shown in Table E.2-7. GLP increases and the mass leak rate decreases with increasing initial bolt stress. The leak area decreases with an increase in initial bolt stress because the increased bolt stress creates a greater lock-up force that must be overcome before the gasket begins to unload. It can be noted that, for 300-pound flanges, the joint relaxation has little effect on the flange leak resistance. Since the bolt yield stress is not exceeded for up to two times GLP for either flange, a variation in bolt yield stress of the magnitude expected for the SA-193-B7 bolts has no effect on the results.

A lognormal standard deviation of 0.18 is recommended for GLP for both flanges. The mass leak rates for pressures less than the GLP are low for both flanges, and the GLPs are high for the median case. A variability of 0.54 for the leak rates for both flanges is used in accordance with Reference E.2-20. Similarly, the leak areas for the flanges are also relatively low, and a combined variability of 0.12 is recommended for the leak areas of both sizes of flanges.

E.2.4.3.3 Valves

A number of valves of various types and sizes are located throughout the Browns Ferry core spray and RHR systems. Past experience has indicated that larger valves tend to have lower leak capacities than smaller valves. Also, lower pressure rated valves have lower capacities. Therefore, a sampling of larger valves along with lower pressure rated valves would be a conservative sample. Such a sample of Brown Ferry valves was chosen.

Three failure modes are postulated for the various valves present in the Browns Ferry core spray and RHR systems. These include failure of the valve body, failure of the stem packing or packing retention flange, and failure of the bolted bonnet. Since the valve body thickness is typically significantly greater than that of the adjacent piping, it was judged that failure of the adjacent piping will occur prior to failure of the valve body. Also, the types of valve stem packing used in the valves tend to compress under high pressure conditions, providing a greater resistance to leakage. Although it is certainly possible that the stem packing for some valves could deteriorate in response to service conditions, it was judged that any resulting leak would be quite small and would have a negligible effect on both the valve and system operation. Thus, it was assumed that the only credible failure mode for the valves considered here pertains to failure of the bolted bonnet seals.

Most bolted bonnet valves are sealed using spiral wound gaskets compressed between the bonnet and valve body, which are machined in a tongue and groove configuration. Occasionally, corrugated soft iron gaskets are used. Most of the large valves of interest here are 300-pound rated. The 20-inch Powell gate valve (74-02) is 150-pound rated, however, as are several of the smaller RHR system valves. Bonnet studs are high strength material, with SA 193-B7 specified for most valves.

In addition to the 74-02 20-inch gate valve, the 74-71 18-inch and 74-46 24-inch gate valves, and the 74-559 20-inch swing check valves were evaluated. Vendor-supplied bolt torques were available for all valves. Gasket dimensions for these valves were estimated from the available outline drawings, which are not to scale, and thus these dimensions may include significant errors. However, as shown in Table E.2-8, these valves are expected to have relatively high GLP (see Reference E.2-19). A lognormal standard deviation of 0.16 is recommended for the GLP for MOV 74-71. A lognormal standard deviation of 0.20 is recommended for GLP for the remaining valves. A lognormal standard deviation of 0.54 is recommended for bonnet leak rates and 0.12 for leak areas for all valves listed in Table E.2-8.

Smaller valves are expected to have somewhat higher capacities, and the pressure relief valves are expected to have significantly higher capacities.

E.2.4.3.4 RHR Heat Exchanger

The RHR heat exchanger is a vertically mounted U-tube heat exchanger. The shell side of the heat exchanger is the side of concern for ISLOCAs. The shell cover cylinder is a 7/8-inch thick, 52-7/8-inch I.D. cylinder fabricated from SA-212 Grade B carbon steel, and the shell cylinder is 13/16-inch thick 51-1/4 I.D. SA-212 Grade B. The 2:1 semiellipsoidal head is also 7/8-inch thick SA-212 Grade B steel with a 56-inch I.D. The U-tubes are 3/4-inch O.D. No. 18 B.W.G. SA-249 type 304 stainless steel. The tube sheet is 61-1/8-inch O.D. by 5-1/4-inch thick, and is secured to the channel and shell-side flanges by fifty-six 1-3/8-inch studs torqued to 879 ft-lb. Sealing is provided by a spiral wound gasket 56-1/2-inch O.D. and 55-1/2-inch I.D. A second gasketed shell flange is located at the bottom of the heat exchanger and connects the lower dished head with the shell-side cylinder. This flange is secured by fifty-six 1-1/2 studs torqued to 1,155 ft-lb, and uses a 61-3/8-inch O.D. by 60-1/4-inch I.D. spiral wound gasket. The shell side of the heat exchanger was designed for 450 psig at 360°F. A corrosion allowance of 0.100 inches was provided for carbon steel surfaces.

Potential failure modes investigated include failure of the shell cylinder due to hoop stress, plastic collapse of the dished head, buckling failure of the U-tubes, and leakage past one or both of the tube sheet flanges. The median failure pressures for the cylinder and dished head buckling capacities for no corrosion, together with their respective variabilities, are shown in Table E.2-9. Table E.2-10 shows similar values for the heat exchanger with 0.100-inch corrosion. The buckling pressure capacity of the tubes is well above the range of interest. Median gross leak pressures, leak rates, and leak areas for the tube sheet for several cases of assumed joint relaxation and initial bolt stress are shown in Table E.2-11. Table E.2-12 shows similar results for the bottom flange.

E.2.4.3.5 Pumps

Both the RHR and core spray pumps were evaluated for the Browns Ferry ISLOCA investigation. The RHR pump is a vertically mounted, single-stage centrifugal pump rated at 10,000 gpm and 560-foot head at 1,760 rpm. The pump casing and stuffing box are ASTM-A216, Grade WCB carbon steel castings. Twenty-four 1-1/4-inch-diameter SA 193-B7 studs, together with a 304 stainless steel asbestos-filled gasket, provide the case to stuffing box seal. The shaft seat is a tungsten carbide/carbon face seal.

Potential failure modes of the RHR pump due to ISLOCA conditions include fracture of the casing or stuffing box, leakage past the casing/stuffing box gasket, lift off of the gland ring, or crushing of the carbon face seal element. The internal pressure capacity of the RHR pump is expected to be controlled leakage past the stuffing box casing gasket. Component-specific torques were not available for the RHR pump. Based on generic torque tables (Reference E.2-24) for Browns Ferry high strength bolts, an estimated torque of 750-ft lb was used for the 1-1/4-inch casing to stuffing box studs. Table E.2-13 shows the expected GLP and corresponding leak rates and leak areas for several initial bolt stress and joint relaxation conditions.

Assuming median initial conditions of 40,000-psi bolt stress and 15% joint relaxation, a median GLP of about 1,290 psig, with a lognormal standard deviation of about 0.17, is expected. The estimated lognormal standard deviation on leak area is 0.12. Failure capacities for the remaining potential failure modes of the RHR pump are all above the range of interest for ISLOCA considerations.

The core spray pump is also a vertically mounted, single-stage centrifugal pump. The core spray pump is rated at 3,125 gpm and 582-foot head. The pump casing is SA-216 Grade WCB, and the pump cover is SA-515. A 304 Flexitallic gasket is specified for the case to stuffing box joint, and the 16 studs are SA 193-B7. The pump outline and sectional drawings was available at the time that this evaluation was conducted. Based on the drawings, the gasket dimensions, stud size, etc., were estimated, and an estimated torque from Reference E.2-24 was used. Table E.2-14 gives the pump cover GLP and leak areas for several assumed initial bolt stresses and joint relaxations based on these estimates. Assuming a median initial bolt stress of 40,000 psi and 15% joint relaxation, a median GLP of about 685 psig is expected, with a corresponding lognormal standard deviation on pressure of 0.17. These values were developed from estimates based on the best information available. The expected variabilities for the leak rates and leak areas are 0.54 and 0.12, respectively. Other potential failure modes for the core spray pump are expected to have significantly higher capacities.

E.2.5 EVENT SEQUENCE ANALYSIS

An interfacing LOCA is initiated by leakage of reactor coolant through valves that separate the nuclear boiler from the RHR or core spray systems. The initiating event for this analysis is a leak that causes loss of reactor vessel inventory to exceed the relief valve capacity. Most smaller leaks would not cause an immediate plant trip, although leakage greater than the technical specification limits would result in a controlled shutdown. The sequence timing and impact of smaller leaks are judged to be insignificant compared with the larger leaks included in this analysis. In addition, failure of the relief valves to open is neglected. The relief valve capacities used to develop the initiating events range from 52 to 267 gpm. If a relief valve failed to open and the low pressure system failed at or below these values, the leak is still small, there is a significant time to respond, and the impact on systems outside primary containment is expected to be minimal.

Pressure and/or temperature indications and alarms would alert the operators in the control room of overpressure conditions in the RHR and core spray systems. In addition, leakage will also be revealed when RHR relief valves open, discharging to the CRW. CRW temperature and level indication and alarms exist in the control room.

For small leaks, flow through the RHR or the core spray system and out the relief valves is governed by the interfacing LOCA leak size. RHR or core spray system pressure is determined by the relief capacity. As the interfacing LOCA rupture size increases, causing RHR or core spray system pressure to exceed the relief valve settings, relief valve flow would become choked. The relief valve discharge would determine flow rate, and the interfacing LOCA rupture size would determine the pressure.

The summary event sequence diagram in Figure E.2-5 describes the general plant response developed for interfacing LOCA initiating events into the RHR and core spray systems. The event sequence diagram is converted into the event tree in Figure E.2-6 for sequence quantification purposes. Because the event sequence diagram and event tree are relatively simple, they are both discussed together below. The descriptions and chances of success for each block in the event sequence diagram depend on the specific initiating event. The following summarizes the interfacing LOCA initiating events defined in Section E.2.2:

Designator	Path Description	Valves
VI	CS Injection	75-26 and 74-25 or 75-54 and 75-53
VITM	CS Injection Test and Maintenance	75-26 and 74-25 or 75-54 and 75-53
VR	RHR Injection	74-54 and 74-53 or 74-68 and 75-67
VRTM	RHR Injection Test and Maintenance	74-54 and 74-53 or 74-68 and 75-67
VS	RHR Suction	74-48 and 74-47

The test and maintenance contributions (VITM and VRTM) were separated explicitly from VI and VR because precursors have occurred (can be quantified based on past operational experience and practices), and it is believed that successful operator response to these human-caused events may be more likely. The interfacing LOCA initiating event paths are shown on Figures E.2-1 through E.2-3 for core spray, RHR injection, and RHR suction, respectively. The following describes the event sequence diagram and the event tree in Figures E.2-5 and E.2-6 for the above initiators:

- **V1 — System Pumps Isolated.** If the initiating leak is not contained by the next set of isolation valves, the leak will be directed to the suppression pool. As shown in Figures E.2-1 and E.2-2, the injection paths have a normally closed pump discharge check valve, a normally closed motor-operated valve, or other combinations of valves that isolate the piping system downstream of the pumps. The isolation valve for each RHR pump shutdown cooling suction path shown in Figure E.2-3 is normally closed, and position indication is provided in the control room on panel 2-9-3. Failure of any isolation barrier to be closed is assumed to result in a LOCA to the suppression pool, and block V2 questions whether the initiating leak is a small LOCA or less. Note that rupture and leakage questions (V3 and V4) are not asked because the system does not overpressurize when V1 fails -- relief is to the suppression pool. Success of block V1 means that the valves are closed, and the next block, V3, questions whether the system remains intact (no rupture).

  Quantification of event tree Top Event V1 depends on the initiating event, as follows:

  - **V1S.** Guaranteed success is used for initiating events VI, VITM, VR, and VRTM because the injection paths are normally maintained full and pressurized to approximately 48 psig. It is unlikely that these barriers could be open for long as water would continuously be lost and noticed. The following pressure indicators are provided in the control room on panel 2-9-3:

Pressure Indicator	Description
2-PI-75-20	Core Spray System I Discharge
2-PI-75-48	Core Spray System II Discharge
2-PI-74-51	RHR System I Discharge
2-PI-74-65	RHR System II Discharge

    In addition, the system loops are vented monthly in accordance with Surveillance Instructions 2-SI-4.5.H.1(I) and 2-SI-4.5.H.1(II) for RHR systems I and II, and 2-SI-4.5.H.2(I) and 2-SI-4.5.H.2(II) for core spray systems I and II.

