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Common Cause Fault Rates for Instrumentation and Control Assemblies

Estimates Based on Licensee Event Reports at U.S. Commercial Nuclear Power Plants, 1976-1978

Prepared by C. L. Atwood

EG&G Idaho, Inc.

Prepared for
U.S. Nuclear Regulatory
Commission

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ABSTRACT

This report presents estimates of common cause fault rates and related quantities, based on Licensee Event Reports of instrumentation and control assemblies in nuclear reactors. The Licensee Event Report data base is briefly described, and imperfections in the data are discussed. The components are grouped into assemblies, for which rates are estimated. For estimating rates, the binomial failure rate model is used, extended to allow for the substantial observed plant-to-plant variability, and for shocks that by their nature cause all the assemblies in a system to fail. Every quantity is estimated by both a point estimate and a 90% interval. All rates are expressed per calendar hour.

FIN No. A6283

Licensee Event Report Failure Rate Analysis Program

SUMMARY

This report presents estimates of common cause fault rates and related quantities, based on Licensee Event Reports of instrumentation and control assemblies in nuclear reactors.

The data consist of 529 Licensee Event Reports describing instrumentation and control faults from 1976 through 1978. The term "fault" includes both failures and command faults. A fault may involve complete inoperability, or merely reduced capability. The components are not considered individually, but instead are grouped into the following assemblies: digital channels, sensing devices, signal conditioning systems, and main steam line radiation monitors. The populations for these assemblies are given. Imperfections in the data are discussed.

Common cause faults are defined as faults that are synchronized by some external shock. Both human errors and hardware failures may act as shocks. The report distinguishes between a nonlethal shock, which causes a random number of assemblies to fail, and a lethal shock, which by its nature causes all of the assemblies in the system to fail.

Examination of the data reveals very little homogeneity from one kind of assembly to another, or from plant to plant. Therefore, the rates are assumed to vary, and distributions are fitted to the data, both for the rate of individual faults, i.e., those not due to common cause, and also for the rate of common cause events when there are enough data. Estimates of the other quantities of interest are then found, based on the binomial failure rate model, extended to allow for lethal shocks. Rates are estimated both for complete inoperability faults and for reduced capability faults. Every quantity is estimated by both a point estimate and a 90% interval. Many of the intervals are quite wide, reflecting the observed plant-to-plant variability. All the rates are expressed per calendar hour.

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INTRODUCTION

Common cause faults are defined, for this report, as faults that are synchronized by some external shock to the system. The seriousness of several components simultaneously failing due to a single cause makes it essential to estimate the rate at which they fail simultaneously. Therefore, this report presents estimates of common cause fault rates and individual fault rates for instrumentation and control (I&C) assemblies in nuclear power plants.

There are many kinds of I&C components, which can be combined at various levels of detail into "assemblies." We choose to define assemblies that are as large as possible, as long as they are realistic from an engineering viewpoint and tractable with our statistical methods. These assemblies are then considered as the basic entities, for which fault rates are to be found.

The data are Licensee Event Reports (LERs). They are described and discussed in the first portion of this report. Two common cause aspects of the data are considered in detail: correctly classifying reported events as common cause events or not, and deciding which groups of assemblies in a plant might be susceptible to simultaneous failure due to a common cause shock.

Vesely's[1] binominal failure rate (BFR) method is used to estimate the common cause rates and related quantities of interest. Every quantity of interest is estimated both by a point estimate and by a 90% interval. Many of the intervals are rather wide, reflecting the substantial plant-to-plant variability evident in the data.

A section of the report discusses how to use BFR estimates in applications such as fault tree analyses.

All the basic methodclogy is described in the body of the report. Certain technical details not covered in the references are given in Appendix A. The required plant information, including calendar hours and I&C assembly populations, is given in Appendix B. The estimates themselves are found in Appendix C. Appendix D consists of a listing of one-line summaries of all the data, and a separate listing of summaries of the reported common cause events.

THE DATA

Event Reports

The raw data consist of 529 LERs, describing I&C faults in U.S. nuclear power plants. The LERs describe events occurring between January 1, 1976, and December 31, 1978, and are summarized by Miller, et al.[2] They involve 41 pressurized water reactors (PWRs), i.e. those designed by Babcock & Wilcox, Combustion Engineering, and Westinghouse, and 24 boiling water reactors (BWRs), i.e. those designed by General Electric. Reports of events that occurred before a plant's initial criticality date are not considered.

The basic information for each plant is tabulated in Appendix B. An additional PWR, Arkansas Nuclear One, Unit 2, is considered in Reference 2. This plant is not considered here, because its I&C system is a very different from that of the other plants, and because less than one month of data is available for this plant in the 1976-1978 time period.

Reference 2 actually contains 1833 LERs. Only 529 are used in this report because only the populations of certain components or systems are known. Without known populations, rates cannot be determined. In particular, Reference 2 only gives populations for I&C systems that directly initiate a reactor trip. So, for example, no populations are given for I&C systems that simply actuate engineered safety features; they are not considered because they do not directly initiate a reactor trip. In addition, Reference 2 gives populations only in systems that monitor either flow, temperature, pressure, level, radiation, or neutron flux, directly from the primary coolant system. For example, no populations are given for I&C systems that initiate a trip based on the voltage across a reactor coolant pump supply breaker, or based on the position of a valve; they do not monitor any of the six listed quantities directly from the primary coolant system. Finally, Reference 2 does not give populations for any portion of a plant's logic matrix. For this report, more detailed population information was obtained than that given in Reference 2. However, the scope is still limited to those systems for which Reference 2 gives populations. For more details concerning the scope and completeness of the data, see pages 1-15 of Reference 2.

One-line summaries of the daa are presented in Appendix D. These summaries are also printed separately for different groups of assemblies, accompanying the estimates in Appendix C. To aid in checking for possible common cause, underscores are used to separate unrelated lines. Lines not so separated describe events that occurred at the same plant on the same date. Appendix C also contains some tabular summaries of the data, giving the total numbers of various kinds of faults.

Except for the common cause coding, the letter and number codes printed in the one-line summaries of Appendixes C and D all have the same meanings as in Reference 2. The codes are briefly explained in a table in Appendix B. In the one-line summaries, the following information is given on each line:

Vendor: This code tells whether the plant was designed by Babcock & Wilcox, Combustion Engineering, Westinghouse, or General Electric.

Plant: This is a three-character code identifying the plant.

Control Number: This is the unique six-digit identifier assigned to the LER. If a single LER refers to more than one diesel generator or more than one date, the control number for this line has another character appended: an asterisk, or a letter A, B, C, etc.

Failure Date: The month, day, and year are given.

System: This code identifies the kind of assembly, for example, source range flux detector or containment pressure switch.

Component: This identifies the failed component within the assembly, such as a comparator or an amplifier. For digital channels (switches) and main steam line radiation monitors, the component is not specifically identified.

Parameter: This code identifies the quantity detected, for example, temperature or neutron flux. It is defined if the assembly is a sensing device, digital channel, or radiation monitor. It is not defined if the assembly is a signal conditioning system.

Failure Mode and Cause: These codes classify the kind of fault. The code for mode means either reduced capability or inoperability. The code for cause might mean, for example, personnel error--maintenance or drift.

Type: This code tells whether the event is a failure or a command fault, whether it is an individual fault or caused by a common cause shock, and whether it is recurrent or not.

Failure Number: This tells the number of assemblies that were inoperable, or for a single assembly, the number of times it was inoperable as reported by this line.

Activity: This tells when the fault was discovered, for example, during normal operation or during maintenance.

Mode Description and Cause Description: These are very condensed narratives from the LER.

There are two failure modes of interest. The first is inoperability, when the component does not function at all. The second failure mode is reduced capability, when the component is operational but does not perform its function within defined limits.

There is another important distinction, between failure and command fault. An event is a failure if the component itself needs work--repair or replacement in the case of inoperability, and adjustment or calibration in the case of reduced capability. An event is a command fault if the component does not operate (at all, or with full capability) because of external inputs or lack of inputs. A command fault is corrected, not by doing anything to the component, but by correcting the inputs.

For example, suppose that an operator fails to trip a bistable. Then the bistable does not perform the desired function, even though it does not need repair or adjustment. This is an inoperability command fault of the bistable. Now suppose instead that the operator incorrectly calibrates the bistable's set point. This is a reduced capability failure of the bistable, because the bistable itself needs adjustment.

In the data for this report, less than 3% of the one-line summaries describe command faults. Therefore failures and command faults are considered together, as faults, and estimated fault rates are given. The text of this report is often expressed in terms of failures rather than faults, because "fail" is a more convenient verb than "be inoperable or have reduced capability." However command faults should be understood to be included, unless the context clearly rules this out. Both modes--inoperability and reduced capability--are common and of interest. Therefore, fault rates are estimated separately for inoperability faults and for reduced capability faults.

Defining Instrumentation and Control Assemblies

The term "instrumentation and control" encompasses a large number of diverse components. This makes instrumentation and control data much harder to handle than data for, say, pumps or diesel generators. It is not practical to treat each kind of component separately, because it would be impossible to get all the population counts, and because many components would have few or no observed failures.

Therefore, the components must be grouped somehow. A natural way would be to consider a channel, a sequence of components that performs a single function, such as initiation of reactor trip based on a high reactor coolant temperature. There are pitfalls to this, however, because some components perform multiple functions. This section describes how the components are grouped into "assemblies." An assembly will be treated as an entity, and its fault rate will be estimated.

The simplest kind of assembly that we consider is a digital channel. It consists simply of a sensing device and a trip point. The output signal is digital, either on or off. Such channels are used when monitoring pressure or level, commonly in BWRs and occasionally in PWRs. In the event descriptions of LERs, they are called pressure switches or level switches.

The other kind of channel is an analog channel. In this, the flow of information proceeds as follows.

Something is detected by one or more sensing devices. The quantity detected may be flow, temperature, radiation, pressure, liquid level, neutron flux, or something else. This quantity is coded as parameter in the LER one-line descriptions. Only the six parameters just mentioned are used in this report. The sensing device is itself actually a system, with components such as wires, amplifiers, diodes, and a transmitter. Regardless of the level of detail reported in an LER, any fault involving a sensing device has the component coded as sensor or transmitter.

From the sensing device, an electrical analog signal is sent through one or more cables, possibly with intermediate amplifiers. The signal usually goes through a converter or conditioner, altering the signal. For example, the converter might change any pulse above a certain size to a square wave and filter out smaller pulses. The signal may then be sent to a computation module, for example, to count pulses per second. If several sensing devices feed one computation module, the module may calculate a difference, an average, or a maximum. Finally, the resulting signal is sent to a bistable, or comparator, which compares the signal to some reference value, and as a result puts out a signal that is either on or off.

The entire sequence described above, from the sensing device through the bistable, is called an analog channel in Reference 2. This definition will also be used in this report.

For most kinds of analog channels, the statistical analysis is complicated by the facts that the number of sensors varies from channel to channel, and that some components act as parts of several channels. For example, in reactor coolant flow channels, Westinghouse plants have one sensor per channel, while Combustion Engineering plants have one sensor per loop per channel. Reactor coolant flow sensors are also used in Babcock & Wilcox and General Electric plants, but only in conjunction with neutron flux. As another example, in PWRs, reactor coolant pressure sensors are used both for a direct trip due to high pressure, and for a more complicated trip based on pressure and temperature. The exact relationship depends on the vendor.

The statistical methods of this report only allow estimation of fault rates for independent entities. If the entities are channels, they cannot have components in common and still act independently.

Therefore, we are forced to consider most analog channels in two parts, the sensing device and the (signal) conditioning system. The signal conditioning system is defined as all of the analog channel except for the sensing device, i.e., everything after the sensing device's transmitter up through the bistable(s). Sometimes signal conditioning systems contain portions in common. For example, most BWRs have two flow units, which do not cause trips directly, but which provide inputs to six average power range monitors (APRMs). In such a case, each portion is considered as a separate signal conditioning system. In the example just mentioned, each flow unit and each APRM is considered as a conditioning system.

There is one kind of analog channel that is treated as a single entity, both in Reference 2 and here. This is the main steam line radiation monitor in BWRs. This channel is the only one considered that monitors radiation. It does not share components with any other channel, so there is no reason to decompose it.

In summary, fault rates are estimated for four basic entities, or assemblies:

- o digital channels (switches)
- o sensing devices, for analog channels
- o signal conditioning systems for analog channels
- o main steam line radiation monitors.

The assemblies are listed, with their populations, in diagrammatic form in Appendix B.

Populations

The populations given in Appendix B are taken, when possible, from plant Final Safety Analysis Reports. Other sources of information are vendors' standard technical specifications, and in a few cases Nuclear Power Experience,[3] individual LERs, or discussions with cognizant personnel. When all other sources are incomplete, the populations are extrapolated from similar plants. This extrapolation is often necessary.

The populations used for this report are not taken directly from Reference 2, although they have been carefully compared with the notes that were used in writing that report. The present populations should be thought of instead as a thorough revision of those of Reference 2, incorporating many corrections and much more detail. They should be examined by people possessing more accurate plant information, for further correction in later reports.

Imperfections in the Data

Two kinds of difficulty are discussed here--imperfections in obtaining and coding the data, and problems in interpreting the results.

Imperfections in Obtaining and Coding the Data

As mentioned in the preceding section, the population counts are not entirely accurate. Also, some LERs may have been overlooked when computer word searches of all LERs were used to build the data base. Miller, et al.,[2] thoroughly discuss the latter concern, and conclude that the data base probably contains a little over 90% of all the LER I&C data.

The data coding of Reference 2 was thoroughly reviewed for this report, and about 220 (about 38%) of the one-line descriptions were changed in some way. About 60 of these changes did not affect the conclusions of this report at all, since they only involved a more consistent definition of "recurrent." Other changes were very important, because they involved the common cause coding. These changes were expected, because the common cause coding of Reference 2 was intended to be quick and tentative, to flag common cause candidates for further consideration in this report. One more cause of changes was the knowledge we had acquired as we gathered more detailed population information on the plants. Having learned better what assemblies could be involved for reactor trip at each plant, we were able to recognize errors and inconsistencies in the LERs, and so were able to correct some of the coding.

In two LERs, the number of failed assemblies is not stated and cannot be inferred. These are discussed individually with the estimates in Appendix C. See the sections there on pressure switches and on reactor coolant temperature sensors.

A final imperfection in the data base is present because the LERs sometimes provide incomplete information, especially concerning the cause of the failures. This may lead to incorrect classification of the event in the data base. A letter is often written to follow up the LER. This was read whenever a one-line description or event classification was questioned, and the coding of the event was changed if appropriate. To minimize the effect of possible misclassification, every event involving more than one assembly or involving a common cause fault was checked at least twice. The effect of data misclassification is discussed in the section, "Common Cause Classification."

Problems in Interpreting the Results

The LER reporting policy varies from plant to plant. Therefore, plant rates can be compared only with great caution. A plant's high failure rate may be attributable to a strict reporting policy. It is not known how much the reporting rate varies, or how important a contributor it is to the substantial plant-to-plant variation observable in the data.

Another problem of interpretation arises from the reporting requirements for LERs. An LER is often submitted only if a prescribed safety requirement has been violated.

For example, an LER from Monticello says that on August 5, 1978, "it was discovered that 1 APRM scram trip was 4 to 5% low. One other APRM in that channel was bypassed, leaving one operable APRM in the channel. Technical Specifications 3.1.A requires two operable APRMs per channel." The implication is that the one low APRM would not have been reported if a second APRM had not already been bypassed. Other LERs contain similar statements.

Another example is found in a LER from Dresden 1. After reporting the drift of five in-core amplifiers on April 28, 1977, the report comments, "The in-core amplifiers have occasionally exhibited trip points above the Tech. Spec. Limit." Such allusion to unreported events is not uncommon in LERs.

An attempt is made in Appendix A to assess the effect of missing data, by using derivatives of the parameter estimates. Although it is beyond the scope of this report to estimate the number of events unreported in the LERs, the derivatives of Appendix A can be used to approximate the effect of any presumed rate of underreporting. See the section, "Effect of Data Inaccuracies." The LER system was not designed to provide a data base for estimating fault fates. Those who use the rates of this report should be very careful with their interpretation, recognizing that not all the faults that occurred appear in the data.

COMMON CAUSE CLASSIFICATION

In order to estimate the rate of common cause faults, it is necessary to determine which events in the data set are common cause faults and which are not. The crucial question for each event is: "Was there some shock, external to the I&C assembly or assemblies under consideration, that caused or could have caused simultaneous faults?" Synchronization of the faults is essential, because the importance of common cause faults stems from the serionsness of several assemblies failing simultaneously.

For example, at Nine Mile Point on May 26, 1978, two APRMs were found to have cross-connected leads from two flux detectors. At Dresden 1 on April 28, 1977, six in-core flux amplifiers in (apparently) five conditioning systems were found to have drifted high, because of high temperatures when the control room air conditioning was being repaired. At Kewaunee on February 6, 1978, all four pressurizer pressure sensors transmitted readings that were too high, because they had been calibrated with a procedure that did not include a head correction. The shocks were, respectively, the rewiring of the APRMs during the previous refueling outage, the abnormally high temperature, and the calibration using the incorrect procedure.

Notice that in the first two examples the number of failed assemblies was random--each shock could potentially have affected a different number of assemblies. On the other hand, the calibration with an incorrect procedure was lethal--by its very nature it caused all the pressure sensors to fail. In a later section, it will be necessary to distinguish between lethal and nonlethal shocks.

Because most shocks cause a random number of assemblies to fail, there may be a shock causing exactly one I&C assembly to fail. When the data are examined, it is usually possible to decide whether an assembly failed on its own or from some shock that could potentially have caused other assemblies to fail. For example, at Millstone 2 on February 9, 1977, a set point for a reactor coolant low flow signal conditioning system was set high, because someone misinterpreted the instructions for determining the set point. At Cook 1 on October 7, 1976, a feedwater flow sensor was giving an incorrect signal, apparently because a technician had made an error in valving out the transmitter. Both events are coded as common cause. In each case, the shock is taken to be the presence of personnel. Faults due to personnel error are often coded as common cause. This is based on the assumption that if a person can make a mistake affecting one assembly, the same mistake can potentially be made at the same time on other assemblies.

As can be seen, the coding of common cause events involves some judgment on the part of the coder. An inadvertent experience with diesel generator data, described by Atwood and Steverson,[4] sheds some light on the importance of the coder's judgement. After all the estimates had been calculated, Atwood and Steverson reexamined the diesel generator data, and changed the common cause coding of eight faults, each involving one diesel generator. Two failures became common cause; five command faults became common cause command faults; and one common cause command fault became not common cause. So there was a net increase of six common cause faults, each involving only one diesel generator. This was in a data base of 369 LERs, with 25 events initially coded as common cause. Of the estimates that would be used in a fault tree, one of them, r_2, changed by almost 25%. This is about 5% of the length of the interval for r_2. The changes are smaller for the other quantities that would be used directly in fault trees. This suggests that the coder's judgement has a noticeable but not overriding effect.

One kind of event does not fit naturally in the shock model. This is an event in which the failure rates of several assemblies are increasing simultaneously. A common I&C example is instrument drift. In such cases, the failures are not fully synchronized, because there is no well-defined shock hitting all the instruments and causing essentially simultaneous failure. On the other hand, the assemblies do not fail independently with constant failure rate because, if the instruments are initially calibrated at the same time, each instrument's likelihood of failure increases with time.

For this report, the decision was made not to count instrument drift as a common cause event, unless there was some other synchronizing factor causing the drift, such as abnormally high temperature. This affected the classification of many of the LERs, as shown by a count of the one-line descriptions with failure cause coded "14":

	Number of Lines	Lines Coded as Drift	Lines Coded as Drift (%)
Digital Channels	82	64	78
Sensors	164	65	40
Conditioning Systems	275	90	33
Radiation Monitors	26	5	19
Total	547	222	41

EXAMINING THE DATA FOR STRUCTURE

The Scope of Common Cause Events

Assemblies that are simultaneously susceptible to a common cause shock need to be considered together. Such a group of assemblies will be called a (common cause) system. This term should not be confused with signal conditioning system. Conditioning systems are assemblies, and are grouped together into common cause systems.

Of the 29 common cause events that affected more than one assembly, all but two affected assemblies of the same kind, for example, two of the four feedwater flow sensors at Kewannee, or three of the four reactor liquid level switches at Brunswick 2, or all six APRMs at Hatch 2. Therefore, the common cause systems are simply taken to be the systems of I&C assemblies shown in Tables B-3 through B-10 of Appendix B, with two exceptions.

The two exceptions, dictated by the data, are these. (a) At Oconee 1 on August 6, 1978, an operator failed to reset the trips for all four nuclear power channels and all four power/flow channels. Only Babcock & Wilcox plants have both kinds of channels, but at each of these plants, the nuclear power and power/flow conditioning systems must be grouped together as a single system containing eight assemblies. (b) At Beaver Valley on May 12, 1976, an operator failed to trip one overpower/delta T bistable and one overtemperature/delta T bistable. These channels only are present at Westinghouse plants, but at these plants, the overpower/delta T and overtemperature/delta T conditioning systems must be grouped together in a single common cause system.

Other systems of assemblies are not combined, because it is more conservative to use many small groups than to use fewer large groups. See Atwood,[5] pp. 8 and 54, for a discussion of this. On the other hand, it is not desirable to break down systems of assemblies of the same kind into even smaller groups, because 18 common cause events involved most or all of the assemblies of a given type.

Future augmentations of the data may require changes in this grouping of assemblies.

Variability in the Fault Rates

Whenever possible, it is desirable to pool similar data, to get as precise fault rate estimates as possible. Examples would be pooling the data from plants of similar design, or from similar kinds of assemblies such as all flux detectors or all pressure switches. Therefore, this report presents generic rates, for the 12 classes of assemblies listed in Table 1.

Within any of these classes of assemblies, the fault rates show substantial plant-to-plant variability. There is also some variation in the rates from system to system. For example, the five systems of pressure switches show some apparent differences in their fault rates. But the plant-to-plant variability is dominant, as discussed below.

As a first step in estimating fault rates, the variability in the rates must be quantified. Suppose that the variability in some fault rate is to be modeled. The rate may be the rate of individual (i.e., not common cause) events, or, if enough data are present, the rate of nonlethal common cause events or the rate of lethal common cause events. The data sources are the different systems at the different plants, for example the five systems of pressure switches, which are present at most of the 65 plants. To model the variation among the different plants and systems, assume that the rate has a two-parameter gamma distribution. A gamma distribution is used because it is a convenient distribution covering the range $(0,\infty)$. Some other distribution, such as lognormal, might work equally well. Based on the observed faults, find the maximum likelihood estimates of the two unknown parameters. This gives a gamma distribution that fits the data. An interval covering 90% of the fitted distribution is an approximate 90% interval for the fault rate. That is, the probability that such an interval will include a randomly chosen new fault rate (say, from a similar system at a plant not yet analyzed) is aproximately 90%. (If not enough faults are observed to

TABLE 1. ASSEMBLIES FOR WHICH RATES ARE ESTIMATED
(Codes in parentheses)

Pressure switches (RP, CP, VP, OP, FP)
Reactor liquid level switches[a] (RL)
Scram discharge volume water level switches[a] (VL)
Source range flux sensing devices (SN)
Intermediate range flux sensing devices (IN)
Power range and wide range flux sensing devices, except for LPRMs[b] (PN, WN)
LPRMs[b] (PN)
Reactor coolant temperature detectors (RT)
Pressure sensors (RP, SP, CP)
Flow and level sensors (SF, FF, RF, SL, PL)
Signal conditioning systems[c] (SN, IN, PN-NF, RN, DT, NT-TT, RT, RP, TP, RF, FF, SL, PL, SP, CP, FU)
Main steam line radiation monitors (SR)

a. No faults were reported for system VL in the period from 1976 through 1978. This is believed to be due to underreporting rather than lack of faults. Therefore separate rates are estimated for the RL and VL level switches.

b. Local power range monitors (LPRMs), the power range flux sensing devices in Model 2-4 BWRs, have a much lower estimated individual fault rate than do other power range flux sensors. Therefore, LPRMs are treated separately.

c. For estimating common cause rates, the systems PN and NF are treated as a single system, as are the systems NT and TT. This is discussed in the section "The Scope of Common Cause Events."

make plant-to-plant variation evident, then a confidence interval rather than a tolerance interval must be used.)

It is conceivable that the fault rate is strongly influenced by the type of plant (BWR or PWR), or by the system. For example, treating the systems of pressure switches separately might result in five short tolerance intervals, covering different ranges, rather than one long tolerance interval. There would be one interval for containment pressure switches, one for reactor coolant pressure switches, etc. Although such a breakdown might conceivably help, in fact it does not. Therefore, system-specific rates are not given, except to the extent that single systems coincide with the classes given in Table 1.

Flow sensors and level sensors are combined as a single class in Table 1. The two kinds of sensors are mechanically similar because they both measure differences in pressure, and their fault rates are very similar.

Typically, most of the plants show no faults, while a few may show recurrent faults. This results in highly skewed fitted distributions. They have a maximum at zero, a long flat tail to the right, and a 90% interval that is orders of magnitude wide. While such a distribution is not what a risk analyst desires, it does reflect the great variability in the data. Occasionally, a single plant or system has so many recurrent faults that it is an outlier, i.e., it is clearly different from the other plants or systems. However, no outliers are so far out that they have to be excluded. For details, see the first section of Appendix A.

ESTIMATING FAULT RATES USING AN EXTENDED BFR MODEL

The Model

Let m be the number of assemblies in a system at a plant. For example, a system might consist of the four reactor coolant temperature detectors in a plant, or the six APRMs. The model assumes that there are three possible kinds of failure:

1. Each assembly can fail individually, and has a constant failure rate λ.

2. A common cause shock can occur in a system, with constant occurrence rate μ. If a shock occurs, the assemblies in the affected system fail independently of each other, each with probability p, so the total number of failed assemblies is random. Vesely[1] calls this the binomial failure rate (BFR) model, because the number of failed assemblies, given that a shock occurs, is a binomial(m,p) random variable. Estimators using this model are developed by Vesely[1] and Atwood.[5,6] These shocks are called <u>nonlethal shocks</u>, to distinguish them from the shocks defined below.

3. A <u>lethal shock</u> can occur in a system, with constant occurrence rate ω. A lethal shock, by its very nature, causes every assembly in the affected system to fail. The number of failed assemblies is not random, but must equal m.

This third kind of event occurs often enough in the I&C data that it must be included it in the model. For example, at Dresden 2 on March 27, 1978, all the main steam line radiation monitor setpoints were set high, because of a typographical error in the procedure. At Browns Ferry 3 on November 28, 1978, all the LPRMs of all 43 strings were found reverse connected to the six APRMs, because of lack of proper explanation of how to connect them. Such events normally involve a procedural error or a personnel misunderstanding.

There are a number of quantities of interest. (The notation for p, λ, and μ agrees with Reference 5. The quantity λ_+ is called λ_+' in that reference.) The quantities are

λ	=	failure rate for an individual assembly, not counting failures due to common cause shock
μ	=	rate of nonlethal shock occurrences
p	=	probability that a specific assembly fails, given that a nonlethal shock occurs.
$\lambda_+ = \mu(1 - q^m)$	=	rate of nonlethal shocks that cause at least one assembly failure, i.e., rate of visible nonlethal shocks (here, $q = 1 - p$)
ω	=	rate of lethal shock occurrences
$r_1 = \lambda + \mu p + \omega$	=	rate at which a specific assembly fails, either due to individual failure or due to a shock
$r_k = \mu p^k + \omega$, for $k \geq 2$	=	rate at which a specific set of k assemblies fails simultaneously (due to a shock)
$\beta = [\mu p(1 - q^{m-1}) + \omega]/r_1$	=	long-term fraction of assembly failures that occur in multiple failures; called the beta factor by Fleming.[7]

The quantities r_1, r_2,... are the relevant rates for fault tree analysis. For, if a cut set of a fault tree involves k assemblies, $k \geq 1$, then the relevant rate is r_k, and the probability that the k assemblies all fail in a short time is $r_k t$ plus terms of order t^2. The use of r_1, r_2, etc., is discussed in the section "Application," and in Appendix A. The expression given for β ignores the time for discovery and repair of failures.

The basic BFR model, as defined in Reference 1, only includes events of the first two kinds. Including the third kind, lethal shocks, has two advantages. First, it models the data more accurately, if lethal shocks are observed, without making the model much more complicated. For some kinds of I&C assemblies, notably for signal conditioning systems, there are so many lethal shocks that the basic BFR model, without such shocks, does not adequately fit the data. Second, inclusion of the lethal shock rate, ω, puts a floor underneath the estimates of r_k, below which they cannot sink. The basic BFR method estimates r_k as μp^k, for $k > 1$. If p is small and k is large, then μp^k can be microscopic. Using $r_k = \mu p^k + \omega$ keeps r_k up at a realistic level, because the Bayes estimate of ω is always positive (even when the observed number of lethal shocks is zero).

Estimation

This section briefly describes the estimation procedure based on the above model. The Bayesian methods developed by Atwood[5,6] are used, extended to allow for plant-to-plant variation and lethal shocks.

The point estimates given are Bayes means. The mean is used, rather than the mode or the median, because it is usually the largest of the three, and in fact often the only one of the three that is not virtually zero. (The median is used for β, because the mean is difficult to compute). It should be realized that when the distribution has a large variance, then no single point--be it median, mean, or some other point--adequately identifies the location of the distribution. The interval estimates given are Bayes 90% intervals, with a 5% probability in each tail.

The use of Bayesian methods is unavoidable, because classical non-Bayesian methods do not give confidence intervals for complicated expressions such as r_1, or even for simple expressions such as p when the data are obtained from systems with different numbers of assemblies. The Bayesian distributions used are either estimated directly from the data, to reflect the apparent variability in the parameters, or else are calculated in the usual way based on diffuse prior distributions. Therefore, the results obtained should not differ markedly from non-Bayesian results, if the latter were obtainable.

First, if enough faults are observed, a gamma distribution is fitted to the observed individual faults of the pumps. This was described in the section "Examining the Data for Structure," and defines a distribution for the parameter λ. For signal conditioning systems, enough common cause faults are also reported to allow a gamma distribution to be fitted to the nonlethal common cause events, and for reduced capability faults to allow a distribution to be fitted to the lethal events; this gives distributions for λ_+ and ω.

Any variability in p, from plant to plant or shock to shock, is not estimated, because a method for doing this has not been developed. Therefore, standard Bayesian methods are used to get posterior distributions for p, for λ when few or no individual faults are observed, and for λ_+ and ω when few or no common cause events occurred. For p, an approximately noninformative prior distribution is used, as described in Reference 5, pp. 16-17. For λ, λ_+, or ω, a noninformative prior distribution is used, proportional to $\lambda^{-1/2}$, $\lambda_+^{-1/2}$, or $\omega^{-1/2}$.

The quantities p, λ, λ_+, and ω are treated as fundamental. The distributions of all the other quantities are obtained from the distributions of the four fundamental quantities, using the equations relating the parameters in the preceding section. Unfortunately, these equations involve m, the number of assemblies in the system in question. Therefore, estimates of μ, β, and r_k, $1 \leq k \leq m$, are found separately for each value of m. Then overall estimates are given, which do not depend on m, as follows. As a point estimate, the median of the point estimates is used. (If the number of point estimates is even, the larger of the two possible medians is used.) As a conservative interval, the smallest lower bound and the largest upper bound are used.

ESTIMATES

The estimates are given in Appendix C for the groups of assemblies listed in Table 2. Depending on the application, either failure mode may be of interest. Therefore, for each group of assemblies, two sets of estimates are given, one for inoperability faults and one for reduced capability faults. Every estimate is given as a triple of numbers, showing the lower limit, the point estimate, and the upper limit. The point estimate is the mean of the Bayes posterior distribution. (For the beta factor, the median rather than the mean is shown.) The upper and lower limits form a 90% interval. Appendix C also contains summaries of the data used to produce the estimates, both tabular summaries and printouts of the one-line summaries of the LERs. A few comments precede each set of estimates.

Application of the estimates is discussed in the next section.

DISCUSSION

Application

All the rates given are per calendar hour. Those who want rates in other units, such as per demand, must perform their own conversions. Users may also wish to adjust the estimated rates to account for presumed under-reporting; see the earlier section "Problems in Interpreting the Results."

The uncertainty intervals should be used, not just the point estimates. There is great variability from one plant to another, so many of the intervals are quite wide, and use of the point estimates alone is overly naive. In some cases, the lower bound is many orders of magnitude less than the point estimate. This happens when most of the plants or systems show no faults, but some of them show several faults. In such cases the distribution has a spike at zero and a very long flat tail. So the lower bound should be regarded as unknown, but essentially zero, and the point estimate should be thought of as a crude way to characterize a wide distribution.

Consider now the effect of delayed discovery of faults. Suppose that an assembly becomes inoperable or develops reduced capability during a time interval t, but that the fault is not discovered until the assembly is tested at the end of the time interval. Faults in the other assemblies are also not discovered until the end of the time interval. If the interval is long enough, then a substantial portion of the simultaneous faults may not be common cause faults, but rather may be individual faults that were not discovered promptly.

In Appendix A, the section "How to Obtain Probabilities from Rates" gives the general method for using the estimated rates to estimate probabilities, for example, the probability that at least three out of four assemblies fail during a time period t. Using the general method, approximations can be found if t is not too large, such as

$$P(\text{1 specific assembly fails}) \doteq r_1 t$$

and

$$P(\text{k specific assemblies fail}) \doteq (\lambda t)^k + r_k t$$

for $k \geq 2$. These approximations are accurate to at least one significant digit if, in the first case, $r_1 t < 0.1$, and in the second case, if $\lambda t < p/10$ and $r_k t < 0.1$. The more general methods of Appendix A should be used if it is too large for these approximations, e.g. if reduced capability faults in main steam line radiation monitors are under consideration, λ is the upper end point of the 90% interval, p is the point estimate, and t is one month (720 hours).

The formulas just given should look familiar to fault tree analysts. In particular, if $k = 2$, $r_2 t$ is used in the way that $\beta r_1 t$ is often used by analysts. The formulas given here are more general than those obtained by the beta-factor method, because they recognize that systems can have more than two assemblies. (The ratio r_k/r_1 would be a beta factor for k assemblies, and the value given in this report as <u>the</u> beta factor is a compromise among these values.)

Diagnostic Check

A final diagnostic check on the BFR assumptions is performed. The statistical details are given in Appendix A, but the idea of the check is this. If the BFR assumptions are correct, then the number of assemblies affected by any (future) nonlethal shock is a binomial(m,p) random variable. Once p has been estimated, the observed numbers of affected assemblies can be compared with the numbers predicted by the BFR assumptions. If they differ greatly, then the BFR assumptions should be questioned. The comparisons are performed by looking at the standardized residuals, defined as

(observed number - expected number)/standard deviation.

There is one residual for the number of common cause events involving exactly one assembly, one residual for the common cause events involving exactly two assemblies, etc. If the BFR assumptions are correct for the data set, then all the residuals should be small.

In many cases, there are no observed nonlethal common cause faults, so the check cannot be performed. In other cases, there is only one such fault, so the residuals have little meaning. In the cases with two or more observed shocks, the largest standardized residual occurs when reduced capability faults are analyzed in signal conditioning systems. Shocks occurred in systems with up to six assemblies, so there are six standardized residuals, corresponding to one through six failed assemblies. They are, respectively, 1.79, -1.30, -1.71, 1.15, 1.52, and -0.18. The largest absolute value is approximately 1.8. This means that no observed count is more than about 1.8 standard deviations from its estimated expected value. Therefore, this investigation finds no strong evidence of departure from the binomial distribution.

CONCLUSIONS

Estimates have been found for common cause fault rates and related quantities. The estimates are based on LERs for I&C assemblies for 1976 through 1978. Because the LER data base seems to be incomplete, the estimates should be used with care.

All the rates presented are per calendar hour. Every quantity has been estimated by both a point estimate and a 90% interval. The width of the intervals reflects both statistical uncertainty, due to the random nature of the data, and also the actual substantial variability in the fault rates from plant to plant or system to system.

How to use the estimates in applications has been discussed. A diagnostic check shows no marked departure in the data from the assumptions of the model.

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APPENDIX A
TECHNICAL DETAILS OF METHODOLOGY

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TECHNICAL DETAILS OF METHODOLOGY

Fitting a Gamma Distribution to the Data

Suppose that λ has a gamma(a,b) distribution, and that, given λ, the number of faults of an assembly has a Poisson(λt) distribution. Then it is not hard to show that the unconditional distribution of the number of faults is negative binomial with parameters a and bt (see Johnson and Kotz[A-1]). Therefore, the maximum likelihood estimates of a and bt can be found numerically, based on the exposure times and observed failures for the assemblies.

To illustrate this, consider the individual inoperability faults in signal conditioning systems. There are 449 groups of conditioning systems at the various plants, such as the group of 4 nuclear power conditioning systems at Calvert Cliffs 1 (CC1-PN) or the group of 3 reactor coolant pressure conditioning systems at Beaver Valley (BV1-RP). When a gamma distribution is fitted to the 147 faults from these 449 sources, the estimated parameters are 0.258 and 1.272E-5, the estimated mean of the distribution is 3.287E-5, and the estimated 90% interval is (7.960E-11, 1.575E-5). The single group of 4 nuclear power conditioning systems at Fort Calhoun (FC1-PN) had 13 faults in 26304 hours. If a and b were equal to their estimates, the probability of getting at least 13 faults in 4 x 26304 assembly hours is only 0.000053. Therefore, the probability that at least one of the 449 data sources would be as extreme as this is approximately 449 x 0.000053 = 0.024. In fact, FC1-PN is influencing the estimates of a and b, so this calculation makes FC1-PN look better than it is. Using estimates based on all the data sources except FC1-PN gives 449 x 0.000009 = 0.004 as the probability of seeing a data source as extreme as FC1-PN. The data source is clearly an outlier.

If FC1-PN is excluded, and a gamma distribution is fitted to the remaining data, the estimated parameters are 0.325 and 9.069E-6, the estimated mean is 2.948E-6, and the estimated 90% interval is (6.399E-10, 1.314E-5). That is, the mean shrinks by 10% (or by 3% of the length of the original interval), and the upper end point shrinks by 17%. These changes are not considered large enough to justify the complication of giving special treatment to the single data source FCl-PN. The rates are estimated based on all the data, which is conservative.

The above case was chosen to illustrate the method because it is the only case with an outlier problem.

How to Obtain Probabilities from Rates

When using the model of this report, the key to evaluating probabilities is to condition on the number of nonlethal shocks. Let N_S be the number of nonlethal shocks, and N_L the number of lethal shocks. Consider any event involving the failure or survival of certain pumps in some time period t. Let $P(A|B)$ denote the conditional probability of A, given B. The following decompositions hold

$$P(\text{event}) = P(\text{event} \mid N_L > 0)\, P(N_L > 0) + P(\text{event} \mid N_L = 0)\, P(N_L = 0)$$

$$P(\text{event} \mid N_L = 0) = \sum_{n=0}^{\infty} P(\text{event} \mid N_L = 0, N_S = n)\, P(N_S = n).$$

Normally, only the first few terms in the sum need to be evaluated.

The model assumes independent shocks with a constant shock rate. Therefore (Reference A-1, Ch. 4.1), the number of shocks in time t is a Poisson random variable, with parameter equal to t times the shock rate. It follows that some of the above probabilities are easy:

$$P(N_L = 0) = e^{-\omega t}$$

$$P(N_L > 0) = 1 - e^{-\omega t}$$

$$P(N_S = n) = e^{-\mu t} (\mu t)^n / n!$$

If t is small, these expressions can be approximated by even simpler ones.

The nontrivial term to evaluate is the conditional probability of the event under consideration, given that $N_L = 0$ and $N_S = n$. As a major step toward evaluating this, let $q = 1 - p$, and note that for any specific single assembly

$$P(\text{survival} \mid N_L = 0, N_S = n) = q^n e^{-\lambda t}.$$

This expression is the probability that the assembly survives all n shocks (q^n), times the probability that it does not become inoperable individually ($e^{-\lambda t}$). Denote this expression by Q_n. To find $P(\text{event} \mid N_L = 0, N_s = n)$, use Q_n and the fact that, given a shock, the assemblies behave independently.

As an example, suppose that a system has four assemblies. What is the probability that at least three of the four become inoperable during some time period t? Given that $N_L = 0$ and $N_S = n$, the conditional probability that a specific assembly survives is Q_n, so the conditional probability that at least three fail to survive is

$$P(\text{exactly 3 fail} \mid N_L = 0, N_S = n) + P(\text{exactly 4 fail} \mid N_L = 0, N_S = n)$$

$$= \binom{4}{3}(1 - Q_n)^3 Q_n + (1 - Q_n)^4 = (1 - Q_n)^3 (1 + 3 Q_n).$$

Therefore, to obtain the desired probability, observe that $P(\text{event} \mid N_L > 0)$ equals 1, and substitute into the equation for P(event) at the beginning of this section. The answer is

$$(1 - e^{-\omega t}) + e^{-\omega t} \sum_n (1 - Q_n)^3 (1 + 3 Q_n) e^{-\mu t} (\mu t)^n / n! \ .$$

Substitution of estimates for p, μ, λ and ω yields an estimate of the desired probability. To obtain upper and lower uncertainty bounds on the probability is not so easy. Using the end points of the 90% intervals for p, μ, λ, and ω is conservative, because it is unlikely that the four parameters are all at their upper ends or all at their lower ends. In principle, a Bayes 90% interval can be found, based on the distributions of p, λ, λ_+, and ω. This is how the intervals for β, r_1, r_2, etc. are found in this report. To perform this operation, however, requires numerical integration.

The point estimate obtained by substituting the Bayes means into some complicated expression is not necessarily the same as the mean of the Bayes distribution of the expression. But it is simple, and credible.

When t is not large, simple approximations can be used. Each of the approximations given here is valid if $\lambda t \ll 1$, $\mu t \ll 1$, and $\omega t \ll 1$. They follow from the Taylor series expansion for e^{-x} and are

$$e^{-\omega t} \doteq 1$$

$$1 - e^{-\omega t} \doteq \omega t$$

$$e^{-\mu t} \doteq 1$$

$$Q_n \doteq q^n$$

$$1 - Q_n \doteq (1 - q^n) + q^n \lambda t$$

$$\sum_{n=1}^{\infty} (1 - Q_n)^i \, Q_n^{\,j} \, P(N_S = n) \doteq (p + q\lambda t)^i \, q^j \, \mu t, \quad \text{for } i \geq 0 \text{ and } j \geq 0.$$

This leads to simple approximations of many probabilities. For each of the probabilities below, the first approximation is valid if $\lambda t \ll 1$, $\mu t \ll 1$, and $\omega t \ll 1$. The second approximation for one specific assembly is valid if in addition $\mu << \lambda$ and $\omega << \lambda$. The second approximation is valid for k assemblies if the first approximation is valid and in addition $q\lambda t << p$.

$$P(\text{1 specific assembly fails}) \doteq \lambda t + p\mu t + \omega t \equiv r_1 t$$
$$\doteq \lambda t$$

$$P(\text{k specific assemblies fail}) \doteq (\lambda t)^k + (q\lambda t + p)^k \mu t + \omega t$$
$$\doteq (\lambda t)^k + p^k \mu t + \omega t \equiv (\lambda t)^k + r_k t \quad \text{for } k \geq 2$$

P(at least k out of m assemblies fail)

$$\doteq \binom{m}{k}(\lambda t)^k + \mu t \sum_{i=k}^{m} \binom{m}{i}(q\lambda t + p)^i q^{m-i} + \omega t$$
$$\doteq \binom{m}{k}(\lambda t)^k + \mu t \sum_{i=k}^{m} \binom{m}{i} p^i q^{m-i} + \omega t$$

for $k \geq 1$.

Diagnostic Check Based on Residuals

If the binomial failure rate (BFR) assumptions hold, then the number of assemblies affected by an observable shock has a binominal(m,p) distribution, truncated because zero cannot be observed. Once p has been estimated, the correctness of this distributional assumption can be studied. The sample sizes in the I&C data are much too small to allow standard goodness of fit tests, but residuals can be used, essentially as described in Section 5 of Atwood.[A-2]

Suppose n_+ nonlethal shocks hit the systems with m assemblies and cause at least one assembly to become inoperable. Then define

$$z_j = \binom{m}{j} p^j q^{m-j} / (1 - q^m)$$

for $1 \leq j \leq m$, with $q = 1 - p$. Let N_j be the number of shocks that affect exactly j assemblies. Conditional on n_+, N_j has mean $E_j = n_+ z_j$ and variance $V_j = n_+ z_j (1 - z_j)$. Now suppose that there are systems with various sizes m_i, and corresponding values n_{+i}, N_{ji}, E_{ji}, and V_{ji}. Then, conditional on the values of n_{+i}, $N_{j\cdot} = \sum N_{ji}$ has mean $E_{j\cdot} = \sum E_{ji}$ and variance $V_{j\cdot} = \sum V_{ji}$. Here, the summations are over all i, such that $m_i \geq j$. Substitution of the estimate of p gives $\hat{E}_{j\cdot}$ and $\hat{V}_{j\cdot}$. Then for each j, a standardized residual can be constructed

$$U_j = \frac{(N_{j\cdot} - \hat{E}_{j\cdot})}{\hat{V}_{j\cdot}^{1/2}} \quad .$$

Under the BFR assumptions, the U_j values have a mean and variance of approximately 0 and 1. Any large value of U_j indicates that the data do not satisfy the BFR assumptions.