  - **V11.** This split fraction is used for initiator VS and is the frequency of any one of four RHR pump suction motor-operated valve being open at the time of the initiator. There are four motor-operated valves that can transfer open between refueling outages when it is assumed that they would be found in the incorrect position.

- **V2 — Initiating Leak Small.** This block questions whether the initiating leak is small or large. Success means the leak is small, which causes less impact than a large leak and gives the operators more time to respond. There are two conditions under which V2 is asked:

  - The leak is to the suppression pool (V1 fails), which only applies quantitatively for the VS initiator as described above. For this case, V2 success means that there is a small LOCA to the suppression pool, which is assumed to be no worse than a stuck-open relief valve. The end state is defined as a small LOCA with both RHR divisions unavailable. Failure means that the leak is greater than a small LOCA (large LOCA is assumed), and since this is an unanalyzed event, it is assumed that the primary containment fails and no credit is given for operator recovery. The end state is core damage with a large primary containment bypass.

  - The low pressure system ruptures (V3 failure) after V1 success, which applies for each initiator close up. In this case, the rupture is large outside primary containment (V3 failure); however, if the initiating leak is small (V2 success), this provides more time for operator actions (V5) than when the leak is large (V2 failure).

  The split fractions are quantified conditional on the initiating event leak size, and small LOCA is defined as a leak less than 600 gpm, within the capacity of RCIC. Therefore, the following split fractions are defined:

  - **V21.** Conditional probability that the leak is greater than 600 gpm (large LOCA assumed); given that the initiating event is VS, initiating leak size is greater than 52 gpm.

  - **V22.** Conditional probability that the leak is greater than 600 gpm (large LOCA assumed); given that the initiating event is VI, initiating leak size is greater than 93 gpm.

  - **V23.** Conditional probability that the leak is greater than 600 gpm (large LOCA assumed); given that the initiating event is VR, initiating leak size is greater than 267 gpm.

  - **V24.** Conditional probability that the leak is greater than 600 gpm (large LOCA assumed); given that the initiating event is VITM, initiating leak size is greater than 93 gpm.

  - **V25.** Conditional probability that the leak is greater than 600 gpm (large LOCA assumed); given that the initiating event is VRTM, initiating leak size is greater than 267 gpm.

- **V3 — System Remains Intact.** This block (and top event) questions whether the system piping, valves, and components remain intact when subjected to RCS operating pressure. Success means that there was no system rupture, and whether there is significant leakage from valve bonnets and other flanges is questioned in

V4. Failure means that a rupture occurs (large LOCA), and operator response (V5) is required quickly.

The event tree top event split fractions are quantified from the overpressure analysis in Section E.2.4. Three split fractions are required to address the core spray discharge, RHR discharge, and RHR suction paths:

- V31. Probability of core spray discharge rupture, given initiating event VI or VITM.
- V32. Probability of RHR discharge rupture, given initiating event VR or VRTM.
- V33. Probability of RHR suction rupture given initiating event VS.

- **V4 — Leak is Less Than Gross Leak Pressure Leakage.** Given that the system did not rupture in V3, this event questions whether the leakage through valve bonnets and other flanges exceeds the leakage at GLP as defined in Section E.2.4. Note that V4 is not asked if V3 fails because a large LOCA has already occurred. Success means that the leakage is no more than that defined by GLP in Section E.2.4, which is very small leakage. This is treated as insignificant leakage, and it is assumed that the operators eventually detect the overpressure condition, isolate it, and correct the initiating cause (SUCCESS end state). Failure means the leakage is greater than GLP, and it is assumed be a small LOCA.

  The event tree top event split fractions are quantified from the overpressure analysis in Section E.2.4. Three split fractions are required to address the core spray discharge, RHR discharge, and RHR suction paths:

  - V41. Probability of core spray discharge leakage greater than GLP, given initiating event VI or VITM.
  - V42. Probability of RHR discharge leakage greater than GLP, given initiating event VR or VRTM.
  - V43. Probability of RHR suction leakage greater than GLP, given initiating event VS.

- **V5 — Operator Isolates before ECCS Flooded.** Given significant leakage (V4 failure) or rupture (V3 failure) in the low pressure system, V5 questions whether operators diagnose the event and isolate the LOCA outside primary containment before all of the ECCS pumps are flooded. The RHR, core spray, HPCI, and RCIC pumps are located at Elevation 519' in corner rooms. This is the bottom floor of the reactor building, and all corner rooms can communicate through the torus room. Indications to the operators and their response depend on the initiating path as well as the leak size and time available.

  The following alarms are in the control room on panel 2-9-3:

Path	Pressure Sensor	Trip Point (psig)	Panel Alarm
Core Spray Discharge I	PS-75-24	400	PA-75-24
Core Spray Discharge II	PS-75-52	400	PA-75-52
RHR Discharge I	PS-74-51	400	PA-74-51
RHR Discharge II	PS-74-65	400	PA-74-51
RHR Suction	PS-74-93	100	PA-74-51

The alarm response procedures correctly identify the interfacing LOCA initiating paths as the probable cause and direct the operators to verify pressure on panel 2-9-3 from the instruments described above for V1S. Then, alarm response procedure for PA-75-52 directs the operators to perform the following:

- CHECK 2-FCV-75-53 and 2-FCV-75-54 closed, on panel 2-9-3.
- REDUCE pressure by cycling CORE SPRAY SYS II TEST VALVE, 2-FCV 75-50.
- If alarm returns, CLOSE CORE SPRAY SYS II OUTBD INJ VALVE, 2-FCV-75-51 to protect low pressure piping.
- REFER to T. S. 3.5.A.

The response for PA-75-24, core spray system I is similar to the above. The response for PA-74-51 refers to 2-OI-74, Section 8.30, which is similar to the above. If high pressure is on one of the discharge paths, the operators are instructed to throttle open the suppression pool path. The procedures do not instruct operators to close the outboard injection valves to protect low pressure piping. If high pressure is not indicated in either discharge path, the operators are instructed to check RHR suction by requesting maintenance to connect a hose (1-1/4 inch) from the discharge of 2-74-666 (SD CLG SPLY HDR TEST) and then open 2-74-666 and crack open 2-74-665.

Whether the leak is large (rupture with large initiator leak) or small (rupture with small initiator leak or no rupture but leakage >GLP) affects the plant response and determines the time required to flood the pumps in the reactor building. The relief valves discharge to sumps (CRW) in the reactor building corner rooms on Elevation 519'. There are temperature and level alarms in the control room. In fact, these alarms are entry conditions to the emergency operating instructions, which direct the operators to identify and isolate the leak as well as scram the reactor if required.

The following split fractions are defined for V5:

- V5F. Guaranteed failure is applied to the case in which the initiator is VS (RHR suction path) and the LOCA outside primary containment is large

(V3=F*V2=F). It is difficult to isolate breaks on the suction side, and it would take time.

- V51. For INIT=VS*(V3=S + V2=S). Even small leaks on the suction side of RHR are difficult to isolate; therefore, it is assumed that the operators must shut down, cool down, and depressurize to reduce the leakage, and eventually isolate the leak or reduce it sufficiently to allow sump pumps to limit flooding.

- V52. (INIT=VITM+INIT=VRTM)*V3=F*V2=F is initiated by operator errors during testing of the injection paths (discharge) and LOCA outside is large. The operators who cause this event are likely nearby and in the vicinity to detect the error. Thus, a higher likelihood of detection and isolation may be appropriate compared with V54.

- V53. (INIT=VITM+INIT=VRTM)*(V4=F+V2=S) is similar to V52 except that the system did not rupture but is leaking (small LOCA). There is more time to respond than for V52, and there should be a higher likelihood of detection and isolation compared with V55.

- V54. (INIT=VI+INIT=VR)*V3=F*V3=F*V2=F is a large LOCA outside primary containment through a core spray or RHR discharge path. For nontest and maintenance leaks through the core spray and RHR discharge paths, the operators must follow the alarm response procedures described above and isolate the leak before it floods the pumps in the reactor building.

- V55. (INIT=VI+INIT=VR)*(V4=F+V2=S) is similar to V54 except that the discharge path did not rupture, and the LOCA outside primary containment is small, allowing more time for operator response.

E.2.6 ACCIDENT SEQUENCE QUANTIFICATION

This section describes the quantification of the initiating events, the event trees, and the event tree top event models. The event tree in Figure E.2-6 is described in the previous section, including event tree top event split fractions.

E.2.6.1 Initiating Event Quantification

The first failure mode of interest in quantifying the initiating events is the frequency of valve rupture or gross leakage exceeding the relief valve capacity in the interfacing LOCA path. Due to lack of data specific to MOVs, the same values are used for both check valves and MOVs. The failure frequency in event per hour is obtained from the curve in Figure E.2-4. The median is taken from the curve, and a lognormal distribution with a range factor of 10 is assumed. The following summarizes the median from the curve and the distribution characteristics:

Leakage (gpm)	Median	Mean	5th Percentile	95th Percentile
>52	4.1×10^{-8}	1.1×10^{-7}	3.9×10^{-9}	4.1×10^{-7}

>93	2.7×10^{-8}	7.5×10^{-8}	2.6×10^{-9}	2.7×10^{-7}
>267	1.1×10^{-8}	2.9×10^{-8}	1.0×10^{-9}	1.1×10^{-7}
>600	5.7×10^{-9}	1.5×10^{-8}	5.3×10^{-10}	5.5×10^{-8}

The first three above are used to quantify the initiating events in which 52 gpm is the relief capacity for the RHR suction path (VS), 93 gpm is the relief capacity of a core spray discharge path (VI and VITM), and 267 gpm is the relief capacity of an RHR discharge path (VR and VRTM). The 600-gpm frequency is used to quantify the conditional frequency of exceeding 600 gpm, given that an initiating event occurs (Top Event V2).

Figures E.2-7 through E.2-11 give the fault trees used to calculate the initiating events. As shown in the fault trees and the equations developed in Section E.2.3, the following additional failure modes are required to quantify the initiating events:

Failure Mode	Description	Mean	5th Percentile	95th Percentile
λ_d	Valve Rupture on Demand	2.2×10^{-4}	2.6×10^{-5}	6.6×10^{-4}
λ_s	MOV Spuriously Opens (/hr)	7.6×10^{-8}	9.2×10^{-9}	2.3×10^{-7}
λ_g	MOV Open, Indicate Closed	1.1×10^{-4}	2.0×10^{-5}	3.0×10^{-4}
λ_r	Check Valve Fails To Close	2.2×10^{-4}	5.1×10^{-5}	6.1×10^{-4}
$\lambda_{T\&M}$	Test and Maintenance Error	5.5×10^{-3}	2.7×10^{-3}	1.1×10^{-2}

Reference E.2-12 developed a median for λ_d to account for the failure of the second valve to hold under pressure shock, given the failure of the first valve. The above distribution assumes a lognormal distribution with a range factor of 5. Because of the lack of plant-specific MOV data for failure rate indicator error, λ_g, a median failure frequency of 7.3×10^{-5} was derived from a search of *Nuclear Power Experience* (Reference E.2-8). The above distribution assumes a lognormal distribution with a range factor of 10.

The following summarizes the initiating event quantification results:

Initiating Event	Description	Mean	5th Percentile	95th Percentile
VI	Core Spray Injection	4.9×10^{-6}	3.8×10^{-8}	1.1×10^{-5}
VR	RHR Injection	1.3×10^{-6}	1.6×10^{-8}	3.1×10^{-6}
VS	RHR Suction	6.3×10^{-6}	3.3×10^{-8}	1.3×10^{-5}
VITM	Core Spray Injection T&M	8.3×10^{-6}	1.6×10^{-6}	1.9×10^{-5}
VRTM	RHR Injection T&M	5.3×10^{-6}	1.2×10^{-6}	1.2×10^{-5}

E.2.6.2 Event Tree Top Event Quantification

The event tree (Figure E.2-6) top events and split fractions are described in Section E.2.5. This section presents the quantitative development of the split fractions.