Effect of Data Inaccuracies

In the main body of this report, in the section "Common Cause Classification," there was a description of an actual experience suggesting the importance of data misclassification. Now let us investigate the effect of data inaccuracies more theoretically, by asking, "What effect does a small relative change in the data have on the estimates?" This effect can be approximated by the use of the relevant derivatives. Let θ denote a parameter to be estimated (λ, λ_+, ω, p, μ, β, or an r_k). Let x denote some quantity in the data (n_I, n_+, n_L, or v, all defined below). Relative change means the change in the quantity, divided by the value of the quantity. Then the rate of relative change in the estimate of θ per relative change in x is

$$C(\theta, x) = \frac{\partial \hat{\theta}}{\partial x} \cdot \frac{x}{\hat{\theta}} \quad . \qquad \text{(A-1)}$$

Approximate formulas will now be derived.

It is convenient during the derivation to work with maximum likelihood estimators rather than Bayes means. The difference between these two estimators is not important here, because the purpose is only to roughly approximate the effect of data inaccuracies. Suppose data are combined from systems with populations m_i and times t_i. Let n_{Ii}, n_{+i}, n_{Li}, and s_i denote the observed numbers of individual faults, nonlethal shocks, lethal shocks, and pumps made inoperable by nonlethal shocks. Then the maximum likelihood estimates satisfy

$$\hat{\lambda} = \frac{\sum n_{Ii}}{\sum m_i t_i}$$

$$\hat{\lambda}_+ = \frac{\sum n_{+i}}{\sum t_i}$$

$$\hat{\omega} = \frac{\sum n_{Li}}{\sum t_i}$$

$$\sum s_i = \hat{p} \sum \frac{m_i \; n_{+i}}{1 - \hat{q}^{m_i}} \quad . \qquad \text{(A-2)}$$

Equation (A-2) requires knowledge of each separate $m_i n_{+i}$. However, it can be approximated by

$$\sum s_i \doteq \frac{\hat{p} \sum m_i n_{+i}}{(1 - \hat{q}^m)}$$

where m, generally not an integer, is the weighted average defined by

$$m = \frac{\sum m_i n_{+i}}{\sum n_{+i}}$$

where the sum is taken over all i such that $m_i > 1$. The terms with $m_i = 1$ are not counted because they contain no information about p.

So now, if we define $n_I = \sum n_{Ii}$, $n_+ = \sum n_{+i}$, $n_L = \sum n_{Li}$, and $v = \sum s_i / \sum m_i n_{+i}$, and if m is as just defined, then the estimates satisfy

$$\hat{\lambda} = \frac{n_I}{\sum m_i t_i}$$

$$\hat{\lambda}_+ = \frac{n_+}{\sum t_i}$$

$$\hat{\omega} = \frac{n_L}{\sum t_L}$$

$$\hat{p} \doteq v\,(1 - \hat{q}^m) \quad .$$

Finally, the coefficients $C(\theta,x)$ defined by Equation (A-1), can be approximated for $\theta = \lambda$, λ_+, ω, p, μ, r_k, or β, and for $x = n_I$, n_+, n_L, or v. Formulas are given in Table A-1, and very rough approximate values are given in Table A-2. For these approximations it is assumed that $\hat{r}_1 \doteq \lambda$.

These coefficients are used as in the following example. Suppose that information is needed about the effect on the estimate $\hat{r}_1$ of increasing n_I and v by 10% and decreasing n_+ by 5%. The relative change is

$$\frac{\Delta \hat{r}_1}{\hat{r}_1} \doteq C(r_1, n_I) \times (0.1) + C(r_1, n_+) \times (-0.05) + C(r_1, v) \times (0.1) \quad .$$

Of course, the real difficulty is not in calculating derivatives, but in deciding how much inaccuracy might realistically be in the data. Inaccuracy due to misclassification of the reported events was addressed in the first part of this section. To assess the amount of missing data (unreported events or overlooked reports) is beyond the scope of this report.

TABLE A-1. FORMULAS FOR $C(\theta, x) = \frac{\partial \hat{\theta}}{\partial x} \cdot \frac{x}{\hat{\theta}}$

θ	x: n_I	n_+	n_L	v
λ	1	0	0	0
λ_+	0	1	0	0
ω	0	0	1	0
p	0	0	0	$\frac{1 - q^m}{1 - q^m - m\,p\,q^{m-1}}$
μ	0	1	0	$1 - C(p,v)$
r_1	$\frac{\lambda}{r_1}$	$\frac{\mu p}{r_1}$	$\frac{\omega}{r_1}$	$\frac{\mu p}{r_1}$
r_k, $k > 1$	0	$\frac{\mu p^k}{r_k}$	$\frac{\omega}{r_k}$	$\frac{\mu p^k}{r_k} [1 + (k - 1)\, C(p,v)]$
β	$\frac{\lambda}{r_1}$	$\frac{D}{D + \omega} \; \frac{\mu p}{r_1}$	$\frac{\omega}{D + \omega}$	$\frac{D + (m - 1)\mu p^2 q^{m-2}\, C(p,v)}{D + \omega} - C(r_1,v)$

Notes:

1. Here, D denotes $\mu p(1 - q^{m-1})$.
2. For typographical clarity, the hat is omitted from estimated quantities.

TABLE A-2. CRUDE APPROXIMATIONS FOR $C(\theta,x)$[a]

	x			
θ	n_I	n_+	n_L	v
λ	1	0	0	0
λ_+	0	1	0	0
ω	0	0	1	0
p	0	0	0	>1
μ	0	1	0	<0
r_1	$\doteq 1$	$\doteq 0$	$\doteq 0$	$\doteq 0$
r_k, $k > 1$	0	<1	<1	varies
β	$\doteq -1$	<1	<1	varies

a. This table shows, for example: if n_I increases by 10%, β will decrease by approximately 10%; if v increases by 5%, p will increase by more than 5%. For unusual data, the assumptions underlying the approximations may not be true. For very small data sets, small relative changes are impossible, so the table is irrelevant.

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APPENDIX B

PLANT INFORMATION, CODE DEFINITIONS, AND SYSTEM POPULATIONS

APPENDIX B

PLANT INFORMATION, CODE DEFINITIONS, AND SYSTEM POPULATIONS

This appendix contains the plant information used in this report. Table B-1 gives the plant code, vendor, and calendar hours for each plant. Table B-2 defines the codes used in the one-line summaries of the data; it gives all the codes except the plant codes, given in Table B-1, and the system codes, given in Tables B-3 through B-10.

Tables B-3 through B-10 give the populations of the instrumentation and control assemblies in the plants and systems considered. The codes for the systems of assemblies are shown in parentheses. These codes are intended to be mnemonic: in the codes for sensors, digital channels, and radiation monitors, the second character is always the code for the corresponding parameter; the codes for conditioning systems are often identical to the codes for the corresponding sensors. The arrows connecting the sensors and conditioning systems show the flow of signals through the channels. If the trip signal is generated, say, by high pressure or by low level, then a word ("hi" or "low") is printed by the final arrow. In more complicated cases, such as mismatch, no word accompanies the final arrow.

TABLE B-1. PLANT CODES, VENDORS, AND CALENDAR HOURS

Plant	Code	Vendor	Calendar Hours
Arkansas Nuclear One 1	AR1	B	26304
Crystal River 3	CR3	B	17184
Davis-Besse 1	DB1	B	11448
Oconee 1	OE1	B	26304
Oconee 2	OE2	B	26304
Oconee 3	OE3	B	26304
Rancho Seco	RS1	B	26304
Three Mile Island 1	TI1	B	26304
Three Mile Island 2	TI2	B	6672
Calvert Cliffs 1	CC1	C	26304
Calvert Cliffs 2	CC2	C	18264
Fort Calhoun	FC1	C	26304
Millstone 2	MI2	C	26304
Main Yankee	MY1	C	26304
Palisades	PA1	C	26304
St. Lucie	SL1	C	23592
Beaver Valley 1	BV1	W	23160
Donald C. Cook 1	DC1	W	26304
Donald C. Cook 2	DC2	W	7104
Haddam Neck	HN1	W	26304
Indian Point 2	IP2	W	26304
Indian Point 3	IP3	W	23976
Joseph M. Farley 1	JF1	W	12216
Kewaunee	KE1	W	26304
North Anna 1	NA1	W	6480
Prairie Island 1	PR1	W	26304
Prairie Island 2	PR2	W	26304
Point Beach 1	PT1	W	26304
Point Beach 2	PT2	W	26304
Robert E. Ginna	RG1	W	26304
H. B. Robinson 2	RO2	W	26304
Salem 1	SA1	W	18000
San Onofre 1	SO1	W	26304
Surry 1	SU1	W	26304
Surry 2	SU2	W	26304
Trojan	TR1	W	26304

TABLE B-1. (continued)

Plant	Code	Vendor	Calendar Hours
Turkey Point 3	TU3	W	26304
Turkey Point 4	TU4	W	26304
Yankee Rowe	YR1	W	26304
Zion 1	ZI1	W	26304
Zion 2	ZI2	W	26304
Browns Ferry 1	BF1	G	26304
Browns Ferry 2	BF2	G	26304
Browns Ferry 3	BF3	G	21000
Big Rock Point	BP1	G	26304
Brunswick 1	BR1	G	19536
Brunswick 2	BR2	G	26304
Cooper Station	CO1	G	26304
Duane Arnold	DA1	G	26304
Dresden 1	DR1	G	26304
Dresden 2	DR2	G	26304
Dresden 3	DR3	G	26304
Edwin I. Hatch 1	EN1	G	26304
Edwin I. Hatch 2	EN2	G	4320
James A. FitzPatrick	FP1	G	26304
Millstone 1	MI1	G	26304
Monticello	MO2	G	26304
Nine Mile Point 1	NM1	G	26304
Oyster Creek 1	OC1	G	26304
Peach Bottom 2	PB2	G	26304
Peach Bottom 3	PB3	G	26304
Pilgrim 1	PI1	G	26304
Quad-Cities 1	QC1	G	26304
Quad-Cities 2	QC2	G	26304
Vermont Yankee	VY1	G	26304

TABLE B-2. CODES USED IN LER ONE-LINE SUMMARIES

CODES USED IN LER ONE-LINE DESCRIPTIONS

FAILURE MODE

CODE	DESCRIPTION
A	REDUCED CAPABILITY
B	INOPERABLE

PARAMETER

CODE	DESCRIPTION
F	FLOW
L	LIQUID LEVEL
N	NUCLEAR (CORE FLUX)
P	PRESSURE/VACUUM
R	RADIATION
T	TEMPERATURE

TYPE OF EVENT

CODE FAILURE	CODE COMMAND FAULT	DESCRIPTION
	S	NONRECURRING, NOT COMMON CAUSE
R	T	RECURRING, NOT COMMON CAUSE
C	U	NONLETHAL COMMON CAUSE
B	V	RECURRING NONLETHAL COMMON CAUSE
L	N	LETHAL COMMON CAUSE
M	O	RECURRING LETHAL COMMON CAUSE

FAILURE CAUSE

CODE	DESCRIPTION
00	UNKNOWN
01	PERSONNEL OPERATION
02	PERSONNEL MAINTENANCE
03	PERSONNEL TESTING
04	DESIGN ERROR
05	FABRICATION/CONSTRUCTION/QUALITY CONTROL
06	DEFECTIVE PROCEDURES
07	EXTREME ENVIRONMENT
08	MECHANICAL MALFUNCTION
09	ELECTRICAL MALFUNCTION
11	LEAKING OR BLOCKED INSTRUMENT SENSING LINES
12	DIRTY,BINDING, OR STICKING
13	PIECE/PART FAILURE
14	DRIFT

COMPONENT

CODE	DESCRIPTION
AM	AMPLIFIER/BUFFER/ISOLATION AMP
CA	CABLE/RECEPTACLE/JUNCTION BOX/TERMINAL
CL	CONTROLLER
CM	COMPARATOR (BISTABLE)
CN	CONVERTER/CONDITIONER
DC	DIGITAL CHANNEL
HS	HAND SWITCH
IM	COMPUTATION MODULE
IN	INDICATOR/METER/ANNUNCIATOR
LM	COMPUTER
LS	LIMIT SWITCH
MO	MONITOR
PS	POWER SUPPLY
RC	RECORDER
RE	RELAY/SOLENOID
SE	SENSOR
TI	TIMER
TR	TRANSFORMER
TX	TRANSMITTER
ZZ	OTHER/UNSPECIFIED

ACTIVITY RESULTING IN DISCOVERY

CODE	DESCRIPTION
N	DURING NORMAL PLANT OPERATION (I.E. OTHER THAN LISTED BELOW)
M	DURING MAINTENANCE
R	DURING RECORDS REVIEW
T	DURING TESTING

NSSS VENDOR

CODE	DESCRIPTION
B	BABCOCK & WILCOX
C	COMBUSTION ENGINEERING
G	GENERAL ELECTRIC
W	WESTINGHOUSE

TABLE B-3. POPULATIONS OF ASSEMBLIES CONSIDERED:
ALL BABCOCK & WILCOX PLANTS AR1, CR3, DB1, OE1, OE2,
OE3, RS1, TI1, TI2
(Codes in Parentheses)

Analog Channels

Parameter	Sensing Device		Conditioning System	
Flux (N)	8 power range flux detectors (=4 2-section detectors) (PN)	→	4 nuclear power[a] (PN) ↓	hi → trip
Flow (F)	8 reactor coolant flow sensors (RF)	→	4 power/flow (NF)	→ trip
Temperature (T)	4 reactor outlet temperature sensors (RT)	→	4 reactor outlet temperature[a] (RT) ↓	hi → trip
			4 pressure/temperature (TP)	→ trip
Pressure (P)	4 reactor coolant pressure sensors (RP)	→	↑ 4 reactor coolant pressure[a] (RP)	hi / low ⇉ trip[b]

Digital Channels

Parameter	Channel	
Pressure (P)	0 or 4[c] reactor building pressure switches (CP)	→ trip

a. Inputs to other conditioning systems are analog signals, sent before the signal reaches a bistable.

b. Each conditioning system has two bistables, one for high-pressure trip, one for low-pressure trip.

c. Apparently none at CR3; four elsewhere.

TABLE B-4. POPULATIONS OF ASSEMBLIES CONSIDERED:
ALL COMBUSTION ENGINEERING PLANTS
TWO LOOPS--CC1, CC2, FC1, MI2, PA1, SL1
THREE LOOPS--MY1
(Codes in Parentheses)

Analog Channels

Parameter	Sensing Device		Conditioning System	
Flux (N)	12, 8, or 2[a] wide range flux detectors (WN)	→	4 or 2[b] rate of flux (RN)	hi → trip
	8[c] power range flux detectors (=4 2-section detectors) (PN)	→	4 nuclear power[d] (PN) ↓ e	hi → trip
Temperature (T)	16 or 6[c,f] temperature sensors (RT)	→	4 thermal margin/ low pressure (TP) ↗ (from RP)	low → trip
Pressure (P)	4 pressurizer narrow range detectors (RP)	→	4 reactor coolant pressure (RP)	hi → trip
	4/loop steam generator pressure sensors (SP)	→	4 steam generator pressure (SP)	low → trip
	4 or 0[g] containment pressure sensors (CP)	→	4 or 0[g] containment pressure (CP)	hi → trip
Flow (F)	4/loop reactor coolant flow sensors (RF)	→	4 reactor coolant flow (RF)	low → trip
Level (L)	4/loop steam generator water level sensors (SL)	→	4 steam generator water level (SL)	low → trip[h]

Digital Channels

Parameter	Channel
Pressure (P)	4 or 2[i] turbine oil pressure (loss of load) (OP) low → trip[j]

a. For each channel, there is one fission chamber, and two (one at MY1, none at PA1) proportional counters.

b. Two at PA1, four elsewhere.

TABLE B-4. (continued)

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c. Not counting sensors for control channels.

d. Inputs to other conditioning systems are analog signals, sent before the signal reaches a bistable.

e. This input seems to be absent at FC1 and PA1.

f. Sixteen at the two-loop plants, six (or possibly a multiple of six) at MY1.

g. None at PA1, four elsewhere.

h. At MI2, this channel has a second bistable, giving an equipment-protective trip for high water level.

i. Two at PA1, four elsewhere. At SL1 these are digital channels. At the other plants, it is not certain whether they are digital or analog.

j. This is an equipment-protective trip.

TABLE B-5. POPULATIONS OF ASSEMBLIES CONSIDERED:
WESTINGHOUSE PLANTS
TWO LOOPS--KE1, PR1, PR2, PT1, PT2, RG1
THREE LOOPS--BV1, JF1, NA1, RO2, SO1, SU1, SU2, TU3, TU4
FOUR LOOPS--DC1, DC2, IP2, IP3, SA1, TR1, ZI1, ZI2
(Codes in Parentheses)

Analog Channels

Parameter	Sensing Device		Conditioning System	
Flux (N)	2 source range flux detectors (SN)	→	2 source range flux (SN)	hi → trip
	2[a] intermediate range flux detectors (IN)	→	2 intermediate range flux (IN)	hi → trip
	8[a] power range flux detectors (PN)	→	4 power range flux[b] (PN)	hi, rates → trip
			3 or 4[d] overpower/delta T (NT)	hi → trip
Temperature (T)	6 or 8[e] reactor coolant temperature detectors (RT)	→	3 or 4[d] T-average/delta T[b] (DT)	
			3 or 4[d] over-temperature/delta T (TT)	hi → trip
Pressure (P)	3 or 4[d] pressurizer pressure sensors (RP)	→	3 or 4[d] reactor coolant pressure (RP)	low, hi → trip[f]
Flow (F)	3/loop reactor coolant flow sensors (RF)	→	3/loop reactor coolant flow (RF)	low → trip
	2/loop steam flow sensors (SF)	↘	2/loop steam flow/feed flow mismatch (FF)	→ trip[g]
	2/loop feedwater flow sensors (FF)	↗		

TABLE B-5. (continued)

Analog Channels (continued)			
Parameter	Sensing Device	Conditioning System	
Level (L)	3/loop steam generator water level sensors (SL) →	3/loop steam generator water level (SL)	$\xrightarrow{\text{low-low}}$ trip
	3/loop pressurizer level (PL) →	3/loop pressurizer level (PL)	$\xrightarrow{\text{hi}}$ trip

Digital Channels

Parameter	Channel
Pressure (P)	3 turbine low autostop oil pressure switches (OP) $\xrightarrow{\text{low}}$ trip[g]

a. At SO1, there are only six power range detectors. The power range and intermediate range detectors are all used for the power range conditioning systems.

b. Inputs to other conditioning systems are analog signals, sent before the signal reaches a bistable.

c. At three-loop plants and TR1, this channel gives a trip if there is high flux, or a high rate of change of flux, or a high negative rate of change of flux. At the other plants, high flux gives a trip but the rate of change does not cause a trip.

d. Three at three-loop plants, four at two-loop and four-loop plants.

e. Six at three-loop plants, eight at two-loop and four-loop plants.

f. Each channel gives a low-pressure trip. At two-loop plants, IP2, and IP3, three of the four channels have a second bistable for a high-pressure trip. At the remaining plants, all the channels have a second bistable for a high-pressure trip.

g. This is an equipment-protective trip. It only occurs in conjunction with a low steam generator level.

TABLE B-6. POPULATIONS OF SYSTEMS CONSIDERED: WESTINGHOUSE PLANT HN1 (Codes in Parentheses)

Analog Channels				
Parameter	Sensing Device		Conditioning System	
Flux (N)	2 source range flux detectors (SN)	→	4 reactor startup rate (RN)	$\xrightarrow{hi}$ trip
	2 intermediate range flux detectors (IN)	↗ ↘		
	6 power range flux detectors (= 3 2-section detectors) (PN)	→	4 neutron flux (PN)	$\xrightarrow{hi}$ trip
Temperature (T)	8 reactor coolant temperature detectors (RT)	→	3 reactor coolant temperature (RT)	$\xrightarrow{low}$ trip
Pressure (P)	3 reactor coolant pressure (RP)	→	3 reactor pressure (RP)	$\xrightarrow{hi}$ trip
Flow (F)	Reactor coolant flow sensors[a] (RF)	→	reactor coolant flow[a] (RF)	$\xrightarrow{low}$ trip
	Steam flow sensors[a] (SF)	→	4 steam flow[b] (SF)	$\xrightarrow{hi}$ trip
	Feedwater flow sensors[a] (FF)	→	steam flow/feed flow mismatch[a] (FF)	→ trip
		↘		
Level (L)	3 pressurizer level sensors (PL)	→	3 pressurizer level (PL)	$\xrightarrow{hi}$ trip

a. Population unknown.

b. Not considered for rate estimates, since this system is not used for trip at other plants.

TABLE B-7. POPULATIONS OF ASSEMBLIES CONSIDERED: WESTINGHOUSE PLANT YR1 (Codes in Parentheses)

Parameter	Sensing Device	Conditioning System	
Flux (N)	2 source range flux detectors (SN)	↘ Rate of change of flux[a] (RN)	$\xrightarrow{hi}$ trip
	3 intermediate range flux detectors (IN)	↗ Rate of change of flux[a] (RN)	
	3 power range flux detectors (PN)	→ 3 power range flux (PN)	$\xrightarrow{hi}$ trip

Populations for other systems are not known.

a. Population unknown.

TABLE B-8. POPULATIONS OF ASSEMBLIES CONSIDERED:
GENERAL ELECTRIC PLANTS: MODEL 3 and 4 BWRS
MODEL 3--DR2, DR3, MI1, MO1, PI1, QC1, QC2
MODEL 4--BF1, BF2, BF3, BR1, BR2, CO1, DA1, EN1, EN2, P1, PB2, PB3, VY1
(Codes in parentheses)

Analog Channels

Parameter	Sensing Device		Conditioning System	
Flux (N)	4 source range monitors (SN)	→	4 source range flux (SN)	$\xrightarrow{hi}$ trip
	8[a] intermediate range (IN)	→	8 intermediate range flux (IN)	$\xrightarrow{hi}$ trip
	Many[b] local power range monitors (PN)	→	6 average power range monitors (PN)	$\xrightarrow{hi}$ trip
Flow (F)	4 reactor coolant flow sensors (RF)	→	↑c 2 flow units (FU)	

Digital Channels

Parameter	Channel	
Pressure (P)	4 reactor vessel steam dome pressure switches (RP)	$\xrightarrow{hi}$ trip
	4 containment pressure switches (CP)	$\xrightarrow{hi}$ trip
	4[d] condenser low vacuum pressure switches (VP)	$\xrightarrow{low}$ trip
	4 turbine control fast closure valve pressure switches (OP)	$\xrightarrow{low}$ trip[e]
	4[f] turbine first stage pressure (FP)	$\xrightarrow{low}$ trip[g]
Level (L)	4 reactor liquid level (RL)	$\xrightarrow{low}$ trip
	4 scram discharge volume water level (VL)	$\xrightarrow{hi}$ trip

TABLE B-8. (continued)

Radiation Monitors		
Parameter	Channel	
Radiation (R)	4 main steam line radiation monitors (SR)	$\xrightarrow{hi}$ trip

a. Six at DA1 and VY1.

b. DR2, DR3, 164; MI1, 120; MO1, 96; PI1, 120; QC1, QC2, 164; BF1, BF2, BF3, 172; BR1, BR2, 124; CO1, 124; DA1, 84; EN1, EN2, 124; FP1, 124; PB2, PB3, 172; VY1, 80. Each LPRM is a fission chamber. They are connected, four to a string. Approximately three-fourths of them are used for reactor trip.

c. The trip setpoint for flux depends on measured flow.

d. Not present at CO1, DA1, EN1, EN2, FP1.

e. This is an equipment-protective trip.

f. Not related to trip, so not counted, at MI1, BR1, or VY1.

g. This permits a trip, rather than initiating one.

TABLE B-9. POPULATIONS OF ASSEMBLIES CONSIDERED:
GENERAL ELECTRIC PLANTS: MODEL 2 BWRS--NM1, OC1
(Codes in Parentheses)

Analog Channels

Parameter	Sensing Device		Conditioning System	
Flux (N)	8 intermediate range monitors (IN)	→	8 intermediate range flux (IN)	$\xrightarrow{hi}$ trip
	120 local power range monitors (PN)	→	8 average power range monitors (PN) ↑	$\xrightarrow{hi}$ trip
Flow (F)	Reactor coolant flow sensors[a] (RF)	→	2 flow units (FU)	

Digital Channels

Parameter	Channel	
Pressure (P)	4 reactor pressure switches (RP)	$\xrightarrow{hi}$ trip
	4 or 8[b] containment pressure switches (CP)	$\xrightarrow{hi}$ trip
	4 condenser low vacuum pressure switches (VP)	$\xrightarrow{low}$ trip
	0 or 4[c] turbine first stage pressure (FP)	$\xrightarrow{low}$ trip
Level (L)	4 reactor liquid level (RL)	$\xrightarrow{low}$ trip
	4 scram discharge volume water level (VL)	$\xrightarrow{hi}$ trip

Radiation Monitors

Parameter	Channel	
Radiation (R)	4 main steam line radiation monitors (SR)	$\xrightarrow{hi}$ trip

a. Populations not available.

b. Eight at NM1, four at OC1.

c. Zero at NM1, four at OC1.

TABLE B-10. POPULATIONS OF ASSEMBLIES CONSIDERED: GENERAL ELECTRIC PLANTS: MODEL 1 BWRS--BP1, DR1 (Codes in Parentheses)

Analog Channels			
Parameter	Sensing Device	Conditioning System	
Flux (N)	2, 3[a] intermediate range flux detectors (IN) →	2, 3[a] short reactor period (RN)	→ trip
	6 power range flux detectors (PN) →	6 power range flux (PN)	hi → trip

Digital Channels		
Parameter	Channel	
Pressure (P)	4 sphere pressure switches (CP)	hi → trip
	4 reactor pressure switches (RP)	hi → trip
	0, 4[a,b] loss of feed pumps pressure switches	low → trip
	4, ?[a] condenser pressure switches (VP)	low → trip
Level (L)	4,?[a,b] steam dome level switches	low → trip
	4, 0[a] reactor level switches (RL)	low → trip

a. Two numbers separated by a comma are the populations for BP1 and DR1 respectively. A zero means that the assembly is not present. A question mark means that the population is unknown but nonzero.

b. Not considered for rate estimates, because this system is not used at other plants.

APPENDIX C

ESTIMATES

APPENDIX C
ESTIMATES

This appendix contains 12 sections, each corresponding to one of the classes of instrumentation and control assemblies defined in Table 1 of this report.

Each section has the same format. There may be a few remarks concerning any special features of the data. Then there is a printout of the estimated parameters, based on all the reported inoperability faults, and a second printout of the estimated parameters, based on all the reported reduced capability faults. Following the estimates are a tabular summary of the data counts and a listing of the one-line descriptions of the relevant LERs.

Pressure Switches

The digital channels (and their codes) considered here are: BWR reactor pressure switches (RP), containment pressure switches (CP), BWR condenser low vacuum pressure switches (VP), turbine control fast closure valve (loss of load) pressure switches (OP), and turbine first stage pressure switches (FP).

There is one event for which the number of failed pressure switches is not known. At FitzPatrick on April 3, 1976, nine drywell pressure switches had drifted. The plant only has four drywell pressure switches used for reactor trip. The LER does not say how many of the drifted switches were in the reactor trip system. For this report, the number was taken to be three. This affects the estimate of λ, when reduced capability faults are used. The effect is very small, because there are 82 such individual faults in all.

Be sure to read the section "Application" in the main body of the report. The following computer printouts give the estimates, followed by summaries of the relevant data.

INOPERABILITY FAULTS IN PRESSURE SWITCHES

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.001, .094, .309)

LAMBDA = (1.2E-07, 3.4E-07, 6.3E-07)

$LAMBDA_{+}$ = (3.1E-07, 1.0E-06, 2.0E-06)

OMEGA = (5.7E-10, 1.4E-07, 5.6E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
2	(1.2E-06, 7.3E-04, 4.1E-04)	(4.8E-07, 1.0E-06, 1.7E-06)	(.008, .117, .308)
3	(9.3E-07, 4.8E-04, 2.7E-04)	(4.0E-07, 8.6E-07, 1.5E-06)	(.010, .158, .399)
4	(7.8E-07, 3.6E-04, 2.0E-04)	(3.6E-07, 7.8E-07, 1.3E-06)	(.011, .182, .438)
8	(5.6E-07, 1.8E-04, 1.0E-04)	(2.8E-07, 6.6E-07, 1.2E-06)	(.011, .199, .512)

OVERALL	(5.6E-07, 4.8E-04, 4.1E-04)	(2.8E-07, 8.6E-07, 1.7E-06)	(.008, .182, .512)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(3.0E-09, 2.0E-07, 6.4E-07)		
3	(2.3E-09, 1.8E-07, 6.1E-07)	(8.5E-10, 1.5E-07, 5.7E-07)	
4	(1.9E-09, 1.8E-07, 6.0E-07)	(8.1E-10, 1.5E-07, 5.7E-07)	(6.5E-10, 1.5E-07, 5.6E-07)
8	(1.4E-09, 1.7E-07, 5.9E-07)	(7.5E-10, 1.5E-07, 5.6E-07)	(6.3E-10, 1.5E-07, 5.6E-07)

OVERALL	(1.4E-09, 1.8E-07, 6.4E-07)	(7.5E-10, 1.5E-07, 5.7E-07)	(6.3E-10, 1.5E-07, 5.6E-07)

REDUCED CAPABILITY FAULTS IN PRESSURE SWITCHES

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

LAMBDA = (4.4E-11, 5.9E-06, 2.9E-05)

$LAMBDA_{+}$ = (5.7E-10, 1.4E-07, 5.6E-07)

OMEGA = (5.7E-10, 1.4E-07, 5.6E-07)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

ALL FAULTS IN PRESSURE SWITCHES

PLANT	HOURS	POP	NUMBER OF INDIV. FAULTS INOP/RED CAP	NUMBER OF NONLETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY NONLETHAL SHOCKS INOP/RED CAP	NUMBER OF LETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY LETHAL SHOCKS INOP/RED CAP
AR1	26304	4	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DB1	11448	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE3	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RS1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI2	6672	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC2	18264	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FC1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MI2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MY1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PA1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SL1	23592	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BV1	23160	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC2	7104	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP3	23976	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	12216	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
KE1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA1	6480	3	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
PR1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT2	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SA1	18000	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

SU1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TP1	26304	3	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
TU3	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU4	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF1	26304	20	0 / 6	0 / 0	0 / 0	0 / 0	0 / 0
BF2	26304	20	0 / 3	1 / 0	1 / 0	0 / 0	0 / 0
BF3	21000	20	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
BP1	26304	12	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
BR1	19536	16	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
BR2	26304	20	0 / 15	0 / 0	0 / 0	0 / 0	0 / 0
CO1	26304	16	0 / 4	1 / 0	1 / 0	0 / 0	0 / 0
DA1	26304	16	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR2	26304	20	0 / 5	0 / 0	0 / 0	0 / 0	0 / 0
DR3	26304	20	1 / 2	0 / 0	0 / 0	0 / 0	0 / 0
EN1	26304	16	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN2	4320	16	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FP1	26304	16	1 / 3	1 / 0	1 / 0	0 / 0	0 / 0
MI1	26304	16	0 / 10	0 / 0	0 / 0	0 / 0	0 / 0
MO1	26304	20	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NM1	26304	16	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
OC1	26304	16	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
PB2	26304	20	0 / 3	0 / 0	0 / 0	0 / 0	0 / 0
PB3	26304	20	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
PI1	26304	20	0 / 6	0 / 0	0 / 0	0 / 0	0 / 0
QC1	26304	20	0 / 5	0 / 0	0 / 0	0 / 0	0 / 0
QC2	26304	20	1 / 8	0 / 0	0 / 0	0 / 0	0 / 0
VY1	26304	16	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	1458360	544	4 / 82	3 / 0	3 / 0	0 / 0	0 / 0

ALL FAULTS IN PRESSURE SWITCHES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
B	AP1	014496	032376	CP	DC	P	A14		1	T	RX BUILDING PRESSURE SWITCH FAILED TO TRIP	INSTRUMENT DRIFT
W	NA1	023480	122878	OP	DC	P	A09		1	N	CH 1 TURB AUTO STOP OIL LOW PRESS SPURIOUS SIGNAL	LOOSE TERMINAL SCREW ON PS-LO-609-4
W	TR1	017759A	050477	OP	DC	P	A14		1	T	PS-6309X EXCEEDED ALLOWABLE SETPOINT LIMIT	INSTRUMENT SETPOINT DRIFT
G	BF1	017077*	012677	VP	DC	P	A14		3	T	PS-2-1A,1B,8A WERE FOUND OPERATING BELOW TECH SPEC	SETPOINT DRIFT
G	BF1	021560*	053078	FP	DC	P	A14		3	T	PS-1-81A,81E,91B(TURBINE PRES PERMISSIVE) DRIFTED	SET POINT DRIFT
G	BF2	016395	111576	OP	DC	P	B02	C	1	T	EHC LOF PRESS. SWITCH (PS-47-142) FAILED	SWITCH PLUGGED WITH TEFLON TAPE
G	BF2	019395	101977	CP	DC	P	A14		1	T	DRYWELL PRESSURE SWITCH DRIFTED BEYOND SET POINT	SETPOINT DRIFT OF PS-64-56C
G	BF2	023292*	121178	RP	DC	P	A14		2	T	RX HIGH PRESS SWITCHS PS-3204A,B EXCEEDED TS LIMIT	SETPOINT DRIFT
G	BF3	017529	031477	CP	DC	P	A14		1	T	DRYWELL HIGH PRESS SWITCH PS-64-56A EXCEED TS LIM.	SETPOINT DRIFT
G	BP1	020937	040778	VP	DC	P	A14		1	T	VACUUM SWITCH SETPOINT FOUND TO BE OUT OF T/S TOL.	SETPOINT DRIFT (MINOR)
G	BR1	017082	012677	CP	DC	P	A05		1	T	HIGH DRYWELL PS C71-PS-N002C FOUND TO HAVE FOR.SUB	FOREIGN SUBSTANCE BEEN THERE SINCE INSTAL
G	BR2	014138*	011076	CP	DC	P	A14		4	T	RPS HIGH DRYWELL PRESSURE SWITCHES FOUND OUT OF CA	SETPOINT DRIFT,OF C72-N002A,B,C AND D
G	BR2	014547	012476	CP	DC	P	A14		1	T	HIGH DRYWELL PRESSURE SWITCH FOUND HIGH OOC	SETPOINT DRIFT OF C72-N002A
G	BR2	014392*	013176	CP	DC	P	A14		2	T	RPS HIGH DRYWELL PRESSURE SWITCHES FOUND OOC HIGH	SETPOINT DRIFT OF C72-N002C AND D
G	BR2	015398*	060876	CP	DC	P	A14		2	T	HIGH DRYWELL PRESS SWITCHES FOUND OUT OF CAL	SETPOINT DRIFT OF 2-C72-PS-N002C AND D
G	BR2	015397*	061976	RP	DC	P	A14		4	T	HP SCRAM PRESS SWITCHES FOUND OUT OF CAL HIGH	SETPOINT DRIFT OF 2-B21-PS-N023A,B,C & D
G	BR2	017588	031377	RP	DC	P	A14		1	T	RX HIGH PRESSURE TRIP,PRESS SW FOUND OOC HIGH	SETPOINT DRIFT OF B21-PS-N023B
G	BR2	018179	061277	RP	DC	P	A14		1	T	RX HIGH PRESS TRIP PRESS SWITCH FOUND OUT OF CAL.	SETPOINT DRIFT OF B21-PS-N023D
G	CO1	016713	111676	OP	DC	P	B02	U	1	N	DURING STARTUP PRESSURE SWITCH TRIP CAUSED RPS TRI	PRESSURE SWITCH LEFT ISOLATED AFTER SURVE
G	CO1	018441*	060877	OP	DC	P	A14		4	T	TGF PRESSURE SWITCHES FAILED TO OPERATE WITHIN LIM	SWITCHES HAVE EXCESSIVE SETPOINT DRIFT
G	DR2	014189	020776	CP	DC	P	A14		1	T	DRYWELL HIGH PRESS SCRAM SENSOR PS216218 SETTING H	SETPOINT DRIFT
G	DR2	015023	061676	RP	DC	P	A14		1	T	REACTOR HIGH PRESS SCRAM SWITCH PS226355C ABOVE LI	INSTRUMENT SETPOINT DRIFT
G	DR2	015024	061676	RP	DC	P	A14		1	T	REACTOR HIGH PRESS SCRAM SW PS226355A ABOVE LIMITS	INSTRUMENT SETPOINT DRIFT
G	DR2	019903	112977	FP	DC	P	A14		1	T	TURBINE FIRST STAGE PS-504C TRIPPED ABOVE SPEC	INSTRUMENT DRIFT
G	DR2	021159	042478	FP	DC	P	A14		1	T	TURBINE FIRST STAGE PS504D TRIPPED ABOVE SPEC	INSTRUMENT SETPOINT DRIFT

ALL FAULTS IN PRESSURE SWITCHES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	DR3	018935	080677	RP	DC	P	B08		1	T	HIGH PRESS SCRAM SWITCH FAILED TO TRIP AS REQUIRED	ADJUSTED MECHANICAL STOP OF BOURDON TUBE
G	DR3	021155*	042478	FP	DC	P	A14		2	T	PS 504C & D 1ST STG TURB PRESS EXCEEDED LIMITS	INSTRUMENT SETPOINT DRIFT
G	FP1	013959	010c76	CP	DC	P	B11	R	1	N	DRYWELL PRESS SW 05-RL-16 INOPERATIVE	MOISTURE IN SENSING LINE BLOCKED SIGNAL
G	FP1	014485*	040376	CP	DC	P	A14		3?	T	NINE HIGH DRYWELL SWITCHES SETPOINTS WERE HIGH	NORMAL DRIFT AND TOO CLOSE TO T S LIMITS
G	FP1	014483	040576	RP	DC	P	B02	C	1	T	REACTOR HIGH PRESS SW 2-3-55D FAILED TO ACTUATE	INCORRECT ADJUSTMENT OF MECHANICAL STOP
G	MI1	014229	021076	VP	DC	P	A14		1	T	CONDENSER VAC SWITCH OUT OF TOLERANCE BY 0.1 IN HG	DIT-H18SS VAC/PRESS SW INST DRIFT
G	MI1	014291	021976	OP	DC	P	A14		1	T	TURBINE CONT VALVE ACC RELAY PRESS SW EARLY TRIP	P72AA-997 PRESS SW SETPOINT DRIFT
G	MI1	016672*	122176	CP	DC	P	A14		2	T	2 OF 4 HIGH DRYWELL PRESS SWITCHES TRIP HIGH	SETPOINT DRIFT OF BARTON SWITCHES
G	MI1	017208	021477	CP	DC	P	A14		1	T	DRYWELL HIGH PRESS SCRAM & CONT ISOL SW TRIP HIGH	MODEL 288 0-5PSI PRESS SW SETPOINT DRIFT
G	MI1	017215*	021577	VP	DC	P	A14		2	T	2 OF 4 COND LOW VAC SCRAM SW TRIPPED OUTSIDE T.S.	MODEL DIT-H18SS PRESS SW SETPOINT DRIFT
G	MI1	022077	07057s	VP	DC	P	A14		1	T	CONDENSER LOW VAC SW TRIP LESS CONSERV THAN T.S.	BARKSDALE PRESS SW SETPOINT DRIFT
G	MI1	022679	101178	CP	DC	P	A14		1	T	DRYWELL HIGH PRESS SW TRIP 2.85PSI VICE 2PST	INSTRUMENT DRIFT OF BARTON 288 SWITCH
G	MI1	022860	110678	CP	DC	P	A14		1	T	DRYWELL HIGH PRESS SW TRIP 2.1PSI VICE 2PSI	BARTON 288 SW SETPOINT DRIFT
G	NM1	014248	020776	CP	DC	P	A14		1	T	HIGH DRYWELL PRESS TRIP 3.35 VICE 3.5 PSIG	BARTON INSTRUMENT SETPOINT DRIFT
G	OC1	014489	040676	CP	DC	P	A14		1	T	DRYWELL HI PRESS SCRAM SENSOR TPD AT 2.1 VS 2.0	INSTRUMENT REPEATABILITY-CAT NO. 2N-M4
G	OC1	023116	112578	RP	DC	P	A14		1	T	RX HI PRESS SCRAM SW RE03C TRIPS LESS CONSRV THAN	TS-SENSOR REPEATABILITY-9 PSI GT DES SETG
G	PB2	017263*	022677	VP	DC	P	A14		3	T	COND LOW VACUUM SWS PS-2-5-11A,B&D TRIPD LOWR THAN	TS LIMIT-SETPT DRFT-MOD DIT-H18SS PRES SW
G	PB3	015083	061876	RP	DC	P	B13		1	T	RX HI PRESS SW PS-3-2-3-55B WOULD NOT TRIP	FAILURE OF ZEN DIODE IN TRIP UNT-XET-1205
G	PB3	015880	092776	VP	DC	P	A14		1	T	COND LO VAC SW PS-3-5-11A TRPD 0.26 IN BELOW TS	SETPOINT DRIFT-BARKSDALE MOD DIT-H18SS PS
G	PI1	017165	020777	VP	DC	P	A14		1	T	LO VAC SCRAM PRES SW PS-5038&D SET AT 22.5 VS 23IN	MINOR SETPOINT DRIFT
G	PI1	017331*	030277	CP	DC	P	A14		3	T	HI DRYWELL PRES PS-512A,B&D FOUND TO HAVE MINOR	SETPOINT DRIFT ON LOW PRESSURE INSTRUMENT
G	PI1	022250*	081878	RP	DC	P	A14		2	T	RX HI PRESS SWS PS-263-55B&C AT 1108 VS 1085 PSIG	SETPOINT DRIFT-0-1500 PSIG-MOD B2T-A12SS
G	QC1	018110*	042277	FP	DC	P	A14		2	T	MAIN TURB FRST STG PRESS SWS PS-1-504A&B SET GT TS	INSTRUMENT SETPOINT DRIFT
G	QC1	018580	072277	FP	DC	P	A14		1	T	TURB FRST STG PRESS SW OUT OF CAL-401 VS 400 PSIG	INST STPOINT DRFT-TOLERANCES TOO CLS LCO
G	QC1	021410	042578	FP	DC	P	A14		1	T	TURB FST STG LO PRES SW PS-1-504A TRPD 401 VS 400	INSTRUMENT SETPOINT DRIFT

ALL FAULTS IN PRESSURE SWITCHES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL	CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	QC1	023382	112278	OP	DC	P	A14				1	T		EHC PRESS SW 1-5600-PS-3 TRPD AT 880 VS 900# DECRS	INSTRUMENT SETPOINT DRIFT
G	QC2	018162*	072476	FP	DC	P	A14		R		2	T		TURB FRST STG PRES SWS PS-2-504A&B EXCEEDED TS LMT	SETPOINT DRIFT-SETPOINT SAME AS LCO
G	QC2	018118	011877	FP	DC	P	A14				1	T		TURB FRST STG PRES SW TRIPPED AT 407-TS LIMIT-400	INSTRUMENT SETPOINT DRIFT
G	QC2	018120*	042277	FP	DC	P	A14				2	T		TURB FRST STG PRES SWS PS-2-504C&D EXCEED TS LIMIT	INST SETPOINT DRIFT - STPT TOO CLSE LCO
G	QC2	018577*	072277	FP	DC	P	A14		R		2	T		"A" RPS TURB FRST STG PRES SWCHS EXCEEDED TS LIMIT	INSTRUMENT SETPOINT DRIFT
G	QC2	018656	072577	OP	DC	P	A14				1	T		ELETROHYD LO PRES SCRAM SW TRPD 15 PSI BELOW TS	INSTRUMENT SETPOINT DRIFT
G	QC2	017103	082277	FP	DC	P	B13		R		1	T		TURB FRST STG PRES SW TRIPPED AT 409 VS 400 PSI	INSTRUMENT SETPOINT DRIFT-INST REPLACED
G	VY1	015741	083076	CP	DC	P	A14				1	T		DRYWELL HI PRESS SCRAM/ISOLATION SWTCHS (1 OF 4SW)	SETPT DRIFT MODEL # 12N-AA4
G	VY1	017138	020177	CP	DC	P	A14				1	T		DRYWELL HI PRESS SCRAM/ISOLATN SW 2.03#VS.2.0#	DRIFTD .1 PSI OVER ONE MONTH

Reactor Liquid Level Switches

These digital channels are coded RL, and they occur only in BWRs. They are treated separately from the water level switches for the scram discharge volume, because of the apparent underreporting for the scram discharge volume switches.

The only observed common cause faults involved reduced capability rather than complete inoperability. Therefore, most parameters cannot be estimated based on inoperability faults.

Be sure to read the section "Application" in the main body of the report. The following computer printouts give the estimates, followed by summaries of the relevant data.

INOPERABILITY FAULTS IN REACTOR LIQUID LEVEL SWITCHES
RATES ARE PER CALENDAR HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

LAMBDA = (2.1E-13, 3.3E-06, 1.8E-05)
LAMBDA$_+$ = (3.4E-09, 8.8E-07, 3.4E-06)
OMEGA = (3.4E-09, 8.8E-07, 3.4E-06)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

REDUCED CAPABILITY FAULTS IN REACTOR LIQUID LEVEL SWITCHES

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.299, .593, .848)

LAMBDA = (2.3E-08, 8.8E-06, 3.5E-05)

$LAMBDA_{+}$ = (1.0E-06, 4.4E-06, 9.7E-06)

OMEGA = (3.1E-07, 2.6E-06, 6.8E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
4	(1.1E-06, 4.7E-06, 1.1E-05)	(3.0E-06, 1.4E-05, 4.0E-05)	(.046, .305, .656)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
4	(1.1E-06, 4.3E-06, 9.3E-06)	(7.6E-07, 3.8E-06, 8.5E-06)	(6.0E-07, 3.4E-06, 8.0E-06)

ALL FAULTS IN REACTOR LIQUID LEVEL SWITCHES

PLANT	HOURS	POP	NUMBER OF INDIV. FAULTS INOP/RED CAP	NUMBER OF NONLETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY NONLETHAL SHOCKS INOP/RED CAP	NUMBER OF LETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY LETHAL SHOCKS INOP/RED CAP
BF1	26304	4	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
BF2	26304	4	0 / 0	0 / 1	0 / 2	0 / 0	0 / 0
BF3	21000	4	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BP1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BR1	19536	4	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
BR2	26304	4	0 / 6	0 / 1	0 / 3	0 / 0	0 / 0
CO1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DA1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR2	26304	4	0 / 3	0 / 0	0 / 0	0 / 0	0 / 0
DR3	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN1	26304	4	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
EN2	4320	4	2 / 1	0 / 0	0 / 0	0 / 0	0 / 0
FP1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MI1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MO1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NM1	26304	4	0 / 3	0 / 0	0 / 0	0 / 0	0 / 0
OC1	26304	4	0 / 0	0 / 0	0 / 0	0 / 1	0 / 4
PB2	26304	4	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PB3	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PI1	26304	4	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
QC1	26304	4	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
QC2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
VY1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ALL	570936	92	5 / 19	0 / 2	0 / 5	0 / 1	0 / 4

ALL FAULTS IN REACTOR LIQUID LEVEL SWITCHES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	BF1	022082	072078	RL	DC	L	A14		1	T		REACTOR WATER LEVEL SWITCH EXCEEDED TS LIMIT	SETPOINT DRIFTED BELOW SPEC. (LIS-3-203B)
G	BF2	018632*	081477	RL	DC	L	A01	C	2	T		TWO RX WATER LOW LEVEL SCRAM SWITCHES WERE +20 IN.	RFFERENCE LEVEL COLUMN 8 WAS NOT FULL
G	BF3	017160	020877	RL	DC	L	B13		1	T		RX LOW WATER LEVEL SWITCH LIS-3-203D FAILED TO OP.	ERRATIC MICRO SWITCH WAS REPLACED
G	BR1	018685	072977	RL	DC	L	A14		1	T		RX LOW WATER LEVEL INST. FOUND OUT OF CALIBRATION	SETPOINT DRIFT,INST.# B21-LIS-N017B
G	BR2	014391*	020776	RL	DC	L	A14		4	T		SCRAM SWITCHES B21-LTS-N017A,B,C AND D FOUND OOC	SETPOINT DRIFT
G	BR2	014944*	061276	RL	DC	L	A04	C	3	T		RX LOW WATER LEVEL SW 2-B21-LIS-N024 A,B,25B ACT L	CIRCUIT DESIGN USED HIGH LEVEL SWITCHES
G	BR2	019018	090277	RL	DC	L	A14		1	T		RX LOW WATER LEVEL INST FOUND OUT OF CALIBRATION	INTRUMENT DRIFT OF B21-LIS-N017B
G	BR2	020725	030478	RL	DC	L	A08		1	T		RX LOW WATER LEVEL #1 INST FOUND OUT OF CAL LOW	DRIVE ARM LINKAGE SLIPED ON B21-LIS-N017D
G	DR2	015747	082176	RL	DC	L	A14		1	T		REACTOR WATER LEVEL INST 226357B ACTUATED ABOVE LI	INSTRUMENT SETPOINT DRIFT
G	DR2	019657	111177	RL	DC	L	A14		1	T		REACTOR WATER LEVEL SWITCH LIS226357A ABOVE SPEC	INSTRUMENT SETPOINT DRIFT
G	DR2	020600	021678	RL	DC	L	A14		1	T		REACTOR LEVEL SWITCH LIS2-263-57B ABOVE LIMITS	INSTRUMENT DRIFT
G	EN1	017593	022477	RL	DC	L	A14		1	T		RX WATER LEVEL SW B21-N017B EXCEEDED LIMIT	SETPOINT DRIFT
G	EN2	023634	111278	RL	DC	L	B13		1	N		LEVEL OUT OUT OF SPEC AND COULD NOT BE CALIBRATED	SENSOR FAILED AND WAS REPLACED
G	EN2	023036	111578	RL	DC	L	B13		1	N		INST 2B21-N017C COULD NOT BE CALIBRATED	SENSOR FAILED AND WAS REPLACED
G	EN2	023068	121078	RL	DC	L	A14		1	T		LEVEL SW 2B21-N017C SETPOINT DRIFT	BARTON 288A SW SETTING HAD DRIFTED
G	NM1	017398	030477	RL	DC	L	A14		1	T		RX LEVEL LO-LO-LO TRIP AT 119 VICE 125 INCH	INSTRUMENT SETPOINT DRIFT
G	NM1	017442	032077	RL	DC	L	A14		1	T		RX LOW-LOW LEVEL TRIP AT 1 IN VICE 5 INCH	SETPOINT DRIFT
G	NM1	018165	060477	RL	DC	L	A14		1	T		RX LOW LEVEL TRIP OUT OF ADJUSTMENT DID NOT TRIP	SWITCH OUT OF ADJUSTMENT
G	OC1	021929*	071478	RL	DC	L	A06	L	4	T		FOUR RX WTR SWTCHS USED FOR SCRAM INI LESS CONSV	THAN TS-DEFICIENCIES IN TEST PROCEDURE
G	PB2	014400	042676	RL	DC	L	B13		1	T		RX LVL SW LIS 2-2-3-101B COULD NOT OBT ACC RESP TI	ME-DEFECTV MICRO SW - MODEL 288A LVL IND
G	PI1	022982*	111578	RL	DC	L	A14		2	T		RX WTR LVL SWS LIS-263-57A&B TRIPPED GT TS LIMITS	MINOR SET POINT DRIFT
G	QC1	020543	011778	RL	DC	L	A14		1	T		RX LO WTR LVL SW LIS 1-263-58B SET AT 7.3 VS 8 IN	INSTRUMENT SETPOINT DRIFT
G	QC1	021786	061578	RL	DC	L	B08	R	1	T		LO-LO RX WTR LVL SW LIS-1-263-72A FAILD TO OPERATE	MERCOID SWCH MISALGND W CAM-MNTD MAGNET

Scram Discharge Volume Water Level Switches

These digital channels are coded VL, and they occur only in BWRs. There are no LERs for them. This may be due to underreporting in the period 1976 through 1978. Because no common cause faults were reported, only a few parameters can be estimated.

Be sure to read the section "Application" in the main body of the report. The following computer printouts give the estimates. No summaries of the data are given, because no faults were reported.

INOPERABILITY FAULTS IN SCRAM DISCHARGE VOLUME WATER LEVEL SWITCHES
RATES ARE PER CALENDAR HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

```
LAMBDA  = ( 9.0E-10, 2.3E-07, 8.8E-07)
LAMBDA+ = ( 3.6E-09, 9.2E-07, 3.5E-06)
OMEGA   = ( 3.6E-09, 9.2E-07, 3.5E-06)
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NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

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REDUCED CAPABILITY FAULTS IN SCRAM DISCHARGE VOLUME WATER LEVEL SWITCHES
RATES ARE PER CALENDAR HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL


LAMBDA  = ( 9.0E-10, 2.3E-07, 8.8E-07)
LAMBDA+ = ( 3.6E-09, 9.2E-07, 3.5E-06)
OMEGA   = ( 3.6E-09, 9.2E-07, 3.5E-06)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES
```

Source Range Flux Sensing Devices

These sensors are coded SN. No common cause faults were reported, so most parameters cannot be estimated. The very wide interval for λ is strongly influenced by a single sensor that is reported to have failed six times.

Be sure to read the section "Application" in the main body of the report. The following computer printouts give the estimates, followed by summaries of the relevant data.

INOPERABILITY FAULTS IN SOURCE RANGE FLUX SENSORS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

LAMBDA = (4.4E-24, 4.8E-06, 2.8E-05)

LAMBDA$_{+}$ = (1.8E-09, 4.6E-07, 1.8E-06)

OMEGA = (1.8E-C9, 4.6E-07, 1.8E-06)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

REDUCED CAPABILITY FAULTS IN SOURCE RANGE FLUX SENSORS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

LAMBDA = (6.2E-10, 1.6E-07, 6.1E-07)

LAMBDA$_+$ = (1.8E-09, 4.6E-07, 1.8E-06)

OMEGA = (1.8E-09, 4.6E-07, 1.8E-06)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

ALL FAULTS IN SOURCE RANGE FLUX SENSORS

PLANT	HOURS	POP	NUMBER OF INDIV. FAULTS INOP/RED CAP	NUMBER OF NONLETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY NONLETHAL SHOCKS INOP/RED CAP	NUMBER OF LETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY LETHAL SHOCKS INOP/RED CAP
BV1	23160	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC1	26304	2	6 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC2	7104	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP3	23976	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	12216	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
KF1	26304	2	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA1	6480	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	26304	2	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT2	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RO2	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SA1	18000	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TR1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU3	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU4	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
YR1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	26304	2	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF3	21000	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BR1	19536	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BR2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

CO1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DA1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR3	26304	4	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN2	4320	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FP1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MI1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MO1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PB2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PB3	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PI1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
VY1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	1082736	130	12 / 0	0 / 0	0 / 0	0 / 0	0 / 0

ALL FAULTS IN SOURCE RANGE FLUX SENSORS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	DC1	021215*	042078	SN	SE	N	813	R	6	T	SOURCE RANGE DETECTOR FAILED SIX TIMES (N-32)	EXACT CAUSE OF FAILURES UNKNOWN
W	KE1	016973	011777	SN	SE	N	813		1	N	CH31 SOURCE RANGE NO OUTPUT	DETECTOR AND PRE-AMP FAILURE
W	PR1	015071	061776	SN	SE	N	813		1	N	NIS SOURCE RNG CH N31 DID NOT RESP PRPRLY ON S/U	FAULTY DETECTOR. DETECTOR REPLACED
W	PR1	020431B	011078	SN	SE	N	803	S	1	T	CONTROL ROOM LOST ALL SOURCE RANGE INDICATION	TEST PRSNL DISCONN CH N32 VS CH N31
W	PR1	020431A	011078	SN	SE	N	813		1	N	IT BCME APPRNT THAT DET FOR SR CH N31 REQD REPLCMT	NO CAUSE WAS GIVEN
W	ZI2	019779	111777	SN	SE	N	813		1	N	SOURCE RANGE DETECTR 2N-32 AUTO ENERGIZED ; FAILD	CHECKD CHNL ELECTRICALY; REPLACED DETECTR
G	DR3	021509A	052078	SN	SE	N	813	S	1	T	SRM 24 FAILED TO INSERT TO STARTUP POSITION	FAULTY DRIVE CABLE

Intermediate Range Flux Sensing Devices

These sensors are coded IN. No common cause faults were reported, so most parameters cannot be estimated. Be sure to read the section "Application" in the main body of the report. The following computer printouts give the estimates, followed by summaries of the relevant data.

INOPERABILITY FAULTS IN INTFRMEDIATE RANGF FLUX SENSORS
RATFS APE PER CALENDAR HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

LAMBDA = (1.4E-14, 7.6E-07, 4.1E-06)
$LAMBDA_+$ = (1.7E-09, 4.2E-07, 1.6E-06)
OMEGA = (1.7E-09, 4.2E-07, 1.6E-06)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

REDUCED CAPABILITY FAULTS IN INTERMEDIATE RANGE FLUX SENSORS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

LAMBDA = (1.5E-17, 1.3E-06, 7.2E-06)

$LAMBDA_+$ = (1.7E-09, 4.2E-07, 1.6E-06)

OMEGA = (1.7E-09, 4.2E-07, 1.6E-06)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

ALL FAULTS IN INTERMEDIATE RANGE FLUX SENSORS

PLANT	HOURS	POP	NUMBER OF INDIV. FAULTS INOP/RED CAP	NUMBER OF NONLETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY NONLETHAL SHOCKS INOP/RED CAP	NUMBER OF LETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY LETHAL SHOCKS INOP/RED CAP
BV1	23160	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC2	7104	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP3	23976	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	17216	2	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
KE1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA1	6480	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	26304	2	1 / 2	0 / 0	0 / 0	0 / 0	0 / 0
PR2	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT2	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RO2	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SA1	18000	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TR1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU3	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU4	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
YR1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF3	21000	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BP1	26304	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BR1	19536	8	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0

BR2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CO1	26304	8	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DA1	26304	6	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DR1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR3	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN2	4320	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FP1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MI1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MO1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NM1	26304	8	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
OC1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR3	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PI1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
VY1	26304	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	1187952	227	4 / 5	0 / 0	0 / 0	0 / 0	0 / 0

ALL FAULTS IN INTERMEDIATE RANGE FLUX SENSORS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	JF1	021234	042478	IN	SE	N	A14		1	T		INTERMEDIATE RANGE N35 HIGH FLUX TRIP LESS CONSERV	NEW DETECTOR LESS SENSITIVE THAN ORICINAL
W	PR1	014206*	020876	IN	TX	N	A16		2	N		BOTH INTRMD RNG HI FLUX TRIPS AT 30 VS 25 PERCENT	CURRENTS CHANGE SIGNIFCTLY OVER CORE LIFE
W	PR1	019603	101577	IN	SE	N	B13		1	N		NIS INTRMD RNG CH N36 FLD TO PROVD INPUT-PRMSV SIG	COMPNSTN CAPABILITY WAS LOST-DET REPLACED
G	BR1	020835*	031578	IN	SE	N	B00		2	N		IRM "A" FAILED WHILE "E" & "H" INOPERABLE	IRM "E" AND "A" FAILED, COMPONENT FAILURE
G	CO1	014839	050776	IN	SE	N	A14		1	N		WHILE SHUTTING DOWN IRMS COULD NOT BE SET AS REQ'D	SENSITIVITY DECREASE WITH EXPOSURS
G	DA1	016205	102476	IN	SE	N	A00		1	T		DURING STARTUP IRM F DID NOT DEMONSTRATE OVERLAP	UNKNOWN
G	NM1	014979	030376	IN	SE	N	B13		1	N		IRM #13 ERRATIC OPERATION	LOW DETECTOR RESISTANCE, REPLACED

Power Range and Wide Range Flux Sensors, Except for LPRMs

The sensors included here are the wide range neutron flux sensors (coded WN) at Combustion Engineering plants, and the power range neutron flux sensors (coded PN) at PWRs and at Model 1 BWRs. No common cause faults were reported, so most parameters cannot be estimated.

Be sure to read the section "Application" in the main body of the report. The following computer printouts give the estimates, followed by summaries of the relevant data.

INOPERABILITY FAULTS IN POWER RANGE AND WIDE RANGE FLUX SENSORS
LPRMS NOT INCLUDED
RATES ARE PER CALENDAR HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

LAMBDA = (2.4E-07, 5.7E-07, 1.0E-06)
$LAMBDA_{+}$ = (1.7E-09, 4.2E-07, 1.6E-06)
OMEGA = (1.7E-09, 4.2E-07, 1.6E-06)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

REDUCED CAPABILITY FAULTS IN POWER RANGE AND WIDE RANGE FLUX SENSORS

LPRMS NOT INCLUDED

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

LAMBDA = (1.8E-08, 1.6E-07, 4.1E-07)

$LAMBDA_+$ = (1.7E-09, 4.2E-07, 1.6E-06)

OMEGA = (1.7E-09, 4.2E-07, 1.6E-06)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

ALL FAULTS IN POWER RANGE AND WIDE RANGE FLUX SENSORS

PLANT	HOURS	POP	NUMBER OF INDIV. FAULTS INOP/RED CAP	NUMBER OF NONLETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY NONLETHAL SHOCKS INOP/RED CAP	NUMBER OF LETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY LETHAL SHOCKS INOP/RED CAP
AR1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CR3	17184	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DB1	11448	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE3	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RS1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI2	6672	8	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	26304	20	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC2	18264	20	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FC1	26304	20	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MI2	26304	20	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MY1	26304	16	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PA1	26304	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SL1	23592	20	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BV1	23160	8	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DC1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC2	7104	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	26304	6	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP3	23976	8	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	12216	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
KE1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA1	6480	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT2	26304	8	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

RO2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SA1	18000	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	26304	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TR1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU3	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU4	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
YR1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BP1	26304	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR1	26304	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	100V824	406	5 / 1	0 / 0	0 / 0	0 / 0	0 / 0

ALL FAULTS IN POWER RANGE AND WIDE RANGE FLUX SENSORS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
B	TI2	021612	041778	PN	SE	N	B05			1	N		RPS CHAN C HI FLUX TRIP INTERMITTENT-DETECTOR NI-7	NI-7 DAMAGD DURN INITIAL INSTALLTN-REPLAC
C	CC2	017206	012577	PN	SE	N	B13			1	N		FLUX PROBLEMS EXPERIENCED IN CH B HI POWER, TM/LP	(CONT) & AXIAL FLUX OFFSET.FAIL DET TUBE
W	BV1	018731	080877	PN	SE	N	A14			1	T		EXCORE NEUTRON DETECTOR READ HIGH (DETECTOR N41)	INSTRUMENT DRIFT
W	HN1	018351	062377	PN	SE	N	B13			1	N		NUCLEAR INST CH 32 DETECTOR CURRENT ERRATIC	DETECTOR AND CABLE DETERIORATION
W	IP3	015115	060376	PN	SE	N	B13			1	T		PWR RANGE CH 43 DECREASING SLOWLY	WL23686 DEFECTIVE AND REPLACED
W	PT2	014746	051476	PN	SE	N	B13			1	N		PWR RNG DETECTOR 2428 WAS DRIFTING	MOD WL23-710 WAS RPLCD WITH MOD WL23-686

Local Power Range Monitors (LPRMs)

These are the power range neutron flux detectors (coded PN) in BWRs, except for Model 1 BWRs. They are connected in strings, with four LPRMs to a string. Usually, three of the LPRMs on any string are connected to average power range monitors (APRMs), and so used for reactor trip. The remaining LPRM is used for other functions such as control. However, this varies from plant to plant. Also, within any plant the exact wiring changes during plant operation, when LPRMs become unusable and other LPRMs are used instead.

When an LER reports a fault involving an LPRM, it is sometimes not possible to decide if the LPRM was being used for reactor trip or not. In every case, it is at least possible that the reactor trip system was involved. Therefore all the LERs involving LPRMs are used, five reports in all. The extent of underreporting of LPRM faults is not known.

It is conceivable that plants do not submit LERs for LPRMs that are not connected to APRMs. If this is the case, then the relevant population sizes for this report are approximately three-fourths of the sizes actually given in Appendix B, and the estimates should be changed accordingly.

For reduced capability faults, no common cause faults were reported, so most parameters cannot be estimated. Be sure to read the section "Application" in the main body of this report. The following computer printouts give the estimates, followed by summaries of the relevant data.

INOPERABILITY FAULTS IN LPRMS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.017, .035, .067)

LAMBDA = (1.5E-08, 4.7E-08, 9.4E-08)

LAMBDA+ = (3.2E-07, 2.8E-06, 7.2E-06)

OMEGA = (3.6E-09, 9.2E-07, 3.5E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
80	(3.6E-07, 3.2E-06, 8.5E-06)	(5.5E-08, 1.1E-06, 3.7E-06)	(.083, .747, .925)
84	(3.6E-07, 3.2E-06, 8.4E-06)	(5.5E-08, 1.1E-06, 3.7E-06)	(.082, .746, .925)
96	(3.5E-07, 3.1E-06, 8.1E-06)	(5.5E-08, 1.1E-06, 3.7E-06)	(.079, .742, .925)
120	(3.4E-07, 2.9E-06, 7.7E-06)	(5.4E-08, 1.1E-06, 3.7E-06)	(.076, .737, .924)
124	(3.4E-07, 2.9E-06, 7.7E-06)	(5.4E-08, 1.1E-06, 3.7E-06)	(.075, .736, .924)
164	(3.3E-07, 2.8E-06, 7.4E-06)	(5.4E-08, 1.1E-06, 3.7E-06)	(.073, .732, .921)
172	(3.3E-07, 2.8E-06, 7.4E-06)	(5.4E-08, 1.1E-06, 3.7E-06)	(.072, .732, .921)

OVERALL	(3.3E-07, 2.9E-06, 8.5E-06)	(5.4E-08, 1.1E-06, 3.7E-06)	(.072, .737, .925)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
80	(3.8E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)
84	(3.8E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)
96	(3.8E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)
120	(3.8E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)
124	(3.8E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)
164	(3.8E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)
172	(3.8E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)

OVERALL	(3.8E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)	(3.6E-09, 9.2E-07, 3.5E-06)

REDUCED CAPABILITY FAULTS IN LPRMS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

LAMBDA = (2.4E-09, 2.0E-08, 5.2E-08)

$LAMBDA_+$ = (3.6E-09, 9.2E-07, 3.5E-06)

OMEGA = (3.6E-09, 9.2E-07, 3.5E-06)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

ALL FAULTS IN LPRMS

PLANT	HOURS	POP	NUMBER OF INDIV. FAULTS INOP/RED CAP	NUMBER OF NONLETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY NONLETHAL SHOCKS INOP/RED CAP	NUMBER OF LETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY LETHAL SHOCKS INOP/RED CAP
BF1	26304	172	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF2	26304	172	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF3	21000	172	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BR1	19536	124	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BR2	26304	124	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CO1	26304	124	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DA1	26304	84	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR2	26304	164	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR3	26304	164	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN1	26304	124	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN2	4320	124	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FP1	26304	124	0 / 1	1 / 0	4 / 0	0 / 0	0 / 0
MI1	26304	120	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MO1	26304	96	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NM1	26304	120	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
OC1	26304	120	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PB2	26304	172	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PB3	26304	172	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PI1	26304	120	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC1	26304	164	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC2	26304	164	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
VY1	26304	80	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	544632	3000	3 / 1	1 / 0	4 / 0	0 / 0	0 / 0

ALL FAULTS IN LPRMS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	C01	017299	012877	PN	SE	N	B13		1	N		APRM B BYPASSED AND DECLARED INOPERATIONAL	LPRM SEAL FAILED, LPRM DRIFTED; RECALIB
G	DA1	016266	101976	PN	SE	N	B13		1	T		LPRM CALIB CALC INDICATE CPRRAT ABOVE SPEC	LPRM DRIFT DUE TO LEAKING SEALS
G	DR3	017511	040477	PN	SE	N	B13		1	N		OUTPUT OF LPRM 16-33-D SHIFTED UPSCALE	CERAMIC SEAL FAILED
G	FP1	015054	062876	PN	SE	N	A14		1	N		LPRM 44-37-C DRIFTED HIGH	NORMAL INSTRUMENT DRIFT
G	FP1	020928*	040178	PN	SE	N	B05	C	4	T		LPRM-36-45 DET A & B, LPRM-12-21 DET B & C NOT OP	DETECTOR WIRING INCORRECT

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Reactor Coolant Temperature Sensors

These sensors are coded RT, and are used in PWRs.

The LER for St. Lucie on February 3, 1978, refers to delayed response times in "selected channels." The number of affected sensors is coded as three in the data summaries, but the number is really unknown. Therefore, this LER is used for estimating λ_+ but not for estimating p.

Be sure to read the section "Application" in the main body of this report. The following computer printouts give the estimates, followed by summaries of the relevant data.

INOPERABILITY FAULTS IN REACTOR COOLANT TEMPERATURE DETECTORS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.231, .499, .762)

LAMBDA = (3.0E-07, 1.2E-06, 2.6E-06)

LAMBDA_+ = (1.9E-07, 1.6E-06, 4.2E-06)

OMEGA = (2.1E-09, 5.4E-07, 2.1E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
4	(2.1E-07, 1.8E-06, 4.9E-06)	(9.3E-07, 2.6E-06, 5.1E-06)	(.031, .244, .548)
6	(2.0E-07, 1.7E-06, 4.5E-06)	(9.0E-07, 2.6E-06, 5.0E-06)	(.009, .165, .475)
8	(1.9E-07, 1.7E-06, 4.3E-06)	(8.9E-07, 2.6E-06, 5.0E-06)	(.004, .134, .424)
16	(1.9E-07, 1.6E-06, 4.2E-06)	(8.8E-07, 2.5E-06, 5.0E-06)	(.002, .110, .363)

OVERALL	(1.9E-07, 1.7E-06, 4.9E-06)	(8.8E-07, 2.6E-06, 5.1E-06)	(.002, .165, .548)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
4	(6.8E-08, 1.0E-06, 2.8E-06)	(2.3E-08, 8.1E-07, 2.5E-06)	(1.1E-08, 7.1E-07, 2.3E-06)
6	(6.0E-08, 9.9E-07, 2.8E-06)	(2.2E-08, 8.0E-07, 2.5E-06)	(1.0E-08, 7.0E-07, 2.3E-06)
8	(5.8E-08, 9.8E-07, 2.8E-06)	(2.1E-08, 8.0E-07, 2.5E-06)	(1.0E-08, 7.0E-07, 2.3E-06)
16	(5.6E-08, 9.8E-07, 2.8E-06)	(2.1E-08, 8.0E-07, 2.5E-06)	(1.0E-08, 7.0E-07, 2.3E-06)

OVERALL	(5.6E-08, 9.9E-07, 2.8E-06)	(2.1E-08, 8.0E-07, 2.5E-06)	(1.0E-08, 7.0E-07, 2.3E-06)

REDUCED CAPABILITY FAULTS IN REACTOR COOLANT TEMPERATURE DETECTORS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.033, .118, .231)

LAMBDA = (1.5E-07, 4.7E-07, 9.5E-07)

$LAMBDA_+$ = (6.2E-07, 2.7E-06, 5.9E-06)

OMEGA = (2.1E-09, 5.4E-07, 2.1E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
4	(1.5E-06, 9.5E-06, 2.6E-05)	(6.4E-07, 1.8E-06, 3.6E-06)	(.043, .302, .527)
6	(1.2E-06, 6.8E-06, 1.8E-05)	(5.3E-07, 1.6E-06, 3.3E-06)	(.044, .344, .598)
8	(1.0E-06, 5.6E-06, 1.4E-05)	(4.8E-07, 1.5E-06, 3.2E-06)	(.040, .354, .634)
16	(7.6E-07, 3.8E-06, 8.9E-06)	(4.1E-07, 1.4E-06, 3.0E-06)	(.020, .316, .676)

OVERALL	(7.6E-07, 6.8E-06, 2.6E-05)	(4.1E-07, 1.6E-06, 3.6E-06)	(.020, .344, .676)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
4	(9.2E-09, 6.4E-07, 2.2E-06)	(2.8E-09, 5.5E-07, 2.1E-06)	(2.2E-09, 5.4E-07, 2.1E-06)
6	(7.0E-09, 6.1E-07, 2.2E-06)	(2.7E-09, 5.5E-07, 2.1E-06)	(2.2E-09, 5.4E-07, 2.1E-06)
8	(6.1E-09, 6.0E-07, 2.1E-06)	(2.6E-09, 5.5E-07, 2.1E-06)	(2.2E-09, 5.4E-07, 2.1E-06)
16	(4.9E-09, 5.9E-07, 2.1E-06)	(2.5E-09, 5.5E-07, 2.1E-06)	(2.2E-09, 5.4E-07, 2.1E-06)

OVERALL	(4.9E-09, 6.1E-07, 2.2E-06)	(2.5E-09, 5.5E-07, 2.1E-06)	(2.2E-09, 5.4E-07, 2.1E-06)

ALL FAULTS IN REACTOR COOLANT TEMPERATURE DETECTORS

PLANT	HOURS	POP	NUMBER OF INDIV. FAULTS INOP/RED CAP	NUMBER OF NONLETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY NONLETHAL SHOCKS INOP/RED CAP	NUMBER OF LETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY LETHAL SHOCKS INOP/RED CAP
AR1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CR3	17184	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DB1	11448	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
OE1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
OE2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
OE3	26304	4	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
RS1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI2	6672	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	26304	16	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC2	18264	16	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
FC1	26304	16	2 / 0	0 / 1	0 / 1	0 / 0	0 / 0
MI2	26304	16	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MY1	26304	6	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PA1	26304	16	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SL1	23592	16	0 / 0	0 / 1	0 / 3	0 / 0	0 / 0
BV1	23160	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC2	7104	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP3	23976	8	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	12216	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
KE1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA1	6480	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	26304	8	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT2	26304	8	0 / 0	1 / 0	4 / 0	0 / 0	0 / 0
RG1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

P02	26304	6	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SA1	18000	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	26304	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	26304	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	26304	6	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
TR1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU3	26304	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU4	26304	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
7I1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	430912	312	9 / 3	1 / 2	4 / 4	0 / 0	0 / 0

ALL FAULTS IN REACTOR COOLANT TEMPERATURE SENSORS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
B	OE3	023312	120878	RT	SE	T	A07		1	T		RPS A RC TEMP READING LOW	MOISTURE FROM LEAKING VALVE ONTO RTD TERM
C	CC1	017796	052277	RT	SE	T	B13		1	N		RPS CH B T-HOT FOUND READING HIGH	ONE OF THE TWO RTD'S HAD HIGH RESISTANCE
C	CC2	017825	051677	RT	SE	T	B13		1	N		RPS CH D TC DISCOVERED READING HIGH	BROKEN LUG CONNECTION ON RTD,RTD REPLACED
C	CC2	017800	051777	RT	SE	T	A09		1	N		SPURIOUS TRIPS ON RPS CH C RECIEVED	NOISE FROM TH RTD,CAUSE UNDETERMINED
C	FC1	016667	121476	RT	TX	T	A06	C	1	V		B CH COLD LEG TEMP HIGH	CALIBRATION PROCEDURE IN ERROR
C	FC1	022544	091878	RT	SE	T	B07		1	T		HOT LEG TEMP IND FAILURE	RTD 104VC HAD WATER IN POTHEAD
C	FC1	022787	101478	RT	SE	T	B13		1	H		COLD LEG IND B/122C HIGH OFFSCALE	RTD 104VC OPEN CIRCUITED
C	MY1	021651	053078	RT	SE	T	B13		2	N		RPS DELTA-T PWR INDICATION NOT STEADY	TWO RTD'S FAILING, VARYING RESISTANCE
C	SL1	020513	020378	RT	SE	T	A06	C	3?	T		RTD RESPONSE TIMES GT. 5SEC. VALUE SET BY VENDOR	RTD'S MOUNTD IN INST.WELLS--NOT ACCTE FOR
W	IP3	022403	091278	RT	SE	T	B07		1	N		HOT LEG RTD-410A INOPERABLE	BORATED WATER LEAK ON RTD WIRING
W	PR2	016720	010177	RT	SE	T	B13		1	N		ONE REACTOR COOLANT DELTA-T CHANNEL FAILED LOW	RTD FAILED - MODEL 176KF
W	PT2	023123*	120978	RT	SE	T	B02	U	4	N		LOOP "A" RTD MANIF ISOLATED WHILE RX WAS CRITICAL	PERSONNEL OVERSIGHT
W	RO2	022334	082178	RT	SE	T	B13		1	N		T-AVE & DELTA T FOR LOOP 3 DRIFTING LOW	HOT LEG RTD FAILED
W	SU2	023016	111578	RT	SE	T	A07		1	N		"B" LOOP HOT LEG SENS ELEMENT DRIFTING LOW--CHAN 2	PACKING LEAK REDUCED RESISTANCE OF ELEMEN

Pressure Sensors

The sensors considered here are used in PWRs. The quantities measured (and their codes) are: reactor coolant pressure or pressurizer pressure (RP), steam generator pressure (SP), and containment pressure (CP).

For reduced capability faults, no common cause faults were reported, so most parameters cannot be estimated. Be sure to read the section "Application" in the main body of this report. The following computer printouts give the estimates, followed by summaries of the relevant data.

INOPERABILITY FAULTS IN PRESSURE SENSORS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.003, .194, .577)

LAMBDA = (3.0E-07, 8.1E-07, 1.5E-06)

$LAMBDA_{+}$ = (1.4E-07, 1.2E-06, 3.1E-06)

OMEGA = (1.6E-09, 4.0E-07, 1.5E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
3	(3.2E-07, 2.3E-04, 1.2E-04)	(6.8E-07, 1.7E-06, 3.2E-06)	(.011, .221, .532)
4	(2.8E-07, 1.8E-04, 9.2E-05)	(6.4E-07, 1.6E-06, 3.1E-06)	(.011, .223, .554)
8	(2.2E-07, 8.8E-05, 4.6E-05)	(5.7E-07, 1.5E-06, 3.0E-06)	(.007, .193, .597)
12	(2.0E-07, 5.9E-05, 3.1E-05)	(5.4E-07, 1.5E-06, 2.9E-06)	(.004, .176, .604)

OVERALL	(2.0E-07, 1.8E-04, 1.2E-04)	(5.4E-07, 1.6E-06, 3.2E-06)	(.004, .221, .604)

SYSTEM SIZE	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
3	(6.6E-09, 5.2E-07, 1.7E-06)	(3.0E-09, 4.5E-07, 1.6E-06)	
4	(5.7E-09, 5.1E-07, 1.7E-06)	(2.8E-09, 4.5E-07, 1.6E-06)	(2.2E-09, 4.2E-07, 1.6E-06)
8	(4.6E-09, 4.9E-07, 1.7E-06)	(2.7E-09, 4.4E-07, 1.6E-06)	(2.1E-09, 4.2E-07, 1.6E-06)
12	(4.3E-09, 4.9E-07, 1.7E-06)	(2.6E-09, 4.4E-07, 1.6E-06)	(2.1E-09, 4.2E-07, 1.6E-06)

OVERALL	(4.3E-09, 5.1E-07, 1.7E-06)	(2.6E-09, 4.5E-07, 1.6E-06)	(2.1E-09, 4.2E-07, 1.6E-06)

REDUCED CAPABILITY FAULTS IN PRESSURE SENSORS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

LAMBDA = (1.7E-10, 2.5E-06, 1.2E-05)

$LAMBDA_{+}$ = (1.6E-09, 4.0E-07, 1.5E-06)

OMEGA = (1.4E-07, 1.2E-06, 3.1E-06)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

ALL FAULTS IN PRESSURE SENSORS

PLANT	HOURS	POP	NUMBER OF INDIV. FAULTS INOP/RED CAP	NUMBER OF NONLETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY NONLETHAL SHOCKS INOP/RED CAP	NUMBER OF LETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY LETHAL SHOCKS INOP/RED CAP
AR1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CR3	17184	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DB1	11449	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE1	26304	4	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DE2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE3	26304	4	0 / 0	1 / 0	1 / 0	0 / 0	0 / 0
RS1	26304	4	0 / 4	0 / 0	0 / 0	0 / 0	0 / 0
TI1	26304	4	1 / 2	0 / 0	0 / 0	0 / 0	0 / 0
TI2	6672	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	26304	16	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC2	18264	16	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
FC1	26304	16	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MI2	26304	16	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MY1	26304	20	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
PA1	26304	12	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SL1	23592	16	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BV1	23160	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC2	7104	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP3	23976	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	12216	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
KE1	26304	4	0 / 1	0 / 0	0 / 0	0 / 1	0 / 4
NA1	6480	3	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
PR1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

RO2	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SA1	18000	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TR1	26304	4	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
TU3	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU4	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	930912	234	4 / 13	1 / 0	1 / 0	0 / 1	0 / 4

ALL FAULTS IN PRESSURE SENSORS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL	CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
B	OE1	022918	102678	RP	TX	P	A07				1	T		RPS CH A TRIP 9.6 HIGHER THAN TS	EXCESS TEMP/HUMIDITY INDUCED DRIFT
B	OE3	019884	122877	RP	TX	P	B06	U			1	N		XMTR LEFT VALVED OUT AFTER REPAIR TO TEST TEE	INCORRECT/INCOMPLETE VALVE CHECKLIST
B	RS1	014503A	040576	RP	TX	P	A14				3	T		3 RPS PRESS XMTRS READ OUTSIDE OF TS - LOW	INST DRIFT-VERITRAK MOD 59 PH 443-7050
B	RS1	014503B	040576	RP	TX	P	A14				1	T		1 RPS PRESS XMTR READ OUTSIDE OF TS - HIGH	INST DRIFT-VERITRAK MOD 59 PH 443-7050
B	TI1	015864*	083176	RP	TX	P	A14				2	T		R/X COOLNT PRESS SETPOINTS LESS CONSERV THAN T.S.	RPS CHAN B&C CALIB. DRIFT(MINOR)
B	TI1	015971	091676	RP	TX	P	B13	R			1	N		RC PRESS TRIP SETPTS. CHAN B LESS CONSRVTV THAN TS	DFFECTV TRANSMITTR(WEST. MODEL 59H)
C	CC1	019734	120577	SP	TX	P	B13				1	N		RPS CH D #12 S/G PRESSURE READ HIGH	FAILED OSCILLATOR IN S/G PRESS XMITTER
C	CC2	018224	062077	SP	TX	P	A14				1	N		CH A S/G PRESSURE,PI-1023A,INDICATED LOW	ZERO SHIFT IN PRESSURE TRANSMITER
C	FC1	014305	022776	SP	TX	P	B13				1	T		PT/D902 PRESS CHANNEL OUT OF CAL	FOXBORO E-11GM XMTR HAD BAD AMP CARD
C	MI2	018340	061777	RP	TX	P	A14				1	T		CH B PZR PRESS TRIP POINT LESS CONSERV THAN T.S.	E11GM XMTR INSTRUMENT DRIFT
C	MI2	022888	102578	RP	TX	P	B09				1	T		RPS CORE PROTECT CALCULATOR HAD GROUNDED INPUT	ELECTRICAL GROUND SOURCE UNKNOWN AS YET
C	MY1	022142	073178	RP	TX	P	A14				1	T		PT-102C RX COOLANT PRESS NON-CONSERVATIVE	FP MODEL 50EP1000 INST DRIFT
W	KE1	017244A	030477	RP	TX	P	A14				1	T		PZR PRESS HIGH PRESS RX TRIP HIGH 7 PSIG	INSTRUMENT SETPOINT DRIFT
W	KE1	020424	020678	RP	TX	P	A06	L			4	R		PZR PRESS READINGS HIGH	PROCEDURE NOT INCLUDING HEAD CORRECTION
W	NA1	022568	092878	RP	TX	P	A14				1	T		CH III PZR PRESS PT-1457 TRIP HIGH NON-CONSERVATIV	XMTR OUTPUT DRIFT
W	TR1	017759B	050477	RP	TX	P	A14				1	T		PT-456 SETPOINT EXCEEDED ALLOWABLE LIMITS	INSTRUMENT SETPOINT DRIFT

PAGE 1

Flow and Level Sensors

The sensing devices considered here all measure flow or level by measuring a difference in pressure. (The scope of this report does not permit checking each plant to find possible exceptions to this assertion.) The quantities detected (and their codes) are: steam flow (SF), feedwater flow (FF), reactor coolant flow (RF), steam generator water level (SL), and pressurizer level (PL). SL sensors are at Combustion Engineering and Westinghouse plants. SF, FF, and PL sensors are at Westinghouse plants. RF sensors are at virtually all plants.

Be sure to read the section "Application" in the main body of this report. The following computer printouts give the estimates, followed by summaries of the relevant data.