- **V1 — System Pumps Isolated.** Split fraction V11 is quantified as one of four RHR suction MOVs transferring open between tests. It is assumed that this valve failure can only be detected during cold shutdown (18 months is assumed). The following distribution is used for an MOV transferring open (events per hour):

Failure Mode	Mean	5th Percentile	95th Percentile
MOV Transfers Open	7.6×10^{-8}	9.2×10^{-9}	2.3×10^{-7}

The point estimate value for V11 is 2.2×10^{-3}.

- **V2 — Initiating Leak Small.** These split fractions are conditional on the initiating event quantification. To quantify the V2 split fractions, each initiating event is requantified using the > 600-gpm valve leakage frequency in Section E.2.6.1. Then, the split fraction can be quantified by dividing the requantified frequency at > 600 gpm by the original initiating event frequency. The following summarizes the split fraction results:

Split Fraction	Description	Mean
V21	> 600/52 gpm, INIT=VS	0.053
V22	> 600/93 gpm, INIT=VI	0.11
V23	> 600/267 gpm, INIT=VR	0.4
V24	> 600/93 gpm, INIT=VITM	0.48
V25	> 600/267 gpm, INIT=VRTM	0.75

- **V3 — System Remains Intact.** These split fractions (probability of rupture) are quantified from the overpressure analysis results in Section E.2.4. The probability that piping, valves, or other components rupture is obtained by using the median capacities (0.5 probability of failure at given capacity) and their uncertainties in Section E.2.4 to calculate the probability of failure at reactor normal operating pressure. The following summarizes the split fraction results:

Split Fraction	Description	Rupture Probability
V31	Core Spray Discharge	1.0×10^{-4}
V32	RHR Discharge	1.0×10^{-3}

V33	RHR Suction	1.0×10^{-4}

V31 is based on the probability of 12-inch standard weight pipe or 14-inch Schedule 30 pipe rupturing. Room temperature and a 0.02 corrosion allowance is assumed. For both, the probability of rupture is 1×10^{-4} at pressures greater than 1,500 psig.

V32 is based on the probability of rupturing 18-inch extra strength pipe or 20-inch Schedule 30 pipe or 24-inch extra strength pipe or a heat exchanger. Room temperature and a 0.02 corrosion allowance is assumed for the pipe. For all three pipe failures, the probability of rupture is 1×10^{-4} at pressures greater than 1,200 psig. The dominant rupture failure modes for the heat exchanger include shell-side cylinder and shell-side head buckling. The probability of head buckling is less than 1×10^{-4} at 1,200 psig, even assuming a 0.1 corrosion allowance. The probability of shell cylinder failure at ambient temperature would be less than 1×10^{-4}, but would be 1×10^{-3} at 400°F and 1,100 psig, assuming a 0.1 corrosion allowance.

V33 is based on the probability of 20-inch standard weight pipe rupture. Room temperature and a 0.02 corrosion allowance are assumed. The probability of rupture is 1×10^{-4} at 1,174 psig.

- **V4 — Leak < GLP Leakage.** These split fractions are quantified from the overpressure analysis results in Section E.2.4 and represent the probability that valve bonnet leakage and other flange leaks are excessive (approaching a small LOCA). The probability that valve bonnet leaks or other component leakage exceeds gross leakage pressure leakage is obtained by using the median capacities (0.5 probability of GLP) and their uncertainties in Section E.2.4 to calculate the probability at reactor normal operating pressure. The following summarizes the split fraction results:

Split Fraction	Description	Probability
V41	Core Spray Discharge	0.001
V42	RHR Discharge	1.0
V43	RHR Suction	0.05

As described in Section E.2.4, the leakage at GLP is very small, and so the use of GLP would be conservative. Therefore, in some cases, the higher pressures and leakage areas are used, as described below.

V41 is based on the probability of GLP at approximately normal operating pressure. The probability that GLP is at 1,085 psig is 1×10^{-3}, using the valve with the least capacity and greatest uncertainty.

V42 is based on both valves and heat exchanger flanges. The valve bonnet contribution is the same as for V41 (1×10^{-3}). As described in Section E.2.4, heat exchanger leakage will dominate the probability and size of a leak. In fact, they are almost guaranteed to leak. Therefore, this split fraction is set to 1.0. The probability that 1.5 GLP is at 1,044 psig is about 0.1 for the heat exchanger, and the leakage would correspond to about 3.5 square inches. The conditional probability of a large LOCA has been neglected. This potential nonconservatism is judged to be a reasonable assumption, given other conservatism. As heat exchanger leakage increases due to pressure, the probability decreases and the RCS depressurizes, reducing leakage.

V43 is based on the probability of GLP at approximately normal operating pressure. The probability that GLP is at 1,010 psig is 5×10^{-2}.

- **V5 — Operator Isolates LOCA.** These split fractions depend on the initiating event cause and the size of the leakage outside primary containment into the reactor building. The following values (derived in Appendix B) are used:

Split Fraction	Description	Point Estimate
V5F	INIT=VS*V3=F*V2=F	1.0
V51	INIT=VS*(V3=S+V2=S)	0.1
V52	(INIT=VITM+INIT=VRTM)*V3=F*V2=F	1.6×10^{-3}
V53	(INIT=VITM+INIT=VRTM)*(V4=F+V2=S)	1.6×10^{-3}
V54	(INIT=VI+INIT=VR)*V3=F*V2=F	4.2×10^{-3}
V55	(INIT=VI+INIT=VR)*(V4=F+V2=S)	4.2×10^{-3}

The master frequency file used to quantify the interfacing systems LOCA scenarios is shown in Table E.2-15.

E.2.6.3 Event Sequence End States

The following table explains the end states used in the quantification and binning of accident sequences:

Top Event Success/Failure	Initiating Event				
	VI	VR	VITM	VRTM	VS
V4=S	S	S	S	S	S
V1=F*V2=S	(1)	(1)	(1)	(1)	SLRHR
V1=F*V2=F	(1)	(1)	(1)	(1)	CDBL
V2=F*V5=S	CS1	RH1	CS1	RH1	(2)
V2=F*V5=F	CDBL	CDBL	CDBL	CDBL	CDBL
V2=S*V5=S	CS1	RH1	CS1	RH1	RH2

V2=S*V5=F	CDBS	CDBS	CDBS	CDBS	CDBS
V4=F*V5=S	CS1	RH1	CS1	RH1	RH2
V4=F*V5=F	CDBS	CDBS	CDBS	CDBS	CDBS

Notes:

1. Cannot occur because V1 is guaranteed to be successful since the "keep-filled" system reduces the frequency of having a valve open.

2. Cannot occur because V5 is guaranteed to fail if V3 and V2 fail (large leak).

If there is no significant leakage (V4=S), the sequence is binned to SUCCESS (S), with the assumption that there is significant time to detect and correct the event. Whenever the operator fails to isolate the LOCA outside primary containment (V5=F), the sequence is binned to core damage with bypass large (CDBL) or small (CDBS). In addition, the RHR suction path LOCA (VS initiator) is binned to CDBL if the leak is to the suppression pool (V1=F) and it is large (V2=F). If the leak to the pool is small, the sequence is a small LOCA to the suppression pool with the RHR system unavailable (SLRHR). Both divisions of RHR are assumed to be unavailable (RH2) if the initiator is VS and the operators successfully isolate and respond to the event (V5=S). For all other initiators, if the operators are successful (V5=S), one division of the system with the initiator is assumed to be unavailable (CS1 or RH1). Each division of core spray and RHR is located in a separate corner room. A detailed spatial and environmental analysis of the impact on systems was not performed. However, the operators must be successful (V5=S) in isolating the LOCA to prevent core damage. In addition, the building is open to the upper elevations, and the RCIC and HPCI are judged to be capable of more severe environmental conditions. Therefore, these assumptions about impact are judged to be reasonable.

E.2.6.4 <u>Quantification Results</u>

The following summarizes end state frequencies (events per reactor-year) from the event tree quantification with credit given to operator actions:

End State	Frequency
SUCCESS	1.9×10^{-5}
SLRHR	1.3×10^{-8}
RH1	6.6×10^{-6}
RH2	2.8×10^{-7}
CS1	1.4×10^{-8}
CDBS	4.5×10^{-8}
CDBL	7.8×10^{-10}

The contribution (events per reactor-year) of initiating events to end states is summarized below:

Initiating Event	End States						
	S	SLRHR	RH1	RH2	CS1	CDBS	CDBL
VI	4.9×10^{-6}	N/A	N/A	N/A	5.4×10^{-9}	2.2×10^{-11}	2.3×10^{-13}
VR	0	N/A	1.3×10^{-6}	N/A	N/A	5.5×10^{-9}	2.2×10^{-12}
VITM	8.3×10^{-6}	N/A	N/A	N/A	9.1×10^{-9}	1.4×10^{-11}	6.4×10^{-13}
VRTM	0	N/A	5.3×10^{-6}	N/A	N/A	8.5×10^{-9}	6.4×10^{-12}
VS	6.0×10^{-6}	1.3×10^{-8}	N/A	2.8×10^{-7}	N/A	3.1×10^{-8}	7.7×10^{-10}

To investigate the importance of operator actions, the event tree quantification was repeated with no credit given for the operator. The results of this sensitivity assessment are summarized below in events per year:

End State	Frequency
SUCCESS	1.9×10^{-5}
SLRHR	1.3×10^{-8}
RH1	0
RH2	0
CS1	0
CDBS	6.9×10^{-6}
CDBL	5.7×10^{-9}

The contribution of initiating events to end states is summarized below:

Initiating Event	End State						
	S	SLRHR	RH1	RH2	CSI	CDBS	CDBL
VI	4.9×10^{-6}	N/A	N/A	N/A	0	5.3×10^{-9}	5.4×10^{-11}
VR	0	N/A	0	N/A	N/A	1.3×10^{-6}	5.2×10^{-10}
VITM	8.3×10^{-6}	N/A	N/A	N/A	0	8.7×10^{-9}	4.0×10^{-10}
VRTM	0	N/A	0	N/A	N/A	5.3×10^{-6}	4.0×10^{-9}
VS	6.0×10^{-6}	1.3×10^{-8}	N/A	0	N/A	3.1×10^{-7}	7.7×10^{-10}

E.2.7 REFERENCES

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E.2-2. TVA Drawings:

- 2-47E820-2(R008) Flow Diagram, CRD Hydraulic System
- 2-47E820-6(R000) Flow Diagram, CRD Hydraulic System
- 2-47E852-2(R010) Flow Diagram, Clean Radwaste and Drains
- 2-47E2610-85-2(R012) Mechanical Control Diagram, CRD Hydraulic System
- 2-47E2610-85-5(R006) Mechanical Control Diagram, CRD Hydraulic System
- 47E200-7(RB) Equipment Plans-Elevation 541.5' and 519'

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E.2-19. Wesley, D. A., and H. Hadidi-Tamjed, "Pressure - Dependent Fragilities for the Brown's Ferry Nuclear Plant Core Spray and RHR Systems," EQE Engineering Consultants, April 1992.

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Table E.2-1 (Page 1 of 2). Primary Containment Penetrations that Connect to Reactor Vessel - Screening			
Penetration Number	Description	Line Diameter (inches)	Screening
X-7A	Main Steam	26	Two normally open MSIVs (FCV 1-14 and 1-15) with high pressure piping.
X-7B	Main Steam	26	Two normally open MSIVs (FCV 1-26 and 1-27) with high pressure piping.
X-7C	Main Steam	26	Two normally open MSIVs (FCV 1-37 and 1-38) with high pressure piping.
X-7D	Main Steam	26	Two normally open MSIVs (FCV 1-51 and 1-52) with high pressure piping.
X-8	Main Steam Drain	3	Two normally closed MOVs (FCV 1-55 and 1-56). Third normally closed valve (1-58) in parallel with 1" line and orifice.
X-9A	Feedwater	24	Two check valves, one inside primary containment and one outside, high pressure design outside primary containment, and normally open manual valve inside. The HPCI connection has two valves in series, normally closed in addition to being a high pressure design.
X-9B	Feedwater	24	Two check valves, one inside primary containment and one outside, high pressure design outside primary containment, and normally open manual valve inside. The RCIC connections and drains have two valves in series, normally closed in addition to being a high pressure design.
X-10	RCIC Steam	3	Two normally open primary containment isolation valves (FCV 71-2 and 73-3) and FCV 71-8, 71-9 (turbine stop) are normally closed, and 71-10 (governor valve), normally open, and system is high pressure design up to turbine.
X-11	HPCI Steam	10	Two normally open primary containment MOVs (FCV-73-2 and 73-3) and FCV 73-16 and 73-18 (governor valve) are normally closed, and 73-17 (turbine stop), normally open, and system is high pressure design up to turbine.
X-12	RHR Shutdown Cooling Suction Line	20	Two normally closed primary containment isolation valves. Piping and additional closed valves outside are designed to 150 psig. Retain as interfacing LOCA path.
X-13A	RHR Injection (LPCI)	24	Check valve inside primary containment and normally closed MOV outside. An additional open MOV outside and design pressure is 450 psig upstream of the MOV. Retain as interfacing LOCA path.
X-13B	RHR Injection (LPCI)	24	Check valve inside primary containment and normally closed MOV outside. An additional open MOV outside and design pressure is 450 psig upstream of the MOV. Retain as interfacing LOCA path.
X-16B	Core Spray Injection	12	Check valve inside, normally closed MOV outside, and lower pressure design (500 psig) outside. Retain as interfacing LOCA path.
X-35A-E	TIP	1 1/2	Actual line size is 3/8 inch, with a ball valve outside and a manual explosive shear valve outside.
X-36	CRD Hydraulic System Return	4	Check valve inside primary containment (85-576) and check valve outside (85-573). Normally closed valve (FCV 85-50) outside and high pressure design.

Table E.2-1 (Page 2 of 2). Primary Containment Penetrations that Connect to Reactor Vessel - Screening

Penetration Number	Description	Line Diameter (inches)	Screening
X-37	CRD Inlets (185)	1	Small lines and high pressure design outside, including the scram discharge volume and isolation valves. If scram discharge instrument volume drains or vents fail to close after a scram, reactor vessel leakage through the CRD seals would discharge to the instrument volume and drain to the reactor building equipment drain sump. There are redundant, fail-closed, air-operated valves in each drain and vent line. There are two scram instrument discharge volumes in the reactor building.
X-38	CRD Outlets (185)	3/4	Small lines and high pressure design outside, including the scram discharge volume and isolation valves. If scram discharge instrument volume drains or vents fail to close after a scram, reactor vessel leakage through the CRD seals would discharge to the instrument volume and drain to the reactor building equipment drain sump. There are redundant, fail-closed, air-operated valves in each drain and vent line. There are two scram instrument discharge volumes in the reactor building.
X-42	SLC	1 1/2	Check valve inside primary containment (63-526) and check valve outside (63-525). Normally closed explosive valves (63 8A and B) and high pressure design up to pump discharge check valves (63-514 and 63-516).

Table E.2-2. Summary of the BWR Emergency Core Cooling System Overpressurization Events*

Plant/LER	Event Date	Percent Power	System Involved	Testable Isolation Check Valve		Normally Closed Injection Valve		Overpressurization	Events Applicable to the BFN Interfacing LOCA Analysis
				Status	Cause	Status	Cause		
Vermont Yankee LER 75-24	12/12/75	99	LPCI/RHR	Open	Unknown	Intentional but Inappropriate Opening	Monthly Testing LPCI	Yes	Yes
Cooper LER 77-04	01/21/77	97	HPCI	Open	Loose Part Obstruction	Inadvertent Opening	Personnel Errors during HPCI Functional Test	Yes	Yes
LaSalle Unit 1 LER 82-115	10/05/82	20	HPCS	Open	Dried Lubricant and Insufficient Preload in Air Operator; Opened Bypass Line	Closed	–	No	No**
LaSalle Unit 1 LER 83-066/08L	06/17/83	48	HPCS	Open	Thermal Binding; Opened Bypass Line	Closed	–	No	No**
LaSalle Unit 1 LER 83-105/01T	09/14/83	0	LPCI	Open	Maintenance Errors	Intentional but Inappropriate Opening	RHR Relay Logic Testing	No, but Drained 5,000 Gallons of RCS Water	No†
Pilgrim LER 83-48	09/29/83	98	HPCI	Open	Rusted Linkage on Air Operator	Inadvertent Opening	Personnel Errors in HPCI Logic Testing	Yes	Yes
Hatch Unit 2 LER 83-112/03L	10/28/83	90	LPCI	Open	Maintenance Errors on Air Operator	Closed	–	No	No**
Browns Ferry Unit 1 LER 84-032	08/14/84	100	LPCS	Open	Maintenance Errors on Air Operator	Inadvertent Opening	Personnel Errors in LPCS Logic Testing	Yes	Yes
Pilgrim	04/10/86	92	LPCI/RHR	Leak	Unknown	Leak	Unknown Leakage Rate is 0.5 gpm at 950 psig	Yes	No††

*The accumulated BWR operational experience for events applicable to this analysis is approximately 250 reactor-years.
**Events not included because the associated motor-operated valve remained closed and no ECCS overpressurization occurred.
†Event not included because the referred test was conducted while the plant was in cold shutdown (Reference E.2-11).
††Event not included because the combined valve leak rate is within the relief valve capacity.

Table E.2-3. Pipe Median Failure Pressures SA 106 Grade B, No Corrosion

Diameter (inches)	Schedule	Failure Pressure (psig)		
		Ambient Temperature	400°F	600°F
12	Standard	3,420	3,740	3,500
20	Standard	2,330	2,550	2,390
14	30	3,090	3,390	3,170
16	30	2,690	2,945	2,750
20	30	2,880	3,150	2,950
18	XS	3,210	3,520	3,290
24	XS	2,380	2,600	2,435
4	40	6,440	7,050	6,590
10	40	3,985	4,360	4,080

Table E.2-4. Pipe Median Failure Pressures SA 106 Grade B, 0.02 Inches Corrosion

Diameter (inches)	Schedule	Failure Pressure (psig)		
		Ambient Temperature	400°F	600°F
12	Standard	3,220	3,530	3,300
20	Standard	2,210	2,420	2,270
14	30	2,920	3,200	2,990
16	30	2,540	2,780	2,600
20	30	2,755	3,020	2,820
18	XS	3,080	3,370	3,155
24	XS	2,280	2,495	2,330
4	40	5,830	6,390	5,980
10	40	3,750	4,110	3,840

Table E.2-5. Pipe Median Failure Pressures SA 106 Grade B, 0.04 Inches Corrosion

Diameter (inches)	Schedule	Failure Pressure (psig)		
		Ambient Temperature	400°F	600°F
12	Standard	3,030	3,320	3,110
20	Standard	2,090	2,295	2,145
14	30	2,750	3,010	2,815
16	30	2,390	2,620	2,450
20	30	2,630	2,890	2,700
18	XS	2,940	3,230	3,020
24	XS	2,180	2,390	2,230
4	40	5,240	5,750	5,370
10	40	3,520	3,850	3,600

Table E.2-6. Pipe Failure Pressure Variabilities (SA 106 Grade B)	
Temperature (°F)	Lognormal Standard Deviation
Ambient Temperature	0.17
400	0.24
600	0.27

Table E.2-7. Pipe Flange Gasket Stress, Gross Leak Pressures, and Leak Areas

Flange	Eff. Gasket Stress (psi)	Act. Gasket Stress (psi)	Gasket Deflect. (inches)	Gross leak Pressure (psi)	Leak Rate at GLP (mg/sec)	Leak Rate at .25 GLP (mg/sec)	Leak Rate at .50 GLP (mg/sec)	Leak Rate at .75 GLP (mg/sec)	Leak Area at 1.25 GLP (mg/sec)	Leak Area at 1.5 GLP (sq. in.)	Leak Area at 1.75 GLP (sq. in.)	Leak Area at 2.0 GLP (sq. in.)	Bolt Stress at 2.0 GLP (psi)
10" 300'lb.	11,265	5,400	0.03	2,320	43	6	15	28	0.03	0.06	0.09	0.12	63,821
20" 150'lb.	9,549	5,400	0.03	1,114	69	6	15	30	0.06	0.13	0.19	0.26	66,502

Notes:
Bolt Yield Stress = 111,700 psi (SA-193-B7)
DGmax = 0.050 in

Table E.2-8. Bolted Bonnet Valve Gasket Stress, Gross Leak Pressure, and Leak Rate for Selected Valves

Valve Number	Valve Size (inches)	Valve Operator	Valve Type	Eff. Gasket Stress (psi)	Act. Gasket Stress (psi)	Pressure Area (sq.in.)	Preload Pressure (psi)	Gross Leak Pressure (psi)	Leak Rate at GLP (mg/sec)	Leak Area at 1.25 GLP (sq.in.)	Leak Area at 1.5 GLP (sq.in.)	Leak Area at 1.75 GLP (sq.in.)	Leak Area at 2.0 GLP (sq.in.)
74-71	18	MOV	Gate	23,662	6,900	380.133	1,558	2,013	29	0.12	0.24	0.37	0.49
74-02	20	MOV	Gate	12,856	9,000	268,803	472	1,403	5	0.10	0.20	0.30	0.39
74-46	24	MOV	Gate	35,276	6,900	754.768	1,860	2,170	41	0.30	0.60	0.89	1.19
74-559	20		Check	25,658	6,900	452.389	1,598	2,012	31	0.19	0.38	0.57	0.76

Table E.2-9. RHR Heat Exchanger Median Failure Pressures and Variabilities (No Corrosion Allowance)

Temperature (°F)	Shell-Side Cylinder		Shell-Side Head Buckling*	
	$\hat{P}$ (psig)	β	$\hat{P}_0$ (psig)	β
Ambient Temperature	2,030	0.11	3,060	0.08
200	2,020	0.14	2,760	0.10
400	2,210	0.18	2,620	0.11
600	2,170	0.22	2,225	0.13

*Assume 0.2 probability of crack formation, given head buckling occurs.
Note: All leak areas are large, uncontrolled leaks.

Table E.2-10. RHR Heat Exchanger Median Failure Pressures and Variabilities (0.100 Corrosion)

Temperature (°F)	Shell-Side Cylinder		Shell-Side Head Buckling*	
	$\hat{P}$ (psig)	β	$\hat{P}_0$ (psig)	β
Ambient Temperature	1,780	0.11	2,680	0.08
200	1,770	0.14	2,420	0.10
400	1,940	0.18	2,290	0.11
600	1,900	0.22	1,950	0.13

*Assume 0.2 probability of crack formation given head buckling occurs.
Note: All leak areas are large, uncontrolled leaks.

Table E.2-11. RHR Heat Exchanger Tube Sheet Flange Gross Leak Pressures and Leak Areas

	Eff. Gasket Stress (psi)	Act. Gasket Stress (psi)	Gasket Deflect. (inches)	Gross Leak Pressure (psi)	Leak Rate at GLP (mg/sec)	Leak Rate at .25 GLP (mg/sec)	Leak Rate at .50 GLP (mg/sec)	Leak Rate at .75 GLP (mg/sec)	Leak Area at 1.25 GLP (sq.in.)	Leak Area at 1.5 GLP (sq.in.)	Leak Area at 1.75 GLP (sq.in.)	Leak Area at 2.0 GLP (sq.in.)	Bolt Stress at 2.0 GLP (psi)
(1)	26,919	26,919	0.073	829	0	0	0	0	0.40	0.79	1.19	1.59	48,119
(2)	31,405	31,405	0.085	967	0	0	0	0	0.46	0.93	1.39	1.85	56,139
(3)	35,892	35,892	0.097	1,106	0	0	0	0	0.53	1.06	1.59	2.12	64,159
(4)	26,694	26,694	0.085	822	0	0	0	0	0.39	0.79	1.18	1.57	51,051
(5)	23,554	23,554	0.085	725	0	0	0	0	0.35	0.69	1.04	1.39	47,658

Notes:
Bolts: (56) 1-3/8" φ bolts
Gasket: O.D. = 56.5"
I. D. = 55.5"
K = 369,000 psi/in

(1) Initial Bolt Stress = 30,000 psi, Joint Relaxation = 0%.
(2) Initial Bolt Stress = 35,000 psi, Joint Relaxation = 0%.
(3) Initial Bolt Stress = 40,000 psi, Joint Relaxation = 0%.
(4) Initial Bolt Stress = 35,000 psi, Joint Relaxation = 15%.
(5) Initial Bolt Stress = 35,000 psi, Joint Relaxation = 25%.