INOPERABILITY FAULTS IN FLOW AND LEVEL SENSORS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.034, .201, .434)

LAMBDA = (1.4E-12, 1.5E-06, 7.9E-06)

$LAMBDA_+$ = (1.5E-07, 6.7E-07, 1.5E-06)

OMEGA = (5.2E-10, 1.3E-07, 5.1E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
3	(3.0E-07, 2.6E-06, 7.4E-06)	(1.6E-07, 1.9E-06, 1.8E-05)	(.008, .262, .557)
4	(2.6E-07, 2.1E-06, 5.7E-06)	(1.3E-07, 1.9E-06, 1.8E-05)	(.008, .289, .577)
6	(2.2E-07, 1.5E-06, 4.0E-06)	(1.0E-07, 1.9E-06, 1.8E-05)	(.007, .281, .610)
8	(2.0E-07, 1.3E-06, 3.2E-06)	(8.9E-08, 1.8E-06, 1.8E-05)	(.005, .249, .637)
9	(1.9E-07, 1.2E-06, 2.9E-06)	(8.4E-08, 1.8E-06, 1.8E-05)	(.004, .235, .648)
12	(1.8E-07, 1.0E-06, 2.4E-06)	(7.5E-08, 1.8E-06, 1.8E-05)	(.003, .204, .671)

OVERALL	(1.8E-07, 1.5E-06, 7.4E-06)	(7.5E-08, 1.9E-06, 1.8E-05)	(.003, .262, .671)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
3	(5.6E-09, 1.9E-07, 5.9E-07)	(1.3E-09, 1.5E-07, 5.4E-07)	
4	(4.4E-09, 1.9E-07, 5.8E-07)	(1.2E-09, 1.5E-07, 5.3E-07)	(7.3E-10, 1.4E-07, 5.2E-07)
6	(3.4E-09, 1.8E-07, 5.7E-07)	(1.1E-09, 1.5E-07, 5.3E-07)	(7.1E-10, 1.4E-07, 5.2E-07)
8	(3.0E-09, 1.7E-07, 5.7E-07)	(1.0E-09, 1.5E-07, 5.3E-07)	(7.0E-10, 1.4E-07, 5.2E-07)
9	(2.8E-09, 1.7E-07, 5.7E-07)	(1.0E-09, 1.5E-07, 5.3E-07)	(7.0E-10, 1.4E-07, 5.2E-07)
12	(2.6E-09, 1.7E-07, 5.7E-07)	(1.0E-09, 1.5E-07, 5.3E-07)	(7.0E-10, 1.4E-07, 5.2E-07)

OVERALL	(2.6E-09, 1.8E-07, 5.9E-07)	(1.0E-09, 1.5E-07, 5.4E-07)	(7.0E-10, 1.4E-07, 5.2E-07)

REDUCED CAPABILITY FAULTS IN FLOW AND LEVEL SENSORS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.001, .105, .336)

LAMBDA = (1.5E-11, 2.6E-06, 1.3E-05)

LAMBDA+ = (4.7E-08, 4.0E-07, 1.0E-06)

OMEGA = (5.2E-10, 1.3E-07, 5.1E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
3	(1.7E-07, 1.7E-04, 8.8E-05)	(9.1E-08, 2.9E-06, 1.9E-05)	(.001, .136, .542)
4	(1.4E-07, 1.3E-04, 6.6E-05)	(7.5E-08, 2.9E-06, 1.9E-05)	(.001, .145, .600)
6	(1.1E-07, 8.4E-05, 4.4E-05)	(5.8E-08, 2.8E-06, 1.9E-05)	(.001, .148, .663)
8	(9.6E-08, 6.3E-05, 3.3E-05)	(4.9E-08, 2.8E-06, 1.9E-05)	(.001, .146, .707)
9	(9.1E-08, 5.6E-05, 2.9E-05)	(4.6E-08, 2.8E-06, 1.9E-05)	(.001, .144, .724)
12	(8.1E-08, 4.2E-05, 2.2E-05)	(4.0E-08, 2.8E-06, 1.9E-05)	(.001, .138, .763)

OVERALL	(8.1E-08, 8.4E-05, 8.8E-05)	(4.0E-08, 2.8E-06, 1.9E-05)	(.001, .145, .763)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
3	(1.3E-09, 1.5E-07, 5.4E-07)	(6.8E-10, 1.4E-07, 5.2E-07)	
4	(1.2E-09, 1.5E-07, 5.3E-07)	(6.6E-10, 1.4E-07, 5.2E-07)	(5.7E-10, 1.3E-07, 5.1E-07)
6	(1.0E-09, 1.5E-07, 5.3E-07)	(6.4E-10, 1.4E-07, 5.2E-07)	(5.7E-10, 1.3E-07, 5.1E-07)
8	(9.6E-10, 1.4E-07, 5.3E-07)	(6.3E-10, 1.4E-07, 5.2E-07)	(5.6E-10, 1.3E-07, 5.1E-07)
9	(9.3E-10, 1.4E-07, 5.3E-07)	(6.3E-10, 1.4E-07, 5.2E-07)	(5.6E-10, 1.3E-07, 5.1E-07)
12	(9.0E-10, 1.4E-07, 5.3E-07)	(6.2E-10, 1.4E-07, 5.2E-07)	(5.6E-10, 1.3E-07, 5.1E-07)

OVERALL	(9.0E-10, 1.5E-07, 5.4E-07)	(6.2E-10, 1.4E-07, 5.2E-07)	(5.6E-10, 1.3E-07, 5.1E-07)

ALL FAULTS IN FLOW AND LEVEL SENSORS

PLANT	HOURS	POP	NUMBER OF INDIV. FAULTS INOP/RED CAP	NUMBER OF NONLETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY NONLETHAL SHOCKS INOP/RED CAP	NUMBER OF LETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY LETHAL SHOCKS INOP/RED CAP
AR1	26304	8	0 / 4	0 / 0	0 / 0	0 / 0	0 / 0
CR3	17184	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DB1	11448	8	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE2	26304	8	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DE3	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RS1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI1	26304	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI2	6672	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	26304	16	0 / 4	0 / 0	0 / 0	0 / 0	0 / 0
CC2	18264	16	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FC1	26304	16	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MI2	26304	16	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MY1	26304	24	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PA1	26304	16	3 / 1	0 / 0	0 / 0	0 / 0	0 / 0
SL1	23592	16	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BV1	23160	39	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC1	26304	52	6 / 6	1 / 0	1 / 0	0 / 0	0 / 0
DC2	7104	52	6 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	26304	3	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
IP2	26304	52	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
IP3	23976	52	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	12216	39	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
KE1	26304	26	2 / 8	1 / 0	2 / 0	0 / 0	0 / 0
NA1	6480	39	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
PR1	26304	26	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	26304	26	0 / 3	0 / 0	0 / 0	0 / 0	0 / 0
PT1	26304	26	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT2	26304	26	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	26304	26	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

RO2	26304	39	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SA1	18000	52	3 / 3	0 / 0	0 / 0	0 / 0	0 / 0
SD1	26304	39	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	26304	39	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
SU2	26304	39	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
TR1	26304	52	0 / 6	0 / 0	0 / 0	0 / 0	0 / 0
TU3	26304	39	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU4	26304	39	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	26304	52	9 / 21	0 / 1	0 / 1	0 / 0	0 / 0
ZI2	26304	52	4 / 15	0 / 0	0 / 0	0 / 0	0 / 0
BF1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF3	21000	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BR1	19536	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BR2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CD1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DA1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR3	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN2	4320	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EP1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MI1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MO1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PB2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PB3	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PI1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
VY1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	1422936	1198	42 / 82	2 / 1	3 / 1	0 / 0	0 / 0

ALL FAULTS IN FLOW AND LEVEL SENSORS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
B	CR3	019009*	090277	RF	TX	F	A14		4	R		4 RCS FLOW INSTRUMENTS OUT OF CALIBRATION	CALIBRATION DRIFT OF D/P TRANSMITTERS
B	DB1	020704	022378	RF	TX	F	B13		1	N		RPS CH 3 LOOP 2 HOT LEG FLOW FTRC1A3 INOPERABLE	DEFECTIVE AMPLIFIER IN FLOW TRANSMITTER
B	DB1	022689	092878	RF	TX	F	B13		1	N		RPS CH 1 LOOP 2 FLOW TRANSMITTER FAILED LOW	DEFECTIVE AMPLIFIER
B	OE2	020346	011878	RF	TX	F	A08		1	T		RPS CH D FLOW INDICATION HIGH	LEAK DUE TO BLOWN GASKET
C	CC1	018951*	082677	RF	TX	F	A07	R	2	N		RPS CH D TRIP UNITS BYPASSED,SPURIOUS LOW FLOW TR.	STEAM LEAK IN AREA OF LOW FLOW XMITTER
C	CC1	018951A	082977	RF	TX	F	A07	R	1	N		RPS CH D TRIP UNITS BYPASSED,SPURIOUS LOW FLOW TR.	STEAM LEAK IN AREA OF LOW FLOW XMITTER
C	CC1	018951B	090777	RF	TX	F	A07	R	1	N		RPS CH D TRIP UNITS BYPASSED,SPURIOUS LOW FLOW TR.	STEAM LEAK IN AREA OF LOW FLOW XMITTER
C	FC1	023133	112278	SL	TX	L	A14		1	T		LEVEL XMTR "C" C/LT-901 OUT OF SPEC	GE/MAC 555 XMTR DRIFTED OUT OF TOLERANCE
C	MI2	014165	012676	RF	TX	F	A11		1	T		LOOP 2 CH C STM GEN DP HIGHER THAN OTHER 3	MODEL 368 DP XMTR FOREIGN MATTER PRESENT
C	MI2	014460	030876	RF	TX	F	B13		1	T		LOOP 2 CH C STM GEN DP HIGHER OUT OF SPEC	MODEL 368 DP XMTR BAD ZERO ADJ POT
C	PA1	019462*	081677	RF	TX	F	B13		2	T		LO FLO DET CHNLS FOR 3&4 PUMP OPER MODES EXCEED TS	ZERO&SPAN DRIFT-MOD 296 W MOD 199 BELLOWS
C	PA1	019438	082477	RF	TX	F	B13		1	T		COOLANT FLO XMTR PDT-0112AA READ 8 PCT HIGH	LOSES ACCRCY WHEN PRESS GT 2000-S/N 86916
C	PA1	020549	020278	SL	TX	L	A14		1	T		SG LVL INST LT-0751C ST PT 40 IN - OUTSIDE TS LMIT	SETPOINT DRIFT-EASILY RECALIBRATED
W	BV1	017555	032677	SL	TX	L	B13		1	N		1A STEAM GENERATOR LEVEL FAILED LOW	FAILED TRANSMITTER
W	DC1	015969	091376	SL	TX	L	A14		1	T		S/G LEVEL TRANSMITTER EXCEEDED LIMIT.(BLP-120)	ZERO SETTING SHIFTED AND REOCCURRED
W	DC1	016114	100776	FF	TX	F	B02	C	1	T		FEED FLOW TRANSMITTER EXCESSIVE ERROR (FFC-211)	PERSONNEL ERROR VALVING OUT TRANSMITTER
W	DC1	015858	091676	PL	TX	L	A14		1	T		PRESSURIZER LEVEL TRANSMITTER EXCESSIVE ERROR	ZERO HAD DRIFTED LOW ON TRANSMITTER
W	DC1	015859	091676	PL	TX	L	A14		1	T		PRESSURIZER LEVEL TRANSMITTER EXCESSIVE ERROR	ZERO HAD DRIFTED LOW ON TRANSMITTER
W	DC1	016771	010177	RF	TX	F	A14		1	T		REACTOR COOLANT FLOW TRANSMITTER ERROR EXCESSIVE	SETPOINT DRIFT (FT-426)
W	DC1	016770	010377	SL	TX	L	B13		1	T		S/G LEVEL TRANSMITTER ERROR EXCESSIVE (BLP-120)	RUST FORMATION AT FLEXURE BAR PLATE
W	DC1	019869	120377	PL	TX	L	A08		2	T		PRESSURIZER LEVEL DEVIATION BETWEEN INDICATING CHA	PARTIAL LOSS OF [illegible] REF LEG (CH I & II)
W	DC1	023529*	012978	PL	TX	L	B11	R	2	T		PRESSURIZER LEVEL INDICATION READING HIGH (CH-1)	GAS POCKET IN REFERENCE SENSING LEGS
W	DC1	021949	070978	PL	TX	L	B11	R	1	T		PRESSURIZER LEVEL INDICATION CHANNEL VARIATION	GAS POCKET IN REFERENCE SENSING LINE(CH-3
W	DC1	022695	102378	PL	TX	L	B11	R	1	T		PRESSURIZER LEVEL CHANNEL DEVIATION TOO GREAT(CH-3	GAS POCKET IN SENSING LINE
W	DC1	023361	122978	PL	TX	L	B11	R	1	N		PRESSURIZER LEVEL INDICATION READING LOW (CH ONE)	GAS POCKET IN SENSING LINE

ALL FAULTS IN FLOW AND LEVEL SENSORS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	DC2	020979A	032478	FF	TX	F	B11		1	N	STEAM FLOW-FEED FLOW MISMATCH (S/G 4 CH 1)	TRANSMITTER AND SENSING LINES AIRBOUND
W	DC2	020979B	032478	FF	TX	F	B11	R	1	N	STEAM FLOW-FEED FLOW MISMATCH (S/G 4 CH 2)	TRANSMITTER AND SENSING LINES AIRBOUND
W	DC2	020933	040178	FF	TX	F	B11	R	1	N	S/G 4 FEED FLOW CHANNEL 2 FAILED	TRANSMITTER SENSING LINES AIRBOUND
W	DC2	021677	061878	PL	TX	L	B11	R	1	N	PRESSURIZER LEVEL CHANNEL 3 INDICATING HIGH	LEAK IN REFERENCE LEG TEE FITTING
W	DC2	021946	071078	SF	TX	F	B13		1	T	STEAM FLOW CHANNEL HFC-120 WAS READING LOW	TRANSMITTER HAD A ZERO SHIFT
W	DC2	022233	080278	PL	TX	L	B11	R	1	T	PRESSURIZER LEVEL CHANNEL 3 INDICATING MALFUNCTION	GAS POCKET IN SENSING LINE
W	HN1	018774	070577	PL	ZZ	L	A14		1	N	PRESSURIZER LEVEL #3 DIFFERS FROM #1 & 2	NORMAL INSTRUMENT DRIFT
W	IP2	017782	042877	PL	TX	L	A14		1	T	LT-460 LEVEL XMTR OUT OF TOLERANCE HIGH	XMTR 613HM-H DRIFTED OUT OF TOLERANCE
W	IP2	016642	121276	SL	TX	L	B11		1	N	LEVEL XMTR OUTPUT DRIFTED HIGH	BLOCKED SENSING LINE TO XMTR
W	IP3	023223	112178	PL	TX	L	B11	R	1	N	PRESSURIZER LEVEL,CH 3,SHOWED LEVEL FAILING HIGH	BLOWDOWN VALVE LEAKING
W	JF1	019696	111177	PL	TX	L	B13		1	N	PRZR LEVEL IND LT-461 READING LOW	DELTA-P UNIT LT-461 DEFECTIVE
W	KE1	014300	022376	PL	TX	L	A14		1	T	PZR LEVEL LT-427 FOUND OUT OF SPECIFICATION LOW	ZERO DRIFT LOW
W	KE1	014396	030976	SF	TX	F	B13		1	T	MAIN STEAM FT-464 OUT OF TOLERANCE NON-LINEAR	DEFECTIVE BELLOWS IN TRASMITTER
W	KE1	016118*	092876	PL	TX	L	A14		2	T	PZR LEVEL TRANSMITTERS (2) TRIPS LESS CONSERVATIVE	INSTRUMENT DRIFT
W	KE1	017156A	021577	PL	TX	L	A14		2	T	2 OF 3 PZR LEVEL XMTRS TRIP SETTINGS NON-CONSERVA.	DRIFT
W	KE1	017156B	021577	PL	TX	L	B13		1	T	1 OF 3 PZR LEVEL XMTRS TRIP SETTINGS NON-CONSERVAT	DEFECTIVE BELLOWS
W	KE1	017372	032377	FF	TX	F	B05	C	2	N	STM GEN LEVEL CONTROLLERS LACK OF CONTROL	CROSSED INSTRUMENT TAPS BETWEEN 2 CHANNEL
W	KE1	021391	050478	PL	TX	L	A14		1	T	PZR LEVEL XMTR OUT OF CAL LESS CONSERVATIVE	BARTON LEVEL XMTR INSTRUMENT DRIFT
W	KE1	021443	051178	RF	TX	F	A14		1	T	1 RCS FLOW XMTR EACH LOOP OUT OF CAL LESS CONSERV	FOXBORO FLOW XMTR INSTRUMENT DRIFT
W	KE1	021629	060178	PL	TX	L	A14		1	N	PZR LEVEL IDICATING HIGH, LESS CONSERVATIVE	BARTON PZR LEVEL XMTR INST DRIFT
W	MA1	022571	092778	RF	TX	F	A06		1	T	RX COOLANT LO-LO FLOW TRIP NON-CONSERVATIVE	XMTR CAL PROCEDURE W/O ELEVATION COMPENSA
W	MA1	022593	100278	SL	TX	L	A11		1	T	CH III SG LEVEL INDICATION 5% DEVIATION	LT-1496 MANIFOLD GASKET LEAK
W	PR2	020126A	121277	SF	TX	F	A14		1	R	1 PROTCN SYS XMITR DRIFTED ST BISTBL STPTS GT TS	INSTMT DRIFT - NO SINGLE CAUSE ESTABLISHD
W	PR2	020126B	121277	RF	TX	F	A14		2	R	2 PROTCN SYS XMITRS DRIFTED ST BISTBL STPTS GT TS	INSTMT DRIFT - NO SINGLE CAUSE ESTABLISHD
W	SA1	017015	012177	SF	TX	F	B13		1	N	NO 13 S/G STM FLO CH 1 HAD INNACCURATE FLO SIGNAL	XMTR DIAPGM & LINKG FLD-MOD 6906A535CA69

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ALL FAULTS IN FLOW AND LEVEL SENSORS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	SA1	021912	062378	SF	TX	F	A14		1	T		NO 11 S/G STM FLO CH II OUT-OF-SPEC LOW	INSTRUMENT DRIFT IN NONCONSERVATV DIRCTN
W	SA1	022154	081578	SL	TX	L	A14		1	T		NO 13 S/G LVL CH IV TRIP POINT EXCD TS LIMITS	TRANSMITTER DRIFT
W	SA1	023229	112878	PL	TX	L	B13	R	1	T		PRESSURIZER LEVEL WAS READING 10 PCT GT OTHER CHLS	STRAIN GAUGE DVLPD HI RES IN OUTPT BRIDGE
W	SA1	023228	113078	SF	TX	F	A14		1	R		NO 13 S/G STM FLO CH I CAL DATA SHOWED TS EXCEEDED	ZERO SHIFT CSD BY S/D & S/U OF UNIT
W	SA1	023227	120178	SL	TX	L	B11	S	1	N		NO 12 S/G LVL CH III FOUND TO BE INOPERABLE	PARTIALLY CLOGGED SENSING LINES
W	SO1	015174	062876	RF	TX	F	B13		1	N		UNIT 1 TRIP AT 330MW SPURIOUS LOW FLOW SIGNAL	FAILD FEEDBACK MOTOR IN FLOW TRANSMITTER
W	SO1	023374	112678	FF	SE	F	B07	S	1	N		"C" FEED FLOW SUDDEN INCREASE;LOSS OF 1 STEAM/FEED	FLOW STRAIGHTNR DISLODGED AGAINST ORIFICE
W	SU1	022642	101178	PL	TX	L	A11		1	N		CHAN 1 PREZ. LEVEL L-I-459 DRIFTD HI--O ADJUSMNT &	LEAKAGE THRU TRANSMITR BYPASS/EQUAL.VALVE
W	SU1	022952	111578	PL	TX	L	A14		1	N		CHAN 1 OF PREZ LEVEL LI-1-459 DRIFTD LOW	DRIFT IS INTERMITTENT;UNKNOWN CAUSE;RECAL
W	SU2	014846*	021776	PL	TX	L	A14		2	N		2OF3 PREZ LEV. TRANSMITR SETPOINTS OUT OF SPEC-92%	LT-459-93% & LT-461-92.08% ELECTRONC DRIF
W	TR1	017759D	050477	PL	TX	L	A14		1	T		LT-461 SETPOINT EXCEEDED ALLOWABLE LIMIT	INSTR SETPOINT DRIFT
W	TR1	017759C	050477	SL	TX	L	A14		1	T		LT-537 SETPOINT EXCEEDED ALLOWABLE LIMIT	INSTR SETPOINT DRIFT
W	TR1	021312*	040578	SL	TX	L	A06		4	T		FOUR OF 12 SG LEVEL INST OUT OF CALIBRATION	"NORMAL" INST. DRIFT; CALIB WHEN COLD
W	ZI1	014268	030576	FF	TX	F	B08		1	T		S.GEN. 1C FEED FLOW XMTR 1FT-520 FAILD HI	LOOSE LINKAGE BETWEEN FORCE BALANC & DISC
W	ZI1	017405	022677	SF	TX	F	B13	R	1	N		1D STEAM GEN FLOW INDICATION LOW -REDUND CHAN AVAL	DEFECTIVE COIL ASMBLY IN FLOW XMTR
W	ZI1	018057	031977	SF	TX	F	B13	R	1	N		FLOW IND 1FI-533 ON S/G 1D CHAN II LOW READING	FAI' D COIL ASMBLY ON XMTR
W	ZI1	018374	041677	SF	TX	F	B13	R	1	N		LOOP D STEAM FLOW INICATR READING 0 LBS/HR	LOSS OF FLUID IN DP XMTR; REPLACD XMTR
W	ZI1	022112	041977	SF	TX	F	B13	R	1	N		1FT-533 STEAM FLOW XMTR SPIKING LOW	LOSS OF XMTR FLUID FILL; REPLACED XMTR
W	ZI1	017858	051277	SF	TX	F	B13	R	1	N		1FT-533 STEAM FLOW XMTR FAILD TO ZERO ; REPLACED	APPARENTLY DUE TO INTERMITTNT CONNECTION
W	ZI1	018375	070877	SF	TX	F	A14		1	T		XMTR 1FT-510 OUT OF TOLERNCE FOR LOOP A	ZERO SHIFT OF THE XMTR
W	ZI1	018530	072977	SF	TX	F	A11	B	1	N		LOOP 1D STEAM FLOW IND. FAILD LOW	DP LINES PLUGGD WITH SEDIMNT; WATR HAMMER
W	ZI1	019520*	102177	SL	TX	L	A14	R	3	T		1LT-537,538 & 539 SG LEVL XMTRS HI (NONCONSERVATV)	ZERO SHIFT TO ALL 3 XMTRS
W	ZI1	013535	080677	PL	TX	L	A14	R	1	T		PZR LEVL XMTR 1LT-461 FOUND LOW;RESULT NONCONSERV.	ZERO SHIFT OF THE XMTR
W	ZI1	019521	102077	PL	TX	L	A14	R	1	T		'LT-461 PZR LEVEL XMTR FOUND LOW RESULT;NONCONSERV	DRIFT OF BARTON MODEL 386
W	ZI1	019516	102877	RF	TX	F	A14	R	1	T		RX COOLNT FLOW XMTR 1FT-425 HIGH (NONCONSERVATIVE)	ZERO SHIFT OF XMTR

ALL FAULTS IN FLOW AND LEVEL SENSORS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	ZI1	019514	103177	RF	TX	F	A14	R	1	T		RX COOLNT FLOW XMTR 1FT-444 HIGH (NONCONSERVATIV)	ZERO SHIFT OF XMTR
W	ZI1	019777*	103177	RF	TX	F	A14	R	2	T		RC FLOW XMTRS 1FT-435 & 434 HIGH (NONCONSERVATIVE)	DRIFT OF XMTRS BY 4.5% & 3.7% RESPECTVLY
W	ZI1	020002	120877	PL	TX	L	A14	R	1	N		PZR LEVL XMTR 1LT-459 OUT OF TOL LOW (NONCONSERVT)	ZERO SHIFT; PREVIOUS LERS
W	ZI1	020001	120977	SF	TX	F	A14	R	1	T		STEAM FLOW IND 1FI-513 S/G LOOP A LOW (NONCONSERV)	ZERO SHIFT; TRENDING INSTRUMNT DRIFTS
W	ZI1	020196	122377	SL	TX	L	A14	R	1	N		1A S/G LEVL IND. 1LI518 HI (NONCONSERV) (1LT518)	ZERO SHIFT; PRESENTLY TRENDING DRIFTS
W	ZI1	020349	011678	SF	TX	F	A14	R	1	N		STEAM FLOW CHANL 1F523 BEGAN IND LOWR THAN OTHER	ZERO SHIFT OF FISCHER-PORTER XMTR
W	ZI1	020257*	012478	SF	TX	F	A14		2	T		STEAM FLOW XMTRS 1FT-532 & 533 LOW (NONCONSERV)	DRIFT OF XMTRS; RECALIBRATED
W	ZI1	021967A	071778	SL	TX	L	B13		1	N		SG 1D LEVL CHNL 538 TRIPPD DUE TO HI INDICATD LEVL	FAILD TRANSMITTER
W	ZI1	021967B	071778	SL	TX	L	A11	S	1	N		CHNL 537 SG LEVL IND HIGHER THAN CHNL 539	PACKING LEAK FROM ROOT VALVE OF XMTR
W	ZI1	022221	080278	SL	TX	L	A14		1	N		SG LEVL CHNL 538 HIGHR THAN CHNLS 537&539 (NONCSV)	DRIFTED OUT OF TOLERANCE; REPLACD W/SPARE
W	ZI1	022512	082278	RF	TX	F	B13		1	T		XMTR 1FT-446 FAILD HI (NONCONSERVTIV) FOR LO RC FLW	FAILD OSCILATR IN XMTR
W	ZI1	022898	102078	FF	TX	F	A14		1	T		FEED FLOW XMTR 1LT-531 OUTPUT RESULT IN NONCONSER	XMTR DRIFT CAUSED CHANNL TO BE OUT OF TOL
W	ZI1	022899	102078	SL	TX	L	A14		1	T		SG 1B LEVL CHNL 1L-548 DRIFTD HI (NONCONSERV SETPT	XMTR DRIFTD OUT OF TOLERANCE
W	ZI1	022900	102078	SL	TX	L	B11		1	T		SG 1D LEVL CHNL 1L-538 NONCONSERVTV SETPOINT	INSTRU LINE TO XMTR BLOCKD
W	ZI1	023126	112578	SF	TX	F	A14		1	T		1FT-523 READIN LT. OTHR FLOW CHANLS ON "C" S/G	FS DRIFT IS NONCONSERV; XMTR OUT OF TOLER
W	ZI2	013943	010676	SL	TX	L	A11		1	N		S/G LEVEL INDICATOR 2LI-538 FOUND READING HIGH	INSTRUMENT ROOT VALVE DEVELOPED A LEAK
W	ZI2	014190	012376	SL	TX	L	A14		1	T		2LT-528 2C S/G LEVL XMTR OUT OF TOL(NONCONSERVTVE)	SCALE SHIFT IN XMTR; RECALIBRATED
W	ZI2	014943	052576	SL	TX	L	B13		1	N		LEVL XMTR 2LT-539 FOUND OUT OF TOL FOLLWNG RX TRIP	REPLACED XMTR WITH SPARE
W	ZI2	015190	070576	SL	TX	L	B08		1	N		S/G LEVL XMTR 2LT-547 FAILD HI	STICKY INTERNAL COMPONENT PARTS
W	ZI2	015282	072976	SL	TX	L	A14	R	1	N		S/G B LEVL XMTR 2LT-549 OUT OF TOL HIGH (NONCONSR)	ZERO SHIFT UNDER INVESTIGATION
W	ZI2	015366	080276	SF	TX	F	A14	R	1	N		STEAMFLOW XMTR 2FT-543 FOR B S/G FOUND LOW	ZERO SHIFT; PLAN MODIFICATIONS BY SUPPLIR
W	ZI2	015370	080276	FF	TX	F	A14	R	1	N		FEED FLOW XMTR 2FT-521 FOR S/G C HIGH	ZERO SHIFT; PLANS TO MODIFY ARE BEING MDE
W	ZI2	015371	080276	SF	TX	F	A14	R	1	N		STEAMFLOW XMTR 2FT-523 FOR S/G C FOUND TO BE LOW	ZERO SHIFT;PLANS TO MODIFY
W	ZI2	022222	090177	SL	TX	L	A14		1	T		S/G LEVL CHNL 2L-527 FOUND READING HIGH (NONCONSR)	XMTR DRIFT; RECALIBRATED
W	ZI2	015841	082176	PL	TX	L	A14		1	T		PZR LEVL CHNL 2LT-461 READING HIGHER THAN OTHER CH	UPPER ROOT VALVE LEAKING THRU BODY TO BNT

ALL FAULTS IN FLOW AND LEVEL SENSORS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL	CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	ZI2	016969	012277	PL	TX	L	A14				1	T		PZR LEVL XMTR 2LT-461 FOUND LOW BY 7%	DRIFTD OUT OF TOLERANCE
W	ZI2	019522	102077	FF	TX	F	A14				1	N		FEED FLOW INDICATR 2FI-540 NONCONSERVTIVE	DRIFT OF XMTR ; RECALIBRATED
W	ZI2	019998	120677	SL	TX	L	A08				1	N		28 S/G LEVL IND. 2LT-547 READING HI (NONCONSERVTV)	STICKING INTERNAL PARTS
W	ZI2	020976	030978	RF	TX	F	A14				1	T		XMTR 2FT-445 HIGH; NONCONSERV FOR RC FLOW RX TRIP	ZERO SHIFTED; RECALIBRATED
W	ZI2	021796	062578	SL	TX	L	800		R		1	N		S/G LEVEL IND 2LI547 FAILD HI-NONCONSERV DIRECTION	CHECKD ROOT VALVS FO STEAM LEAKS-NONE
W	ZI2	022801	091978	SL	TX	L	800		R		1	N		2L-547 FAILD HI;NONCONSERV FOR SF/FW MISMATCH	REPLACED XMTR --NO CAUSE FOUND YET
W	ZI2	022798	100878	SL	TX	L	A11				1	N		S/G LEVL CHNL 2 LI-538 HI;NONCONSERV FOR LOLO S/G	DIRT IN SENSIN LINES, TUNED OSCILATOR
W	ZI2	021344	042578	PL	TX	L	A14				1	N		PZR LEVL CHANL 2L-459 OUT OF TOL HIGH NONCONSERVTV	RANGE SHIFT OF XMTR
W	ZI2	021708	060978	PL	TX	L	A14		R		1	T		PZR LEVL CHANL 459 FOUND LO-NONCONSERV FOR HI TRIP	ZERO SHIFT ,READJUSTED

Signal Conditioning Systems

The signal conditioning systems (and their codes) are for: source range flux (SN), intermediate range flux (IN), power range flux or nuclear power (PN), power to flow (NF), rate of change of flux (RN), T-average/delta T (DT), overpower/delta T (NT), overtemperature/delta T (TT), reactor outlet temprature (RT), reactor coolant pressure (RP), pressure/temperature or thermal margin/low pressure (TP), reactor coolant flow (RF), steam flow/feed flow mismatch (FF), steam generator water level (SL), pressurizer level (PL), steam generator pressure (SP), containment pressure (CP), and flow unit (FU). When considering common cause faults, PN and NF are grouped together, and NT and TT are grouped together; this is discussed in the section "The Scope of Common Cause Events" in the main body of this report.

At FitzPatrick on June 26, 1977, during advance preparations for LPRM replacement, a contractor cut 19 of the 31 LPRM strings, causing the loss of the 15% APRM scram function. Apparently all six APRMs were affected. The LER does not make it clear whether this should be regarded as a lethal shock, automatically causing all the APRMs to fail, or a nonlethal shock that only happened to cause them all to fail. The event is classified here as a lethal shock, because then the data show a much better fit to the extended BFR model.

Enough common cause events were reported to allow gamma distributions to be fitted for λ_+, and for reduced capability faults to allow a gamma distribution to be fitted for ω. The corresponding intervals are very wide. This reflects the observed tendency of the faults to recur at certain plants. The wide intervals have unrealisticaly small lower end points. These end points should be understood to be unknown, but virtually zero.

Be sure to read the section "Application" in the main body of this report. The following computer printouts give the esimates, followed by summaries of the relevant data.

INOPERABILITY FAULTS IN SIGNAL CONDITIONING SYSTEMS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

```
      P = ( .073, .156, .254)
LAMBDA  = ( 8.0E-11, 3.3E-06, 1.6E-05)
LAMBDA+ = ( 5.4E-33, 1.4E-06, 7.1E-06)
OMEGA   = ( 1.1E-07, 3.5E-07, 7.1E-07)
```

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
2	(2.0E-32, 5.4E-06, 2.7E-05)	(3.9E-09, 4.4E-06, 2.3E-05)	(.003, .207, .373)
3	(1.5E-32, 3.9E-06, 1.9E-05)	(4.9E-09, 4.2E-06, 2.2E-05)	(.002, .276, .500)
4	(1.2E-32, 3.1E-06, 1.6E-05)	(6.2E-09, 4.1E-06, 2.1E-05)	(.002, .312, .564)
6	(9.3E-33, 2.4E-06, 1.2E-05)	(9.1E-09, 4.0E-06, 2.1E-05)	(.003, .340, .623)
8	(7.5E-33, 2.0E-06, 1.0E-05)	(1.2E-08, 3.9E-06, 2.1E-05)	(.005, .340, .649)
9	(7.5E-33, 1.9E-06, 9.6E-06)	(1.3E-08, 3.9E-06, 2.1E-05)	(.006, .333, .656)
12	(6.3E-33, 1.7E-06, 8.6E-06)	(1.7E-08, 3.9E-06, 2.1E-05)	(.010, .307, .663)

OVERALL	(6.3E-33, 2.4E-06, 2.7E-05)	(3.9E-09, 4.0E-06, 2.3E-05)	(.002, .312, .663)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS		
	R2	R3	R4
2	(5.6E-09, 4.7E-07, 1.6E-06)		
3	(1.9E-08, 4.4E-07, 1.3E-06)	(1.1E-07, 3.7E-07, 7.6E-07)	
4	(3.2E-08, 4.2E-07, 1.2E-06)	(1.1E-07, 3.7E-07, 7.5E-07)	(1.1E-07, 3.6E-07, 7.1E-07)
6	(5.0E-08, 4.1E-07, 1.0E-06)	(1.1E-07, 3.6E-07, 7.4E-07)	(1.1E-07, 3.6E-07, 7.1E-07)
8	(6.0E-08, 4.0E-07, 9.7E-07)	(1.1E-07, 3.6E-07, 7.3E-07)	(1.1E-07, 3.6E-07, 7.1E-07)
9	(6.3E-08, 4.0E-07, 9.6E-07)	(1.1E-07, 3.6E-07, 7.3E-07)	(1.1E-07, 3.6E-07, 7.1E-07)
12	(6.6E-08, 3.9E-07, 9.3E-07)	(1.1E-07, 3.6E-07, 7.3E-07)	(1.1E-07, 3.6E-07, 7.1E-07)

OVERALL	(5.6E-09, 4.1E-07, 1.6E-06)	(1.1E-07, 3.6E-07, 7.6E-07)	(1.1E-07, 3.6E-07, 7.1E-07)

REDUCED CAPABILITY FAULTS IN SIGNAL CONDITIONING SYSTEMS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.293, .427, .562)

LAMBDA = (3.5E-14, 2.4E-06, 1.3E-05)

LAMBDA$_{+}$ = (1.8E-22, 8.0E-07, 4.7E-06)

OMEGA = (8.7E-91, 7.9E-07, 1.0E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
2	(2.7E-22, 1.2E-06, 7.1E-06)	(1.5E-09, 3.7E-06, 1.8E-05)	(.000, .004, .620)
3	(2.3E-22, 1.0E-06, 5.9E-06)	(1.3E-09, 3.6E-06, 1.7E-05)	(.000, .004, .667)
4	(2.0E-22, 9.2E-07, 5.3E-06)	(1.2E-09, 3.6E-06, 1.7E-05)	(.000, .003, .636)
6	(1.9E-22, 8.4E-07, 4.9E-06)	(1.1E-09, 3.5E-06, 1.7E-05)	(.000, .001, .552)
8	(1.8E-22, 8.2E-07, 4.8E-06)	(1.1E-09, 3.5E-06, 1.7E-05)	(.000, .001, .498)
9	(1.8E-22, 8.1E-07, 4.7E-06)	(1.1E-09, 3.5E-06, 1.7E-05)	(.000, .000, .482)
12	(1.8E-22, 8.0E-07, 4.7E-06)	(1.1E-09, 3.5E-06, 1.7E-05)	(.000, .000, .457)

OVERALL	(1.8E-22, 8.4E-07, 7.1E-06)	(1.1E-09, 3.5E-06, 1.8E-05)	(.000, .001, .667)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(4.8E-23, 1.0E-06, 3.1E-06)		
3	(3.9E-23, 9.7E-07, 2.8E-06)	(1.6E-23, 8.7E-07, 1.7E-06)	
4	(3.6E-23, 9.6E-07, 2.6E-06)	(1.5E-23, 8.7E-07, 1.7E-06)	(6.2E-24, 8.2E-07, 1.3E-06)
6	(3.3E-23, 9.5E-07, 2.5E-06)	(1.4E-23, 8.6E-07, 1.6E-06)	(5.7E-24, 8.2E-07, 1.3E-06)
8	(3.2E-23, 9.4E-07, 2.4E-06)	(1.3E-23, 8.6E-07, 1.6E-06)	(5.5E-24, 8.2E-07, 1.3E-06)
9	(3.2E-23, 9.4E-07, 2.4E-06)	(1.3E-23, 8.6E-07, 1.6E-06)	(5.4E-24, 8.2E-07, 1.3E-06)
12	(3.2E-23, 9.4E-07, 2.4E-06)	(1.3E-23, 8.6E-07, 1.6E-06)	(5.4E-24, 8.2E-07, 1.3E-06)

OVERALL	(3.2E-23, 9.5E-07, 3.1E-06)	(1.3E-23, 8.6E-07, 1.7E-06)	(5.4E-24, 8.2E-07, 1.3E-06)

ALL FAULTS IN SIGNAL CONDITIONING SYSTEMS

PLANT	HOURS	POP	NUMBER OF INDIV. FAULTS INOP/RED CAP	NUMBER OF NONLETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY NONLETHAL SHOCKS INOP/RED CAP	NUMBER OF LETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY LETHAL SHOCKS INOP/RED CAP
AP1	26304	20	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CR3	17184	20	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DB1	11448	20	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE1	26304	20	0 / 0	0 / 0	0 / 0	0 / 1	0 / 8
DE2	26304	20	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE3	26304	20	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
RS1	26304	20	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
TI1	26304	20	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI2	6672	20	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	26304	32	6 / 3	1 / 0	1 / 0	0 / 0	0 / 0
CC2	18264	32	5 / 2	2 / 0	2 / 0	0 / 0	0 / 0
FC1	26304	32	18 / 2	0 / 0	0 / 0	0 / 0	0 / 0
MI2	26304	32	5 / 7	0 / 1	0 / 1	1 / 0	4 / 0
MY1	26304	32	10 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PA1	26304	26	0 / 5	0 / 1	0 / 1	0 / 0	0 / 0
SL1	23592	32	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BV1	23160	53	13 / 0	1 / 1	2 / 1	0 / 0	0 / 0
DC1	26304	68	5 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DC2	7104	68	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	26304	17	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
IP2	26304	68	1 / 3	0 / 0	0 / 0	0 / 0	0 / 0
IP3	23976	68	1 / 8	0 / 0	0 / 0	0 / 0	0 / 0
JF1	12216	53	3 / 7	0 / 0	0 / 0	0 / 0	0 / 0
KF1	26304	46	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
NA1	6480	50	3 / 1	0 / 0	0 / 0	0 / 0	0 / 0
PR1	26304	46	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	26304	46	2 / 3	0 / 0	0 / 0	0 / 0	0 / 0
PT1	26304	46	4 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT2	26304	46	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	26304	46	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0

RO2	26304	53	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SA1	18000	68	7 / 5	2 / 0	3 / 0	0 / 0	0 / 0
SO1	26304	53	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	26304	53	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	26304	53	4 / 2	0 / 0	0 / 0	0 / 0	0 / 0
TR1	26304	68	2 / 1	0 / 0	0 / 0	0 / 0	0 / 0
TU3	26304	53	2 / 3	0 / 0	0 / 0	0 / 0	0 / 0
TU4	26304	53	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
YR1	26304	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	26304	68	7 / 3	0 / 0	0 / 0	0 / 1	0 / 4
ZI2	26304	68	10 / 3	0 / 0	0 / 0	0 / 0	0 / 0
BF1	26304	20	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF2	26304	20	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF3	21000	20	0 / 0	1 / 0	2 / 0	1 / 0	6 / 0
BP1	26304	8	0 / 0	1 / 0	1 / 0	0 / 0	0 / 0
BR1	19536	20	0 / 3	0 / 0	0 / 0	0 / 1	0 / 6
BR2	26304	20	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CO1	26304	20	2 / 1	2 / 0	2 / 0	0 / 0	0 / 0
DA1	26304	18	4 / 2	0 / 1	0 / 4	0 / 0	0 / 0
DR1	26304	9	1 / 10	0 / 1	0 / 5	0 / 0	0 / 0
DR2	26304	20	4 / 5	0 / 0	0 / 0	0 / 3	0 / 6
DR3	26304	20	3 / 8	0 / 1	0 / 2	0 / 0	0 / 0
EN1	26304	20	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
EN2	4320	20	0 / 2	0 / 0	0 / 0	0 / 1	0 / 6
FP1	26304	20	0 / 4	0 / 0	0 / 0	1 / 0	6 / 0
MI1	26304	20	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MO1	26304	20	0 / 0	0 / 2	0 / 5	0 / 0	0 / 0
NM1	26304	18	0 / 6	1 / 0	2 / 0	0 / 0	0 / 0
OC1	26304	18	4 / 0	2 / 0	3 / 0	0 / 0	0 / 0
PB2	26304	20	0 / 3	0 / 0	0 / 0	0 / 0	0 / 0
PB3	26304	20	2 / 3	0 / 0	0 / 0	0 / 0	0 / 0
PI1	26304	20	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC1	26304	20	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC2	26304	20	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
VY1	26304	18	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	1554456	2161	147 /115	13 / 8	18 / 19	3 / 7	16 / 30

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ALL FAULTS IN SIGNAL CONDITIONING SYSTEMS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	FAIL CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
B	DB1	019943	120777	NF	PS	B13			1	N		RPS CH 3 FLOW LOOP B FAILED LOW	FAULTY CONTACT ON POWER SUPPLY FUSE HOLDE
B	DB1	020706*	0[illegible]1078	RT	CA	B09			2	T		RPS CH 3 HOT LEG TEMP STRING TI-RC3B4 INOPERABLE	LOOSE WIRE CONNECTION AT TEMP ELEMENT
B	OE1	022174A	080678	NF	ZZ	A06	N		4	N		QUADRANT POWER TILT EXCEEDED TECH SPEC	OPERATOR FAILED TO RESET TRIPS
B	OE1	022174B	080678	PN	ZZ	A06	N		4	N		QUADRANT POWER TILT EXCEEDED TECH SPEC	OPERATOR FAILED TO RESET TRIPS
B	OE3	017452	032577	NF	ZZ	A00			1	T		FLUX/FLOW IMBALANCE, CH B RX.COOL.FLOW TRIPPED LOW	UNKNOWN NON-REPETITIVE
B	OE3	019487	100577	RT	CM	B13			1	T		CH B HIGH RX COOLANT FAIL TO TRIP ANY LEVEL	NORMAL USAGE FAILURE REPLACED
B	RS1	018006	041977	NF	CN	A14			1	T		RPS CH A FLUX/IMBALNCE/FLOW TRIP ENVELOPE OUTSD TS	DRIFT OF FUNCTION GEN MOD 6625027A1
B	TI1	015866	083076	NF	CA	B09			1	N		"D" CHANL TRIPPD (FLUX/IMBALANC/FLOW);"C" IN BYPAS	SHORT IN JUNCTION BOX;"C" PLACED IN NORML
B	TI1	016306	102776	RT	CA	B12			1	T		RC HI TEMP BISTABLE CHAN "C" FAILD TO TRIP	DIRTY CONNECTOR ON BISTABLE; CLEANED CONN
C	CC1	014284	021876	RF	PS	B13			1	T		NON-CONSERVATIVE LOW FLOW TRIP,RPS CH B,FOUND	DEFECTIVE POWER SUPPLY CAUSED DRIFT
C	CC1	017994	033077	PN	CA	B02	C		1	N		POWER RANGE UPPER DETECTOR CIRCUIT,CH A, FAILED	DETECTOR DRAWER FIELD CABLE CONN. DISCONN
C	CC1	017712	040477	RP	CA	A09			1	N		PRESSURIZER PRESSURE INDICATION AT 1C06 READ HIGH	DIRTY SIDE LINK CONNECTIONS AT 1C25D
C	CC1	017713	050377	PN	CM	B13			1	N		VARIABLE OVERPOWER TRIP,CH D, WHOULD NOT RESET	LOW LEVEL ALARM COMPARATOR HAD FAILED
C	CC1	017907	052377	PN	CM	A09	R		1	N		RPS CH A HIGH POWER TRIPS GAVE SPURIOUS TRIPS	NOISE ON TEMP LOOP SIGNALS
C	CC1	018307	070177	TP	CA	A07			1	N		RPS CH B TRIP UNITS BYPASSED DUE TO LOW TC IND.	DUST ON THE SLIDE LINK TERMINALS INC RES.
C	CC1	018305	070177	PN	CM	B13			1	N		RPS CH A HIGH POWER TRIP UNIT BECAME ERRATIC	COMPARATOR FAILURE
C	CC1	018860	081177	PN	PS	B13			1	T		RPS CH C TRIP UNITS WERE BYPASSED	POWER SUPPLY REGULATING HIGH,REPLACED
C	CC1	019122	091577	TP	IM	B13			1	N		RPS CHANNEL B TM/L TRIM UNIT ACTUATED	THERMAL MARGIN/LOW PRESS CALCULATOR FAIL
C	CC1	019619	102877	PN	CM	B13			1	N		RPS CH C ASI INDICATOR DECLARED INOPERABLE	FAILED COMPARATOR MODULE
C	CC2	016725	121276	PN	CA	B05	C		1	N		CH D ASI OBSERVED GOING OPPOSITE DIRECTION	CABLES REVERSED DUE TO MISLABLING
C	CC2	016996*	011777	TP	CA	A09			2	N		CHANNEL B THERMAL MARGIN/LP SPURIOUS TRIPS	TM SIGNAL LEADS WERE LOOSE
C	CC2	017207	012677	PN	AM	B13			1	N		CH A AXIAL FLUX OFFSET POSITIVE LIMIT FAILED HIGH	FAILED AMPLIFIER
C	CC2	017983	042177	PN	PS	B03	C		1	T		POWER SUPPLY FOR CH B LINEAR RANGE NUC INS FAILED	POWER SUPPLY GROUNDED BY TECHNICIAN
C	CC2	017823	051677	RF	IM	B13			1	N		RPS CH C RX COOLANT FLOW-LOW TRIP,TRIPPED	FAILED FLOW SIGNAL CHARACTERIZER
C	CC2	018879	081977	PN	IM	B13			1	T		CH A AXIAL FLUX OFFSET POS LIMIT TRIP FOUND INOP.	MULTPLIER/DIVIDER FOUND LIMITING APD SIG.