Table E.2-12. RHR Heat Exchanger Lower Head Flange Gross Leak Pressures and Leak Areas

	Eff. Gasket Stress (psi)	Act. Gasket Stress (psi)	Gasket Deflect. (inches)	Gross Leak Pressure (psi)	Leak Rate at GLP (mg/sec)	Leak Rate at .25 GLP (mg/sec)	Leak Rate at .50 GLP (mg/sec)	Leak Rate at .75 GLP (mg/sec)	Leak Area at 1.25 GLP (sq.in.)	Leak Area at 1.5 GLP (sq.in.)	Leak Area at 1.75 GLP (sq.in.)	Leak Area at 2.0 GLP (sq.in.)	Bolt Stress at 2.0 GLP (psi)
(1)	26,230	26,230	0.071	850	0	0	0	0	0.48	0.96	1.43	1.91	48,072
(2)	30,602	30,602	0.083	991	0	0	0	0	0.56	1.12	1.67	2.23	56,083
(3)	34,973	34,973	0.095	1,133	0	0	0	0	0.64	1.27	1.91	2.55	64,095
(4)	26,012	26,012	0.083	842	0	0	0	0	0.47	0.95	1.42	1.90	51,004
(5)	22,951	22,951	0.083	743	0	0	0	0	0.42	0.84	1.25	1.67	47,617

Notes:
Bolts: (56) 1-1/2" ϕ bolts
Gasket: O.D. = 61.375"
I. D. = 60.250"
K = 369,000 psi/in

(1) Initial Bolt Stress = 30,000 psi, Joint Relaxation = 0%.
(2) Initial Bolt Stress = 35,000 psi, Joint Relaxation = 0%.
(3) Initial Bolt Stress = 40,000 psi, Joint Relaxation = 0%.
(4) Initial Bolt Stress = 35,000 psi, Joint Relaxation = 15%.
(5) Initial Bolt Stress = 35,000 psi, Joint Relaxation = 25%.

Table E.2-13. RHR Pump Gasket Gross Leak Pressures and Leak Areas

	Eff. Gasket Stress (psi)	Act. Gasket Stress (psi)	Gasket Deflect. (inches)	Gross Leak Pressure (psi)	Leak Rate at GLP (mg/sec)	Leak Rate at .25 GLP (mg/sec)	Leak Rate at .50 GLP (mg/sec)	Leak Rate at .75 GLP (mg/sec)	Leak Area at 1.25 GLP (sq.in.)	Leak Area at 1.5 GLP (sq.in.)	Leak Area at 1.75 GLP (sq.in.)	Leak Area at 2.0 GLP (sq.in.)	Bolt Stress at 2.0 GLP (psi)
(1)	21,843	21,843	0.091	1,326	0	0	0	0	0.08	0.16	0.24	0.32	67,875
(2)	24,963	24,963	0.104	1,516	0	0	0	0	0.09	0.19	0.28	0.37	77,571
(3)	28,084	28,084	0.117	1,705	0	0	0	0	0.10	0.21	0.31	0.42	87,267
(4)	21,219	21,219	0.104	1,288	0	0	0	0	0.08	0.16	0.24	0.31	71,935
(5)	18,723	18,723	0.104	1,137	0	0	0	0	0.07	0.14	0.21	0.28	68,178

Notes:
Bolts: (24) 1-1/4" φ SA 193-B7
Gasket: O.D. = 28.5"
I.D. = 27.5"
Thickness = 0.125"
K = 240,000 psi/in

(1) Initial Bolt Stress = 30,000 psi, Joint Relaxation = 0%.
(2) Initial Bolt Stress = 35,000 psi, Joint Relaxation = 0%.
(3) Initial Bolt Stress = 40,000 psi, Joint Relaxation = 0%.
(4) Initial Bolt Stress = 35,000 psi, Joint Relaxation = 15%.
(5) Initial Bolt Stress = 35,000 psi, Joint Relaxation = 25%.

Table E.2-14. Core Spray Pump Gasket Gross Leak Pressures and Leak Areas

	Eff. Gasket Stress (psi)	Act. Gasket Stress (psi)	Gasket Deflect. (inches)	Gross Leak Pressure (psi)	Leak Rate at GLP (mg/sec)	Leak Rate at .25 GLP (mg/sec)	Leak Rate at .50 GLP (mg/sec)	Leak Rate at .75 GLP (mg/sec)	Leak Area at 1.25 GLP (sq.in.)	Leak Area at 1.5 GLP (sq.in.)	Leak Area at 1.75 GLP (sq.in.)	Leak Area at 2.0 GLP (sq.in.)	Bolt Stress at 2.0 GLP (psi)
(1)	7,587	7,587	0.032	705	13	1	2	4	0.04	0.09	0.13	0.17	66,746
(2)	8,670	8,670	0.036	806	6	0	1	2	0.05	0.10	0.15	0.19	76,281
(3)	9,754	9,754	0.041	907	3	0	0	1	0.05	0.11	0.16	0.22	85,816
(4)	7,370	7,370	0.036	685	15	1	2	4	0.04	0.08	0.12	0.17	70,839
(5)	6,503	6,503	0.036	605	28	1	3	8	0.04	0.07	0.11	0.15	67,211

Notes:
Bolts: (24) 3/4" ϕ SA 193-B7
Gasket: O.D. = 18.5"
I.D. = 17.5"
Thickness = 0.125"
K = 240,000 psi/in

(1) Initial Bolt Stress = 30,000 psi, Joint Relaxation = 0%.
(2) Initial Bolt Stress = 35,000 psi, Joint Relaxation = 0%.
(3) Initial Bolt Stress = 40,000 psi, Joint Relaxation = 0%.
(4) Initial Bolt Stress = 35,000 psi, Joint Relaxation = 15%.
(5) Initial Bolt Stress = 35,000 psi, Joint Relaxation = 25%.

Table E.2-15. Master Frequency File Used To Quantify Interfacing Systems LOCA Scenarios

MODEL Name: BFNVSEQ
Master Frequency File: MFFVSEQ

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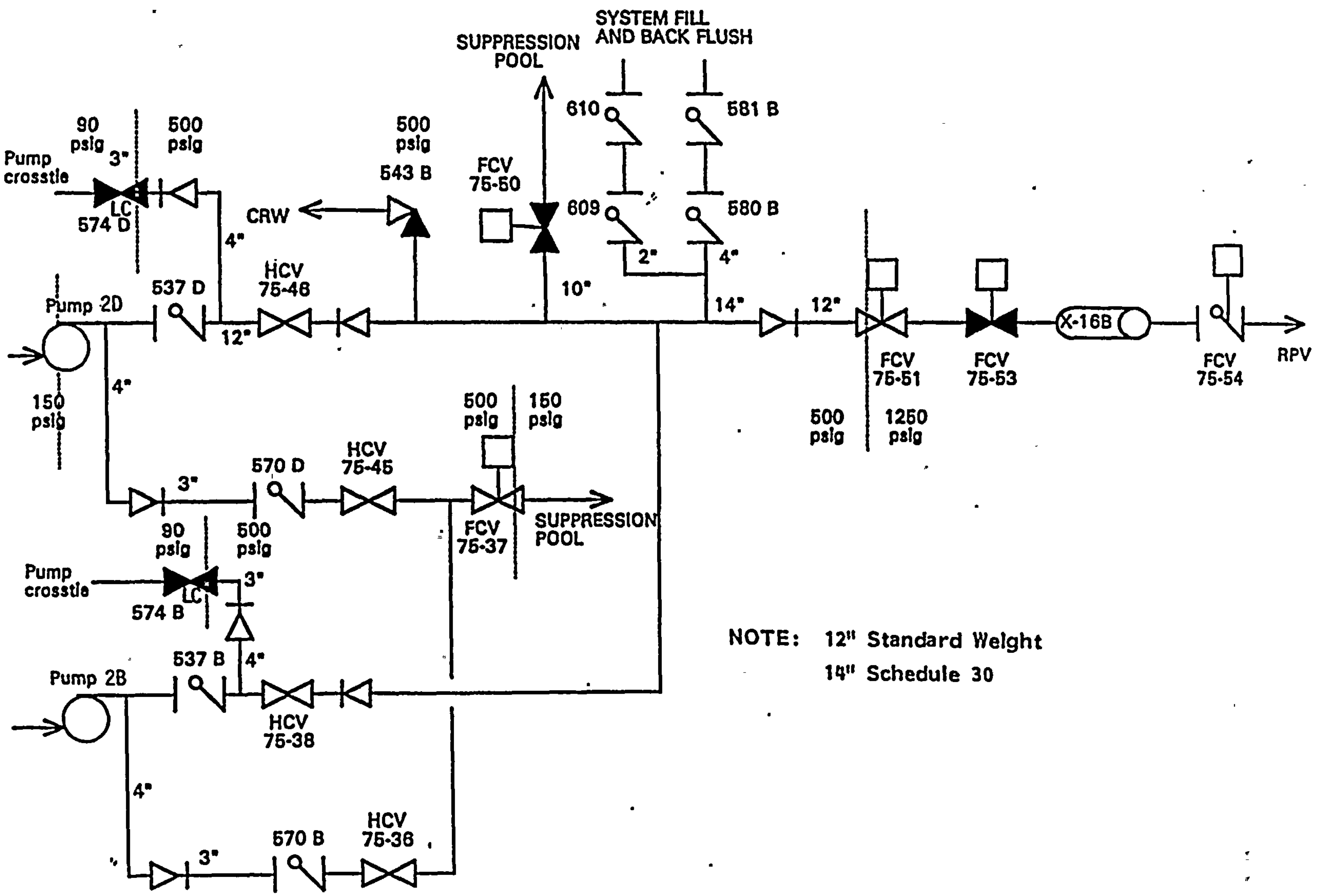
SF Name...	Top.......	SF Value...	Split Fraction Description..................
V11	V1	2.2000E-03	SYSTEM PUMPS ISOLATED ALL OTHER INITIATORS
V1S	V1	0.0000E+00	SYSTEM PUMPS ISOLATED INIT=VI+VR+VITM+VRTM
V21	V2	5.3000E-02	INITIAL LEAK SMALL INIT=VS
V22	V2	1.1000E-01	INITIAL LEAK SMALL INIT=VI
V23	V2	4.0000E-01	INITIAL LEAK SMALL INIT=VR
V24	V2	4.8000E-01	INITIAL LEAK SMALL INIT=VITM
V25	V2	7.5000E-01	INITIAL LEAK SMALL INIT=VRTM
V2F	V2	1.0000E+00	INITIAL LEAK SMALL DEFAULT CONDITION
V31	V3	1.0000E-04	SYSTEM REMAINS INTACT INIT=VI+VITM
V32	V3	1.0000E-03	SYSTEM REMAINS INTACT INIT=VR+VRTM
V33	V3	1.0000E-04	SYSTEM REMAINS INTACT ALL OTHER INITIATORS
V41	V4	1.0000E-03	LEAKAGE GREATER THAN GLP INIT=VI+VITM
V42	V4	1.0000E+00	LEAKAGE GREATER THAN GLP INIT=VR+VRTM
V43	V4	5.0000E-02	LEAKAGE GREATER THAN GLP ALL OTHER INITIATORS
V51	V5	1.0000E-01	OPERATOR ISOLATES LOCA INIT=VS AND SMALL LEAK
V52	V5	1.6000E-03	OPERATOR ISOLATES LOCA INIT DURING TM AND LARGE LEAK
V53	V5	1.6000E-03	OPERATOR ISOLATES LOCA INIT DURING TM AND SMALL LEAK
V54	V5	4.2000E-03	OPERATOR ISOLATES LOCA INIT=VI+VR AND LARGE LEAK
V55	V5	4.2000E-03	OPERATOR ISOLATES LOCA INIT=VI+VR AND SMALL LEAK
V5F	V5	1.0000E+00	OPERATOR ISOLATES LOCA ALL OTHER INITIATORS



NOTE: 12" Standard Weight
14" Schedule 30

Figure E.2-1. Core Spray Injection Division B

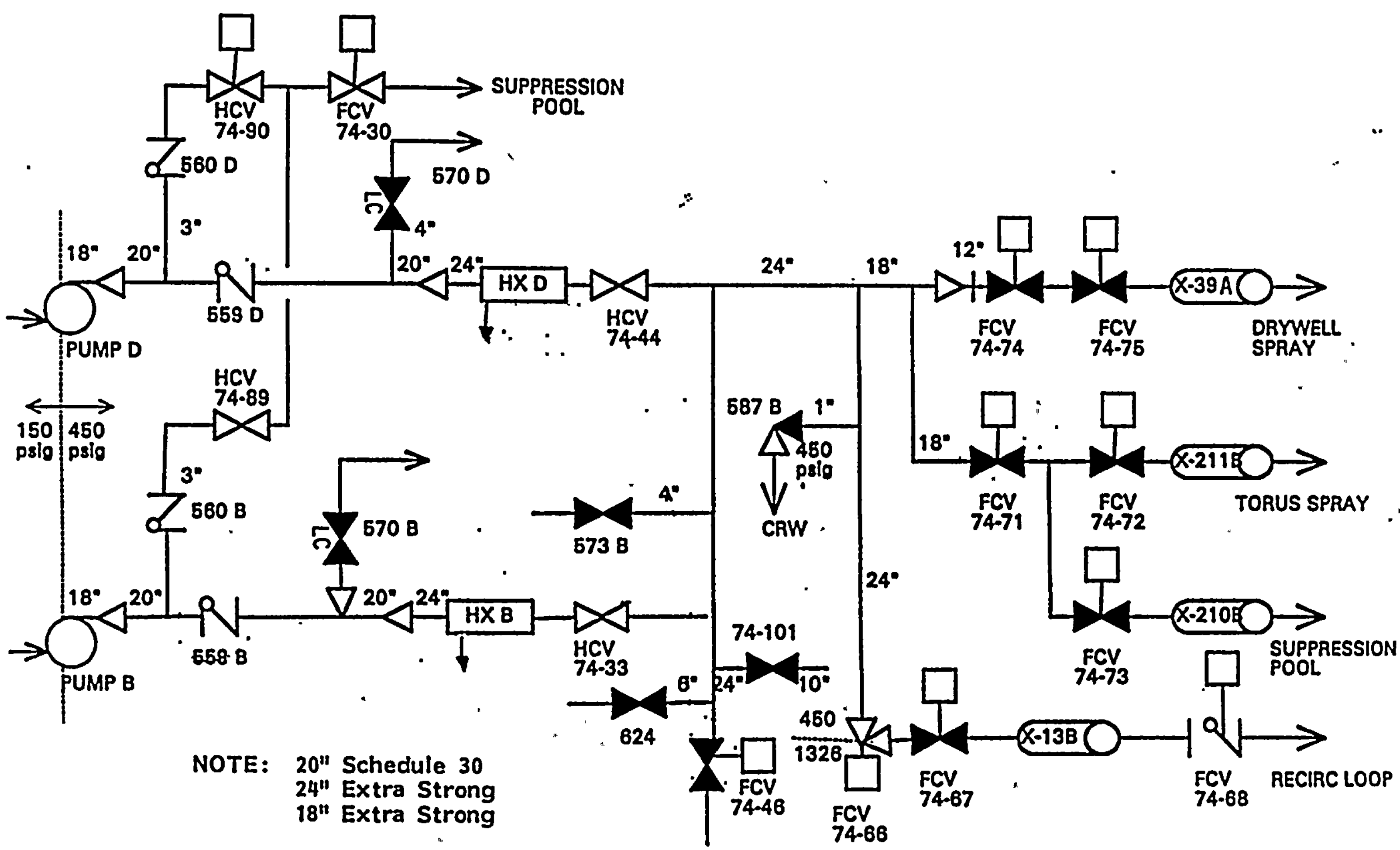


Figure E.2-2. RHR Injection Division B

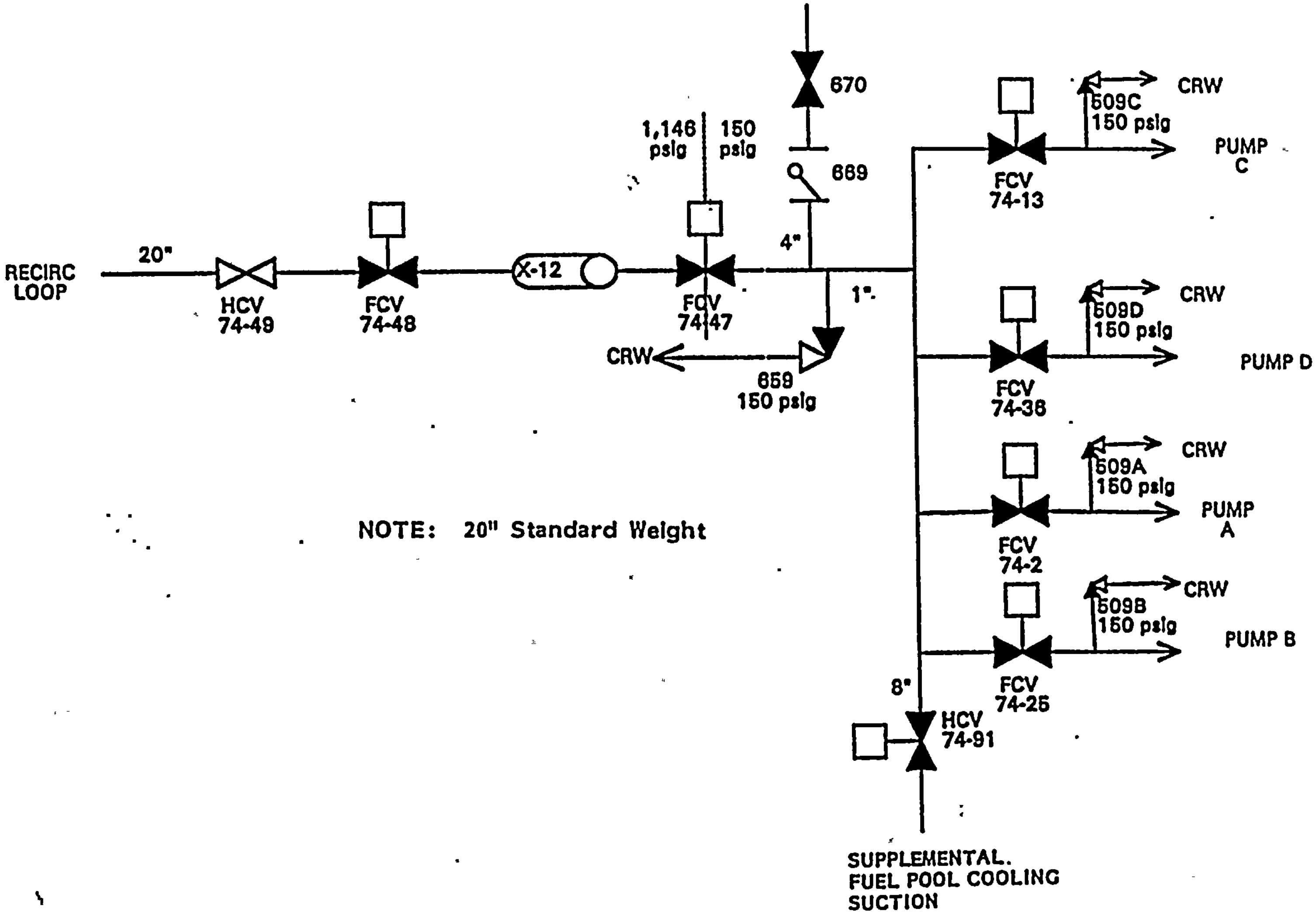


Figure E.2-3. RHR Shutdown Cooling Suction Line

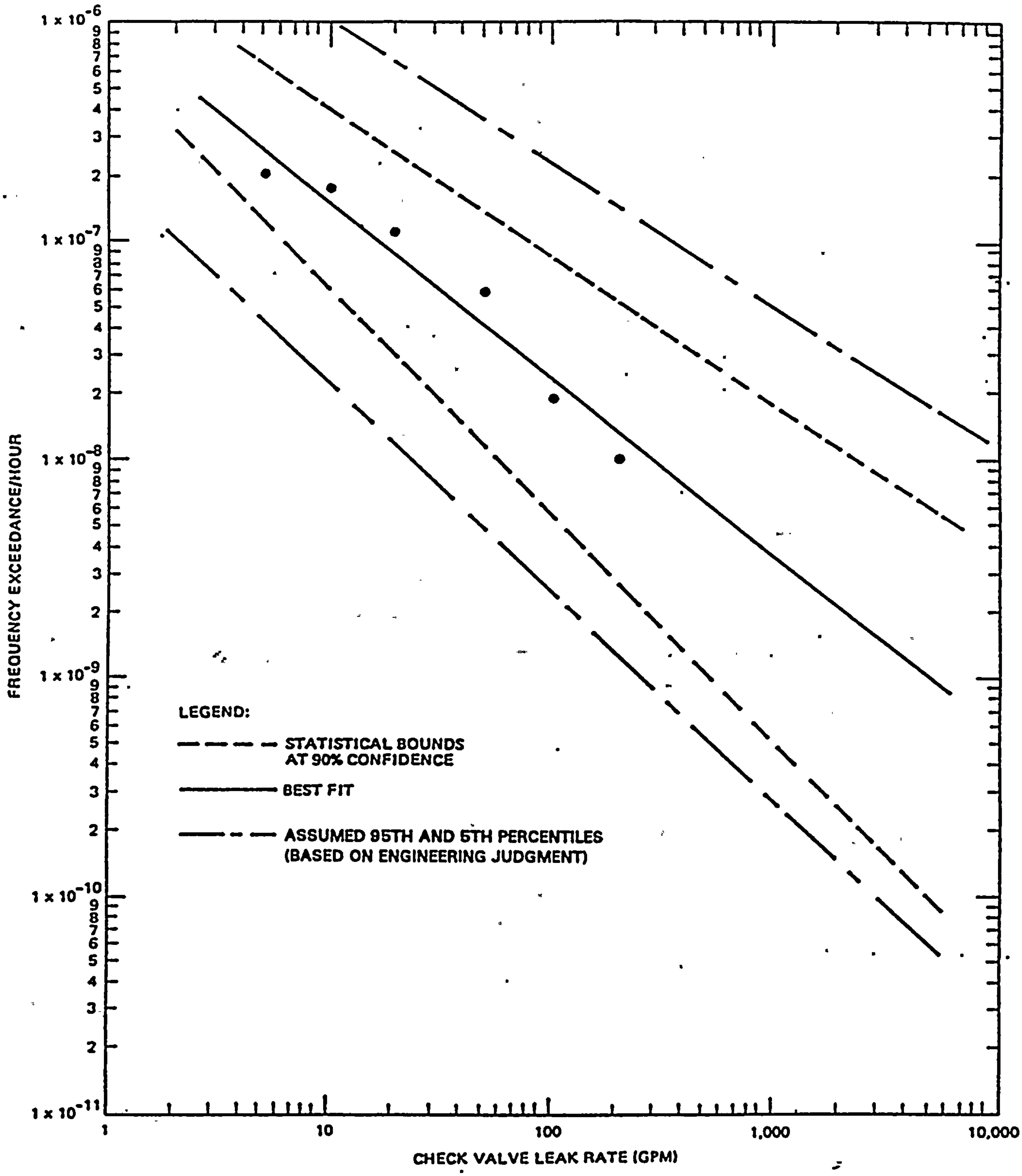


Figure E.2-4. Frequency of Check Valve Leakage Events

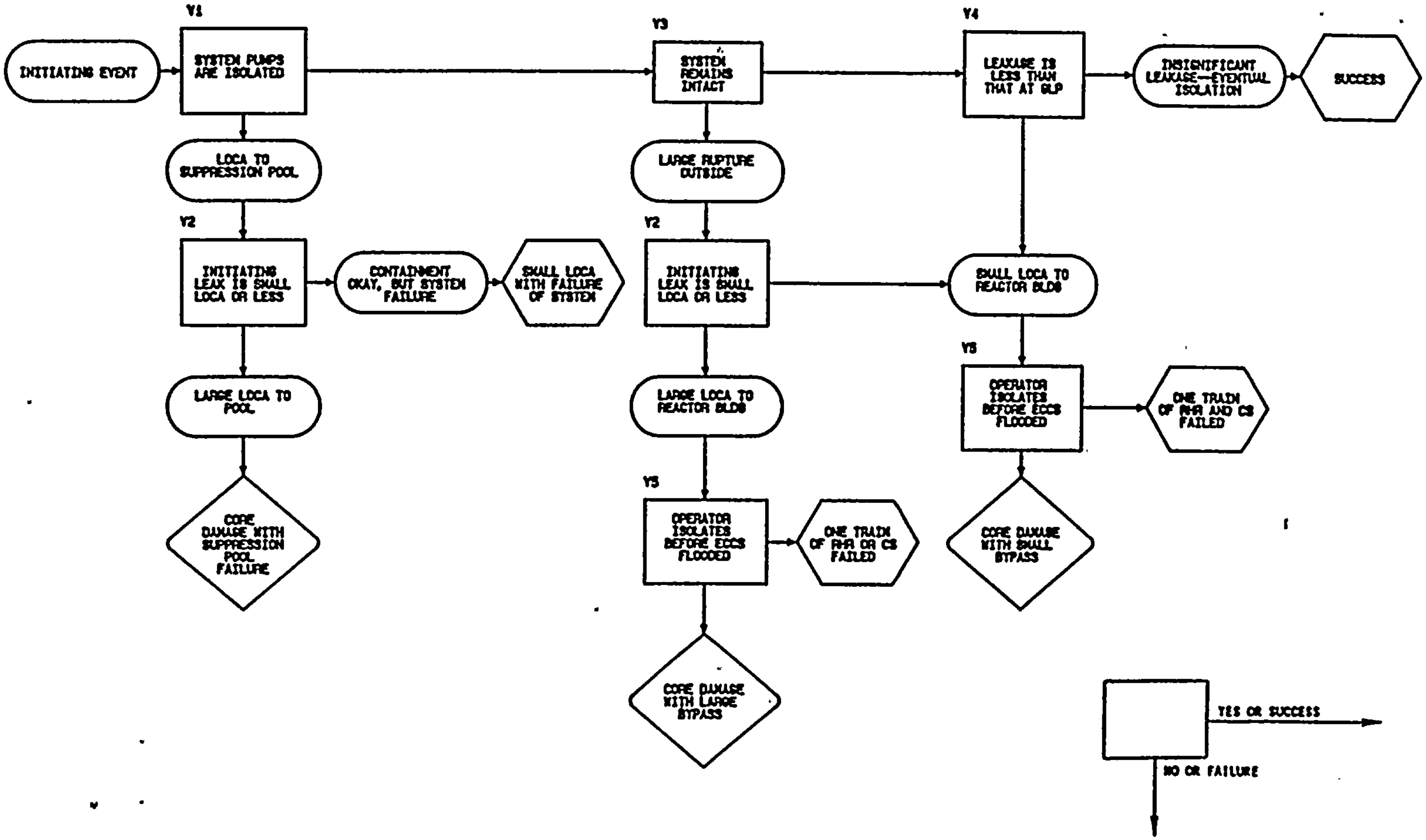
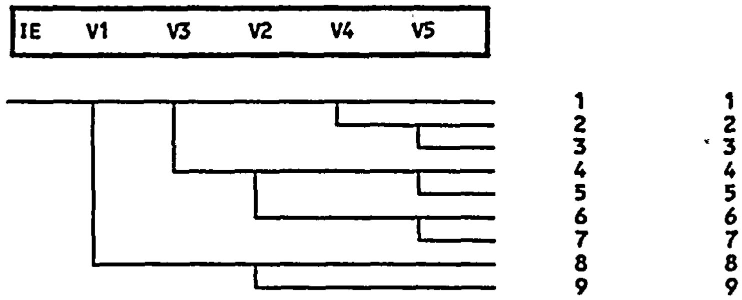


Figure E.2-5. RHR and Core Spray Interfacing LOCA Event Sequence Diagram



Top Event Designator.....	Top Event Description............................
IE	Initiating Event
V1	SYSTEM PUMPS ISOLATED (NOT TO POOL)
V3	SYSTEM REMAINS INTACT (NO RUPTURE)
V2	INITIAL LEAK SMALL (LESS THAN 600 GPM)
V4	LEAK LESS THAN GLP (NO SMALL LOCA)
V5	OPERATORS ISOLATE LOCA