ALL FAULTS IN SIGNAL CONDITIONING SYSTEMS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	FAIL CODE	TYP	FAIL NUM	DISCOV / ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
C	CC2	019620	110477	CP	TR	B13		1	T	CONT. PRESS INPUT TO CH B RPS FOUND OCILLATING	FAILED E/E SIGNAL ISOLATOR
C	CC2	020560	022178	RN	CA	B09		1	T	RPS CH B WIDE RANGE NEUT. INDI COULD NOT BE ALIGN	HIGH CAPAC CONNECTION
C	FC1	014301	022776	SL	CM	B13		1	N	RPS A STM GEN B LEVEL TRIP DID NOT ACTUATE	BISTABLE INPUT RESISTOR OUT OF TOLERANCE
C	FC1	014507*	032676	PN	IM	B04	R	1	N	B&H 19-301A ADD-SUB MODULE WENT INTO OSCILLATION	POSITIVE LIMIT MODULE DEFECTIVE REPLACED
C	FC1	014509	032776	PN	IM	B04	R	1	N	B&H 19-301A ADD-SUB MODULE WENT INTO OSCILLATION	CIRCUIT MODIFIED PER LATER LER
C	FC1	014499	040176	PN	IM	A14		1	T	VHPM TRIP B AT 6 VICE 4.2	B&H 19-317-2X FBL MOD OUTPUT DRIFTED
C	FC1	014510	040576	PN	IM	B04	R	1	N	CH B APD POS LIMIT HIGH	B&H 19-301A ADD-SUB MODULE OSCILLATING
C	FC1	014558	041376	PN	IM	B04	R	6	N	CH A&B APD POS LIMIT HIGH 6 TIMES	B&H 19-301A MOD OSCILLATES, RANDOM NOISE
C	FC1	017237	021677	SP	CM	B13		1	T	RPS D TRIP 6 SG PRESS FAILED TO TRIP	TRIP INDICATION BULBS OUT OF TOLERANCE
C	FC1	019385	102077	SL	CM	B13		1	T	RPS D TRIP 4 S331 LEVEL OUT OF SPEC	TRIP UNIT ELD-240-0000-1F INTERNAL FAILUR
C	FC1	019563	103177	PN	PS	B13		1	N	SETPOINTS FOR APD "D" OF RPS INCORRECT	LAMBDA PS LCD-A-22 LOW OUTPUT, REPLACED
C	FC1	020849	032778	TP	IM	B13		1	N	VAR HP TRIP "B" NOT INDICATING PROPERLY	B&H 19-309 MULTIPLIER MODULE FAILED
C	FC1	021697	061978	PN	IM	B13		1	N	VAR HP TRIP NOT INDICATING PROPERLY	B&H 19-502 AMP SELECT MODULE FAILED
C	FC1	021800	070378	RF	CM	A14		1	T	"C" LOW FLOW TRIP SETPOINT OUT OF TOLERANCE	GEN ATOMICS ELD240-0090-1F B/S DRIFT
C	FC1	021801	071278	SP	PS	B13		1	T	STM GEN PRESS TRIP OUT OF TOLERANCE	PWR MATE PS DRA 15-750 FAILED
C	FC1	022303	081478	PN	PS	B13		1	T	"C" LIN PWR METERS READING LOW	PS MC-14.5-1.0 LOST REGULATION
C	FC1	022230	083078	PN	PS	B13		1	N	"B"RPS VAR OVER POWER TRIP RESET DEM ALARM ACTUATD	PS 19-601A 18VOLT FAILED UP TO 27VOLT
C	MI2	014015*	011476	TP	IM	B04	L	4	R	4 OF 4 TM/LP TRIP NON-CONSERVATIVE FOR ALL CONDITI	DESIGN WIRING ERROR INPUT TO CEA FUNC GEN
C	MI2	015079	061376	TP	AM	B13		1	N	TM/LP CALCULATOR ERRATIC NON-CONSERVATIVE TRIP PT	B&H DUAL BIPOLAR AMP 381441-01 FAILURE
C	MI2	015580	080676	SL	CM	A14		1	T	CH A STM GEN LEVEL HIGH TRIPS HIGHER THAN SPEC	ELD-240-0000-1F BISTABLE INST DRIFT
C	MI2	017116	020977	RF	CM	A02	C	1	T	RPS LOW FLOW SETPOINT SET HIGH NONCONSERVATIVE	PERSONNEL MISINTERPRETED FORMULA
C	MI2	017489	031377	PN	AM	B13		1	N	CH B RPS LIN PWR RNG LOWER DET CH FAIL FULL SCALE	ELC-179-2110 LIN CURRENT AMP FAILURE
C	MI2	018736*	080477	RF	CM	A14		2	T	2 OF 4 LOW FLOW TRIPS LESS CONSERVATIVE THAN T.S.	BISTABLE INSTRUMENT DRIFT
C	MI2	019601	101477	PN	AM	B13		1	N	RPS CH D LIN PWR UPPER FAILED HIGH	FAILED AMP ELC-179-2110
C	MI2	020458*	011378	SL	CM	A14		2	T	STM GEN LEVEL TRIPS B & C OUT OF SPEC HIGH	ELD 240-0000-1F SETPOINT DRIFT

ALL FAULTS IN SIGNAL CONDITIONING SYSTEMS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
C	MI2	021353	042578	PN	CA	B09		1	N	PWR RNG CH D INDICATION FAILED LOW	LOOSE CONNECTOR TO CHAN D DETECTOR
C	MI2	022132	080178	RF	CM	A14		1	T	RPS RX COOLANT FLOW LOW TRIP OUT OF SPEC NONCONSER	ELD-240-0000-IF INSTRUMENT DRIFT
C	MI2	022883	100478	RF	CM	A14		1	T	RPS CH B RX COOL LOW TRIP OUT OF SPEC NON-CONSERVA	ELD-240-0000-IF INSTRUMENT DRIFT
C	MI2	023210	113078	PN	PS	B13		1	N	RPS CH B CORE PROTECT CALCULATOR FAILED	LCD-A-22 PWR SUPPLY FAILURE
C	MY1	014009	011676	PN	IM	B13		1	T	RPS VAR OVER-POWER HIGH TRIP NON-CONSERVATIVE	FEEDBACK LIMITER MODULE WORN POTENTIOMETR
C	MY1	014123	011676	RF	PS	B13		1	T	REACTOR LOW FLOW TRIP NON-CONSERVATIVE	PS DRA 15-750/15-750B IMPROPER OUTPUT
C	MY1	014010	012376	TP	IM	B13		1	M	DELTA-T INPUT TO TM/LP TRIP CALCULATOR LOW/ERRATIC	B&H 10 TURN POTENTIOMETER WORN/DIRTY
C	MY1	014262	021976	RP	PS	B13		1	T	RPS PZR PRESS HIGH TRIP POINT NON-CONSERVATIVE	DRA 15-750/15-750B PS INCORRECT OUTPUT
C	MY1	014261	022476	RN	PS	B13		1	N	RPS "D" WIDE RANGE LOG NUCLEAR HIGH VOLT ALARM	BENRUS TECHNIPOWER PS MODULE FAILURE
C	MY1	015074	061576	RP	PS	B13		1	T	RPS HIGH PRESS PZR TRIP NON-CONSERVATIVE	DRA 15-750/15-750B PS INCORRECT VOLTAGE
C	MY1	015276	072676	TP	IM	B13		1	T	CH B TM/LP TRIP LOWER THAN OTHER 3 CHANNELS	B&H 19-301A ADD/SUB MODULE FAILED
C	MY1	015275	080376	TP	IM	B13		1	N	SPURIOUS TRIP CH D TM/LP	B&H 19-502 AMPLITUDE SELECTOR FAILED
C	MY1	016754	011877	RF	PS	B13		1	T	RPS LOW REACTOR COOLANT FLOW TRIP NON-CONSERVATIVE	DRA 15-750/15-750B PS INCORRECT VOLTAGE
C	MY1	023558	122678	TP	IM	B13		1	N	RPS"C" VAR PRESS SETPOINT FOR TM/LP LOW	DIRTY POT IN TM/LP MODULE
C	PA1	014395	030676	PN	ZZ	A00	R	1	T	PWR RNG SAFTY CHNL NI006 TRIPPED AT 107.1 PRCNT	LINP CH PT NO-ELJ 147-000-1A,SN-NP-6-1C5
C	PA1	016490	111576	PN	CM	A14		1	T	NEUT MON CHNL C TRIP AT 108.4 VS 106.5 PERCENT	INSTRUMENT SET POINT DRIFT
C	PA1	016621	120676	SL	CM	A14		1	T	SG LO LVL TRIP(CH D) BELOW TS BY .135 INCHES	SET POINT DRFT AND ADMIN LMT CLOSE TO TS
C	PA1	020622	120577	RP	CM	A14		1	T	PRI PRESS ST PT FOR CHNL "C" WAS 1747 VS 1750	INSTRUMENT DRIFT(3 PSI)-MOD 562
C	PA1	021323	041478	RF	CM	A06	C	1	T	CH A LO PRI FLOW WAS 94.6 PCT, TS REQ MIN 95 PCT	CALIB PROCED REQS CHK THAT AFFECTS TRIP
C	PA1	022783	102078	RP	CM	A14		1	T	PCS CH D PRESS INST(PT-0102D) TRIP AT 1745 VS 1750	ZERO SHIFT CAUSED BY INCREASE IN AMB TEMP
W	BV1	014606A	051276	NT	CM	B01	U	1	N	OVERPOWER BISTABLE NOT TRIPPED WHEN REQ.	OPERATOR FAILED TO TRIP BISTABLES
W	BV1	014606B	051276	TT	CM	B01	U	1	N	OVERTEMP BISTABLE NOT TRIPPED WHEN REQ.	OPERATOR FAILED TO TRIP BISTABLES
W	BV1	014691	051376	TT	CM	B02	S	1	T	LOOP 1A OVERTEMP DT BISTABLE TRIPPED CAUSING RX TR	VOLTAGE SPIKE CAUSED BY PERSONNEL(MAIN.)
W	BV1	015726	082376	DT	AM	B13		1	N	LOOP A DT INDICATOR DISCOVERED LESS THAN ZERO	HAGAN SIGNAL ISOLATOR FAILURE
W	BV1	017623	041677	FF	IM	B13		1	N	1A S/G FEED FLOW INSTRUMENT FAILED HIGH	FAILED SQUARE ROOT EXTRACTOR

ALL FAULTS IN SIGNAL CONDITIONING SYSTEMS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	FAIL CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	BV1	017695	042677	TT	IM	B13			1	N		1C RCL OVERTEMP DT SETPOINT DISCOVERED FULL SCALE	FAILED LEAD-LAG MODULE,WEST.MODEL 131-114
W	BV1	018830	072177	PN	IM	B13			1	N		CH1 OVERPOWER PT SETPOINT READING HIGHER THAN OTHE	FAILED SUMMATOR
W	BV1	019932	121077	DT	CA	B13			1	N		LOOP 3 DT INDICATOR FAILED LOW	TEMPERATURE DETECTOR CABLE DAMAGED
W	BV1	020129	121477	RP	AM	B13			1	N		PZR PRESSURE INDICATOR FAILED LOW ,CHANNEL 445	FAILED ISOLATION AMPLIFIER
W	BV1	020127	121677	FF	IM	B13			1	N		LOOP 3 FEED FLOW CHANNEL 496 INDICATED LOW	FAILED CHANNEL MUTIPLIER-DIVIDER MODULE
W	BV1	020440	011678	IN	AM	B13			1	N		INTER. RANGE CHANNEL N36 INDICATED BELOW OP. LIMIT	FAILED CURRENT AMPLIFIER
W	BV1	020755*	021178	NT	CM	B13	R		2	N		ON TWO SEPARAT DAYS,OVERPOWER DT SETPOINT READ HI	MODULE OUTPUT DRIFT,MODULE REPLACED
W	BV1	020793	022878	PN	AM	B13			1	N		POTENTIOMETER DISCOVERED OPERATING ERRATICALLY	NON-CONTINUOUS AREA ON POTENTIOMETER(N41)
W	BV1	026843	042478	DT	AM	B13			1	N		LOOP B DT-TAVE INDICATION FAILED LOW	FAILED CAPACITOR IN LOW-LEVEL AMPLIFIER
W	BV1	022881	101378	PN	CM	A02	C		1	T		EX CORE INST.,CH N41,RATE TRIP SETPOINT TOO HIGH	INADVERTENT READJUSTMENT
W	DC1	014723	051376	FF	IM	A14			1	T		EXCESSIVE ERROR IN SQUARE ROOT EXTRACTOR(IFY-521B)	SET POINT DRIFT
W	DC1	019767*	112377	SN	ZZ	B00			2	N		TWO SOURCE RANGE CHANNELS INOPERABLE FOR ABOUT 1 H	CAUSE UNKNOWN-FAILURE COULD NOT BE LOCATE
W	DC1	022333*	082878	SL	CM	B13	R		2	T		S/G LEVEL BISTABLE EXCEEDED MINIMUM SETPOINT	BAD SOLDER JOINT ON RESISTOR
W	DC1	022535	092478	SN	CA	B09			1	N		SOURCE RANGE CHANNEL BECAME INOPERABLE (N-31)	CHANGED CABLE FROM DETECTOR TO DRAWER
W	DC2	020931	040178	TT	IM	B13			1	N		REACTOR COOLANT LOOP 1 DELTA T OVERTEMPERATURE FAI	MODULE ZTY-411C FAILED
W	DC2	022502	091378	RP	CM	B13			1	T		PRESSURIZER PRESSURE HIGH REACTOR TRIP BISTABLE FA	BISTABLE FAILED DUE TO A BAD TRIAC
W	DC2	023113	112578	SN	CA	B12			1	N		SOURCE RANGE NEUTRON FLUX CHANNEL N-31 INOPERABLE	HIGH VOLTAGE & SIGNAL CABLE CONN CLEANED
W	HN1	014005	010876	PN	CM	A14			1	T		CH 33 OVERPOWER TRIP ABOVE LIMIT	NORMAL INSTRUMENT DRIFT
W	HN1	014161	021976	PN	CM	A14			1	T		CH 34 OVERPOWER TRIP ABOVE LIMIT	NORMAL INSTRUMENT DRIFT
W	IP2	014204	011676	SL	PS	B13			1	T		BISTABLE LC-4(76-2-2)B OUT OF SPEC	M/63 ALARM UNIT PWR SUP DEFECTIVE
W	IP2	016220	101376	DT	ZZ	A00			1	T		DELTA-T CH22 DIFFERS FROM OTHER 3 CHANNELS	CHANGE OF DELTA-T SINCE PHYSICS TESTING
W	IP2	016556*	112876	PN	AM	A14			2	T		PWR RNG F (DELTA I) FOR CH 41 & 43 OUT OF SPEC	STATIC GAIN UNIT 62H-2 OUT OF CALIBRATION
W	IP3	015131	052576	RP	CM	A14			1	T		BISTABLE 63U-AC-OHAA-F SETPOINT DRIFT	PC-457A READJUSTED
W	IP3	015114	060576	RF	AM	B13			1	T		FT-434 OUTPUT DRIFTING	FT AMP ASSY 143SY DEFECTIVE
W	IP3	016340	102976	NT	AM	A14	R		1	T		CH II OVERPOWER-DELTA-T SETPOINT NONCONSERVATIVE	STATIC GAIN UNIT MODEL DQ OUT OF ADJUST

ALL FAULTS IN SIGNAL CONDITIONING SYSTEMS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	FAIL	CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	IP3	017123	112576	NT	AM	A14		R		1	T		CH II OVERPOWER-DELTA-T SETPOINT NONCONSERVATIVE	DQ STATIC GAIN UNIT OUT OF ADJUSTMENT
W	IP3	016468	113076	NT	AM	A14		R		1	T		CH II OVERPOWER-DELTA-T SETPOINTS NONCONSERVATIVE	DQ STATIC GAIN UNIT OUT OF ADJUSTMENT
W	IP3	016634	113076	NT	AM	A14		R		1	T		CH II OVERPOWER-DELTA-T SETPOINTS NONCONSERVATIVE	DQ STATIC GAIN UNIT OUT OF ADJUSTMENT
W	IP3	017121	012777	NT	AM	A14		R		1	T		CH II OVERPOWER-DELTA-T SETPOINTS NONCONSERVATIVE	DQ STATIC GAIN UNIT OUT OF ADJUSTMENT
W	IP3	019263	092877	NT	AM	A14				1	T		CH IV OVERPOWER-DELTA-T SETPOINTS NONCONSERVATIVE	DQ STATIC GAIN UNIT OUT OF ADJUSTMENT
W	IP3	021652	060278	PN	AM	A14		R		1	T		F(DQ) NO. 41 SETPOINTS NONCONSERVATIVE	DQ STATIC GAIN UNIT OUT OF ADJUSTMENT
W	JF1	019056	082277	DT	IM	A14				1	N		LOOP C LO-LO TAVG TB-432E SETPOINT OUT OF TOLERANC	TB-432E OUT OF CALIBRATION
W	JF1	019358	090777	PL	CM	A14				1	T		PZR LEVEL LB-459A(2) SETPOINT OUT OF TOLERANCE	INSTRUMENT DRIFT
W	JF1	019364	092177	DT	IM	A14				1	T		TB-4328-1 SETPOINT OUT OF TOLERANCE	INSTRUMENT DRIFT
W	JF1	019371	100877	DT	IM	B13				1	T		DELTA-T/TAVG CH II OUT OF TOLERANCE	LEAD/LAG CARD TY-422E FAILED
W	JF1	019697	111777	IN	CM	A14				1	T		HIGH LEVEL TRIP BISTABLE NC206 IN EXCESS OF T.S.	B/S RELAY DRIVER NC206 INST DRIFT
W	JF1	019849	112977	RP	CM	B13				1	N		PZR HIGH PRESS PB-4571 TRIPPED ABOVE SETPOINT	NAL CARD PB-457A DEFECTIVE
W	JF1	019848	120277	FF	IM	A14				1	N		STM FLOW IND FI-484 READING LOW	NMD CARD FY-484 OUT OF CALIBRATION
W	JF1	019846	120577	RP	CM	B13				1	N		PZR HIGH PRESS PB-457A TRIPPED ON	DEFECTIVE BISTABLE CARD
W	JF1	020282*	011278	FF	CM	A14				2	T		STM VS FEED FLOW MISMATCH TRIP LESS CONSERVATIVE	CARDS FB-498B & FY-497 NORMAL DRIFT
W	KF1	017244B	030477	RP	CM	A14				1	T		PZR PRESS HIGH PRESS RX TRIP HIGH 4 PSIG	INSTRUMENT SETPOINT DRIFT
W	[illegible]1	017723	033077	PL	CM	A14				1	T		PZR HIGH LEVEL TRIP CHANNEL ABOVE T.S. SETPOINT	ALARM BISTABLE DRIFT
W	NA1	021541	052978	DT	AM	B13				1	T		PROTECT TAVG LOW, PROTECT DT HIGH T-1412	COLD LEG RTD AMP FAILURE
W	NA1	022557	083178	RP	PS	B13				1	N		PZR PRESS CH P-455 SPIKE INTERMITTENTLY	FAULTY PZR PRESS LOOP POWER SUPPLY
W	NA1	022937	101278	FF	PS	B09				1	N		FEEDWATER FLOW FT-1496 LOOP C FAILED LOW	POWER FUSE BLOWN
W	NA1	022771	101778	FF	IM	A14				1	T		STM-FEEDWATER FLOW MISMATCH TRIP HIGH	DRIFT OF MULTIPLIER-DIVIDER CARD
W	PR2	014202	020976	TT	CM	A14				1	T		ONE DIFF OVRTEMP SETPOINT FOUND OUTSIDE TS LIMITS	SET POINT DRIFT
W	PR2	014275	022976	RP	CM	A09				1	T		ONE LO PSZR PRESS SI STG FOUND 9 PSI BELOW TS LMIT	LOOSE LOOP RESISTOR
W	PR2	016341	110376	SN	AM	B13				1	N		NUCLEAR SOURCE RANGE CHANNEL 2N-32 FAILED	FAULTY PREAMPLIFIER
W	PR2	017112	020477	NT	IM	A14				1	T		OVERPOWER FUNCTION DELTA-T SP2 TRIPPED OUT OF SPEC	INSTMT DRIFT IN SUMMING AMP -MOD 66RC-CL

ALL FAULTS IN SIGNAL CONDITIONING SYSTEMS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	FAIL CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	PR2	022716	081878	PN	PS	B13			1	M		NIS POWER RANGE CHANNEL 2N41 FAILED	FAILURE OF -25V LOW VLTG PS-MOD UPM-44KW
W	PT1	013946	011076	PN	PS	B13	R		1	N		PWR RNG CH 41 PWR SUP FAILED-41 DETECTOR INOPERATV	MOD UPM-4 [illegible] POWER SUPPLY REPLACED
W	PT1	016573	113076	PN	PS	B13	R		1	N		PWR RNG CH 42 FAILD TO TRIP POSITN CAUSNG CUTBACK	MOD UPM-44K -25V PWR SUPPLY FAILED
W	PT1	021444	051278	NT	IM	B13			1	N		SPECIAL SUMMER(1-TM-404V)IN OVR PWR DELTA T CH SP2	DRFTD HI-DFCTV ZERO POT- 66RC-OL
W	PT1	023304	121978	PN	PS	B13	R		1	N		PWR RNG CH 44 FAILED,CAUSING TURBINE RUNBACK	PWR SUPPLY FAILED - MOD PUMP-X54W
W	PT2	014951	061376	PN	PS	B00			1	N		UNIT EXPER TURB RUNBACK FOLLOWING LOSS OF PR DET V	CAUSE UNKNOWN - MODEL UPMD-X54W
W	RG1	014203	012976	PN	PS	B13			1	N		BOTH CONTROL POWER FUSES BLEW FOR N42 PWR RNG CHNL	CAPACTR IN AUX PWR SUP BD FLD-UPMDX54
W	RG1	014715	041276	PN	PS	B13			1	N		N44 PWR RNG HI VLTG PWR SUP FAILED TO 57V DC	MODULAR BLOCK PT NO IV-101 - MOD UPMD-X54
W	SA1	016026*	092776	IN	CA	B07	C		2	N		BOTH INTERMEDIATE RANGE NUCLEAR INST CHNLS INOPER	WETTING OF DTCTRS WITHIN WELL-HI CONN FES
W	SA1	017017	012077	RF	ZZ	B05	S		1	N		NO 12 RX COOLANT FLOW CHANNEL 1 BECAME INOPERABLE	SWAGELOK TUBE FITNG BACKED OFF-CONST EROR
W	SA1	017267	021577	DT	IM	A14	R		1	T		#14 RX CLNT LOOP DELTA-T/TAVG TRIP POINT GT TS LMT	SLIGHT COMP VALUE CHGS WITHIN SLD ST CKTY
W	SA1	017423	031477	DT	IM	A14	R		1	T		#14 RX CLNT LOOP DELTA T/TAVG TRIP POINT GT TS LMT	CHANNEL DRIFT - CMN FAILURE CMPNTS UNDET
W	SA1	017888	060377	PL	CM	B13			1	N		CHANNEL III PSRZR LEVEL WAS DECLARED INOPERABLE	DUAL OUTPT COMPARATOR FLD-2 CAPCTRS ON PS
W	SA1	019923	120577	FF	IM	A14	R		1	T		#14 S/G FLO CH II TRP PT 31MVDC GT ALLOWED BY TS	INST DRIFT IN SQ ROOT EXTRCTR-PN/ 4111511
W	SA1	019922	120677	RF	IM	B13			1	N		#11 RC LOOP FLOW CHANNEL II FAILED	SIGNAL ISOLATOR FAILED-CONSOLE IND LOST
W	SA1	019921	120777	RF	AM	B13			1	T		#12 RC LOOP CH II OPDT SETPT DETRMND TO EXCD TS	LOW LEVEL AMPLIFIER FAILED - MOD 111
W	SA1	020456	010378	FF	IM	A14	R		1	T		NO 14 S/G STM FLO CH II TRIPPED GT TS LIMIT	INST DRIFT IN SQ RT EXTRACTOR-PN/ 4111511
W	SA1	020457	010678	TT	IM	B13			1	N		LOOP 13 OVR TEMP DELTA-T CHANNEL FAILED	FAILED CAPCTR IN TYPE 4111513 FNCTN GEN
W	SA1	021030	031078	PN	CM	A14			1	T		PWR RNG CH N43 TRIP SETPOINT FOUND 1.4 PCT GT ALLW	INSTRUMENT DRIFT
W	SA1	021648*	061078	PN	CA	B02	C		1	N		TWO INOPERABLE POWER RANGE CH WERE IDNTFD(N41&N42)	MAINT PERS DISCONN WRONG LEADS FOR RX COM
W	SA1	022157	080978	FF	AM	B13			1	T		NO 11 S/G FEED FLO CH 2 BISTBL SETPT ABOVE TS LMTS	FAILED OP AMP IN THE DUAL COMPARATOR MOD
W	SA1	022413	091278	RP	CM	B13	R		1	T		PRESS PROTCTN CH 2 RX TRIP SETPT GT TECH SPEC LIMT	UNSTABLE OUTPT FRM COMPARATOR FDG TRIP BS
W	SO1	015998	082376	FF	PS	B13			1	N		S/G FEED CONT. B/U POWER SUPPLY DEGRADED CAUSING	INOP FEED FLOW R/X TRIP; FAILD DIODES
W	SU1	016257	110176	TT	CM	B13			1	T		COMPARATOR(TC-1-432C) FAILD TO TRIP	POWER CAPACITOR MALFUNCTION
W	SU1	017420	032877	FF	RE	B12			1	T		HI STEAM FLOW RELAY(FC-485-XA) MALFUNCTND- SI TEST	DEBRIS IN BF-48 RELAY CONTACTS

ALL FAULTS IN SIGNAL CONDITIONING SYSTEMS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	SU1	020097	121677	SL	PS	B13		1	T	"A" S/G LEVEL CHAN II COMPARATOR FAILD TO TRIP	2 OPEN CAPACITORS IN COMP. POWER SUPPLY
W	SU2	014842	021176	TT	IM	A09		1	N	CHAN 3 HI TEMP SETPOINT DRIFTD 9% IN NONCONSERVATV	LOOSE CONNECTION ON SUMMATOR
W	SU2	015527	062176	PN	PS	B13		1	N	LOSS OF DETECTR VOLT ALARM TO PWR RANGE NI CHAN 42	-25 VOLT POWER SUPPLY FAILD ;3 CHAN OPER.
W	SU2	015528	062676	PN	IM	A14		1	N	NIS POWR RANGE CHAN N42 DEVIATD BY 3% FROM OTHR CH	OUTPUT OF LEVEL & SUMMING AMPLIFR DRIF LO
W	SU2	016140	101376	SL	CM	B13		1	T	DUAL COMPARATR OF S/G "B" NARROW RANG CHAN 2;LOW L	OPEN CAPACITOR;CM WOULDN'T DENERGIZE
W	SU2	017201	020977	DT	AM	B13		1	N	"C" LOOP TCOLD CHAN T-432 FOR OVRPWR & OVR TEMP	MALFUNC.OF SPAN POTENTIOMTR IN LEVEL APPL
W	SU2	018476	071877	RF	CM	B13		1	T	R/X COOLNT FLOW COMP. FC-2-414 FAILD TO TRIP	CAPACITOR LEAKAGE; 2 REDUNDT. SYS OPERABL
W	TR1	016798	010777	SL	AM	B13		1	T	C STEAM GEN LO LEVEL BI-STABL 537C FAILD TO TRIP	OPERATIONAL AMPLIFIER ON CKT BRD FAILD
W	TR1	018586	070877	SL	CM	A14		1	T	S/G LEVEL PROTECTN SET IV LB-537C TRIPPN LOWER LEV	FOUND TO HAVE HI RATE OF SETPOINT DRIFT
W	TR1	019113	090377	SN	PS	B13		1	N	SOURCE RANGE CHAN N-31 FAILD TO ENERGIZE AT 10-10A	REMOVED& REPLACED FUSES;OPERATED OK THEN
W	TU3	015007	051976	PL	CM	A14		1	T	PRZR LEVEL COMP.LC-459A TRIPPIN AT 4.685V VS. 4.68	SETPOINT DRIFT; WILL ADJUST TO COMPENSATE
W	TU3	016886	112576	FF	PS	B13	R	1	T	STEAM FLOW COMPRTR FC-3-484 SETPOINT NONCONSERVATV	2 FILTR CAPACTRS ON PRNTD CKT.BD.IN PWR S
W	TU3	017590*	012777	NT	CM	A14		2	T	TRIP SETPTS OF OVERPWR COMPS.TC-3-432B & 432C LOW	SETPOINT DRIFT;EXACT CAUSE OF DRIFT UNKWN
W	TU3	022768	092978	FF	PS	B13	R	1	T	STEAM FLOW COMP. FC-3-484 SETPT LESS CONSERVATIVE	FAULTY REG. AMP IN PWR SUPPLY BOARD
W	TU4	014878	013076	DT	IM	B13		1	T	CHAN 2 DELTA-T TRIP SETPT 1 DEG HIGHR THAN ALLOWD	2 FILTR CAP. FAILD IN SIGNL SUM.TM-4-422F
W	ZI1	014221	020976	DT	AM	B13		1	T	DELTA T TRIP TC-422 C/D COMPARATOR INOPERABLE	OPERTNL AMPS A2 & A3 DEFECTIVE
W	ZI1	014285*	022176	PN	ZZ	A03	L	4	T	RESCALED PWR RANGE DET.1N41,42,43 & 44 HOWEVR DID	NOT RESCALE DELTA I SUMMATORS--NONCONSERV
W	ZI1	015189	061876	NT	IM	B13		1	T	SUMMATOR 1TM-411C OVERPWR & DELTA T PROT. RAMBLING	FAILD CAPACITOR C8
W	ZI1	016481	111776	DT	IM	B13		1	N	DELTA T DEVIATION ALARM LOOP D SOUNDED	DEFECTIVE LEAD/LAG MODULE 1TM431J
W	ZI1	016984	120176	RF	PS	B13		1	T	COMPARATOR 1FC-416 FOR RX COOLNT FLOW OUT OF TOLRN	BAD CAPACITOR IN POWER SUPPLY FOR COMPRTR
W	ZI1	017406	030377	DT	IM	B13		1	N	DELTA T IND ERRATIC DROPPD FROM 100 TO 80% LOOP D	GROUNDED SUMMATOR, DEFECTIVE INTEGRTD CKT
W	ZI1	018529	071977	RP	IM	B13		1	T	ONE OF PRESSZR PRESS CHANLS READING HIGH	BAD LEAD/LAG MODULE; 2 FAILD CAPACITORS
W	ZI1	020589	012778	RF	RE	B12		1	T	RX PROT. A RELAY 1FC426-XA FOR LOOP C FLOW TRAIN A	FOUND HUNGUP--BINDING PLUNGER PIN ON RLAY
W	ZI1	021449	050978	FF	IM	A14		1	T	FEED FLOW CHANL 1F-511 SQ.RT.EXTRACTR HI (NONCONS)	DRIFT OF CLOCK PULSE FOR SQUARE ROOT EXT.
W	ZI1	023441	092578	DT	IM	A14		1	T	FUNCTION GENERATOR 1NM-441B OUTPUT OUT OF TOL LOW	SETPTS NONCONSERVTIVE; INSTRUMNT DRIFT

ALL FAULTS IN SIGNAL CONDITIONING SYSTEMS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	ZI1	022902	102178	RF	CM	A14		1	T	RC FLOW CHANL IF-414 LOOP A TRIP SETPOIMT DRIF LOW	SETPOINT DRIFT; 2OTHER LOOP CHANLS OPEFBL
W	ZI2	016049	091076	FF	AM	B13		1	N	LOOP B COMPARTR 2FC-541B & 2FC-541A FOUND HIGH	BAD OPERATIONAL AMPLIFIER A-1 ; REPLACED
W	ZI2	016050	091476	RP	CM	B13		1	N	COMPARTR 2PC-456A PZR HIGH RX TRIP FOUND HIGH	COMPRTR WAS REPLACED WITH SPARE
W	ZI2	016491	112476	FF	IM	B13	R	1	N	LOOP D S/G FLOW IND FAILD TO ZERO THEN NORML ATIME	BAD MULTIPLIER/DIVIDER MODULE
W	ZI2	016698	120376	FF	IM	B13		1	N	LOOP D S/G STEAMFLOW IND LOW ; SQUARE ROOT EXTRACT	BAD CAPACITORS C11 & C12 IN SQ.RT.FM-533B
W	ZI2	017250	020377	FF	IM	A14		1	T	SQUARE ROOT EXTRACTR LOOP B STEAM FLOW FOUND HIGH	DRIFT OF LOW END SETTING OF SQ.RT.EXTRCTR
W	ZI2	017249	020777	FF	IM	A14		1	T	SQ.ROOT EXTRACTR FOR LOOP D STEAM FLOW FOUND HIGH	DRIFT OF LOW END SETTING 2FM-530B
W	ZI2	018054	041177	RP	AM	B13		1	T	COMPARATR 2PC-456A WOULD NOT TRIP; PUT IN TRIP MOD	BAD OPERATIONL AMPLIFIER A-3
W	ZI2	020392	122377	RF	RE	B12		1	T	2FC416-XB LOOP A RC FLOW TRIP LOGIC TRAIN B HUNGUP	BINDING PLUNGER PIN AGAINST RELAY HOUSING
W	ZI2	020350	012178	FF	AM	B13		1	N	FW FLOW IND 2FI-510A DRIFTD HI (NONCONSERV)	FAILD OSCILLATOR AMPLIFIER IN XMTR
W	ZI2	020564	020178	FF	IM	B13	R	1	N	UNIT 2 D S/G STM.FLOW LOOP 532 OUT OF TOL(NONCONS)	MALFUNCT SQUARE ROOT EXTRACTOR
W	ZI2	023499	022078	PL	CM	B13		1	T	PZR LEVL CHANL 2L-460 OUT OF TOL HI AND LO ENDS	REVERSD DIODE CAUSN IMPRPR VOLT REGULATIN
W	ZI2	022802	091578	PN	PS	B13		1	N	PWR RANGE CHANL N42 READING LOW;NONCONSERV TRIP	BAD 25 VOLT PWR SUPPLY
W	ZI2	022800	092578	PL	CM	A00	R	1	N	PZR LEVL 2LT-459 LOW;NONCONSERV FOR HI LEVL TRIP	NO CAUSE COULD BE FOUND
G	BF3	022824A	102978	IN	CA	B02	C	1	N	IRM F CHANNEL DECLARED INOPERABLE	SIGNAL CABLE SHEARED
G	BF3	022824B	102978	IN	CA	B02	C	1	N	IRM H CHANNEL DECLARED INOPERABLE	SIGNAL CABLE DISCONN
G	BF3	023032*	112878	PN	CA	B06	L	6	T	ALL LRPM'S OF 43 STRINGS FOUND REVERSE CONNECTED	LACK OF EXPLANATION OF PROPER LPRM CONNEC
G	BP1	015443	081376	PN	CA	B02	C	1	N	PR NEUTRON MONITOR DID NOT RESPOND PROPERLY (#2)	POLARIZING VOLT. ON COMP ION CHAM SWAPFED
G	BR1	016855*	010577	PN	CM	A06	L	6	T	HIGH FLUX TRIP FOR APRM'S FOUND TO BE TOO HIGH	DEFFECTIVE PROCEDURE
G	BR1	019185	092677	PN	CM	A06		1	T	APRM CHANNEL F UPSCALE THERMAL TRIPS BEYOND T/S	RECAL. DONE WITH INADEQUATE PROCEDURE
G	BR1	020679	012878	PN	CM	A14		1	T	APRM CHANNEL E TRIPED AT >120 PERCENT (122 PER)	SETPOINT DRIFT
G	BR1	020680	021478	PN	CM	A14		1	T	APRM CHANNEL C SETPOINT FOUND ABOVE TS LIMIT	SETPOINT DRIFT
G	BR2	020917	040378	IN	CA	B12		1	T	IRM E HAD NO RESPONSE TO CHANGING FLUX	DIRTY AND WET DETECTOR CABLE CONNECTIONS
G	CO1	018897	041677	IN	ZZ	A14		1	T	IRM "H" FOUND TO READ 80 AS OPPOSED TO 125-TEST	INSTRUMENT DRIFT IN TWO MODULES
G	CO1	018899	081077	PN	AM	B13		1	N	APRM FLOW INDICATION DECREASED-CAUSED UPSCALE ALAR	BAD ISOLATION AMP IN SUMMER UNIT-REPLACED

ALL FAULTS IN SIGNAL CONDITIONING SYSTEMS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	C01	019286	092377	SN	CA	B02	B	1	M	SRM WAS READING HIGH AND ERRATIC DURING REFUELING	BREAK IN OUTER SHIELD OF TRIAXIAL CABLE
G	C01	020799	012978	PN	PS	B13		1	N	APRM +20V POWER SUPPLY FLUCTUATED-CAUSED HALF SCRA	ZENER DIODE FAILED IN POWER SUPPLY
G	C01	021197	040878	SN	CA	B02	B	1	M	SRM WOULD NOT RESPOND PROPERLY DURING REFUELING	BREAK IN SHIELD OF TRIAXIAL CABLE
G	DA1	014378	031476	"N	PS	B13		1	T	SRM A(4573A) FOUND READING APPROX 50% LOW	FAULTY DIODE IN VOLTAGE PREREGULATOR
G	DA1	014514	041776	FU	CM	B13		1	T	APRM/RBM FLOW UNIT D COMPARATOR EXCEEDED LIMIT	DEFECTIVE FLOW UNIT SUMMER CIRCUIT
G	DA1	014732	051276	PN	CM	A14		1	T	APRM CH A UPSCALE TRIP EXCEEDED LIMIT	INSTRUMENT DRIFT
G	DA1	015322	081276	SN	CM	A14		1	T	SRM D UPSCALE RB TRIP EXCEEDED LIMIT	INSTRUMENT DRIFT
G	DA1	019128	090277	IN	PS	B13		1	T	IRM CH A DOWNSCALE TRIP FOUND INOPERABLE	VOLT REG AND PRE-REG WERE DEFECTIVE
G	DA1	019208	091577	IN	PS	B13		1	T	IRM CH B DOWNSCALE TRIP FOUND INOPERABLE	LOOSE CONN ON PWR SUPPLY CAUSED FUSE TC B
G	DA1	019965*	112877	PN	CA	A01	C	4	T	NONCONSERV ERRORS INDUCED IN APRM CH A,B,C & D	PERSONNEL-REVERSED INPUT/OUTPUT OF LPRP
G	DR1	015078	061176	PN	CM	A14		1	T	POWER RANGE CH 3 ACTUATES ABOVE LIMITS	INSTRUMENT SETPOINT DRIFT
G	DR1	016591	112676	PN	AM	A14		1	T	IN CORE NEUTRON FLUX AMPLIFIER 103C TRIPPED HIGH	INSTRUMENT SETPOINT DRIFT
G	DR1	017294	022377	PN	AM	A14		1	T	IN CORE NEUTRON FLUX AMPLIFIER 109A TRIPPED HIGH	INSTRUMENT SETPOINT DRIFT
G	DR1	017733*	042377	PN	CM	A14		2	T	POWER RANGE CH 1 & 2 ACTUATED ABOVE SPEC	INSTRUMENT SETPOINT DRIFT
G	DR1	017797*	042877	PN	AM	A14	C	5	T	IN-CORE FLUX AMPS 104B 110D 112D 113A 113C 114D HI	INSTRUMENT SETPOINT DRIFT DUE TO HIGH TEM
G	DR1	019015	090477	PN	AM	A14		1	T	CH 3 HIGH NEUTRON MONITOR FAILED TO TRIP DURING TE	INSTRUMENT SETPOINT DRIFT
G	DR1	019199	093077	PN	AM	B13		1	N	CH 2 OUT OF CORE NEUTRON MONITOR FAILED DOWN SCALE	TUBE FAILURE IN AMPLIFIER CIRCUIT
G	DR1	019320	101777	PN	CM	A14		1	T	CH 1 RIC-281 TRIP EXCEEDED LIMITS WHEN TESTED	SETPOINT DRIFT
G	DR1	021016	031878	PN	AM	A14		1	T	INCORE MONITOR AMP 104B EXCEEDED TRI: LIMIT	INSTRUMENT DRIFT
G	DR1	021515	052578	PN	AM	A14		1	T	INCORE MONITOR AMP 109A EXCEEDED TRIP LIMIT	TRIP ADJ BIAS VOLTAGE 25KOHM RESIS DRIFTE
G	DR1	021514	060278	PN	AM	A14		1	T	INCORE MONITOR AMP 113C EXCEEDED TRIP LIMIT	TRIP ADJ BIAS VOLTAGE 25KOHM RESIS DRIFTE
G	DR2	015160A	063076	PN	AM	B05		1	N	APRM CH5 INDICATION DROPPED FROM 54 TO 31 PERCENT	BROKEN LEAD ON DC AMPLIFIER
G	DR2	015160B	063076	PN	ZZ	A14		1	N	APRM CH5 AGAF HIGH VALUE	INSTRUMENT DRIFT
G	DR2	017184*	012877	FU	CN	A06	M	2	T	APRM FLOW-BIAS FLOW INDICATION EXCEEDED 100% (A&B)	PROCEDURE FOR TC"AL CORE FLOW IND REVISED
G	DR2	017221	021477	PN	RE	B13		1	T	REED RELAY CONTACTS ON RELAY K6 WERE SEPARATED	CONTACTS REPLACED,APRM AVE CARD RELAY

ALL FAULTS IN SIGNAL CONDITIONING SYSTEMS

VEN	PLT	CONT. NO.	FAIL DATE	SYS	COMP	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	DR2	017793	022377	IN	CM	A14		1	T		IRM#16 TRIPPED ABOVE SETPOINT DURING TEST	INSTRUMENT SETPOINT DRIFT
G	DR2	01?651*	042577	FU	CN	A06	M	2	T		APRM/RBM FLOW BIAS EXCEEDED 100% AT 100% CORE FLOW	APRM/RBM CONVERTERS CALIB TO ORIG SPECS
G	DR2	019190	092077	IN	IM	A14		1	T		APRM 5 WAS FOUND TO INOP ON 12 INSTEAD OF 11 LPRMS	ELECTRONIC DRIFT OR DIRTY CONTACTS ON CAR
G	DR2	019904	113077	IN	CM	B13		1	T		IRM#13 DID NOT TRIP AS REQ'D BY SURVEILLANCE PROCE	DEFECTIVE DUAL TRIP MODULE
G	DR2	019989	120877	IN	CM	A14		1	T		IRM#13 TRIPPED ABOVE LIMITS	INSTRUMENT DRIFT
G	DR2	019910*	122277	FU	CN	A06	M	2	N		APRM FLOW BIAS SCRAM & ROD BLOCK SETPOINTS NON-CON	DEFICIENT PROCEDURE
G	DR2	021881	062678	PN	CM	A14		1	T		APRM CH 4 ROD BLOCK TRIP HIGH	SETPOINT DRIFT
G	DR2	022071	080178	PN	ZZ	B13		1	T		APRM CH#3 SCRAM SETPOINT FOUND ABOVE SPEC	BROKEN WIRE AND TRANSISTOR FAILURE
G	DR3	017212	020877	PN	RE	B13		1	N		APRM #6 FOUND FLUCTUATING	FAILED REED RELAY CONTACTS
G	DR3	017325A	022077	PN	CM	A14		1	T		APRM 3 ROD BLOCK TRIP EXCEEDED LIMITS	ELECTRONIC DRIFT
G	DR3	017325B	022077	PN	CM	A14		1	T		APRM 6 ROD BLOCK TRIP EXCEEDED LIMITS	ELECTRONIC DRIFT
G	DR3	017974	052677	FU	AM	B13		1	N		CH A & CH B FLOW EXCEEDED MISMATCH	FAULTY PROPORTIONAL AMPLIFIER
G	DR3	017975	052677	PN	IM	A14		1	T		APRM 4 INOPERABLE	ELECTRONIC DRIFT
G	DR3	018550	072577	PN	PS	A12		1	T		APRM 4 WOULD NOT GENERATE AN INOP UNTIL 13 LPRM'S	VOLTAGE SHIFT-DIRTY POWER SUPPLY(PIN-1&)
G	DR3	018937*	082777	PN	IM	A14		2	T		APRM ? & 2 WOULD NOT GENERATE INOP UNTIL 12 LPRM'S	ELECTRONIC DRIFT
G	DR3	019176*	092977	PN	ZZ	A14	C	2	T		APRM'S 4 & 6 GENERATED INOP WITH 12 LPRM'S BYPASSE	ABNORMAL ELECTRONIC DRIFT
G	DR3	020603*	020278	IN	CM	A14		2	T		IRM 15 & 16 EXCEEDED TRIP SETPOINT	INSTRUMENT DRIFT
G	DR3	021509B	052078	SN	CA	B13		1	T		SRM 21 DECLARED INOPERABLE	BAD SIGNAL CABLE
G	EN1	020020	100477	PN	CM	A14		1	T		APRM CH A FOUND OUT OF TOLERANCE	SETPOINT DRIFT
G	EN2	022676*	101178	PN	CM	A06	L	6	T		HIGH FLUX SCRAM SETPOINTS SET VERY HIGH	PROCEDURE DID NOT LIST STARTUP SETTING
G	EN2	022704	101678	PN	IM	A14		2	N		RPS CHANS A&E INOPERATIVE	APRM E DRIFTED HIGH, APRM A COUNT CKT CRI
G	FP1	015497	080876	PN	IM	A14		1	T		APRM C WOULD NOT TRIP AT LESS THAN 11 INPUTS	RANDOM SET POINT DRIFT
G	FP1	015851	090576	PN	IM	A00		1	T		APRM INOP SIGNAL WOULD NOT FUNCTION	CAUSE NOT GIVEN
G	FP1	017328	022777	PN	CM	A14		1	T		APRM "E" DOWNSCALE TRIP SETPOINT HIGH	NORMAL DRIFT
G	FP1	018051*	062677	PN	CA	B02	L	6	M		LOSS OF 15% APRM SCRAM FUNCTION	CONTRACTOR CUT 19 OF 31 LPRM STRINGS

ALL FAULTS IN SIGNAL CONDITIONING SYSTEMS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	FAIL CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	FP1	022031	070778	PN	IM	A14			1	N		APRM D LPRM COUNT TRIP SETPOINT HIGH	SET?OINT DRIFT, READJUS?ED CIRCUITS
G	MI1	015456	081376	IN	CM	A14			1	T		INTERMED RANGE MONITOR SETPOINT LESS CONSERVATIVE	SETPOINT DRIFT OF INSTRUMENT CHANNEL
G	MO1	021562*	060678	PN	CM	A06	C		4	T		4 OF 6 APRM SCRAM SETTINGS 3 TO 4% LOW	BIASED DISTRIB OF LPRMS WITHIN APRM PAGES
G	MO1	022186*	080578	PN	CM	A06	B		1	T		1 APRM SETTING 4 TO 5% LOW, 1 BYPASSED	LRG PWR SHAPE CHNG DEFECT PROCEDURES
G	NM1	014983	032176	PN	CM	A02			1	T		APRM #18 FAILED TO TRIP AT 20% FLOW POINT	TEST METER OFFSET CAUSED BAD CALIBRATION
G	NM1	015170*	061376	PN	CM	A14			2	T		2 OF 8 APRM FAILED TO TRIP AT REQUIRED FLOW BIAS	APRM 17 & 18 SETPOINT DRIFT
G	NM1	015171*	062776	PN	CM	A14			2	T		APRM 11 & 15 FAIL TO TRIP AT REQUIRED FLOW BIAS	SETPOINT DRIFT LESS THAN 1%
G	NM1	018593	073177	PN	ZZ	A14			1	T		BYPASS 6 VICE 5 LPRMS TO GET APRM-16 INOP LIGHT	APRM 216X513G2 SETPOINT DRIFT
G	NM1	021439*	052678	PN	CA	B02	C		2	T		LPRM DET A&B TO APRM 11 & 15 CROSS CONNECTED	GE-NA-100 DETECTORS CROSS-CONNECTED
G	OC1	015286*	080576	PN	CA	B13			2	T		TWO APRM'S IN THE SAME TRIP SYS CONCRNTLY INOPERAB	FAULTY PIN RECEPTACLE
G	OC1	018574A	072277	IN	CA	B02	B		1	T		IRM CHNL 13 FOUND INOPERABLE	WIRE TO DETECTOR DISCONN - MAINTEN
G	OC1	018574B	072277	IN	CA	B02	B		1	T		IRM CHNL 14 FOUND INOPERABLE	WIRE TO DETECTOR DAMGD - MAINTEN
G	OC1	018877A	090177	FU	CN	B13	R		1	N		RECIRC FLO SIG FOR APRM I 1.7% HIER THAN ACT FLOW	FLO CNVTR NO 135B8308G1-ZERO SHIFT
G	OC1	018877B	090177	FU	CN	B13	R		1	N		RECIRC FLO SIG FOR APRM II 1.7% HIER THAN ACT FLOW	FLO CNVTR NO.135B8308G1-HI GAIN ADJUSTMT
G	OC1	022743	101978	IN	CA	B02	B		1	N		IRM 12 BECAME INOPERATIVE WHILE IRM 14 DISCONNECTD	CABLE FOR IRM 12 DAMA?ED BY MAINT ACTIVIT
G	PB2	015760	082876	PN	CM	A14			1	N		APRM "A" TRIP PTS LESS CONSERVATIVE THAN TECH SPEC	INSTRUMENT DRIFT-INSTRUMENT RECALIBRATED
G	PB2	017774	041777	PN	IM	A14			1	R		APRM A INOP TRIP DID NOT OCCUR IAW TS (9 VS 8 LPRM	SETP? SHIFT - MOD GEK-32537A APRM
G	PB2	021707	070578	PN	IM	A14			1	T		SCRAM CLAMP TRP STPT FOR "A" APRM WAS 1 PCT GT TS	SETPOINT DRIFT-IMMEDIATELY RECALIBRATED
G	PB3	014683	050776	PN	ZZ	B13			1	T		CH "E" ARPM TRPD AT FLUX LVLS HIER THAN LICENSE TS	SETPT SHIFT - DEF IN4734A ZENER DIODE
G	PB3	015084	061276	PN	RE	B13			1	T		"F" APRM ROD BLOCK NOT OBTND FRM SIM HI FLUX CONDT	FAILURE OF MOD 35AT600 4RI RELAY
G	PB3	016174	101176	FU	AM	A09			1	N		CORE FLO BIAS INPUT TO THE A LOGIC APRM STRNG - HI	ABSENCE OF OFFSET SIGNAL IN FLO BIAS APP
G	PB3	017548	041677	PN	CM	A14			1	T		DWNSCLE TRIP FOR APRM E FOUND AT 2.3, TS IS 2.5PCT	SETPOINT SHIFT ON A MOD GEM-32537A APRM
G	PB3	017778	050977	PN	CM	A14			1	T		DWNSCLE TRIP FOR APRM D FND AT 1.5 VS 2.5 PERCENT	SETPOINT SHIFT - MOD GEK-32537A
G	PI1	022799	103078	SN	ZZ	B02	S		1	R		SOURCE RNG MON "A" BECAME INOPERABLE	PERSONNEL JUMPERED ENTIRE LOGIC FOR SRM A
G	VY1	018061	052577	FU	CN	A14			1	N		APRM FLOW BIAS HI FLUX TRIP OUT OF SPEC & ALARMED	FLOW CONVRTR REPLACED, NO REASON FOR DRIF

Main Steam Line Radiation Monitors

These channels are in BWRs, and are coded SR. Be sure to read the section "Application" in the main body of this report. The following computer printouts give the estimates, followed by summaries of the relevant data.