Figure E.2-6. Interfacing Systems LOCA Event Tree

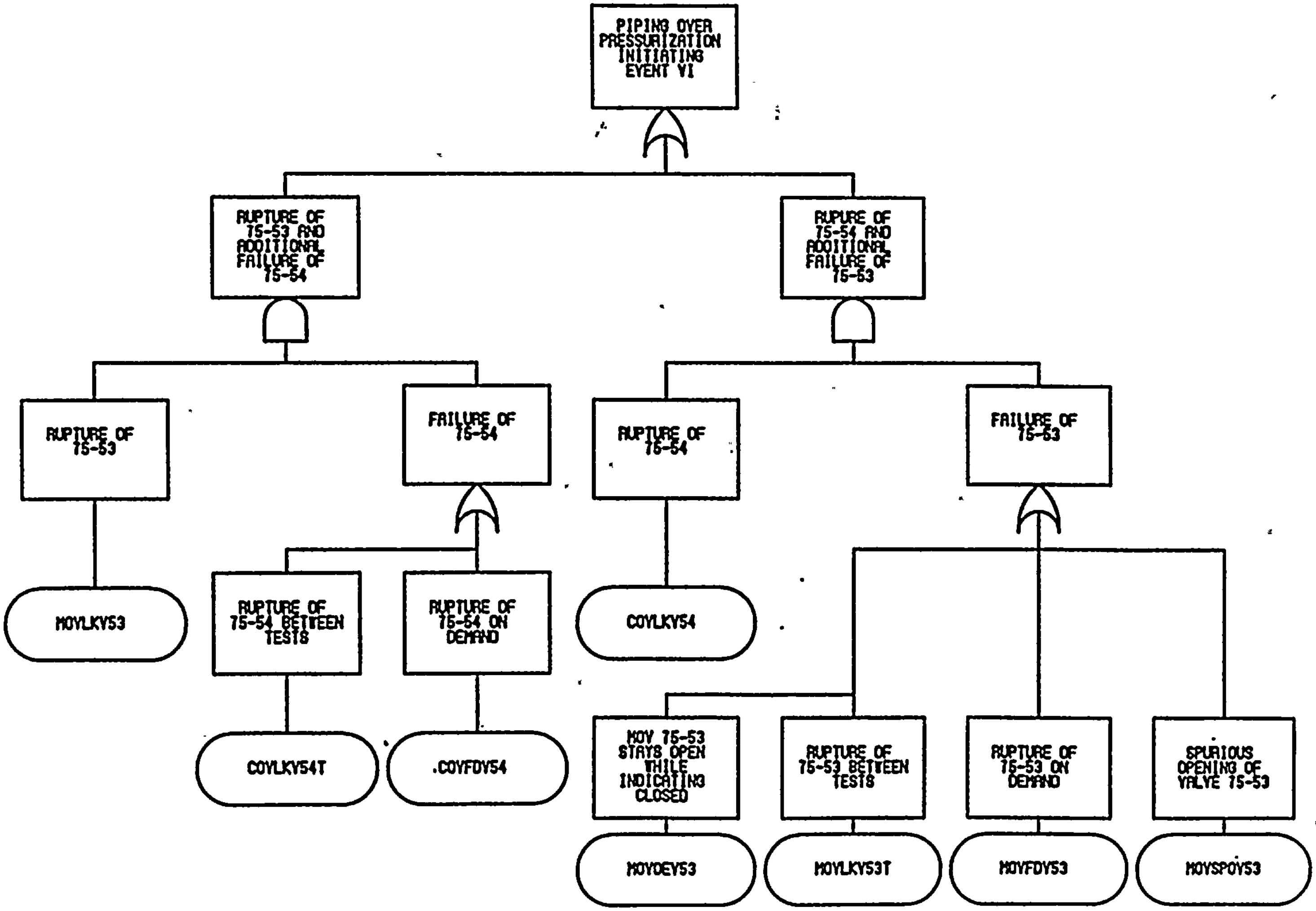


Figure E.2-7. Equipment Failure — Core Spray Injection Fault Tree

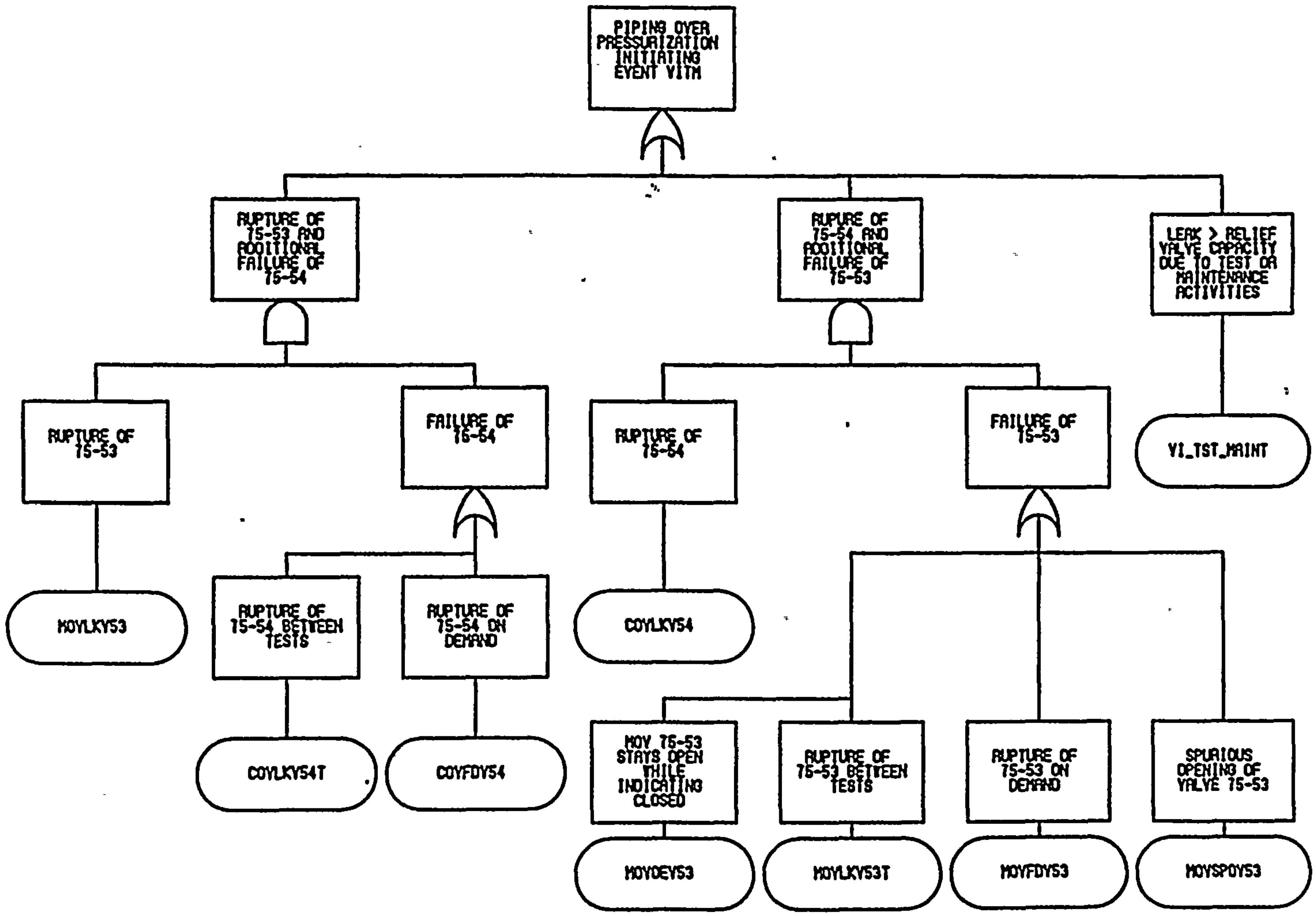


Figure E.2-8. Test and Maintenance Activities — Core Spray Injection Fault Tree

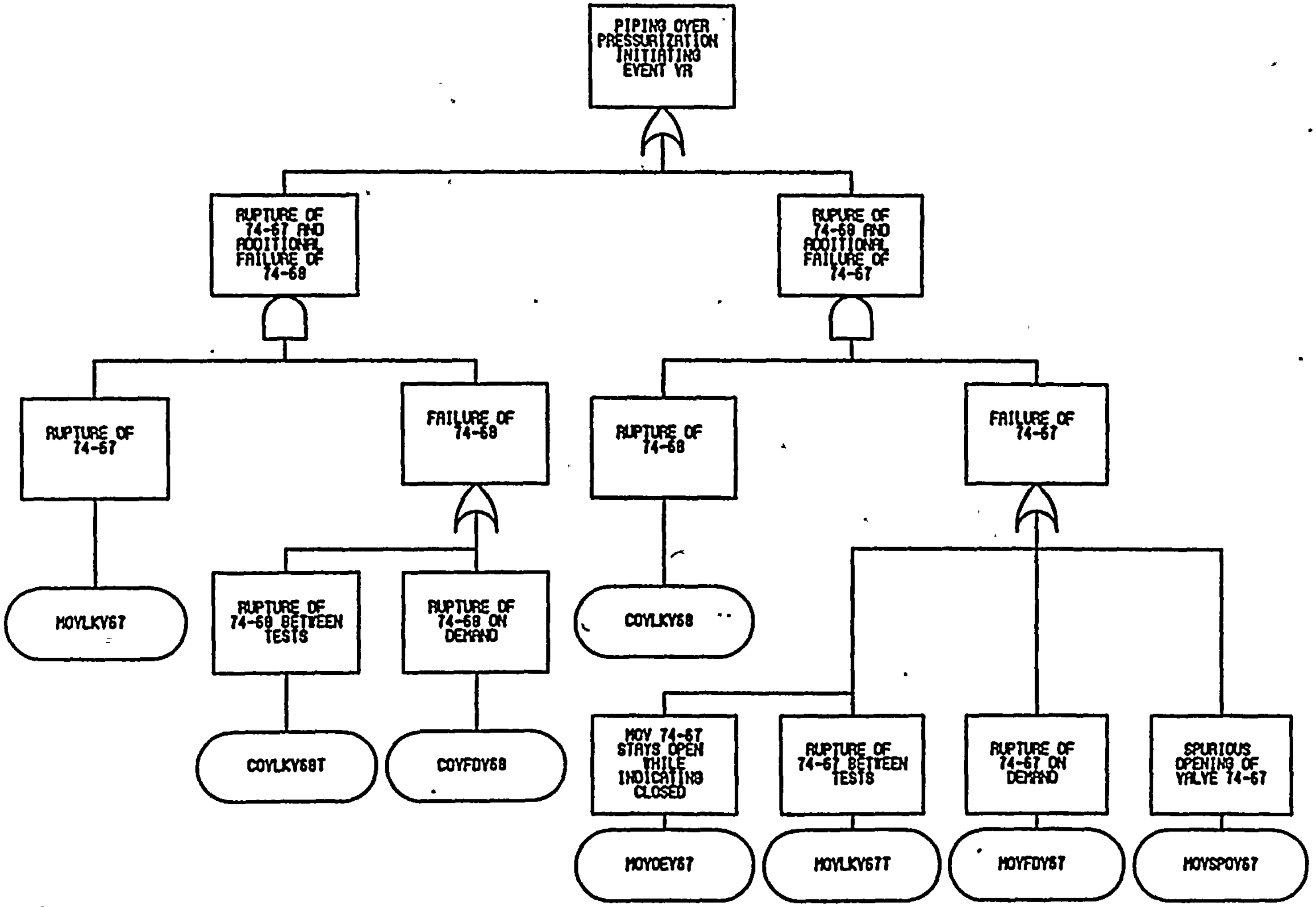


Figure E.2-9. Equipment Failure — RHR Injection Fault Tree

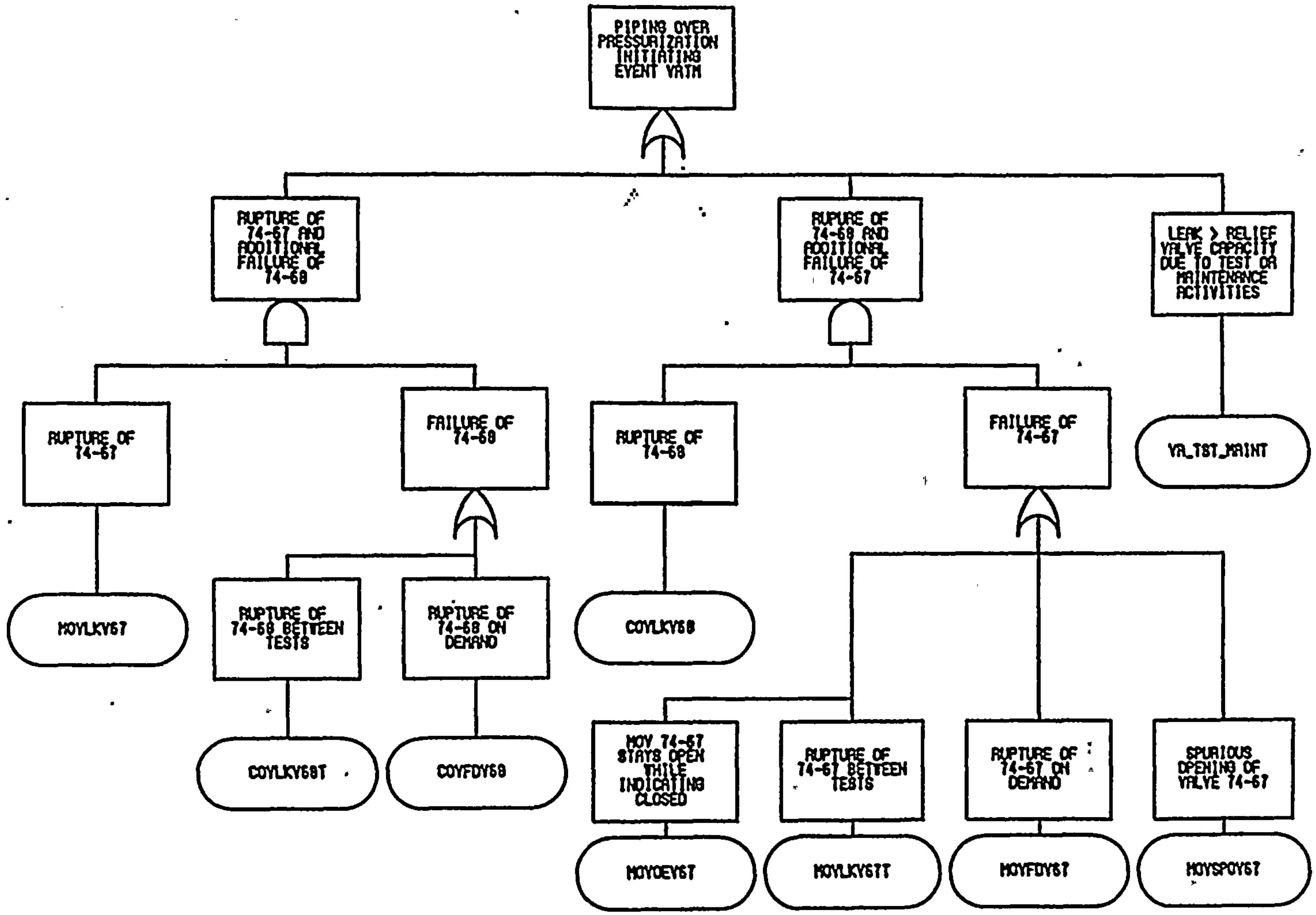


Figure E.2-10. Test and Maintenance Activities — RHR Injection Fault Tree

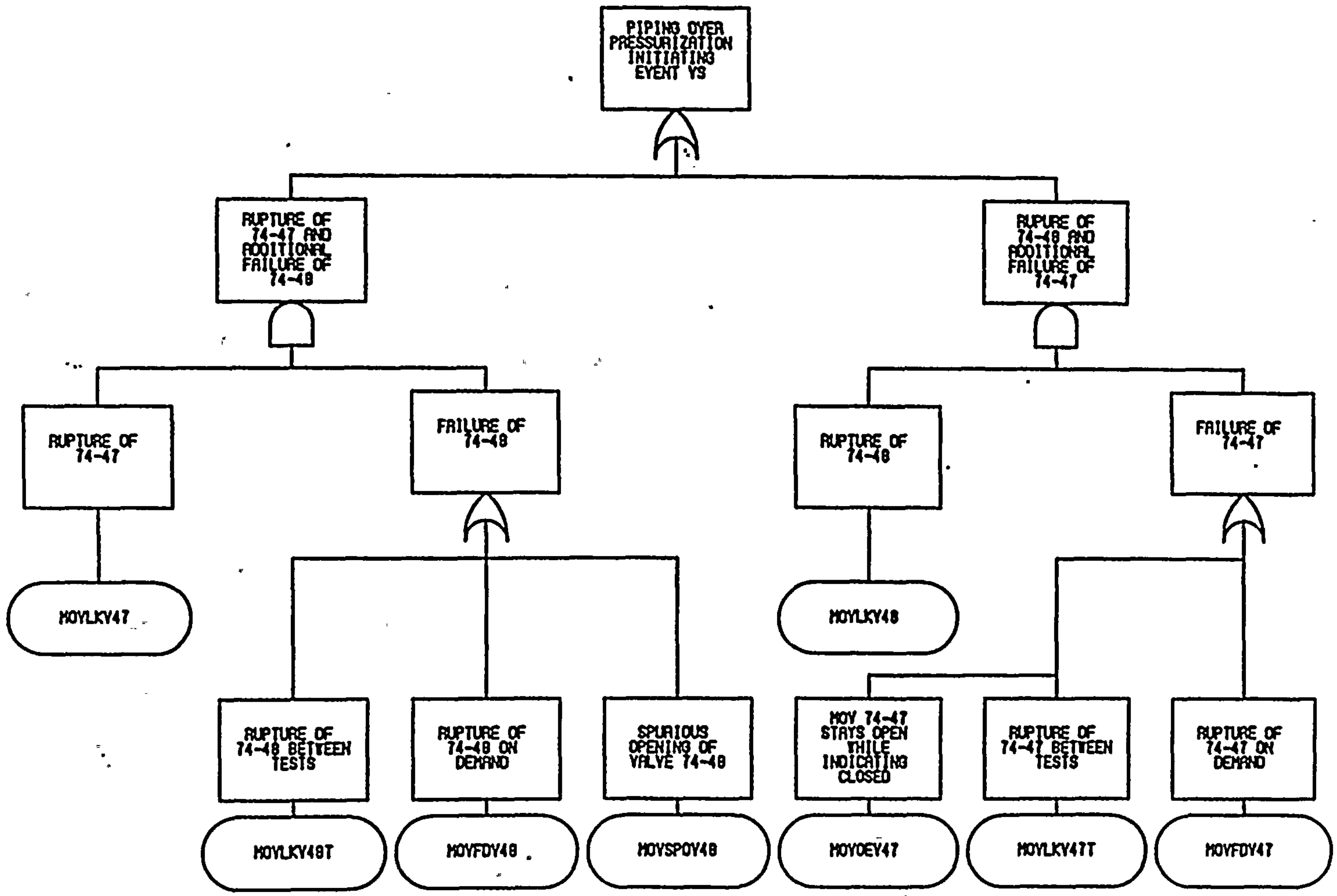


Figure E.2-11. RHR Suction Line Fault Tree