INOPERABILITY FAULTS IN BWR MAIN STEAM LINE RADIATION MONITORS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.003, .194, .577)

LAMBDA = (2.7E-06, 4.8E-06, 7.5E-06)

$LAMBDA_+$ = (3.2E-07, 2.8E-06, 7.2E-06)

OMEGA = (3.6E-09, 9.2E-07, 3.5E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
4	(6.4E-07, 4.0E-04, 2.1E-04)	(3.7E-06, 6.7E-06, 1.1E-05)	(.004, .118, .423)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
4	(1.3E-08, 1.2E-06, 3.9E-06)	(6.5E-09, 1.0E-06, 3.7E-06)	(5.0E-09, 9.7E-07, 3.6E-06)

REDUCED CAPABILITY FAULTS IN BWR MAIN STEAM LINE RADIATION MONITORS

RATES ARE PER CALENDAR HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

```
         P  = ( .001, .094, .309)
LAMBDA      = ( 1.9E-08, 4.7E-06, 1.8E-05)
LAMBDA+     = ( 2.0E-06, 6.4E-06, 1.3E-05)
OMEGA       = ( 1.1E-06, 4.6E-06, 1.0E-05)
```

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
4	(4.9E-06, 2.3E-03, 1.3E-03)	(3.5E-06, 1.1E-05, 2.5E-05)	(.134, .527, .749)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
4	(1.2E-06, 4.8E-06, 1.0E-05)	(1.1E-06, 4.6E-06, 1.0E-05)	(1.1E-06, 4.6E-06, 1.0E-05)

ALL FAULTS IN BWR MAIN STEAM LINE RADIATION MONITORS

PLANT	HOURS	POP	NUMBER OF INDIV. FAULTS INOP/RED CAP	NUMBER OF NONLETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY NONLETHAL SHOCKS INOP/RED CAP	NUMBER OF LETHAL SHOCKS INOP/RED CAP	ASSEMBLIES AFFECTED BY LETHAL SHOCKS INOP/RED CAP
BF1	26304	4	0 / 0	0 / 0	0 / 0	0 / 1	0 / 4
BF2	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF3	21000	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BR1	19536	4	1 / 3	1 / 0	1 / 0	0 / 0	0 / 0
BR2	26304	4	2 / 0	0 / 1	0 / 1	0 / 0	0 / 0
CO1	26304	4	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
DA1	26304	4	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR2	26304	4	0 / 0	0 / 0	0 / 0	0 / 1	0 / 4
DR3	26304	4	1 / 0	0 / 1	0 / 1	0 / 0	0 / 0
EN1	26304	4	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN2	4320	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FP1	26304	4	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MI1	26304	4	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MO1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NM1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
OC1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PB2	26304	4	2 / 2	0 / 0	0 / 0	0 / 0	0 / 0
PB3	26304	4	1 / 2	0 / 0	0 / 0	0 / 0	0 / 0
PI1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC2	26304	4	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
VY1	26304	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	544632	88	10 / 10	1 / 3	1 / 3	0 / 2	0 / 8

ALL FAULTS IN BWR MAIN STEAM LINE RADIATION MONITORS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	BF2	022854*	111478	SR	MO	R	A06	L	4	T		M/S LINE RAD MON RM-90-135,136,137,138 SETPOINT HI	INSTRUCTION DEFICIENT IN REQUIREMENTS
G	BR1	016851	121576	SR	MO	R	B13		1	T		MAIN STEAM LINE D RAD MON. DISCOVERED OUT OF CAL.	COMPONENT FAILURE,MONITOR RECALIBRATED
G	BR1	018544	071377	SR	MO	R	A14		1	T		MS LINE HIGH RADIATION INST. FOUND OUT OF CAL.	SETPOINT DRIFT,D12-RM-K603C
G	BR1	018889	081577	SR	MO	R	A00		1	T		HIGH STEAMLINE RAD MONITOR SETPOINT FOUND TO BE HI	UNKNOWN CAUSE,INST. ID D12-RM-K603A
G	BR1	020770	030178	SR	MO	R	B02	C	1	M		MAIN STEAM LINE RAD MONITOR "D" PS FAILED	IRM CABLES DAMAGED D12-RM-K603D PS
G	BR1	021187	041478	SR	MO	R	A00		1	T		MAIN STEAM LINE RAD MON D12-RM-N603C OUT OF SPECS	INST RECALIBRATED,RETURNED TO SERVICE
G	BR2	020168	010278	SR	MO	R	A02	C	1	T		MAIN STEAM LINE RAD MON D12-RM-K603 READ DOWNSCALE	PREVIOUS CALIBRATION PERFORM WRONG
G	BR2	020968A	032478	SR	MO	R	B13	R	1	N		MAIN STEAM RAD MON,CHANNEL C, BECAME ERRATIC	PROBABLE CAUSE,TWO BAD TRANSISTORS
G	BR2	020968B	032978	SR	MO	R	B13	R	1	N		MAIN STEAM RAD MON,CHANNEL C, BECAME ERRATIC	PROBABLE CAUSE,TWO BAD TRANSISTORS
G	CO1	021747	052778	SR	MO	R	A06	C	1	N		MAIN STEAM LINE RAD MONITOR TRIP POINT NOT ADJUSTE	PROCEEDURAL DEFICIENCY FOR SOURCE CALIBRA
G	DA1	017758	041877	SR	MO	R	B13		1	T		MSL RAD MONITOR RC 4448D DID NOT RESPOND PROPERLY	TWO VACUUM TUBES & ONE DIODE WERE DEFECTI
G	DR2	020869*	032778	SR	MO	R	A06	L	4	T		MSL HIGH RAD ISOLATION SETPOINT SET HIGH	TYPOGRAPHICAL ERROR IN PROCEDURE
G	DR3	019188	092877	SR	MO	R	B13		1	N		MSL RAD MONITOR B INDICATION DOUBLED	DETECTOR MALFUNCTIONED
G	DR3	020871	032778	SR	MO	R	A03	C	1	T		MSL HIGH RAD SCRAM ISOL MONITOR SETPOINT HIGH	PERSONNEL ERROR-SETPOINT ADJUSTED HIGH
G	EN1	022745	110178	SR	MO	R	B13		1	T		MSL RAD MON D11-K603D DID NOT INITIATE HALF SCRAM	LOOSE WIRE AND DAMAGED COMPONENTS
G	FP1	015061	061076	SR	MO	R	A00		1	N		MN STM LINE RAD MONITOR EP-17-RM-251A SPURIOUS	TESTED AND WORKED PROPERLY CAUSE UNKNOWN
G	MI1	014214	012076	SR	MO	R	A14		1	T		MAIN STEAMLINE RADIATION MONITOR 40% LOW OUTPUT	AMPLIFIER DRIFT WITHIN MONITOR
G	PB2	019323A	100377	SR	MO	R	B08	R	1	T		2C MN STM LINE RAD MON DWN SCL TRP IND FLD TO CLR	DEFECTIVE REED RELAY - RPLCD IN KIND
G	PB2	019323B	100777	SR	MO	R	B02		1	N		2C MN STM LINE RAD MON DN SCL TRP IND FLD TO CLEAR	INADEQUATE INST WARMUP PRIOR TO CALIBRTN
G	PB2	019329	101077	SR	MO	R	A14		1	T		2C MN STM LN RAD MON HI-HI TRIP OUTSIDE TS LIMIT	SETPOINT DRIFT-RECAL & RETURNED TO SERVIC
G	PB2	019829	112877	SR	MO	R	A09		1	N		MN STM LINE RAD MON RIS-2-2-251B DVLPD UPSCL SPIKG	CONTACT MISALIGNMENT PROBLEM
G	PB3	013987	010676	SR	MO	R	A14		1	T		MN STM LN RAD MON RIS-251A DID NOT TRIP WHEN DESIR	SMALL STPT DRFT ON LOG SCL-194X629G0C7
G	PB3	018702	080877	SR	MO	R	A00		1	N		IND ON MN STM LN RAD MON RIS-3-17-251D ERRATIC	CAUSE COULD NOT BE DETRMND-RETURNED TO SV
G	PB3	022282	090478	SR	MO	R	B13		1	T		"D" MN STM LN RAD MON FAILED TO CAUSE HALF SCRAM	DEFCTV XISTR IN TRIP UNIT-MOD 194X629007
G	QC2	020942	022878	SR	MO	R	B02		1	N		2D MAIN STEAM LINE RAD MON READING DOWNSCALE	HI VLTG LEAD TO MON WAS IMPRPRLY ATTACHED

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ALL FAULTS IN BWR MAIN STEAM LINE RADIATION MONITORS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL	CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	QC2	022667	083178	SR	MO	R	A14				1	N		MN STM LN RAD MON 2-1705-2D FLD IN DWNSCL CONDITN	INST DRIFT ENHANCED BY HI TEMPERATURES

APPENDIX D

ONE-LINE SUMMARIES OF INSTRUMENTATION AND CONTROL LICENSEE EVENT REPORTS

APPENDIX D

ONE-LINE SUMMARIES OF INSTRUMENTATION AND CONTROL LICENSEE EVENT REPORTS

This appendix contains a listing of one-line summaries of the instrumentation and control LERs considered in this report. Following this listing is a listing of the one-line summaries of common cause events.

ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
B	AR1	014496	032376	CP	DC	P	A14			1	T		RX BUILDING PRESSURE SWITCH FAILED TO TRIP	INSTRUMENT DRIFT
B	CR3	019009*	090277	RF	TX	F	A14			4	R		4 RCS FLOW INSTRUMENTS OUT OF CALIBRATION	CALIBRATION DRIFT OF D/P TRANSMITTERS
B	DB1	019943	120777	NF	PS		B13			1	N		RPS CH 3 FLOW LOOP B FAILED LOW	FAULTY CONTACT ON POWER SUPPLY FUSE HOLDE
B	DB1	020706*	021078	RT	CA		B09			2	T		RPS CH 3 HOT LEG TEMP STRING TI-RC384 INOPERABLE	LOOSE WIRE CONNECTION AT TEMP ELEMENT
B	DB1	020704	022378	RF	TX	F	B13			1	N		RPS CH 3 LOOP 2 HOT LEG FLOW FTRC1A3 INOPERABLE	DEFECTIVE AMPLIFIER IN FLOW TRANSMITTER
B	DB1	022689	092878	RF	TX	F	B13			1	N		RPS CH 1 LOOP 2 FLOW TRANSMITTER FAILED LOW	DEFECTIVE AMPLIFIER
B	OE1	022174A	080678	NF	ZZ		A06	N		4	N		QUADRANT POWER TILT EXCEEDED TECH SPEC	OPERATOR FAILED TO RESET TRIPS
B	OE1	022174B	080678	PN	ZZ		A06	N		4	N		QUADRANT POWER TILT EXCEEDED TECH SPEC	OPERATOR FAILED TO RESET TRIPS
B	OF1	022918	102678	RP	TX	P	A07			1	T		RPS CH A TRIP 9.6 HIGHER THAN TS	EXCESS TEMP/HUMIDITY INDUCED DRIFT
B	OE2	020346	011878	RF	TX	F	A08			1	T		RPS CH D FLOW INDICATION HIGH	LEAK DUE TO BLOWN GASKET
B	OE3	017452	032577	NF	ZZ		A00			1	T		FLUX/FLOW IMBALANCE, CH B RX.COOL.FLOW TRIPPED LOW	UNKNOWN NON-REPETITIVE
B	OE3	019487	100577	RT	CM		B13			1	T		CH B HIGH RX COOLANT FAIL TO TRIP ANY LEVEL	NORMAL USAGE FAILURE REPLACED
B	OE3	019884	122877	RP	TX	P	B06	U		1	N		XMTR LEFT VALVED OUT AFTER REPAIR TO TEST TEE	INCORRECT/INCOMPLETE VALVE CHECKLIST
B	OE3	023312	120878	RT	SE	T	A07			1	T		RPS A RC TEMP READING LOW	MOISTURE FROM LEAKING VALVE ONTO RTD TERM
B	RS1	014503A	040576	RP	TX	P	A14			3	T		3 RPS PRESS XMTRS READ OUTSIDE OF TS - LOW	INST DRIFT-VERITRAK MOD 59 PH 443-7050
B	RS1	014503B	040576	RP	TX	P	A14			1	T		1 RPS PRESS XMTR READ OUTSIDE OF TS - HIGH	INST DRIFT-VERITRAK MOD 59 PH 443-7050
B	RS1	018006	041977	NF	CN		A14			1	T		RPS CH A FLUX/IMBALNCE/FLOW TRIP ENVELOPE OUTSD TS	DRIFT OF FUNCTION GEN MOD 6625027A1
B	TI1	015866	083076	NF	CA		B09			1	N		"D" CHANL TRIPPD (FLUX/IMBALANC/FLOW); "C" IN BYPAS	SHORT IN JUNCTION BOX; "C" PLACED IN NORML
B	TI1	015864*	083176	RP	TX	P	A14			2	T		R/X COOLNT PRESS SETPOINTS LESS CONSERV THAN T.S.	RPS CHAN B&C CALIB. DRIFT (MINOR)
B	TI1	015971	091676	RP	TX	P	B13	R		1	N		RC PRESS TRIP SETPTS. CHAN B LESS CONSRVTV THAN TS	DEFECTV TRANSMITTR(WEST. MODEL 59H)
B	TI1	016306	102776	RT	CA		B12			1	T		RC HI TEMP BISTABLE CHAN "C" FAILD TO TRIP	DIRTY CONNECTOR ON BISTABLE; CLEANED CONN
B	TI2	021612	041778	PN	SE	N	B05			1	N		RPS CHAN C HI FLUX TRIP INTERMITTENT-DETECTOR NI-7	NI-7 DAMAGD DURN INITIAL INSTALLTN-REPLAC
C	CC1	014284	021876	RF	PS		B13			1	T		NON-CONSERVATIVE LOW FLOW TRIP, RPS CH B, FOUND	DEFECTIVE POWER SUPPLY CAUSED DRIFT
C	CC1	017994	033077	PN	CA		B02	C		1	N		POWER RANGE UPPER DETECTOR CIRCUIT, CH A, FAILED	DETECTOR DRAWER FIELD CABLE CONN. DISCONN
C	CC1	017712	040477	RP	CA		A09			1	N		PRESSURIZER PRESSURE INDICATION AT 1C06 READ HIGH	DIRTY SIDE LINK CONNECTIONS AT 1C25D

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ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
C	CC1	017713	050377	PN	CM		B13			1	N		VARIABLE OVERPOWER TRIP,CH D, WHOULD NOT RESET	LOW LEVEL ALARM COMPARATOR HAD FAILED
C	CC1	017796	052277	RT	SE	T	B13			1	N		RPS CH B T-HOT FOUND READING HIGH	ONE OF THE TWO RTD'S HAD HIGH RESISTANCE
C	CC1	017907	052377	PN	CM		A09	R		1	N		RPS CH A HIGH POWER TRIPS GAVE SPURIOUS TRIPS	NOISE ON TEMP LOOP SIGNALS
C	CC1	018305	070177	PN	CM		B13			1	N		RPS CH A HIGH POWER TRIP UNIT BECAME ERRATIC	COMPARATOR FAILURE
C	CC1	018307	070177	TP	CA		A07			1	N		RPS CH B TRIP UNITS BYPASSED DUE TO LOW TC IND.	DUST ON THE SLIDE LINK TERMINALS INC RES.
C	CC1	018860	081177	PN	PS		B13			1	T		RPS CH C TRIP UNITS WERE BYPASSED	POWER SUPPLY REGULATING HIGH,REPLACED
C	CC1	018951*	082677	RF	TX	F	A07	R		2	N		RPS CH D TRIP UNITS BYPASSED,SPURIOUS LOW FLOW TR.	STEAM LEAK IN AREA OF LOW FLOW XMITTER
C	CC1	018951A	082977	RF	TX	F	A07	R		1	N		RPS CH D TRIP UNITS BYPASSED,SPURIOUS LOW FLOW TR.	STEAM LEAK IN AREA OF LOW FLOW XMITTER
C	CC1	018951B	090777	RF	TX	F	A07	R		1	N		RPS CH D TRIP UNITS BYPASSED,SPURIOUS LOW FLOW TR.	STEAM LEAK IN AREA OF LOW FLOW XMITTER
C	CC1	019122	091577	TP	IM		B13			1	N		RPS CHANNEL B TM/LP TRIM UNIT ACTUATED	THERMAL MARGIN/LOW PRESS CALCULATOR FAIL
C	CC1	019619	102877	PN	CM		B13			1	N		RPS CH C ASI INDICATOR DECLARED INOPERABLE	FAILED COMPARATOR MODULE
C	CC1	019734	120577	SP	TX	P	B13			1	N		RPS CH D #12 S/G PRESSURE READ HIGH	FAILED OSCILLATOR IN S/G PRESS XMITTER
C	CC2	016725	121276	PN	CA		B05	C		1	N		CH D ASI OBSERVED GOING OPPOSITE DIRECTION	CABLES REVERSED DUE TO MISLABLING
C	CC2	016996*	011777	TP	CA		A09			2	N		CHANNEL B THERMAL MARGIN/LP SPURIOUS TRIPS	TH SIGNAL LEADS WERE LOOSE
C	CC2	017206	012577	PN	SE	N	B13			1	N		FLUX PROBLEMS EXPERIENCED IN CH B HI POWER, TM/LP	(CONT) & AXIAL FLUX OFFSET.FAIL DET TUBE
C	CC2	017207	012677	PN	AM		B13			1	N		CH A AXIAL FLUX OFFSET POSITIVE LIMIT FAILED HIGH	FAILED AMPLIFIER
C	CC2	017983	042177	PN	PS		B03	C		1	T		POWER SUPPLY FOR CH B LINEAR RANGE NUC INS FAILED	POWER SUPPLY GROUNDED BY TECHNICIAN
C	CC2	017823	051677	RF	IM		B13			1	N		RPS CH C RX COOLANT FLOW-LOW TRIP,TRIPPED	FAILED FLOW SIGNAL CHARACTERIZER
C	CC2	017825	051677	RT	SE	T	B13			1	N		RPS CH D TC DISCOVERED READING HIGH	BROKEN LUG CONNECTION ON RTD,RTD REPLACED
C	CC2	017800	051777	RT	SE	T	A09			1	N		SPURIOUS TRIPS ON RPS CH C RECIEVED	NOISE FROM TH RTD,CAUSE UNDETERMINED
C	CC2	018224	062077	SP	TX	P	A14			1	N		CH A S/G PRESSURE,PI-1023A,INDICATED LOW	ZERO SHIFT IN PRESSURE TRANSMITER
C	CC2	018879	081977	PN	IM		B13			1	T		CH A AXIAL FLUX OFFSET POS LIMIT TRIP FOUND INOP.	MULTPLIER/DIVIDER FOUND LIMITING APD SIG.
C	CC2	019620	110477	CP	TR		B13			1	T		CONT. PRESS INPUT TO CH B RPS FOUND OCILLATING	FAILED E/E SIGNAL ISOLATOR
C	CC2	020560	022178	PN	CA		B09			1	T		RPS CH B WIDE RANGE NEUT. INDI COULD NOT BE ALIGN	HIGH CAPAC CONNECTION
C	FC1	014301	022776	SL	CM		B13			1	N		RPS A STM GEN B LEVEL TRIP DID NOT ACTUATE	BISTABLE INPUT RESISTOR OUT OF TOLERANCE

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ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL	CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
C	FC1	014305	022776	SP	TX	P	B13				1	T		PT/D902 PRESS CHANNEL OUT OF CAL	FOXBORO E-11GM XMTR HAD BAD AMP CARD
C	FC1	014507*	032676	PN	IM		B04	R			1	N		B&H 19-301A ADD-SUB MODULE WENT INTO OSCILLATION	POSITIVE LIMIT MODULE DEFECTIVE REPLACED
C	FC1	014509	032776	PN	IM		B04	R			1	N		B&H 19-301A ADD-SUB MODULE WENT INTO OSCILLATION	CIRCUIT MODIFIED PER LATER LER
C	FC1	014499	040176	PN	IM		A14				1	T		VHPM TRIP B AT 6 VICE 4.2	B&H 19-317-2X FBL MOD OUTPUT DRIFTED
C	FC1	014510	040576	PN	IM		B04	R			1	N		CH B APD POS LIMIT HIGH	B&H 19-301A ADD-SUB MODULE OSCILLATING
C	FC1	014558	041376	PN	IM		B04	R			6	N		CH A&B APD POS LIMIT HIGH 6 TIMES	B&H 19-301A MOD OSCILLATES, RANDOM NOISE
C	FC1	016667	121476	RT	TX	T	A06	C			1	T		B CH COLD LEG TEMP HIGH	CALIBRATION PROCEDURE IN ERROR
C	FC1	017237	021677	SP	CM		B13				1	T		RPS D TRIP 6 SG PRESS FAILED TO TRIP	TRIP INDICATION BULBS OUT OF TOLERANCE
C	FC1	019385	102077	SL	CM		B13				1	T		RPS D TRIP 4 SG31 LEVEL OUT OF SPEC	TRIP UNIT ELD-240-0000-1F INTERNAL FAILUR
C	FC1	019563	103177	PN	PS		B13				1	N		SETPOINTS FOR APD "D" OF RPS INCORRECT	LAMBDA PS LCD-A-22 LOW OUTPUT, REPLACED
C	FC1	020849	032778	TP	IM		B13				1	N		VAR HP TRIP "B" NOT INDICATING PROPERLY	B&H 19-309 MULTIPLIER MODULE FAILED
C	FC1	021697	061978	PN	IM		B13				1	N		VAR HP TRIP NOT INDICATING PROPERLY	B&H 19-502 AMP SELECT MODULE FAILED
C	FC1	021800	070378	RF	CM		A14				1	T		"C" LOW FLOW TRIP SETPOINT OUT OF TOLERANCE	GEN ATOMICS ELD240-0000-1F B/S DRIFT
C	FC1	021801	071278	SP	PS		B13				1	T		STM GEN PRESS TRIP OUT OF TOLERANCE	PWR MATE PS DRA 15-750 FAILED
C	FC1	022303	081478	PN	PS		B13				1	T		"C" LIN PWR METERS READING LOW	PS MC-14.5-1.0 LOST REGULATION
C	FC1	022230	083078	PN	PS		B13				1	N		"B"RPS VAR OVER POWER TRIP RESET DEM ALARM ACTUATD	PS 19-601A 18VOLT FAILED UP TO 27VOLT
C	FC1	022544	091878	RT	SE	T	B07				1	T		HOT LEG TEMP IND FAILURE	RTD 104VC HAD WATER IN POTHEAD
C	FC1	022787	101478	RT	SE	T	B13				1	N		COLD LEG IND B/122C HIGH OFFSCALE	RTD 104VC OPEN CIRCUITED
C	FC1	023133	112278	SL	TX	L	A14				1	T		LEVEL XMTR "C" C/LT-901 OUT OF SPEC	GE/MAC 555 XMTR DRIFTED OUT OF TOLERANCE
C	MI2	014015*	011476	TP	IM		B04	L			4	R		4 OF 4 TM/LP TRIP NON-CONSERVATIVE FOR ALL CONDITI	DESIGN WIRING ERROR INPUT TO CEA FUNC GEN
C	MI2	014165	012676	RF	TX	F	A11				1	T		LOOP 2 CH C STM GEN DP HIGHER THAN OTHER 3	MODEL 368 DP XMTR FOREIGN MATTER PRESENT
C	MI2	014460	030876	RF	TX	F	B13				1	T		LOOP 2 CH C STM GEN DP HIGHER OUT OF SPEC	MODEL 368 DP XMTR BAD ZERO ADJ POT
C	MI2	015079	061376	TP	AM		B13				1	N		TM/LP CALCULATOR ERRATIC NON-CONSERVATIVE TRIP PT	B&H DUAL BIPOLAR AMP 381441-01 FAILURE
C	MI2	015580	080676	SL	CM		A14				1	T		CH A STM GEN LEVEL HIGH TRIPS HIGHER THAN SPEC	ELD-240-0000-IF BISTABLE INST DRIFT
C	MI2	017116	020977	RF	CM		A02	C			1	T		RPS LOW FLOW SETPOINT SET HIGH NONCONSERVATIVE	PERSONNEL MISINTERPRETED FORMULA

ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
C	MI2	017489	031377	PN	AM		B13		1	N		CH B RPS LIN PWR RNG LOWER DET CH FAIL FULL SCALE	ELC-179-2110 LIN CURRENT AMP FAILURE
C	MI2	018340	061777	RP	TX	P	A14		1	T		CH B PZR PRESS TRIP POINT LESS CONSERV THAN T.S.	E11GM XMTR INSTRUMENT DRIFT
C	MI2	018736*	080477	RF	CM		A14		2	T		2 OF 4 LOW FLOW TRIPS LESS CONSERVATIVE THAN T.S.	BISTABLE INSTRUMENT DRIFT
C	MI2	019601	101477	PN	AM		B13		1	N		RPS CH D LIN PWR UPPER FAILED HIGH	FAILED AMP ELC-179-2110
C	MI2	020458*	011378	SL	CM		A14		2	T		STM GEN LEVEL TRIPS B & C OUT OF SPEC HIGH	ELD 240-0000-IF SETPOINT DRIFT
C	MI2	021353	042578	PN	CA		B09		1	N		PWR RNG CH D INDICATION FAILED LOW	LOOSE CONNECTOR TO CHAN D DETECTOR
C	MI2	022132	080178	RF	CM		A14		1	T		RPS RX COOLANT FLOW LOW TRIP OUT OF SPEC NONCONSER	ELD-240-0000-IF INSTRUMENT DRIFT
C	MI2	022883	100478	RF	CM		A14		1	T		RPS CH B RX COOL LOW TRIP OUT OF SPEC NON-CONSERVA	ELD-240-0000-IF INSTRUMENT DRIFT
C	MI2	022888	102578	RP	TX	P	B09		1	T		RPS CORE PROTECT CALCULATOR HAD GROUNDED INPUT	ELECTRICAL GROUND SOURCE UNKNOWN AS YET
C	MI2	023210	113078	PN	PS		B13		1	N		RPS CH B CORE PROTECT CALCULATOR FAILED	LCD-A-22 PWR SUPPLY FAILURE
C	MY1	014009	011676	PN	IM		B13		1	T		RPS VAR OVER-POWER HIGH TRIP NON-CONSERVATIVE	FEEDBACK LIMITER MODULE WORN POTENTIOMETR
C	MY1	014123	011676	RF	PS		B13		1	T		REACTOR LOW FLOW TRIP NON-CONSERVATIVE	PS DRA 15-750/15-750B IMPROPER OUTPUT
C	MY1	014010	012376	TP	IM		B13		1	N		DELTA-T INPUT TO TM/LP TRIP CALCULATOR LOW/ERRATIC	B&H 10 TURN POTENTIOMETER WORN/DIRTY
C	MY1	014262	021976	RP	PS		B13		1	T		RPS PZR PRESS HIGH TRIP POINT NON-CONSERVATIVE	DRA 15-750/15-750B PS INCORRECT OUTPUT
C	MY1	014261	022476	RN	PS		B13		1	N		RPS "D" WIDE RANGE LOG NUCLEAR HIGH VOLT ALARM	BENRUS TECHNIPOWER PS MODULE FAILURE
C	MY1	015074	061576	RP	PS		B13		1	T		RPS HIGH PRESS PZR TRIP NON-CONSERVATIVE	DRA 15-750/15-750B PS INCORRECT VOLTAGE
C	MY1	015276	072676	TP	IM		B13		1	T		CH B TM/LP TRIP LOWER THAN OTHER 3 CHANNELS	B&H 19-301A ADD/SUB MODULE FAILED
C	MY1	015275	080376	TP	IM		B13		1	N		SPURIOUS TRIP CH D TM/LP	B&H 19-502 AMPLITUDE SELECTOR FAILED
C	MY1	016754	011877	RF	PS		B13		1	T		RPS LOW REACTOR COOLANT FLOW TRIP NON-CONSERVATIVE	DRA 15-750/15-750B PS INCORRECT VOLTAGE
C	MY1	021651	053078	RT	SE	T	B13		2	N		RPS DELTA-T PWR INDICATION NOT STEADY	TWO RTD'S FAILING, VARYING RESISTANCE
C	MY1	022142	073178	RP	TX	P	A14		1	T		PT-102C RX COOLANT PRESS NON-CONSERVATIVE	FP MODEL 50EP1000 INST DRIFT
C	MY1	023558	122678	TP	IM		B13		1	N		RPS"C" VAR PRESS SETPOINT FOR TM/LP LOW	DIRTY POT IN TM/LP MODULE
C	PA1	014395	030676	PN	ZZ		A00	R	1	T		PWR RNG SAFTY CHNL NI006 TRIPPED AT 107.1 PRCNT	LINR CH PT NO-ELJ 147-000-1A,SN-NP-6-105
C	PA1	016490	111576	PN	CM		A14		1	T		NEUT MON CHNL C TRIP AT 108.4 VS 106.5 PERCENT	INSTRUMENT SET POINT DRIFT
C	PA1	016621	120676	SL	CM		A14		1	T		SG LO LVL TRIP(CH D) BELOW TS BY .135 INCHES	SET POINT DRFT AND ADMIN LMT CLOSE TO TS

ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
C	PA1	019462*	081677	RF	TX	F	B13		2	T	LO FLO DET CHNLS FOR 3&4 PUMP OPER MODES EXCEED TS	ZERO&SPAN DRIFT-MOD 296 W MOD 199 BELLOWS
C	PA1	019438	082477	RF	TX	F	B13		1	T	COOLANT FLO XMTR PDT-0112AA READ 8 PCT HIGH	LOSES ACCRCY WHEN PRESS GT 2000-S/N E6916
C	PA1	020622	120577	RP	CM		A14		1	T	PRI PRESS ST PT FOR CHNL "C" WAS 1747 VS 1750	INSTRUMENT DRIFT(3 PSI)-MOD 562
C	PA1	020549	020278	SL	TX	L	A14		1	T	SG LVL INST LT-0751C ST PT 40 IN - OUTSIDE TS LMIT	SETPOINT DRIFT-EASILY RECALIBRATED
C	PA1	021323	041478	RF	CM		A06	C	1	T	CH A LO PRI FLOW WAS 94.6 PCT, TS REQ MIN 95 PCT	CALIB PROCED REQS CHK THAT AFFECTS TRIP
C	PA1	022783	102078	RP	CM		A14		1	T	PCS CH D PRESS INST(PT-0102D) TRIP AT 1745 VS 1750	ZERO SHIFT CAUSED BY INCREASE IN AMB TEMP
C	SL1	020513	0203[illegible]	RT	SF	T	A06	C	3	T	RTD RESPONSE TIMES GT. 5SEC. VALUE SET BY VENDOR	RTD'S MOUNTD IN INST.WELLS--NOT ACCTD FOR
W	BV1	014606A	0512[illegible]	NT	CM		B01	U	1	N	OVERPOWER BISTABLE NOT TRIPPED WHEN REQ.	OPERATOR FAILED TO TRIP BISTABLES
W	BV1	014606B	051276	TT	CM		B01	U	1	N	OVERTEMP BISTABLE NOT TRIPPED WHEN REQ.	OPERATOR FAILED TO TRIP BISTABLES
W	BV1	014691	051376	TT	CM		B02	S	1	T	LOOP 1A OVERTEMP DT BISTABLE TRIPPED CAUSING RX TR	VOLTAGE SPIKE CAUSED BY PERSONNEL(MAIN.)
W	BV1	015726	082376	DT	AM		B13		1	N	LOOP A DT INDICATOR DISCOVERED LESS THAN ZERO	HAGAN SIGNAL ISOLATOR FAILURE
W	BV1	017555	032677	SL	TX	L	B13		1	N	1A STEAM GENERATOR LEVEL FAILED LOW	FAILED TRANSMITTER
W	BV1	017623	041677	FF	IM		B13		1	N	1A S/G FEED FLOW INSTRUMENT FAILED HIGH	FAILED SQUARE ROOT EXTRACTOR
W	BV1	017695	042677	TT	IM		B13		1	N	1C RCL OVERTEMP DT SETPOINT DISCOVERED FULL SCALE	FAILED LEAD-LAG MODULE,WEST.MODEL 131-114
W	BV1	018830	072177	PN	IM		B13		1	N	CH1 OVERPOWER PT SETPOINT READING HIGHER THAN OTHE	FAILED SUMMATOR
W	BV1	018731	080877	PN	SE	N	A14		1	T	EXCORE NEUTRON DETECTOR READ HIGH (DETECTOR N41)	INSTRUMENT DRIFT
W	BV1	019932	121077	DT	CA		B13		1	N	LOOP 3 DT INDICATOR FAILED LOW	TEMPERATURE DETECTOR CABLE DAMAGED
W	BV1	020129	121477	RP	AM		B13		1	N	PZR PRESSURE INDICATOR FAILED LOW ,CHANNEL 445	FAILED ISOLATION AMPLIFIER
W	BV1	020127	121677	FF	IM		B13		1	N	LOOP 3 FEED FLOW CHANNEL 496 INDICATED LOW	FAILED CHANNEL MUTIPLIER-DIVIDER MODULE
W	BV1	020440	011678	IN	AM		B13		1	N	INTER. RANGE CHANNEL N36 INDICATED BELOW OP. LIMIT	FAILED CURRENT AMPLIFIER
W	BV1	020755*	021178	NT	CM		B13	R	2	N	ON TWO SEPARAT DAYS,OVERPOWER DT SETPOINT READ HI	MODULE OUTPUT DRIFT,MODULE REPLACED
W	BV1	020793	022878	PN	AM		B13		1	N	POTENTIOMETER DISCOVERED OPERATING ERRATICALLY	NON-CONTINUOUS AREA ON POTENTIOMETER(N41)
W	BV1	026843	042478	DT	AM		B13		1	N	LOOP B DT-TAVE INDICATION FAILED LOW	FAILED CAPACITOR IN LOW-LEVEL AMPLIFIER
W	BV1	022881	101378	PN	CM		A02	C	1	T	EX CORE INST.,CH N41,RATE TRIP SETPOINT TOO HIGH	INADVERTENT READJUSTMENT
W	DC1	014723	051376	FF	IM		A14		1	T	EXCESSIVE ERROR IN SQUARE ROOT EXTRACTOR(IFY-5218)	SET POINT DRIFT

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VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	DC1	015969	091376	SL	TX	L	A14		1	T		S/G LEVEL TRANSMITTER EXCEEDED LIMITS(BLP-120)	ZERO SETTING SHIFTED AND REOCCURRED
W	DC1	015858	091676	PL	TX	L	A14		1	T		PRESSURIZER LEVEL TRANSMITTER EXCESSIVE ERROR	ZERO HAD DRIFTED LOW ON TRANSMITTER
W	DC1	015859	091676	PL	TX	L	A14		1	T		PRESSURIZER LEVEL TRANSMITTER EXCESSIVE ERROR	ZERO HAD DRIFTED LOW ON TRANSMITTER
W	DC1	016114	100776	FF	TX	F	B02	C	1	T		FEED FLOW TRANSMITTER EXCESSIVE ERROR (FFC-211)	PERSONNEL ERROR VALVING OUT TRANSMITTER
W	DC1	016771	010177	RF	TX	F	A14		1	T		REACTOR COOLANT FLOW TRANSMITTER ERROR EXCESSIVE	SETPOINT DRIFT (FT-426)
W	DC1	016770	010377	SL	TX	L	B13		1	T		S/G LEVEL TRANSMITTER ERROR EXCESSIVE (BLP-120)	RUST FORMATION AT FLEXURE BAR PLATE
W	DC1	019767*	112377	SN	ZZ		B00		2	N		TWO SOURCE RANGE CHANNELS INOPERABLE FOR ABOUT 1 H	CAUSE UNKNOWN-FAILURE COULD NOT BE LOCATE
W	DC1	019869	120377	PL	TX	L	A08		2	T		PRESSURIZER LEVEL DEVIATION BETWEEN INDICATING CHA	PARTIAL LOSS OF TX REF LEG (CH I & II)
W	DC1	023529*	012978	PL	TX	L	B11	R	2	T		PRESSURIZER LEVEL INDICATION READING HIGH (CH-1)	GAS POCKET IN REFERENCE SENSING LEGS
W	DC1	021215*	042078	SN	SE	N	B13	R	6	T		SOURCE RANGE DETECTOR FAILED SIX TIMES (N-32)	EXACT CAUSE OF FAILURES UNKNOWN
W	DC1	021949	070978	PL	TX	L	B11	R	1	T		PRESSURIZER LEVEL INDICATION CHANNEL VARIATION	GAS POCKET IN REFERENCE SENSING LINE(CH-3
W	DC1	022333*	082878	SL	CM		B13	R	2	T		S/G LEVEL BISTABLE EXCEEDED MINIMUM SETPOINT	BAD SOLDER JOINT ON RESISTOR
W	DC1	022535	092478	SN	CA		B09		1	N		SOURCE RANGE CHANNEL BECAME INOPERABLE (N-31)	CHANGED CABLE FROM DETECTOR TO DRAWER
W	DC1	022695	102378	PL	TX	L	B11	R	1	T		PRESSURIZER LEVEL CHANNEL DEVIATION TOO GREAT(CH-3	GAS POCKET IN SENSING LINE
W	DC1	023361	122978	PL	TX	L	B11	R	1	N		PRESSURIZER LEVEL INDICATION READING LOW (CH ONE)	GAS POCKET IN SENSING LINE
W	DC2	020979A	032478	FF	TX	F	B11		1	N		STEAM FLOW-FEED FLOW MISMATCH (S/G 4 CH 1)	TRANSMITTER AND SENSING LINES AIRBOUND
W	DC2	020979B	032478	FF	TX	F	B11	R	1	N		STEAM FLOW-FEED FLOW MISMATCH (S/G 4 CH 2)	TRANSMITTER AND SENSING LINES AIRBOUND
W	DC2	020931	040178	TT	IM		B13		1	N		REACTOR COOLANT LOOP 1 DELTA T OVERTEMPERATURE FAI	MODULE ZTY-411C FAILED
W	DC2	020933	040178	FF	TX	F	B11	R	1	N		S/G 4 FEED FLOW CHANNEL 2 FAILED	TRANSMITTER SENSING LINES AIRBOUND
W	DC2	021677	061878	PL	TX	L	B11	R	1	N		PRESSURIZER LEVEL CHANNEL 3 INDICATING HIGH	LEAK IN REFERENCE LEG TEE FITTING
W	DC2	021946	071078	SF	TX	F	B13		1	T		STEAM FLOW CHANNEL HFC-120 WAS READING LOW	TRANSMITTER HAD A ZERO SHIFT
W	DC2	022233	080278	PL	TX	L	B11	R	1	T		PRESSURIZER LEVEL CHANNEL 3 INDICATING MALFUNCTION	GAS POCKET IN SENSING LINE
W	DC2	022502	091378	PP	CM		B13		1	T		PRESSURIZER PRESSURE HIGH REACTOR TRIP BISTABLE FA	BISTABLE FAILED DUE TO A BAD TRIAC
W	DC2	023113	112578	SN	CA		B12		1	N		SOURCE RANGE NEUTRON FLUX CHANNEL N-31 INOPERABLE	HIGH VOLTAGE & SIGNAL CABLE CONN CLEANED
W	HN1	014005	010876	PN	CM		A14		1	T		CH 33 OVERPOWER TRIP ABOVE LIMIT	NORMAL INSTRUMENT DRIFT

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W	HN1	014161	021976	PN	CM		A14		1	T		CH 34 OVERPOWER TRIP ABOVE LIMIT	NORMAL INSTRUMENT DRIFT
W	HN1	018351	062377	PN	SE	N	B13		1	N		NUCLEAR INST CH 32 DETECTOR CURRENT ERRATIC	DETECTOR AND CABLE DETERIORATION
W	HN1	018774	070577	PL	ZZ	L	A14		1	N		PRESSURIZER LEVEL #3 DIFFERS FROM #1 & 2	NORMAL INSTRUMENT DRIFT
W	IP2	014204	011676	SL	PS		B13		1	T		BISTABLE LC-4(76-2-2)B OUT OF SPEC	M/63 ALARM UNIT PWR SUP DEFECTIVE
W	IP2	016220	101376	DT	ZZ		A00		1	T		DELTA-T CH22 DIFFERS FROM OTHER 3 CHANNELS	CHANGE OF DELTA-T SINCE PHYSICS TESTING
W	IP2	016556*	112876	PN	AM		A14		2	T		PWR RNG F (DELTA I) FOR CH 41 & 43 OUT OF SPEC	STATIC GAIN UNIT 62H-2 OUT OF CALIBRATION
W	IP2	016642	121276	SL	TX	L	B11		1	N		LEVEL XMTR OUTPUT DRIFTED HIGH	BLOCKED SENSING LINE TO XMTR
W	IP2	017782	042877	PL	TX	L	A14		1	T		LT-460 LEVEL XMTR OUT OF TOLERANCE HIGH	XMTR 613HM-H DRIFTED OUT OF TOLERANCE
W	IP3	015131	052576	RP	CM		A14		1	T		BISTABLE 63U-AC-OHAA-F SETPOINT DRIFT	PC-457A READJUSTED
W	IP3	015115	060376	PN	SE	N	B13		1	T		PWR RANGE CH 43 DECREASING SLOWLY	WL23686 DEFECTIVE AND REPLACED
W	IP3	015114	060576	RF	AM		B13		1	T		FT-434 OUTPUT DRIFTING	FT AMP ASSY 143SY DEFECTIVE
W	IP3	016340	102976	NT	AM		A14	R	1	T		CH II OVERPOWER-DELTA-T SETPOINT NONCONSERVATIVE	STATIC GAIN UNIT MODEL DQ OUT OF ADJUST
W	IP3	017123	112576	NT	AM		A14	R	1	T		CH II OVERPOWER-DELTA-T SETPOINT NONCONSERVATIVE	DQ STATIC GAIN UNIT OUT OF ADJUSTMENT
W	IP3	016468	113076	NT	AM		A14	R	1	T		CH II OVERPOWER-DELTA-T SETPOINTS NONCONSERVATIVE	DQ STATIC GAIN UNIT OUT OF ADJUSTMENT
W	IP3	016634	113076	NT	AM		A14	R	1	T		CH II OVERPOWER-DELTA-T SETPOINTS NONCONSERVATIVE	DQ STATIC GAIN UNIT OUT OF ADJUSTMENT
W	IP3	017121	012777	NT	AM		A14	R	1	T		CH II OVERPOWER-DELTA-T SETPOINTS NONCONSERVATIVE	DQ STATIC GAIN UNIT OUT OF ADJUSTMENT
W	IP3	019263	092877	NT	AM		A14		1	T		CH IV OVERPOWER-DELTA-T SETPOINTS NONCONSERVATIVE	DQ STATIC GAIN UNIT OUT OF ADJUSTMENT
W	IP3	021652	060278	PN	AM		A14	R	1	T		F(DQ) NO. 41 SETPOINTS NONCONSERVATIVE	DQ STATIC GAIN UNIT OUT OF ADJUSTMENT
W	IP3	022403	091278	RT	SE	T	B07		1	N		HOT LEG RTD-410A INOPERABLE	BORATED WATER LEAK ON RTD WIRING
W	IP3	023223	112178	PL	TX	L	B11	R	1	N		PRESSURIZER LEVEL,CH 3,SHOWED LEVEL FAILING HIGH	BLOWDOWN VALVE LEAKING
W	JF1	019056	082277	DT	IM		A14		1	N		LOOP C LO-LO TAVG TB-432E SETPOINT OUT OF TOLERANC	TB-432E OUT OF CALIBRATION
W	JF1	019358	090777	PL	CM		A14		1	T		PZR LEVEL LB-459A(2) SETPOINT OUT OF TOLERANCE	INSTRUMENT DRIFT
W	JF1	019364	092177	DT	IM		A14		1	T		TB-432B-1 SETPOINT OUT OF TOLERANCE	INSTRUMENT DRIFT
W	JF1	019371	100877	DT	IM		B13		1	T		DELTA-T/TAVG CH II OUT OF TOLERANCE	LEAD/LAG CARD TY-422E FAILED
W	JF1	019696	111177	PL	TX	L	B13		1	N		PRZR LEVEL IND LT-461 READING LOW	DELTA-P UNIT LT-461 DEFECTIVE

ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	JF1	019697	111777	IN	CM		A14		1	T	HIGH LEVEL TRIP BISTABLE NC206 IN EXCESS OF T.S.	B/S RELAY DRIVER NC206 INST DRIFT
W	JF1	019849	112977	RP	CM		B13		1	N	PZR HIGH PRESS PB-4571 TRIPPED ABOVE SETPOINT	NAL CARD PB-457A DEFECTIVE
W	JF1	019848	120277	FF	IM		A14		1	N	STM FLOW IND FI-484 READING LOW	NMD CARD FY-484 OUT OF CALIBRATION
W	JF1	019846	120577	RP	CM		B13		1	N	PZR HIGH PRESS PB-457A TRIPPED ON	DEFECTIVE BISTABLE CARD
W	JF1	020282*	011278	FF	CM		A14		2	T	STM VS FEED FLOW MISMATCH TRIP LESS CONSERVATIVE	CARDS FB-4988 & FY-497 NORMAL DRIFT
W	JF1	021234	042478	IN	SE	N	A14		1	T	INTERMEDIATE RANGE N35 HIGH FLUX TRIP LESS CONSERV	NEW DETECTOR LESS SENSITIVE THAN ORIGINAL
W	KE1	014300	022376	PL	TX	L	A14		1	T	PZR LEVEL LT-427 FOUND OUT OF SPECIFICATION LOW	ZERO DRIFT LOW
W	KE1	014396	030976	SF	TX	F	B13		1	T	MAIN STEAM FT-464 OUT OF TOLERANCE NON-LINEAR	DEFECTIVE BELLOWS IN TRASMITTER
W	KE1	016118*	092876	PL	TX	L	A14		2	T	PZR LEVEL TRANSMITTERS (2) TRIPS LESS CONSERVATIVE	INSTRUMENT DRIFT
W	KF1	016973	011777	SN	SE	N	B13		1	N	CH31 SOURCE RANGE NO OUTPUT	DETECTOR AND PRE-AMP FAILURE
W	KE1	017156A	021577	PL	TX	L	A14		2	T	2 OF 3 PZR LEVEL XMTRS TRIP SETTINGS NON-CONSERVAT	DRIFT
W	KE1	017156B	021577	PL	TX	L	B13		1	T	1 OF 3 PZR LEVEL XMTRS TRIP SETTINGS NON-CONSERVAT	DEFECTIVE BELLOWS
W	KE1	017244A	030477	RP	TX	P	A14		1	T	PZR PRESS HIGH PRESS RX TRIP HIGH 7 PSIG	INSTRUMENT SETPOINT DRIFT
W	KE1	017244B	030477	RP	CM		A14		1	T	PZR PRESS HIGH PRESS RX TRIP HIGH 4 PSIG	INSTRUMENT SETPOINT DRIFT
W	KE1	017372	032377	FF	TX	F	B05	C	2	N	STM GEN LEVEL CONTROLLERS LACK OF CONTROL	CROSSED INSTRUMENT TAPS BETWEEN 2 CHANNEL
W	KE1	017723	033077	PL	CM		A14		1	T	PZR HIGH LEVEL TRIP CHANNEL ABOVE T.S. SETPOINT	ALARM BISTABLE DRIFT
W	KE1	020424	020678	RP	TX	P	A06	L	5	R	PZR PRESS READINGS HIGH	PROCEDURE NOT INCLUDING HEAD CORRECTION
W	KE1	021391	050478	PL	TX	L	A14		1	T	PZR LEVEL XMTR OUT OF CAL LESS CONSERVATIVE	BARTON LEVEL XMTR INSTRUMENT DRIFT
W	KE1	021443	051178	RF	TX	F	A14		1	T	1 RCS FLOW XMTR EACH LOOP OUT OF CAL LESS CONSERV	FOXBORO FLOW XMTR INSTRUMENT DRIFT
W	KE1	021629	060178	PL	TX	L	A14		1	N	PZR LEVEL IDICATING HIGH, LESS CONSERVATIVE	BARTON PZR LEVEL XMTR INST DRIFT
W	NA1	021541	052978	DT	AM		B13		1	T	PROTECT TAVG LOW, PROTECT DT HIGH T-1412	COLD LEG RTD AMP FAILURE
W	NA1	022557	083178	RP	PS		B13		1	N	PZR PRESS CH P-455 SPIKE INTERMITTENTLY	FAULTY PZR PRESS LOOP POWER SUPPLY
W	NA1	022571	092778	RF	TX	F	A06		1	T	RX COOLANT LO-LO FLOW TRIP NON-CONSERVATIVE	XMTR CAL PROCEDURE W/O ELEVATION COMPENSA
W	NA1	022568	092878	RP	TX	P	A14		1	T	CH III PZR PRESS PT-1457 TRIP HIGH NON-CONSERVATIV	XMTR OUTPUT DRIFT
W	NA1	022593	100278	SL	TX	L	A11		1	T	CH III SG LEVEL INDICATION 5% DEVIATION	LI-1496 MANIFOLD GASKET LEAK

ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	NA1	022937	101278	FF	PS		B09			1	N		FEEDWATER FLOW FT-1496 LOOP C FAILED LOW	POWER FUSE BLOWN
W	NA1	022771	101778	FF	IM		A14			1	T		STM-FEEDWATER FLOW MISMATCH TRIP HIGH	DRIFT OF MULTIPLIER-DIVIDER CARD
W	NA1	023480	122878	OP	DC	P	A09			1	N		CH 1 TURB AUTO STOP OIL LOW PRESS SPURIOUS SIGNAL	LOOSE TERMINAL SCREW ON PS-LO-609-4
W	PR1	014206*	020876	IN	TX	N	A14			2	N		BOTH INTRMD RNG HI FLUX TRIPS AT 30 VS 25 PERCENT	CURRENTS CHANGE SIGNIFCTLY OVER CORE LIFE
W	PR1	015071	061776	SN	SE	N	B13			1	N		NIS SOURCE RNG CH N31 DID NOT RESP PRPRLY ON S/U	FAULTY DETECTOR. DETECTOR REPLACED
W	PR1	019603	101577	IN	SE	N	B13			1	N		NIS INTRMD RNG CH N36 FLD TO PROVD INPUT-PRMSV SIG	COMPNSTN CAPABILITY WAS LOST-DET REPLACED
W	PR1	020431A	011078	SN	SE	N	B13			1	N		IT BCME APPRNT THAT DET FOR SR CH N31 REQD REPLCMT	NO CAUSE WAS GIVEN
W	PR1	020431B	011078	SN	SE	N	B03	S		1	T		CONTROL ROOM LOST ALL SOURCE RANGE INDICATION	TEST PRSNL DISCONN CH N32 VS CH N31
W	PR2	014202	020976	TT	CM		A14			1	T		ONE DIFF OVRTEMP SETPOINT FOUND OUTSIDE TS LIMITS	SET POINT DRIFT
W	PR2	014275	022976	RP	CM		A09			1	T		ONE LO PSZR PRESS SI STG FOUND 9 PSI BELOW TS LMIT	LOOSE LOOP RESISTOR
W	PR2	016341	110376	SN	AM		B13			1	N		NUCLEAR SOURCE RANGE CHANNEL 2N-32 FAILED	FAULTY PREAMPLIFIER
W	PR2	016720	010177	RT	SE	T	B13			1	N		ONE REACTOR COOLANT DELTA-T CHANNEL FAILED LOW	RTD FAILED - MODEL 176KF
W	PR2	017112	020477	NT	IM		A14			1	T		OVERPOWER FUNCTION DELTA-T SP2 TRIPPED OUT OF SPEC	INSTMT DRIFT IN SUMMING AMP -MOD 66RC-DL
W	PR2	020126A	121277	SF	TX	F	A14			1	R		1 PROTCN SYS XMITR DRIFTED ST BISTBL STPTS GT TS	INSTMT DRIFT - NO SINGLE CAUSE ESTABLISHD
W	PR2	020126B	121277	RF	TX	F	A14			2	R		2 PROTCN SYS XMITRS DRIFTED ST BISTBL STPTS GT TS	INSTMT DRIFT - NO SINGLE CAUSE ESTABLISHD
W	PR2	022716	081878	PN	PS		B13			1	M		NIS POWER RANGE CHANNEL 2N41 FAILED	FAILURE OF -25V LOW VLTG PS-MOD UPM-44KW
W	PT1	013946	011076	PN	PS		B13	R		1	N		PWR RNG CH 41 PWR SUP FAILED-41 DETECTOR INOPERATV	MOD UPM-44K POWER SUPPLY REPLACED
W	PT1	016573	113076	PN	PS		B13	R		1	N		PWR RNG CH 42 FAILD TO TRIP POSITN CAUSNG CUTBACK	MOD UPM-44K -25V PWR SUPPLY FAILED
W	PT1	021444	051278	NT	IM		B13			1	N		SPECIAL SUMMER(1-TM-404V)IN OVR PWR DELTA T CH SP2	DRFTD HI-DFCTV ZERO POT- 66RC-DL
W	PT1	023304	121978	PN	PS		B13	R		1	N		PWR RNG CH 44 FAILED,CAUSING TURBINE RUNBACK	PWR SUPPLY FAILED - MOD PUMP-X54W
W	PT2	014746	051476	PN	SE	N	B13			1	N		PWR RNG DETECTOR 242B WAS DRIFTING	MOD WL23-710 WAS RPLCD WITH MOD WL23-686
W	PT2	014951	061376	PN	PS		B00			1	N		UNIT EXPER TURB RUNBACK FOLLOWING LOSS OF PR DET V	CAUSE UNKNOWN - MODEL UPMD-X54W
W	PT2	023123*	120978	RT	SE	T	B02	U		4	N		LOOP "A" RTD MANIF ISOLATED WHILE RX WAS CRITICAL	PERSONNEL OVERSIGHT
W	RG1	014203	012976	PN	PS		B13			1	N		BOTH CONTROL POWER FUSES BLEW FOR N42 PWR RNG CHNL	CAPACTR IN AUX PWR SUP BD FLD-UPMDX54
W	RG1	014715	041276	PN	PS		B13			1	N		N44 PWR RNG HI VLTG PWR SUP FAILED TO 57V DC	MODULAR BLOCK PT NO IV-101 - MOD UPMC-X54

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VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	R02	022334	082178	RT	SE	T	B13			1	N		T-AVE & DELTA T FOR LOOP 3 DRIFTING LOW	HOT LEG RTD FAILED
W	SA1	016026*	092776	IN	CA		B07	C		2	N		BOTH INTERMEDIATE RANGE NUCLEAR INST CHNLS INOPER	WETTING OF DTCTRS WITHIN WELL-HI CONN RES
W	SA1	017017	012077	RF	ZZ		B05	S		1	N		NO 12 RX COOLANT FLOW CHANNEL 1 BECAME INOPERABLE	SWAGELOK TUBE FITNG BACKED OFF-CONST EROR
W	SA1	017015	012177	SF	TX	F	B13			1	N		NO 13 S/G STM FLO CH 1 HAD INNACCURATE FLO SIGNAL	XMTR DIAPGM & LINKG FLD-MOD 6906A535CA69
W	SA1	017267	021577	DT	IM		A14	R		1	T		#14 RX CLNT LOOP DELTA-T/TAVG TRIP POINT GT TS LMT	SLIGHT COMP VALUE CHGS WITHIN SLD ST CKTY
W	SA1	017423	031477	DT	IM		A14	R		1	T		#14 RX CLNT LOOP DELTA T/TAVG TRIP POINT GT TS LMT	CHANNEL DRIFT - CMN FAILURE CMPNTS UNDET
W	SA1	017888	060377	PL	CM		B13			1	N		CHANNEL III PSRZR LEVEL WAS DECLARED INOPERABLE	DUAL OUTPT COMPARATOR FLD-2 CAPCTRS ON PS
W	SA1	019923	120577	FF	IM		A14	R		1	T		#14 S/G FLO CH II TRP PT 31MVDC GT ALLOWED BY TS	INST DRIFT IN SQ ROOT EXTRCTR-PN/ 4111511
W	SA1	019922	120677	RF	IM		B13			1	N		#11 RC LOOP FLOW CHANNEL II FAILED	SIGNAL ISOLATOR FAILED-CONSOLE IND LOST
W	SA1	019921	120777	RF	AM		B13			1	T		#12 RC LOOP CH II OPDT SETPT DETRMND TO EXCD TS	LOW LEVEL AMPLIFIER FAILED - MOD 111
W	SA1	020456	010378	FF	IM		A14	R		1	T		NO 14 S/G STM FLO CH II TRIPPED GT TS LIMIT	INST DRIFT IN SQ RT EXTRACTOR-PN/ 4111511
W	SA1	020457	010678	TT	IM		B13			1	N		LOOP 13 OVR TEMP DELTA-T CHANNEL FAILED	FAILED CAPCTR IN TYPE 4111513 FNCTN GEN
W	SA1	021030	031078	PN	CM		A14			1	T		PWR RNG CH N43 TRIP SETPOINT FOUND 1.4 PCT GT ALLW	INSTRUMENT DRIFT
W	SA1	021648*	061078	PN	CA		B02	C		1	N		TWO INOPERABLE POWER RANGE CH WERE IDNTFD(N41&N42)	MAINT PERS DISCONN WRONG LEADS FOR RX COM
W	SA1	021912	062378	SF	TX	F	A14			1	T		NO 11 S/G STM FLO CH II OUT-OF-SPEC LOW	INSTRUMENT DRIFT IN NONCONSERVATV DIRCTN
W	SA1	022157	080978	FF	AM		B13			1	T		NO 11 S/G FEED FLO CH 2 BISTBL SETPT ABOVE TS LMTS	FAILED OP AMP IN THE DUAL COMPARATOR MOD
W	SA1	022154	081578	SL	TX	L	A14			1	T		NO 13 S/G LVL CH IV TRIP POINT EXCD TS LIMITS	TRANSMITTER DRIFT
W	SA1	022413	091278	RP	CM		B13	R		1	T		PRESS PROTCTN CH 2 RX TRIP SETPT GT TECH SPEC LIMT	UNSTABLE OUTPT FRM COMPARATOR FOG TRIP BS
W	SA1	023229	112878	PL	TX	L	B13	R		1	T		PRESSURIZER LEVEL WAS READING 10 PCT GT OTHER CHLS	STRAIN GAUGE DVLPD HI RES IN OUTPT BRIDGE
W	SA1	023228	113078	SF	TX	F	A14			1	R		NO 13 S/G STM FLO CH I CAL DATA SHOWED TS EXCEEDED	ZERO SHIFT CSD BY S/D & S/U OF UNIT
W	SA1	023227	120178	SL	TX	L	B11	S		1	N		NO 12 S/G LVL CH III FOUND TO BE INOPERABLE	PARTIALLY CLOGGED SENSING LINES
W	S01	015174	062876	RF	TX	F	B13			1	N		UNIT 1 TRIP AT 330MW SPURIOUS LOW FLOW SIGNAL	FAILD FEEDBACK MOTOR IN FLOW TRANSMITTER
W	S01	015998	082376	FF	PS		B13			1	N		S/G FEED CONT. B/U POWER SUPPLY DEGRADED CAUSING	INOP FEED FLOW R/X TRIP; FAILD DIODES
W	S01	023374	112678	FF	SE	F	B07	S		1	N		"C" FEED FLOW SUDDEN INCREASE;LOSS OF 1 STEAM/FEED	FLOW STRAIGHTNR DISLODGED AGAINST ORIFICE
W	SU1	016257	110176	TT	CM		B13			1	T		COMPARATOR(TC-1-432C) FAILD TO TRIP	POWER CAPACITOR MALFUNCTION

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VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	SU1	01.'20	032877	FF	RE		B12		1	T		HI STEAM FLOW RELAY(FC-485-XA) MALFUNCTNO- ST TEST	DEBRIS IN BF-48 RELAY CONTACTS
W	SU1	0200[illegible]	121677	SL	PS		B13		1	T		"A" S/G LEVEL CHAN II COMPARATOR FAILD TO TRIP	2 OPEN CAPACITORS IN COMP. POWER SUPPLY
W	SU1	022642	101178	PL	TX	L	A11		1	N		CHAN 1 PREZ. LEVEL L-I-459 DRIFTD HI--O ADJUSMNT &	LEAKAGE THRU TRANSMITR BYPASS/EQUAL.VALVE
W	SU1	022952	111578	PL	TX	L	A14		1	N		CHAN 1 OF PREZ LEVEL LI-1-459 DRIFTD LOW	DRIFT IS INTERMITTENT;UNKNOWN CAUSE;RECAL
W	SU2	014842	021176	TT	IM		A09		1	N		CHAN 3 HI TEMP SETPOINT DRIFTD 9% IN NONCONSERVATV	LOOSE CONNECTION ON SUMMATOR
W	SU2	014846*	021776	PL	TX	L	A14		2	N		2OF3 PREZ LEV. TRANSMITR SETPOINTS OUT OF SPEC-92%	LT-459-93% & LT-461-92.08% ELECTRONC DRIF
W	SU2	015527	062176	PN	PS		B13		1	N		LOSS OF DETECTR VOLT ALARM TO PWR RANGE NI CHAN 42	-25 VOLT POWER SUPPLY FAILD ;3 CHAN (PER.
W	SU2	015528	062676	PN	IM		A14		1	N		NIS POWR RANGE CHAN N42 DEVIATD BY 3% FROM OTHR CH	OUTPUT OF LEVEL & SUMMING AMPLIFR DRIF LO
W	SU2	016140	101376	SL	CM		B13		1	T		DUAL COMPARATR OF S/G "B" NARROW RANG CHAN 2;LOW L	OPEN CAPACITOR;CM WOULDN'T DENERGIZE
W	SU2	017201	020977	DT	AM		B13		1	N		"C" LOOP TCOLD CHAN T-432 FOR OVRPWR & OVR TEMP	MALFUNC.OF SPAN POTENTIOMTR IN LEVEL AMPL
W	SU2	018476	071877	RF	CM		B13		1	T		R/X COOLNT FLOW COMP. FC-2-414 FAILD TO TRIP	CAPACITOR LEAKAGE; 2 REDUNDT. SYS OPERABL
W	SU2	023016	111578	RT	SE	T	A07		1	N		"B" LOOP HOT LEG SENS ELEMENT DRIFTING LOW--CHAN 2	PACKING LEAK REDUCED RESISTANCE OF ELEMEN
W	TR1	016798	010777	SL	AM		B13		1	T		C STEAM GEN LO LEVEL BI-STABL 537C FAILD TO TRIP	OPERATIONAL AMPLIFIER ON CKT BRD FAILD
W	TR1	017759A	050477	OP	DC	P	A14		1	T		PS-6309X EXCEEDED ALLOWABLE SETPOINT LIMIT	INSTRUMENT SETPOINT DRIFT
W	TR1	017759B	050477	RP	TX	P	A14		1	T		PT-456 SETPOINT EXCEEDED ALLOWABLE LIMITS	INSTRUMENT SETPOINT DRIFT
W	TR1	017759C	050477	SL	TX	L	A14		1	T		LT-537 SETPOINT EXCEEDED ALLOWABLE LIMIT	INSTR SETPOINT DRIFT
W	TR1	017759D	050477	PL	TX	L	A14		1	T		LT-461 SETPOINT EXCEEDED ALLOWABLE LIMIT	INSTR SETPOINT DRIFT
W	TR1	018586	070877	SL	CM		A14		1	T		S/G LEVEL PROTECTN SET IV LB-537C TRIPPN LOWER LEV	FOUND TO HAVE HI RATE OF SETPOINT DRIFT
W	TR1	019113	090377	SN	PS		B13		1	N		SOURCE RANGE CHAN N-31 FAILD TO ENERGIZE AT 10-10A	REMOVED& REPLACED FUSES;OPERATED OK THEN
W	TR1	021312*	040578	SL	TX	L	A06		4	T		FOUR OF 12 SG LEVEL INST OUT OF CALIBRATION	"NORMAL" INST. DRIFT; CALIB WHEN COLD
W	TU3	015007	051976	PL	CM		A14		1	T		PRZR LEVEL COMP.LC-459A TRIPPIN AT 4.685V VS. 4.68	SETPOINT DRIFT; WILL ADJUST TO COMPENSATE
W	TU3	016886	112576	FF	PS		B13	R	1	T		STEAM FLOW COMPRTR FC-3-484 SETPOINT NONCONSERVATV	2 FILTR CAPACTRS ON PRNTD CKT.BD.IN PWR S
W	TU3	017590*	012777	NT	CM		A14		2	T		TRIP SETPTS OF OVERPWR COMPS.TC-3-432B & 432C LOW	SETPOINT DRIFT;EXACT CAUSE OF DRIFT UNKWN
W	TU3	022768	092978	FF	PS		B13	R	1	T		STEAM FLOW COMP. FC-3-484 SETPT LESS CONSERVATIVE	FAULTY REG. AMP IN PWR SUPPLY BOARD
W	TU4	014878	013076	DT	IM		B13		1	T		CHAN 2 DELTA-T TRIP SETPT 1 DEG HIGHR THAN ALLOWD	2 FILTR CAP. FAILD IN SIGNL SUM.TM-4-422F

ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	ZI1	014221	020976	DT	AM		B13		1	T	DELTA T TRIP 1TC-422 C/D COMPARATOR INOPERABLE	OPERTNL AMPS A2 & A3 DEFECTIVE
W	ZI1	014285*	022176	PN	ZZ		A03	L	4	T	RESCALED PWR RANGE DET.1N41,42,43 & 44 HOWEVE DID	NOT RESCALE DELTA I SUMMATORS--NONCONSERV
W	ZI1	014268	030576	FF	TX	F	B08		1	T	S.GEN. 1C FEED FLOW XMTR 1FT-520 FAILD HI	LOOSE LINKAGE BETWEEN FORCE BALANC & DISC
W	ZI1	015189	061876	NT	IM		B13		1	T	SUMMATOR 1TM-411C OVERPWR & DELTA T PROT. RAMBLING	FAILD CAPACITOR C8
W	ZI1	016481	111776	DT	IM		B13		1	N	DELTA T DEVIATION ALARM LOOP D SOUNDED	DEFECTIVE LEAD/LAG MODULE 1TM431J
W	ZI1	016984	120176	RF	PS		B13		1	T	COMPARATOR 1FC-416 FOR RX COOLNT FLOW OUT OF TOLRN	BAD CAPACITOR IN POWER SUPPLY FOR COPPRTR
W	ZI1	017405	022677	SF	TX	F	B13	R	1	N	1D STEAM GEN FLOW INDICATION LOW -REDUND CHAN AVAL	DEFECTIVE COIL ASMBLY IN FLOW XMTR
W	ZI1	017406	030377	DT	IM		B13		1	N	DELTA T IND ERRATIC DROPPD FROM 100 TO 80% LOOP D	GROUNDED SUMMATOR, DEFECTIVE INTEGRTC CKT
W	ZI1	018057	031977	SF	TX	F	B13	R	1	N	FLOW IND 1FI-533 ON S/G 1D CHAN II LOW READING	FAILD COIL ASMBLY ON XMTR
W	ZI1	018374	041677	SF	TX	F	B13	R	1	N	LOOP D STEAM FLOW INICATR READING 0 LBS/HR	LOSS OF FLUID IN DP XMTR; REPLACD XMTR
W	ZI1	022112	041977	SF	TX	F	B13	R	1	N	1FT-533 STEAM FLOW XMTR SPIKING LOW	LOSS OF XMTR FLUID FILL; REPLACED XMTR
W	ZI1	017858	051277	SF	TX	F	B13	R	1	N	1FT-533 STEAM FLOW XMTR FAILD TO ZERO ; REPLACED	APPARENTLY DUE TO INTERMITTNT CONNECTION
W	ZI1	018375	070877	SF	TX	F	A14		1	T	XMTR 1FT-510 OUT OF TOLERNCE FOR LOOP A	ZERO SHIFT OF THE XMTR
W	ZI1	018529	071977	RP	IM		B13		1	T	ONE OF PRESSZR PRESS CHANLS READING HIGH	BAD LEAD/LAG MODULE; 2 FAILD CAPACITORS
W	ZI1	018530	072977	SF	TX	F	A11	B	1	N	LOOP 1D STEAM FLOW IND. FAILD LOW	DP LINES PLUGGD WITH SEDIMNT; WATR HAMMER
W	ZI1	018535	080677	PL	TX	L	A14	R	1	T	PZR LEVL XMTR 1LT-461 FOUND LOW;RESULT NONCONSERV.	ZERO SHIFT OF THE XMTR
W	ZI1	019521	102077	PL	TX	L	A14	R	1	T	1LT-461 PZR LEVEL XMTR FOUND LOW RESULT;NONCONSERV	DRIFT OF BARTON MODEL 386
W	ZI1	019520*	102177	SL	TX	L	A14	R	3	T	1LT-537,538 & 539 SG LEVL XMTRS HI (NONCONSERVATV)	ZERO SHIFT TO ALL 3 XMTRS
W	ZI1	019516	102877	RF	TX	F	A14	R	1	T	RX COOLNT FLOW XMTR 1FT-425 HIGH (NONCONSERVATIVE)	ZERO SHIFT OF XMTR
W	ZI1	019514	103177	RF	TX	F	A14	R	1	T	RX COOLNT FLOW XMTR 1FT-444 HIGH (NONCONSERVATIV)	ZERO SHIFT OF XMTR
W	ZI1	019777*	103177	RF	TX	F	A14	R	2	T	RC FLOW XMTRS 1FT-435 & 434 HIGH (NONCONSERVATIVE)	DRIFT OF XMTRS BY 4.5% & 3.7% RESPECTVLY
W	ZI1	020002	120877	PL	TX	L	A14	R	1	N	PZR LEVL XMTR 1LT-459 OUT OF TOL LOW (NONCONSERVT)	ZERO SHIFT; PREVIOUS LERS
W	ZI1	020001	120977	SF	TX	F	A14	R	1	T	STEAM FLOW IND 1FI-513 S/G LOOP A LOW (NONCONSERV)	ZERO SHIFT; TRENDING INSTRUMNT DRIFTS
W	ZI1	020196	122377	SL	TX	L	A14	R	1	N	1A S/G LEVL IND. 1LI518 HI (NONCONSERV) (1LT518)	ZERO SHIFT; PRESENTLY TRENDING DRIFTS
W	ZI1	020349	011678	SF	TX	F	A14	R	1	N	STEAM FLOW CHANL 1F523 BEGAN IND LOWR THAN OTHER	ZERO SHIFT OF FISCHER-PORTER XMTR

ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	ZI1	020257*	012478	SF	TX	F	A14		2	T		STEAM FLOW XMTRS 1FT-532 & 533 LOW (NONCONSERV)	DRIFT OF XMTRS; RECALIBRATED
W	ZI1	020589	012778	RF	RE		B12		1	T		RX PROT. A RELAY 1FC426-XA FOR LOOP C FLOW TRAIN A	FOUND HUNGUP--BINDING PLUNGER PIN ON RLAY
W	ZI1	021449	050978	FF	IM		A14		1	T		FEED FLOW CHANL 1F-511 SQ.RT.EXTRACTR HI (NONCONS)	DRIFT OF CLOCK PULSE FOR SQUARE ROOT EXT.
W	ZI1	021967A	071778	SL	TX	L	B13		1	N		SG 1D LEVL CHNL 538 TRIPPD DUE TO HI INDICATD LEVL	FAILD TRANSMITTER
W	ZI1	021967B	071778	SL	TX	L	A11	S	1	N		CHNL 537 SG LEVL IND HIGHER THAN CHNL 539	PACKING LEAK FROM ROOT VALVE OF XMTR
W	ZI1	022221	080278	SL	TX	L	A14		1	N		SG LEVL CHNL 538 HIGHR THAN CHNLS 537&539 (NONCSV)	DRIFTED OUT OF TOLERANCE; REPLACD W/SPARE
W	ZI1	022512	082278	RF	TX	F	B13		1	T		XMTR 1FT-446 FAILD HI (NONCONSERVTV) FOR LO RC FLW	FAILD OSCILATR IN XMTR
W	ZI1	023441	092578	DT	IM		A14		1	T		FUNCTION GENERATOR 1NM-4418 OUTPUT OUT OF TOL LOW	SETPTS NONCONSERVTVE; INSTRUMNT DRIFT
W	ZI1	022898	102078	FF	TX	F	A14		1	T		FEED FLOW XMTR 1LT-5[illegible]1 OUTPUT RESULT IN NONCONSER	XMTR DRIFT CAUSED CHANNL TO BE OUT OF TOL
W	ZI1	022899	102078	SL	TX	L	A14		1	T		SG 1B LEVL CHNL 1L-548 DRIFTD HI (NONCONSERV SETPT	XMTR DRIFTD OUT OF TOLERANCE
W	ZI1	022900	102078	SL	TX	L	B11		1	T		SG 1D LEVL CHNL 1L-538 NONCONSERVTV SETPOINT	INSTRU LINE TO XMTR BLOCKD
W	ZI1	022902	102178	RF	CM		A14		1	T		RC FLOW CHANL 1F-414 LOOP A TRIP SETPOINT DRIF LOW	SETPOINT DRIFT; 2OTHER LOOP CHANLS OPERBL
W	ZI1	023126	112578	SF	TX	F	A14		1	T		1FT-523 READIN LT. OTHR FLOW CHANLS ON "C" S/G	FS DRIFT IS NONCONSERV; XMTR OUT OF TOLER
W	ZI2	013943	010676	SL	TX	L	A11		1	N		S/G LEVEL INDICATOR 2LI-538 FOUND READING HIGH	INSTRUMENT ROOT VALVE DEVELOPED A LEAK
W	ZI2	014190	012376	SL	TX	L	A14		1	T		2LT-528 2C S/G LEVL XMTR OUT OF TOL(NONCONSERVTVE)	SCALE SHIFT IN XMTR; RECALIBRATED
W	ZI2	014943	052576	SL	TX	L	B13		1	N		LEVL XMTR 2LT-539 FOUND OUT OF TOL FOLLWNG RX TRIP	REPLACED XMTR WITH SPARE
W	ZI2	015190	070576	SL	TX	L	B08		1	N		S/G LEVL XMTR 2LT-547 FAILD HI	STICKY INTERNAL COMPONENT PARTS
W	ZI2	015282	072976	SL	TX	L	A14	R	1	N		S/G B LEVL XMTR 2LT-549 OUT OF TOL HIGH (NONCONSR)	ZERO SHIFT UNDER INVESTIGATION
W	ZI2	015366	080276	SF	TX	F	A14	R	1	M		STEAMFLOW XMTR 2FT-543 FOR B S/G FOUND LOW	ZERO SHIFT; PLAN MODIFICATIONS BY SUPPLIR
W	ZI2	015370	080276	FF	TX	F	A14	R	1	N		FEED FLOW XMTR 2FT-521 FOR S/G C HIGH	ZERO SHIFT; PLANS TO MODIFY ARE BEING MDE
W	ZI2	015371	080276	SF	TX	F	A14	R	1	N		STEAMFLOW XMTR 2FT-523 FOR S/G C FOUND TO BE LOW	ZERO SHIFT;PLANS TO MODIFY
W	ZI2	015841	082176	PL	TX	L	A11		1	T		PZR LEVL CHNL 2LT-461 READING HIGHER THAN OTHER CH	UPPER ROOT VALVE LEAKING THRU BODY TC BNT
W	ZI2	016049	091076	FF	AM		B13		1	N		LOOP B COMPARTR 2FC-541B & 2FC-541A FOUND HIGH	BAD OPERATIONAL AMPLIFIER A-1 ; REPLACED
W	ZI2	016050	091476	RP	CM		B13		1	N		COMPARTR 2PC-456A PZR HIGH RX TRIP FOUND HIGH	COMPRTR WAS REPLACED WITH SPARE
W	ZI2	016491	112476	FF	IM		B13	R	1	N		LOOP D S/G FLOW IND FAILD TO ZERO THEN NORML 6TIME	BAD MULTIPLIER/DIVIDER MODULE

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ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
W	ZI2	016698	120376	FF	IM		B13			1	N		LOOP D S/G STEAMFLOW IND LOW ; SQUARE ROOT EXTRACT	BAD CAPACITORS C11 & C12 IN SQ.RT.FM-533B
W	ZI2	016969	012277	PL	TX	L	A14			1	T		PZR LEVL XMTR 2LT-461 FOUND LOW BY 7%	DRIFTD OUT OF TOLERANCE
W	ZI2	017250	020377	FF	IM		A14			1	T		SQUARE ROOT EXTRACTR LOOP B STEAM FLOW FOUND HIGH	DRIFT OF LOW END SETTING OF SQ.RT.EXTRCTR
W	ZI2	017249	020777	FF	IM		A14			1	T		SQ.ROOT EXTRACTR FOR LOOP D STEAM FLOW FOUND HIGH	DRIFT OF LOW END SETTING 2FM-530B
W	ZI2	018054	041177	RP	AM		B13			1	T		COMPARATR 2PC-456A WOULD NOT TRIP; PUT IN TRIP MOD	BAD OPERATIONL AMPLIFIER A-3
W	ZI2	022222	090177	SL	TX	L	A14			1	T		S/G LEVL CHNL 2L-527 FOUND READING HIGH (NONCONSR)	XMTR DRIFT; RECALIBRATED
W	ZI2	019522	102077	FF	TX	F	A14			1	N		FEED FLOW INDICATR 2FI-540 NONCONSERVTIVE	DRIFT OF XMTR ; RECALIBRATED
W	ZI2	019779	111777	SN	SE	N	B13			1	N		SOURCE RANGE DETECTR 2N-32 AUTO ENERGIZED ; FAILD	CHECKD CHNL ELECTRICALY; REPLACED DETECTR
W	ZI2	019998	120677	SL	TX	L	A08			1	N		2B S/G LEVL IND. 2LT-547 READING HI (NONCONSERVTV)	STICKING INTERNAL PARTS
W	ZI2	020392	122377	RF	RE		B12			1	T		2FC416-XB LOOP A RC FLOW TRIP LOGIC TRAIN B HUNGUP	BINDING PLUNGER PIN AGAINST RELAY HOUSING
W	ZI2	020350	012178	FF	AM		B13			1	N		FW FLOW IND 2FI-510A DRIFTD HI (NONCONSERV)	FAILD OSCILLATOR AMPLIFIER IN XMTR
W	ZI2	020564	020178	FF	IM		B13	R		1	N		UNIT 2 D S/G STM.FLOW LOOP 532 OUT OF TOL(NONCONS)	MALFUNCT SQUARE ROOT EXTRACTOR
W	ZI2	023499	022078	PL	CM		B13			1	T		PZR LEVL CHANL 2L-460 OUT OF TOL HI AND LO ENDS	REVERSD DIODE CAUSN IMPRPR VOLT REGULATIN
W	ZI2	020976	030978	RF	TX	F	A14			1	T		XMTR 2FT-445 HIGH; NONCONSERV FOR RC FLOW RX TRIP	ZERO SHIFTED; RECALIBRATED
W	ZI2	021344	042578	PL	TX	L	A14			1	N		PZR LEVL CHANL 2L-459 OUT OF TOL HIGH NONCONSERVTV	RANGE SHIFT OF XMTR
W	ZI2	021708	060978	PL	TX	L	A14	R		1	T		PZR LEVL CHANL 459 FOUND LO-NONCONSERV FOR HI TRIP	ZERO SHIFT ,READJUSTED
W	ZI2	021796	062578	SL	TX	L	B00	R		1	N		S/G LEVEL IND 2LI547 FAILD HI-NONCONSERV DIRECTION	CHECKD ROOT VALVS FO STEAM LEAKS-NONE
W	ZI2	022802	091578	PN	PS		B13			1	N		PWR RANGE CHANL N42 READING LOW;NONCONSERV TRIP	BAD 25 VOLT PWR SUPPLY
W	ZI2	022801	091978	SL	TX	L	B00	R		1	N		2L-547 FAILD HI;NONCONSERV FOR SF/FW MISMATCH	REPLACED XMTR --NO CAUSE FOUND YET
W	ZI2	022800	092578	PL	CM		A00	R		1	N		PZR LEVL 2LT-459 LOW;NONCONSERV FOR HI LEVL TRIP	NO CAUSE COULD BE FOUND
W	ZI2	022798	100878	SL	TX	L	A11			1	N		S/G LEVL CHNL 2 LI-538 HI;NONCONSERV FOR LOLO S/G	DIRT IN SENSIN LINES. TUNED OSCILATOR
G	BF1	017077*	012677	VP	DC	P	A14			3	T		PS-2-1A,1B,8A WERE FOUND OPERATING BELOW TECH SPEC	SETPOINT DRIFT
G	BF1	021560*	053078	FP	DC	P	A14			3	T		PS-1-81A,81E,91B(TURBINE PRES PERMISSIVE) DRIFTED	SET POINT DRIFT
G	BF1	022082	072078	RL	DC	L	A14			1	T		REACTOR WATER LEVEL SWITCH EXCEEDED TS LIMIT	SETPOINT DRIFTED BELOW SPEC. (LIS-3-203B)
G	BF2	016395	111576	OP	DC	P	B02	C		1	T		EHC LOF PRESS. SWITCH (PS-47-142) FAILED	SWITCH PLUGGED WITH TEFLON TAPE

ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

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VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	BF2	018632*	081477	RL	DC	L	A01	C	2	T		TWO RX WATER LOW LEVEL SCRAM SWITCHES WERE +20 IN.	REFERENCE LEVEL COLUMN B WAS NOT FULL
G	BF2	019395	101977	CP	DC	P	A14		1	T		DRYWELL PRESSURE SWITCH DRIFTED BEYOND SET POINT	SETPOINT DRIFT OF PS-64-56C
G	BF2	022854*	111478	SR	MO	R	A06	L	4	T		M/S LINE RAD MON RM-90-135,136,137,138 SETPOINT HI	INSTRUCTION DEFICIENT IN REQUIREMENTS
G	BF2	023292*	121178	RP	DC	P	A14		2	T		RX HIGH PRESS SWITCHS PS-3204A,B EXCEEDED TS LIMIT	SETPOINT DRIFT
G	BF3	017160	020877	RL	DC	L	B13		1	T		RX LOW WATER LEVEL SWITCH LIS-3-203D FAILED TO OP.	ERRATIC MICRO SWITCH WAS REPLACED
G	BF3	017529	031477	CP	DC	P	A14		1	T		DRYWELL HIGH PRESS SWITCH PS-64-56A EXCEED TS LIM.	SETPOINT DRIFT
G	BF3	022824A	102978	IN	CA		B02	C	1	N		IRM F CHANNEL DECLARED INOPERABLE	SIGNAL CABLE SHEARED
G	BF3	022824B	102978	IN	CA		B02	C	1	N		IRM H CHANNEL DECLARED INOPERABLE	SIGNAL CABLE DISCONN
G	BF3	023032*	112878	PN	CA		B06	L	6	T		ALL LRPM'S OF 43 STRINGS FOUND REVERSE CONNECTED	LACK OF EXPLANATION OF PROPER LPRM CONNEC
G	BP1	015443	081376	PN	CA		B02	C	1	N		PR NEUTRON MONITOR DID NOT RESPOND PROPERLY (#2)	POLARIZING VOLT. ON COMP ION CHAM SWAPPED
G	BP1	020937	040778	VP	DC	P	A14		1	T		VACUUM SWITCH SETPOINT FOUND TO BE OUT OF T/S TOL.	SETPOINT DRIFT (MINOR)
G	BR1	016851	121576	SR	MO	R	B13		1	T		MAIN STEAM LINE D RAD MON. DISCOVERED OUT OF CAL.	COMPONENT FAILURE,MONITOR RECALIBRATED
G	BR1	016855*	010577	PN	CM		A06	L	6	T		HIGH FLUX TRIP FOR APRM'S FOUND TO BE TOO HIGH	DEFECTIVE PROCEDURE
G	BR1	017082	012677	CP	DC	P	A05		1	T		HIGH DRYWELL PS C71-PS-N002C FOUND TO HAVE FOR.SUB	FOREIGN SUBSTANCE BEEN THERE SINCE INSTAL
G	BR1	018544	071377	SR	MO	R	A14		1	T		MS LINE HIGH RADIATION INST. FOUND OUT OF CAL.	SETPOINT DRIFT,D12-RM-K603C
G	BR1	018685	072977	RL	DC	L	A14		1	T		RX LOW WATER LEVEL INST. FOUND OUT OF CALIBRATION	SETPOINT DRIFT,INST.# B21-LIS-N017B
G	BR1	018889	081577	SR	MO	R	A00		1	T		HIGH STEAMLINE RAD MONITOR SETPOINT FOUND TO BE HI	UNKNOWN CAUSE,INST. ID D12-RM-K603A
G	BR1	019185	092677	PN	CM		A06		1	T		APRM CHANNEL F UPSCALE THERMAL TRIPS BEYOND T/S	RECAL. DONE WITH INADEQUATE PROCEDURE
G	BR1	020679	012878	PN	CM		A14		1	T		APRM CHANNEL E TRIPED AT >120 PERCENT (122 PER)	SETPOINT DRIFT
G	BR1	020680	021478	PN	CM		A14		1	T		APRM CHANNEL C SETPOINT FOUND ABOVE TS LIMIT	SETPOINT DRIFT
G	BR1	020770	030178	SR	MO	R	B02	C	1	M		MAIN STEAM LINE RAD MONITOR "D" PS FAILED	IRM CABLES DAMAGED D12-RM-K603D PS
G	BR1	020835*	031578	IN	SE	N	B00		2	N		IRM "A" FAILED WHILE "E" & "H" INOPERABLE	IRM "E" AND "A" FAILED, COMPONENT FAILURE
G	BR1	021187	041478	SP	MO	R	A00		1	T		MAIN STEAM LINE RAD MON D12-RM-N603C OUT OF SPECS	INST RECALIBRATED,RETURNED TO SERVICE
G	BR2	014138*	011076	CP	DC	P	A14		4	T		RPS HIGH DRYWELL PRESSURE SWITCHES FOUND OUT OF CA	SETPOINT DRIFT,OF C72-N002A,B,C AND C
G	BR2	014547	012476	CP	DC	P	A14		1	T		HIGH DRYWELL PRESSURE SWITCH FOUND HIGH OOC	SETPOINT DRIFT OF C72-N002A

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VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	BR2	014392*	013176	CP	DC	P	A14		2	T		RPS HIGH DRYWELL PRESSURE SWITCHES FOUND OOC HIGH	SETPOINT DRIFT OF C72-N002C AND D
G	BR2	014391*	020776	RL	DC	L	A14		4	T		SCRAM SWITCHES B21-LTS-N017A,B,C AND D FOUND OOC	SETPOINT DRIFT
G	BR2	015398*	060876	CP	DC	P	A14		2	T		HIGH DRYWELL PRESS SWITCHES FOUND OUT OF CAL	SETPOINT DRIFT OF 2-C72-PS-N002C AND D
G	BR2	014944*	061276	RL	DC	L	A04	C	3	T		RX LOW WATER LEVEL SW 2-B21-LIS-N024 A,B,25B ACT L	CIRCUIT DESIGN USED HIGH LEVEL SWITCHES
G	BR2	015397*	061976	RP	DC	P	A14		4	T		HP SCRAM PRESS SWITCHES FOUND OUT OF CAL HIGH	SETPOINT DRIFT OF 2-B21-PS-N023A,B,C & D
G	BR2	017588	031377	RP	DC	P	A14		1	T		RX HIGH PRESSURE TRIP,PRESS SW FOUND OOC HIGH	SETPOINT DRIFT OF B21-PS-N023B
G	BR2	018179	061277	RP	DC	P	A14		1	T		RX HIGH PRESS TRIP PRESS SWITCH FOUND OUT OF CAL.	SETPOINT DRIFT OF B21-PS-N023D
G	BR2	019018	090277	RL	DC	L	A14		1	T		RX LOW WATER LEVEL INST FOUND OUT OF CALIBRATION	INTRUMENT DRIFT OF B21-LIS-N017B
G	BR2	020168	010278	SR	MO	R	A02	C	1	T		MAIN STEAM LINE RAD MON D12-RK-K603 READ DOWNSCALE	PREVIOUS CALIBRATION PERFORM WRONG
G	BR2	020725	030478	RL	DC	L	A08		1	T		RX LOW WATER LEVEL #1 INST FOUND OUT OF CAL LOW	DRIVE ARM LINKAGE SLIPED ON B21-LIS-N017D
G	BR2	020968A	032478	SR	MO	R	B13	R	1	N		MAIN STEAM RAD MON,CHANNEL C, BECAME ERRATIC	PROBABLE CAUSE,TWO BAD TRANSISTORS
G	BR2	020968B	032978	SR	MO	R	B13	R	1	N		MAIN STEAM RAD MON,CHANNEL C, BECAME ERRATIC	PROBABLE CAUSE,TWO BAD TRANSISTORS
G	BR2	020917	040378	IN	CA		B12		1	T		IRM E HAD NO RESPONSE TO CHANGING FLUX	DIRTY AND WET DETECTOR CABLE CONNECTIONS
G	C01	014839	050776	IN	SE	N	A14		1	N		WHILE SHUTTING DOWN IRMS COULD NOT BE SET AS REQ'D	SENSITIVITY DECREASE WITH EXPOSURE
G	C01	016713	111676	OP	DC	P	B02	U	1	N		DURING STARTUP PRESSURE SWITCH TRIP CAUSED RPS TRI	PRESSURE SWITCH LEFT ISOLATED AFTER SURVE
G	C01	017299	012877	PN	SE	N	B13		1	N		APRM B BYPASSED AND DECLARED INOPERATIONAL	LPRM SEAL FAILED, LPRM DRIFTED; RECALIB
G	C01	018897	041677	IN	ZZ		A14		1	T		IRM "H" FOUND TO READ 80 AS OPPOSED TO 125-TEST	INSTRUMENT DRIFT IN TWO MODULES
G	C01	018441*	060877	OP	DC	P	A14		4	T		TGF PRESSURE SWITCHES FAILED TO OPERATE WITHIN LIM	SWITCHES HAVE EXCESSIVE SETPOINT DRIFT
G	C01	018899	081077	PN	AM		B13		1	N		APRM FLOW INDICATION DECREASED-CAUSED UPSCALE ALAR	BAD ISOLATION AMP IN SUMMER UNIT-REPLACED
G	C01	019286	092377	SN	CA		B02	B	1	M		SRM WAS READING HIGH AND ERRATIC DURING REFUELING	BREAK IN OUTER SHIELD OF TRIAXIAL CABLE
G	C01	020799	012978	PN	PS		B13		1	N		APRM +20V POWER SUPPLY FLUCTUATED-CAUSED HALF SCRA	ZENER DIODE FAILED IN POWER SUPPLY
G	C01	021197	040878	SN	CA		B02	B	1	M		SRM WOULD NOT RESPOND PROPERLY DURING REFUELING	BREAK IN SHIELD OF TRIAXIAL CABLE
G	C01	021747	052778	SR	MO	R	A06	C	1	N		MAIN STEAM LINE RAD MONITOR TRIP POINT NOT ADJUSTE	PROCEEDURAL DEFICIENCY FOR SOURCE CALIBRA
G	DA1	014378	031476	SN	PS		B13		1	T		SRM A(4573A) FOUND READING APPROX 50% LOW	FAULTY DIODE IN VOLTAGE PREREGULATOR
G	DA1	014514	041776	FU	CM		B13		1	T		APRM/RBM FLOW UNIT D COMPARATOR EXCEEDED LIMIT	DEFECTIVE FLOW UNIT SUMMER CIRCUIT

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ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	DA1	014732	051276	PN	CM		A14		1	T		APRM CH A UPSCALE TRIP EXCEEDED LIMIT	INSTRUMENT DRIFT
G	DA1	015322	081276	SN	CM		A14		1	T		SRM D UPSCALE RB TRIP EXCEEDED LIMIT	INSTRUMENT DRIFT
G	DA1	016266	101976	PN	SE	N	B13		1	T		LPRM CALIB CALC INDICATE CPRRAT ABOVE SPEC	LPRM DRIFT DUE TO LEAKING SEALS
G	DA1	016205	102476	IN	SE	N	A00		1	T		DURING STARTUP IRM F DID NOT DEMONSTRATE OVERLAP	UNKNOWN
G	DA1	017758	041877	SR	MO	R	B13		1	T		MSL RAD MONITOR RC 4448D DID NOT RESPOND PROPERLY	TWO VACUUM TUBES & ONE DIODE WERE DEFECTI
G	DA1	019128	090277	IN	PS		B13		1	T		IRM CH A DOWNSCALE TRIP FOUND INOPERABLE	VOLT REG AND PRE-REG WERE DEFECTIVE
G	DA1	019208	091577	IN	PS		B13		1	T		IRM CH B DOWNSCALE TRIP FOUND INOPERABLE	LOOSE CONN ON PWR SUPPLY CAUSED FUSE TO B
G	DA1	019965*	112877	PN	CA		A01	C	4	T		NONCONSERV ERRORS INDUCED IN APRM CH A,B,C & D	PERSONNEL-REVERSED INPUT/OUTPUT OF LPRM
G	DR1	015078	061176	PN	CM		A14		1	T		POWER RANGE CH 3 ACTUATES ABOVE LIMITS	INSTRUMENT SETPOINT DRIFT
G	DR1	016591	112676	PN	AM		A14		1	T		IN CORE NEUTRON FLUX AMPLIFIER 103C TRIPPED HIGH	INSTRUMENT SETPOINT DRIFT
G	DR1	017294	022377	PN	AM		A14		1	T		IN CORE NEUTRON FLUX AMPLIFIER 109A TRIPPED HIGH	INSTRUMENT SETPOINT DRIFT
G	DR1	017733*	042377	PN	CM		A14		2	T		POWER RANGE CH 1 & 2 ACTUATED ABOVE SPEC	INSTRUMENT SETPOINT DRIFT
G	DR1	017797*	042877	PN	AM		A14	C	5	T		IN-CORE FLUX AMPS 104B 110D 112D 113A 113C 114D HI	INSTRUMENT SETPOINT DRIFT DUE TO HIGH TEM
G	DR1	019015	090477	PN	AM		A14		1	T		CH 3 HIGH NEUTRON MONITOR FAILED TO TRIP DURING TE	INSTRUMENT SETPOINT DRIFT
G	DR1	019199	093077	PN	AM		B13		1	N		CH 2 OUT OF CORE NEUTRON MONITOR FAILED DOWN SCALE	TUBE FAILURE IN AMPLIFIER CIRCUIT
G	DR1	019320	101777	PN	CM		A14		1	T		CH 1 RIC-281 TRIP EXCEEDED LIMITS WHEN TESTED	SETPOINT DRIFT
G	DR1	021016	031878	PN	AM		A14		1	T		INCORE MONITOR AMP 104B EXCEEDED TRIP LIMIT	INSTRUMENT DRIFT
G	DR1	021515	052578	PN	AM		A14		1	T		INCORE MONITOR AMP 109A EXCEEDED TRIP LIMIT	TRIP ADJ BIAS VOLTAGE 25KOHM RESIS DRIFTE
G	DR1	021514	060278	PN	AM		A14		1	T		INCORE MONITOR AMP 113C EXCEEDED TRIP LIMIT	TRIP ADJ BIAS VOLTAGE 25KOHM RESIS DRIFTE
G	DR2	014189	020776	CP	DC	P	A14		1	T		DRYWELL HIGH PRESS SCRAM SENSOR PS21621B SETTING H	SETPOINT DRIFT
G	DR2	015023	061676	RP	DC	P	A14		1	T		REACTOR HIGH PRESS SCRAM SWITCH PS226355C ABOVE LI	INSTRUMENT SETPOINT DRIFT
G	DR2	015024	061676	RP	DC	P	A14		1	T		REACTOR HIGH PRESS SCRAM SW PS226355A ABOVE LIMITS	INSTRUMENT SETPOINT DRIFT
G	DR2	015160A	063076	PN	AM		B05		1	N		APRM CH5 INDICATION DROPPED FROM 54 TO 31 PERCENT	BROKEN LEAD ON DC AMPLIFIER
G	DR2	015160B	063076	PN	ZZ		A14		1	N		APRM CH5 AGAF HIGH VALUE	INSTRUMENT DRIFT
G	DR2	015747	082176	RL	DC	L	A14		1	T		REACTOR WATER LEVEL INST 226357B ACTUATED ABOVE LI	INSTRUMENT SETPOINT DRIFT

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ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	DR2	017184*	012877	FU	CN		A06	M	2	T		APRM FLOW-BIAS FLOW INDICATION EXCEEDED 100% (A&B)	PROCEDURE FOR TOTAL CORE FLOW IND REVISED
G	DR2	017221	021477	PN	RE		B13		1	T		REED RELAY CONTACTS ON RELAY K6 WERE SEPARATED	CONTACTS REPLACED,APRM AVE CARD RELAY
G	DR2	017293	022377	IN	CM		A14		1	T		IRM#16 TRIPPED ABOVE SETPOINT DURING TEST	INSTRUMENT SETPOINT DRIFT
G	DR2	017651*	042577	FU	CN		A06	M	2	T		APRM/RBM FLOW BIAS EXCEEDED 100% AT 100% CORE FLOW	APRM/RBM CONVERTERS CALIB TO ORIG SPECS
G	DR2	019190	092077	IN	IM		A14		1	T		APRM 5 WAS FOUND TO INOP ON 12 INSTEAD OF 11 LPRMS	ELECTRONIC DRIFT OR DIRTY CONTACTS ON CAR
G	DR2	019657	111177	RL	DC	L	A14		1	T		REACTOR WATER LEVEL SWITCH LIS226357A ABOVE SPEC	INSTRUMENT SETPOINT DRIFT
G	DR2	019903	112977	FP	DC	P	A14		1	T		TURBINE FIRST STAGE PS-504C TRIPPED ABOVE SPEC	INSTRUMENT DRIFT
G	DR2	019904	113077	IN	CM		B13		1	T		IRM#13 DID NOT TRIP AS REQ'D BY SURVEILLANCE PROCE	DEFECTIVE DUAL TRIP MODULE
G	DR2	019989	120877	IN	CM		A14		1	T		IRM#13 TRIPPED ABOVE LIMITS	INSTRUMENT DRIFT
G	DR2	019910*	122277	FU	CN		A06	M	2	N		APRM FLOW BIAS SCRAM & ROD BLOCK SETPOINTS NON-CON	DEFICIENT PROCEDURE
G	DR2	020600	021678	RL	DC	L	A14		1	T		REACTOR LEVEL SWITCH LIS2-263-57B ABOVE LIMITS	INSTRUMENT DRIFT
G	DR2	020869*	032778	SR	MO	R	A06	L	4	T		MSL HIGH RAD ISOLATION SETPOINT SET HIGH	TYPOGRAPHICAL ERROR IN PROCEDURE
G	DR2	021159	042478	FP	DC	P	A14		1	T		TURBINE FIRST STAGE PS504D TRIPPED ABOVE SPEC	INSTRUMENT SETPOINT DRIFT
G	DR2	021881	062678	PN	CM		A14		1	T		APRM CH 4 ROD BLOCK TRIP HIGH	SETPOINT DRIFT
G	DR2	022071	080178	PN	ZZ		B13		1	T		APRM CH#3 SCRAM SETPOINT FOUND ABOVE SPEC	BROKEN WIRE AND TRANSISTOR FAILURE
G	DR3	017212	020877	PN	RE		B13		1	N		APRM #6 FOUND FLUCTUATING	FAILED REED RELAY CONTACTS
G	DR3	017325A	022077	PN	CM		A14		1	T		APRM 3 ROD BLOCK TRIP EXCEEDED LIMITS	ELECTRONIC DRIFT
G	DR3	017325B	022077	PN	CM		A14		1	T		APRM 6 ROD BLOCK TRIP EXCEEDED LIMITS	ELECTRONIC DRIFT
G	DR3	017511	040477	PN	SE	N	B13		1	N		OUTPUT OF LPRM 16-33-D SHIFTED UPSCALE	CERAMIC SEAL FAILED
G	DR3	017974	052677	FU	AM		B13		1	N		CH A & CH B FLOW EXCEEDED MISMATCH	FAULTY PROPORTIONAL AMPLIFIER
G	DR3	017975	052677	PN	IM		A14		1	T		APRM 4 INOPERABLE	ELECTRONIC DRIFT
G	DR3	018550	072577	PN	PS		A12		1	T		APRM 4 WOULD NOT GENERATE AN INOP UNTIL 13 LPRM'S	VOLTAGE SHIFT-DIRTY POWER SUPPLY(PIN-16)
G	DR3	018935	080677	RP	DC	P	B08		1	T		HIGH PRESS SCRAM SWITCH FAILED TO TRIP AS REQUIRED	ADJUSTED MECHANICAL STOP OF BOURDON TUBE
G	DR3	018937*	082777	PN	IM		A14		2	T		APRM 1 & 2 WOULD NOT GENERATE INOP UNTIL 12 LPRM'S	ELECTRONIC DRIFT
G	DR3	019188	092877	SR	MO	R	B13		1	N		MSL RAD MONITOR B INDICATION DOUBLED	DETECTOR MALFUNCTIONED

ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	DR3	019176*	092977	PN	ZZ		A14	C	2	T		APRM'S 4 & 6 GENERATED INOP WITH 12 LPRM'S BYPASSE	ABNORMAL ELECTRONIC DRIFT
G	DR3	020603*	020278	IN	CM		A14		2	T		IRM 15 & 16 EXCEEDED TRIP SETPOINT	INSTRUMENT DRIFT
G	DR3	020871	032778	SR	MO	R	A03	C	1	T		MSL HIGH RAD SCRAM ISOL MONITOR SETPOINT HIGH	PERSONNEL ERROR-SETPOINT ADJUSTED HIGH
G	DR3	021155*	042478	FP	DC	P	A14		2	T		PS 504C & D 1ST STG TURB PRESS EXCEEDED LIMITS	INSTRUMENT SETPOINT DRIFT
G	DR3	021509A	052078	SN	SE	N	B13	S	1	T		SRM 24 FAILED TO INSERT TO STARTUP POSITION	FAULTY DRIVE CABLE
G	DR3	021509B	052078	SN	CA		B13		1	T		SRM 21 DECLARED INOPERABLE	BAD SIGNAL CABLE
G	EN1	017593	022477	RL	DC	L	A14		1	T		RX WATER LEVEL SW B21-N017B EXCEEDED LIMIT	SETPOINT DRIFT
G	EN1	020020	100477	PN	CM		A14		1	T		APRM CH A FOUND OUT OF TOLERANCE	SETPOINT DRIFT
G	EN[illegible]	022745	110178	SR	MO	R	B13		1	T		MSL RAD MON D11-K603D DID NOT INITIATE HALF SCRAM	LOOSE WIRE AND DAMAGED COMPONENTS
G	EN2	022676*	101178	PN	CM		A06	L	6	T		HIGH FLUX SCRAM SETPOINTS SET VERY HIGH	PROCEDURE DID NOT LIST STARTUP SETTING
G	EN2	022704	101678	PN	IM		A14		2	N		RPS CHANS A&E INOPERATIVE	APRM E DRIFTED HIGH, APRM A COUNT CKT DRI
G	EN2	023634	111278	RL	DC	L	B13		1	N		LEVEL OUT OUT OF SPEC AND COULD NOT BE CALIBRATED	SENSOR FAILED AND WAS REPLACED
G	EN7	023036	111578	RL	DC	L	B13		1	N		INST 2B21-N017C COULD NOT BE CALIBRATED	SENSOR FAILED AND WAS REPLACED
G	EN2	023068	121078	RL	DC	L	A14		1	T		LEVEL SW 2B21-N017C SETPOINT DRIFT	BARTON 288A SW SETTING HAD DRIFTED
G	FP1	013959	010676	CP	DC	P	B11	R	1	N		DRYWELL PRESS SW 05-RL-16 INOPERATIVE	MOISTURE IN SENSING LINE BLOCKED SIGNAL
G	FP1	014485*	040376	CP	DC	P	A14		3	T		NINE HIGH DRYWELL SWITCHES SETPOINTS WERE HIGH	NORMAL DRIFT AND TOO CLOSE TO T S LIMITS
G	FP1	014483	040576	RP	DC	P	B02	C	1	T		REACTOR HIGH PRESS SW 2-3-55D FAILED TO ACTUATE	INCORRECT ADJUSTMENT OF MECHANICAL STOP
G	FP1	015061	061076	SR	MO	R	A00		1	N		MN STM LINE RAD MONITOR EP-17-RM-251A SPURIOUS	TESTED AND WORKED PROPERLY CAUSE UNKNOWN
G	FP1	015054	062876	PN	SE	N	A14		1	N		LPRM 44-37-C DRIFTED HIGH	NORMAL INSTRUMENT DRIFT
G	FP1	015497	080876	PN	IM		A14		1	T		APRM C WOULD NOT TRIP AT LESS THAN 11 INPUTS	RANDOM SET POINT DRIFT
G	FP1	015851	090576	PN	IM		A00		1	T		APRM INOP SIGNAL WOULD NOT FUNCTION	CAUSE NOT GIVEN
G	FP1	017328	022777	PN	CM		A14		1	T		APRM "E" DOWNSCALE TRIP SETPOINT HIGH	NORMAL DRIFT
G	FP1	018051*	062677	PN	CA		B02	L	6	M		LOSS OF 15% APRM SCRAM FUNCTION	CONTRACTOR CUT 19 OF 31 LPRM STRINGS
G	FP1	020928*	040178	PN	SE	N	B05	C	4	T		LPRM-36-45 DET A & B, LPRM-12-21 DET B & C NOT OP	DETECTOR WIRING INCORRECT
G	FP1	022031	070778	PN	IM		A14		1	N		APRM D LPRM COUNT TRIP SETPOINT HIGH	SETPOINT DRIFT, READJUSTED CIRCUITS

ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

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VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	MI1	014214	012076	SR	MO	R	A14		1	T	MAIN STEAMLINE RADIATION MONITOR 40% LOW OUTPUT	AMPLIFIER DRIFT WITHIN MONITOR
G	MI1	014229	021076	VP	DC	P	A14		1	T	CONDENSER VAC SWITCH OUT OF TOLERANCE BY 0.1 IN HG	DIT-H18SS VAC/PRESS SW INST DPIFT
G	MI1	014291	021976	OP	DC	P	A14		1	T	TURBINE CONT VALVE ACC RELAY PRESS SW EARLY TRIP	P72AA-997 PRESS SW SETPOINT DRIFT
G	MI1	015456	081376	IN	CM		A14		1	T	INTERMED RANGE MONITOR SETPOINT LESS CONSERVATIVE	SETPOINT DRIFT OF INSTRUMENT CHANNEL
G	MI1	016672*	122176	CP	DC	P	A14		2	T	2 OF 4 HIGH DRYWELL PRESS SWITCHES TRIP HIGH	SETPOINT DRIFT OF BARTON SWITCHES
G	MI1	017208	021477	CP	DC	P	A14		1	T	DRYWELL HIGH PRESS SCRAM & CONT ISOL SW TRIP HIGH	MODEL 288 0-5PSI PRESS SW SETPOINT DRIFT
G	MI1	017215*	021577	VP	DC	P	A14		2	T	2 OF 4 COND LOW VAC SCRAM SW TRIPPED OUTSIDE T.S.	MODEL DIT-H18SS PRESS SW SETPUINT DRIFT
G	MI1	022077	070578	VP	DC	P	A14		1	T	CONDENSER LOW VAC SW TRIP LESS CONSERV THAN T.S.	BARKSDALE PRESS SW SETPOINT DRIFT
G	MI1	022679	101178	CP	DC	P	A14		1	T	DRYWELL HIGH PRESS SW TRIP 2.85PSI VICE 2PSI	INSTRUMENT DRIFT OF BARTON 288 SWITCH
G	MI1	022860	110678	CP	DC	P	A14		1	T	DRYWELL HIGH PRESS SW TRIP 2.1PSI VICE 2PSI	BARTON 288 SW SETPOINT DRIFT
G	MO1	021562*	060678	PN	CM		A06	C	4	T	4 OF 6 APRM SCRAM SETTINGS 3 TO 4% LOW	BIASED DISTRIB OF LPRMS WITHIN APRM PAGES
G	MO1	022186*	080578	PN	CM		A06	B	1	T	1 APRM SETTING 4 TO 5% LOW, 1 BYPASSED	LRG PWR SHAPE CHNG DEFECT PROCEDURES
G	NM1	014248	020776	CP	DC	P	A14		1	T	HIGH DRYWELL PRESS TRIP 3.35 VICE 3.5 PSIG	BARTON INSTRUMENT SETPOINT DRIFT
G	NM1	014979	030376	IN	SE	N	B13		1	N	IRM #13 ERRATIC OPERATION	LOW DETECTOR RESISTANCE, REPLACED
G	NM1	014983	032176	PN	CM		A02		1	T	APRM #18 FAILED TO TRIP AT 20% FLOW POINT	TEST METER OFFSET CAUSED BAD CALIBRATION
G	NM1	015170*	061376	PN	CM		A14		2	T	2 OF 8 APRM FAILED TO TRIP AT REQUIRED FLOW BIAS	APRM 17 & 18 SETPOINT DRIFT
G	NM1	015171*	062776	PN	CM		A14		2	T	APRM 11 & 15 FAIL TO TRIP AT REQUIRED FLOW BIAS	SETPOINT DRIFT LESS THAN 1%
G	NM1	017398	030477	RL	DC	L	A14		1	T	RX LEVEL LO-LO-LO TRIP AT 119 VICE 125 INCH	INSTRUMENT SETPOINT DRIFT
G	NM1	017442	032077	RL	DC	L	A14		1	T	RX LOW-LOW LEVEL TRIP AT 1 IN VICE 5 INCH	SETPOINT DRIFT
G	NM1	018165	060477	RL	DC	L	A14		1	T	RX LOW LEVEL TRIP OUT OF ADJUSTMENT DID NOT TRIP	SWITCH OUT OF ADJUSTMENT
G	NM1	018593	073177	PN	ZZ		A14		1	T	BYPASS 6 VICE 5 LPRMS TO GET APRM-16 INOP LIGHT	APRM 216X513G2 SETPOINT DRIFT
G	NM1	021439*	052678	PN	CA		B02	C	2	T	LPRM DET A&B TO APRM 11 & 15 CROSS CONNECTED	GE-NA-100 DETECTORS CROSS-CONNECTED
G	OC1	014489	040676	CP	DC	P	A14		1	T	DRYWELL HI PRESS SCRAM SENSOR TPD AT 2.1 VS 2.0	INSTRUMENT REPEATABILITY-CAT NO. 2N-M4
G	OC1	015286*	080576	PN	CA		B13		2	T	TWO APRM'S IN THE SAME TRIP SYS CONCRNTLY INOPERAB	FAULTY PIN RECEPTACLE
G	OC1	018574A	072277	IN	CA		B02	B	1	T	IRM CHNL 13 FOUND INOPERABLE	WIRE TO DETECTOR DISCONN - MAINTEN

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VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	OC1	018574B	072277	IN	CA		B02	B		1	T		IRM CHNL 14 FOUND INOPERABLE	WIRE TO DETECTOR DAMGD - MAINTEN
G	OC1	018877A	090177	FU	CN		B13	R		1	N		RECIRC FLO SIG FOR APRM I 1.7% HIER THAN ACT FLOW	FLO CNVTR NO.135B8308G1-ZERO SHIFT
G	OC1	018877B	090177	FU	CN		B13	R		1	N		RECIRC FLO SIG FOR APRM II 1.8% HIER THAN ACT FLOW	FLO CNVTR NO.135B8308G1-HI GAIN ADJUSTMT
G	OC1	021929*	071478	RL	DC	L	A06	L		4	T		FOUR RX WTR SWTCHS USED FOR SCRAM INI LESS CONSV	THAN TS-DEFICIENCIES IN TEST PROCEDURE
G	OC1	022743	101978	IN	CA		B02	B		1	N		IRM 12 BECAME INOPERATIVE WHILE IRM 14 DISCONNECTD	CABLE FOR IRM 12 DAMAGED BY MAINT ACTIVIT
G	OC1	023116	112578	RP	DC	P	A14			1	T		RX HI PRESS SCRAM SW RE03C TRIPS LESS CONSRV THAN	TS-SENSOR REPEATABILITY-9 PSI GT DES SETG
G	PB2	014400	042676	RL	DC	L	B13			1	T		RX LVL SW LIS 2-2-3-101B COULD NOT OBT ACC RESP TI	ME-DEFECTV MICRO SW - MODEL 288A LVL IND
G	PB2	015760	082876	PN	CM		A14			1	N		APRM "A" TRIP PTS LESS CONSERVATIVE THAN TECH SPEC	INSTRUMENT DRIFT-INSTRUMENT RECALIBRATED
G	PB2	017263*	022677	VP	DC	P	A14			3	T		COND LOW VACUUM SWS PS-2-5-11A,B&D TRIPD LOWR THAN	TS LIMIT-SETPT DRFT-MOD DIT-H18SS PRES SW
G	PB2	017774	041777	PN	IM		A14			1	R		APRM A INOP TRIP DID NOT OCCUR IAW TS (9 VS 8 LPRM	SETPT SHIFT - MOD GEK-32537A APRM
G	PB2	019323A	100377	SR	MO	R	B08	R		1	T		2C MN STM LINE RAD MON DWN SCL TRP IND FLD TO CLR	DEFECTIVE REED RELAY - RPLCD IN KIND
G	PB2	019323B	100777	SR	MO	R	B02			1	N		2C MN STM LINE RAD MON DN SCL TRP IND FLD TO CLEAR	INADEQUATE INST WARMUP PRIOR TO CALIBRTN
G	PB2	019329	101077	SR	MO	R	A14			1	T		2C MN STM LN RAD MON HI-HI TRIP OUTSIDE TS LIMIT	SETPOINT DRIFT-RECAL & RETURNED TO SERVIC
G	PB2	019829	112877	SR	MO	R	A09			1	N		MN STM LINE RAD MON RIS-2-2-251B DVLPD UPSCL SPIKG	CONTACT MISALIGNMENT PROBLEM
G	PB2	021707	070578	PN	IM		A14			1	T		SCRAM CLAMP TRP STPT FOR "A" APRM WAS 1 PCT GT TS	SETPOINT DRIFT-IMMEDIATELY RECALIBRATED
G	PB3	013987	010676	SR	MO	R	A14			1	T		MN STM LN RAD MON RIS-251A DID NOT TRIP WHEN DESIR	SMALL STPT DRFT ON LOG SCL-194X629G0C7
G	PB3	014683	050776	PN	ZZ		B13			1	T		CH "E" ARPM TRPD AT FLUX LVLS HIER THAN LICENSE TS	SETPT SHIFT - DEF IN4734A ZENER DIODE
G	PB3	015084	061276	PN	RE		B13			1	T		"F" APRM ROD BLOCK NOT OBTND FRM SIM HI FLUX CONDT	FAILURE OF MOD 35AT600 4RI RELAY
G	PB3	015083	061876	RP	DC	P	B13			1	T		RX HI PRESS SW PS-3-2-3-55B WOULD NOT TRIP	FAILURE OF ZEN DIODE IN TRIP UNT-XET-1205
G	PB3	015880	092776	VP	DC	P	A14			1	T		COND LO VAC SW PS-3-5-11A TRPD 0.26 IN BELOW TS	SETPOINT DRIFT-BARKSDALE MOD DIT-H18SS PS
G	PB3	016174	101176	FU	AM		A09			1	N		CORE FLO BIAS INPUT TO THE A LOGIC APRM STRNG - HI	ABSENCE OF OFFSET SIGNAL IN FLO BIAS AMP
G	PB3	017548	041677	PN	CM		A14			1	T		DWNSCLE TRIP FOR APRM E FOUND AT 2.3, TS IS 2.5PCT	SETPOINT SHIFT ON A MOD GEM-32537A APRM
G	PB3	017778	050977	PN	CM		A14			1	T		DWNSCLE TRIP FOR APRM D FND AT 1.5 VS 2.5 PERCENT	SETPOINT SHIFT - MOD GEK-32537A
G	PB3	018702	080877	SR	MO	R	A00			1	N		IND ON MN STM LN RAD MON RIS-3-17-251D ERRATIC	CAUSE COULD NOT BE DETRMND-RETURNED TO SV
G	PB3	022282	090478	SR	MO	R	B13			1	T		"D" MN STM LN RAD MON FAILED TO CAUSE HALF SCRAM	DEFCTV XISTR IN TRIP UNIT-MOD 194X625007

ALL FAULTS CONSIDERED IN INSTRUMENTATION & CONTROL ASSEMBLIES

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	PI1	017165	020777	VP	DC	P	A14		1	T	LO VAC SCRAM PRES SW PS-503B&D SET AT 22.5 VS 23IN	MINOR SETPOINT DRIFT
G	PI1	017331*	030277	CP	DC	P	A14		3	T	HI DRYWELL PRES PS-512A,B&D FOUND TO HAVE MINOR	SETPOINT DRIFT ON LOW PRESSURE INSTRUMENT
G	PI1	022250*	081878	RP	DC	P	A14		2	T	RX HI PRESS SWS PS-263-55B&C AT 1108 VS 1085 PSIG	SETPOINT DRIFT-0-1500 PSIG-MOD 82T-A12SS
G	PI1	022799	103078	SN	ZZ		B02	S	1	R	SOURCE RNG MON "A" BECAME INOPERABLE	PERSONNEL JUMPERED ENTIRE LOGIC FOR SPM A
G	PI1	022982*	111578	RL	DC	L	A14		2	T	RX WTR LVL SWS LIS-263-57A&B TRIPPED GT TS LIMITS	MINOR SET POINT DRIFT
G	QC1	018110*	042277	FP	DC	P	A14		2	T	MAIN TURB FRST STG PRESS SWS PS-1-504A&B SET GT TS	INSTRUMENT SETPOINT DRIFT
G	QC1	018580	072277	FP	DC	P	A14		1	T	TURB FRST STG PRESS SW OUT OF CAL-401 VS 400 PSIG	INST STPOINT DRFT-TOLERANCES TOO CLS LCO
G	QC1	020543	011778	RL	DC	L	A14		1	T	RX LO WTR LVL SW LIS 1-263-58B SET AT 7.3 VS 8 IN	INSTRUMENT SETPOINT DRIFT
G	QC1	021410	042578	FP	DC	P	A14		1	T	TURB FST STG LO PRES SW PS-1-504A TRPD 401 VS 400	INSTRUMENT SETPOINT DRIFT
G	QC1	021786	061578	RL	DC	L	B08	R	1	T	LO-LO RX WTR LVL SW LIS-1-263-72A FAILD TO OPERATE	MERCOID SWCH MISALGND W CAM-MNTD MAGNET
G	QC1	023382	112278	OP	DC	P	A14		1	T	EHC PRESS SW 1-5600-PS-3 TRPD AT 880 VS 900# DECRS	INSTRUMENT SETPOINT DRIFT
G	QC2	018162*	072476	FP	DC	P	A14	R	2	T	TURB FRST STG PRES SWS PS-2-504A&B EXCEEDED TS LMT	SETPOINT DRIFT-SETPOINT SAME AS LCO
G	QC2	018118	011877	FP	DC	P	A14		1	T	TURB FRST STG PRES SW TRIPPED AT 407-TS LIMIT-400	INSTRUMENT SETPOINT DRIFT
G	QC2	018120*	042277	FP	DC	P	A14		2	T	TURB FRST STG PRES SWS PS-2-504C&D EXCEED TS LIMIT	INST SETPOINT DRIFT - STPT TOO CLSE LCO
G	QC2	018577*	072277	FP	DC	P	A14	R	2	T	"A" RPS TURB FRST STG PRES SWCHS EXCEEDED TS LIMIT	INSTRUMENT SETPOINT DRIFT
G	QC2	018656	072577	OP	DC	P	A14		1	T	ELETROHYD LO PRES SCRAM SW TRPD 15 PSI BELOW TS	INSTRUMENT SETPOINT DRIFT
G	QC2	019103	082277	FP	DC	P	B13	R	1	T	TURB FRST STG PRES SW TRIPPED AT 409 VS 400 PSI	INSTRUMENT SETPOINT DRIFT-INST REPLACED
G	QC2	020942	022878	SR	MO	R	B02		1	N	2D MAIN STEAM LINE RAD MON READING DOWNSCALE	HI VLTG LEAD TO MON WAS IMPRPRLY ATTACHED
G	QC2	022667	083178	SR	MO	R	A14		1	N	MN STM LN RAD MON 2-1705-2D FLD IN DWNSCL CONDITN	INST DRIFT ENHANCED BY HI TEMPERATURES
G	VY1	015741	083076	CP	DC	P	A14		1	T	DRYWELL HI PRESS SCRAM/ISOLATION SWTCHS (1 OF 4SW)	SETPT DRIFT MODEL # 12N-AA4
G	VY1	017138	020177	CP	DC	P	A14		1	T	DRYWELL HI PRESS SCRAM/ISOLATN SW 2.03#VS.2.0#	DRIFTD .1 PSI OVER ONE MONTH
G	VY1	018061	052577	FU	CN		A14		1	N	APRM FLOW BIAS HI FLUX TRIP OUT OF SPEC & ALARMED	FLOW CONVRTR REPLACED, NO REASON FOR DRIF

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ALL COMMON CAUSE FAULTS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
B	OE1	022174A	080678	NF	ZZ		A06	N	4	N	QUADRANT POWER TILT EXCEEDED TECH SPEC	OPERATOR FAILED TO RESET TRIPS
B	OE1	022174B	080678	PN	ZZ		A06	N	4	N	QUADRANT POWER TILT EXCEEDED TECH SPEC	OPERATOR FAILED TO RESET TRIPS
B	OE3	019884	122877	RP	TX	P	B06	U	1	N	XMTR LEFT VALVED OUT AFTER REPAIR TO TEST TEE	INCORRECT/INCOMPLETE VALVE CHECKLIST
C	CC1	017994	033077	PN	CA		B02	C	1	N	POWER RANGE UPPER DETECTOR CIRCUIT,CH A, FAILED	DETECTOR DRAWER FIELD CABLE CONN. DISCONN
C	CC2	016725	121276	PN	CA		B05	C	1	N	CH D ASI OBSERVED GOING OPPOSITE DIRECTION	CABLES REVERSED DUE TO MISLABLING
C	CC2	017983	042177	PN	PS		B03	C	1	T	POWER SUPPLY FOR CH B LINEAR RANGE NUC INS FAILED	POWER SUPPLY GROUNDED BY TECHNICIAN
C	FC1	016667	121476	RT	TX	T	A06	C	1	T	B CH COLD LEG TEMP HIGH	CALIBRATION PROCEDURE IN ERROR
C	MI2	014015*	011476	TP	IM		B04	L	4	R	4 OF 4 TM/LP TRIP NON-CONSERVATIVE FOR ALL CONDITI	DESIGN WIRING ERROR INPUT TO CEA FUNC GEN
C	MI2	017116	020977	RF	CM		A02	C	1	T	RPS LOW FLOW SETPOINT SET HIGH NONCONSERVATIVE	PERSONNEL MIS'NTERPRETED FORMULA
C	PA1	021323	041478	RF	CM		A06	C	1	T	CH A LO PRI FLOW WAS 94.6 PCT, TS REQ MIN 95 PCT	CALIB PROCED REQS CHK THAT AFFECTS TRIP
C	SL1	020513	020378	RT	SE	T	A06	C	3	T	RTD RESPONSE TIMES GT. 5SEC. VALUE SET BY VENDOR	RTD'S MOUNTD IN INST.WELLS--NOT ACCTE FOR
W	BV1	014606A	051276	NT	CM		B01	U	1	N	OVERPOWER BISTABLE NOT TRIPPED WHEN REQ.	OPERATOR FAILED TO TRIP BISTABLES
W	BV1	014606B	051276	TT	CM		B01	U	1	N	OVERTEMP BISTABLE NOT TRIPPED WHEN REQ.	OPERATOR FAILED TO TRIP BISTABLES
W	BV1	022881	101378	PN	CM		A02	C	1	T	EX CORE INST.,CH N41,RATE TRIP SETPOINT TOO HIGH	INADVERTENT READJUSTMENT
W	DC1	016114	100776	FF	TX	F	B02	C	1	T	FEED FLOW TRANSMITTER EXCESSIVE ERROR (FFC-211)	PERSONNEL ERROR VALVING OUT TRANSMITTER
W	KE1	017372	032377	FF	TX	F	B05	C	2	N	STM GEN LEVEL CONTROLLERS LACK OF CONTROL	CROSSED INSTRUMENT TAPS BETWEEN 2 CHANNEL
W	KE1	020424	020678	RP	TX	P	A06	L	4	R	PZR PRESS READINGS HIGH	PROCEDURE NOT INCLUDING HEAD CORRECTION
W	PT2	023123*	120978	RT	SE	T	B02	U	4	N	LOOP "A" RTD MANIF ISOLATED WHILE RX WAS CRITICAL	PERSONNEL OVERSIGHT
W	SA1	016026*	092776	IN	CA		B07	C	2	N	BOTH INTERMEDIATE RANGE NUCLEAR INST CHNLS INOPER	WETTING OF DTCTRS WITHIN WELL-HI CONN RES
W	SA1	021648*	061078	PN	CA		B02	C	1	N	TWO INOPERABLE POWER RANGE CH WERE IDNTFD(N41&N42)	MAINT PERS DISCONN WꞦONG LEADS FOR RX COM
W	ZI1	014285*	022176	PN	ZZ		A03	L	4	T	RESCALED PWR RANGE DET.1N41,42,43 & 44 HOWEVE DID	NOT RESCALE DELTA I SUMMATORS--NONCONSERV
W	ZI1	018530	072977	SF	TX	F	A11	B	1	N	LOOP 1D STEAM FLOW IND. FAILD LOW	DP LINES PLUGGD WITH SEDIMNT; WATR HAMMER
G	BF2	016395	111576	DP	DC	P	B02	C	1	T	EHC LOF PRESS. SWITCH (PS-47-142) FAILED	SWITCH PLUGGED WITH TEFLON TAPE
G	BF2	018632*	081477	RL	DC	L	A01	C	2	T	TWO RX WATER LOW LEVEL SCRAM SWITCHES WERE +20 IN.	REFERENCE LEVEL COLUMN B WAS NOT FULL
G	BF2	022854*	111478	SR	MO	R	A06	L	4	T	M/S LINE RAD MON RM-90-135,136,137,138 SETPOINT HI	INSTRUCTION DEFICIENT IN REQUIREMENTS

ALL COMMON CAUSE FAULTS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL	CODE	TYP	FAIL	NUM	DISCOV	ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	BF3	022824A	102978	IN	CA		B02	C			1	N		IRM F CHANNEL DECLARED INOPERABLE	SIGNAL CABLE SHEARED
G	BF3	022824B	102978	IN	CA		B02	C			1	N		IRM H CHANNEL DECLARED INOPERABLE	SIGNAL CABLE DISCONN
G	BF3	023032*	112878	PN	CA		B06	L			6	T		ALL LRPM'S OF 43 STRINGS FOUND REVERSE CONNECTED	LACK OF EXPLANATION OF PROPER LPRM CONNEC
G	BP1	015443	081376	PN	CA		B02	C			1	N		PR NEUTRON MONITOR DID NOT RESPOND PROPERLY (#2)	POLARIZING VOLT. ON COMP ION CHAM SWAPPED
G	BR1	016855*	010577	PN	CM		A06	L			6	T		HIGH FLUX TRIP FOR APRM'S FOUND TO BE TOO HIGH	DEFECTIVE PROCEDURE
G	BR1	020770	030178	SR	MO	R	B02	C			1	M		MAIN STEAM LINE RAD MONITOR "D" PS FAILED	IRM CABLES DAMAGED D12-RM-K603D PS
G	BR2	014944*	061276	RL	DC	L	A04	C			3	T		RX LOW WATER LEVEL SW 2-B21-LIS-N024 A,B,25B ACT L	CIRCUIT DESIGN USED HIGH LEVEL SWITCHES
G	BR2	020168	010278	SR	MO	R	A02	C			1	T		MAIN STEAM LINE RAD MON D12-RM-K603 READ DOWNSCALE	PREVIOUS CALIBRATION PERFORM WRONG
G	CO1	016713	111676	OP	DC	P	B02	U			1	N		DURING STARTUP PRESSURE SWITCH TRIP CAUSED RPS TRI	PRESSURE SWITCH LEFT ISOLATED AFTER SURVE
G	CO1	019286	092377	SN	CA		B02	B			1	M		SRM WAS READING HIGH AND ERRATIC DURING REFUELING	BREAK IN OUTER SHIELD OF TRIAXIAL CABLE
G	CO1	021197	040878	SN	CA		B02	B			1	M		SRM WOULD NOT RESPOND PROPERLY DURING REFUELING	BREAK IN SHIELD OF TRIAXIAL CABLE
G	CO1	021747	052778	SR	MO	R	A06	C			1	N		MAIN STEAM LINE RAD MONITOR TRIP POINT NOT ADJUSTE	PROCEEDURAL DEFICIENCY FOR SOURCE CALIBRA
G	DA1	017965*	112877	PN	CA		A01	C			4	T		NONCONSERV ERRORS INDUCED IN APRM CH A,B,C & D	PERSONNEL-REVERSED INPUT/OUTPUT OF LPRM
G	DR1	017797*	042877	PN	AM		A14	C			5	T		IN-CORE FLUX AMPS 104B 110D 112D 113A 113C 114D HI	INSTRUMENT SETPOINT DRIFT DUE TO HIGH TEM
G	DR2	017184*	012877	FU	CN		A06	M			2	T		APRM FLOW-BIAS FLOW INDICATION EXCEEDED 100% (A&B)	PROCEDURE FOR TOTAL CORE FLOW IND REVISED
G	DR2	017651*	042577	FU	CN		A06	M			2	T		APRM/RBM FLOW BIAS EXCEEDED 100% AT 100% CORE FLOW	APRM/RBM CONVERTERS CALIB TO ORIG SPECS
G	DR2	019910*	122277	FU	CN		[illegible]	M			2	N		APRM FLOW BIAS SCRAM & ROD BLOCK SETPOINTS NON-CON	DEFICIENT PROCEDURE
G	DR2	020869*	032778	SR	MO	R	A06	L			4	T		MSL HIGH RAD ISOLATION SETPOINT SET HIGH	TYPOGRAPHICAL ERROR IN PROCEDURE
G	DR3	019176*	092977	PN	ZZ		A14	C			2	T		APRM'S 4 & 6 GENERATED INOP WITH 12 LPRM'S BYPASSE	ABNORMAL ELECTRONIC DRIFT
G	DR3	020871	032778	SR	MO	R	A03	C			1	T		MSL HIGH RAD SCRAM ISOL MONITOR SETPOINT HIGH	PERSONNEL ERROR-SETPOINT ADJUSTED HIGH
G	EN2	022676*	101178	PN	CM		A06	L			6	T		HIGH FLUX SCRAM SETPOINTS SET VERY HIGH	PROCEDURE DID NOT LIST STARTUP SETTING
G	FP1	014483	040576	RP	DC	P	B02	C			1	T		REACTOR HIGH PRESS SW 2-3-55D FAILED TO ACTUATE	INCORRECT ADJUSTMENT OF MECHANICAL STOP
G	FP1	018051*	062677	PN	CA		B02	L			6	M		LOSS OF 15% APRM SCRAM FUNCTION	CONTRACTOR CUT 19 OF 31 LPRM STRINGS
G	FP1	020928*	040178	PN	SE	N	B05	C			4	T		LPRM-36-45 DET A & B, LPRM-12-21 DET B & C NOT OP	DETECTOR WIRING INCORRECT
G	MO1	021562*	060678	PN	CM		A06	C			4	T		4 OF 6 APRM SCRAM SETTINGS 3 TO 4% LOW	BIASED DISTRIB OF LPRMS WITHIN APRM PAGES

ALL COMMON CAUSE FAULTS

VEN	PLT	CONT.NO.	FAIL DATE	SYS	COMP	PARAM	FAIL CODE	TYP	FAIL NUM	DISCOV ACTIVITY	MODE DESCRIPTION	CAUSE DESCRIPTION
G	M01	022186*	080578	PN	CM		A06	B	1	T	1 APRM SETTING 4 TO 5% LOW, 1 BYPASSED	LRG PWR SHAPE CHNG DEFECT PROCEDURES
G	NM1	021439*	052678	PN	CA		802	C	2	T	LPRM DET A6B TO APRM 11 & 15 CROSS CONNECTED	GE-NA-100 DETECTORS CROSS-CONNECTED
G	OC1	018574A	072277	IN	CA		802	B	1	T	IRM CHNL 13 FOUND INOPERABLE	WIRE TO DETECTOR DISCONN - MAINTEN
G	OC1	018574B	072277	IN	CA		802	B	1	T	IRM CHNL 14 FOUND INOPERABLE	WIRE TO DETECTOR DAMGD - MAINTEN
G	OC1	021929*	071478	RL	DC	L	A06	L	4	T	FOUR RX WTR SWTCHS USED FOR SCRAM INI LESS CONSV	THAN TS-DEFICIENCIES IN TEST PROCEDURE
G	OC1	022743	101978	IN	CA		802	B	1	N	IRM 12 BECAME INOPERATIVE WHILE IRM 14 DISCONNECTD	CABLE FOR IRM 12 DAMAGED BY MAINT ACTIVIT

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16. ABSTRACT (200 words or less)
This report presents estimates of common cause fault rates and related quantities, based on Licensee Event Reports of instrumentation and control assemblies in nuclear reactors. The Licensee Event Report data base is briefly described, and imperfections in the data are discussed. The components are grouped into assemblies, for which rates are estimated. For estimating rates, the binomial failure rate model is used, extended to allow for the substantial observed plant-to-plant variability, and for shocks that by their nature cause all the assemblies in a system to fail. Every quantity is estimated by both a point estimate and a 90 percent interval. All rates are expressed per calendar hour.

17. KEY WORDS AND DOCUMENT ANALYSIS

17a. DESCRIPTORS

Common Cause
Failure Rates
Licensee Event Report (LER)
Binomial Failure Rate Model
Parameter Estimation
Instrumentation and Control Assemblies
Shocks
Bayesian Methods
Plant-to-Plant Variation
Diagnostic Checks
Methodology
Gamma Distribution
Point and Interval Estimates

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