NINE MILE POINT NUCLEAR STATION - UNIT 1
INDIVIDUAL PLANT EXAMINATION for EXTERNAL EVENTS
(IPEEE)

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1.0 Executive Summary

The Nine Mile Point Unit 1 (NMP1) Individual Plant Examination of External Events (IPEEE) is a systematic evaluation of plant risk utilizing the latest technology available for assessment of external events. In addition to using industry information and information referenced in Generic Letter 88-20, Supplement 4[2] and NUREG-1407[3], the NMP1 IPEEE made extensive use of the NMP1 Individual Plant Examination (IPE)[1].

The IPEEE scope for NMP1 included three classes of external hazards: seismic, fire, and others. The Seismic Margins Assessment (SMA)[11] approach was used for the seismic portion of the analysis. In addition, fragility's were developed to allow the extension of SMA results to include the type of quantitative results obtained by PRA analysis. The fire portion of the study utilized the Fire Induced Vulnerability Evaluation (FIVE)[25] including the NRC recommended enhancements. Recognizing the necessity and benefits of a full quantitative analysis, the FIVE assessment was extended to a fire PRA. The "Others" portion of the analysis utilized the progressive screening approach outlined by the NRC in Generic Letter 88-20, Supplement 4 and NUREG-1407. The other hazards include high winds, flooding, transportation, and nearby industrial facilities.

Figures of merit commonly quoted in PRA type studies are core damage frequency (CDF) and the frequency of an "large early" release (LERF). The following table shows these values for NMP1. Note that a number of improvements have been initiated based on the IPEEE and A-46 programs. The table shows results before and after the implementation of the improvements.

Assessment Type/Area		Pre-IPEEE Improvements		Post-IPEEE Improvements	
		CDF(/yr)	LERF (/yr)	CDF (/yr)	LERF (/yr)
Seismic	EPRI	9.9E-6	9.9E-7	1.1E-6	5.0E-7
	NUREG (*not in totals)	3.0E-5	3.0E-6	4.5E-6	2.3E-6
Fire		8.2E-5	8.2E-6	2.0E-5	2.0E-6
Other Hazards		2.1E-6	1.0E-6	1.6E-6	7.6E-7
Total IPEEE		9.4E-5	1E-5	2.3E-5	3.3E-6
IPE Internal Hazards		5.4E-6	6.9E-7	5.4E-6	6.9E-7
Total NMP1		9.9E-5	1.1E-5	2.8E-5	4.0E-6

These results suggest that operation of NMP1 poses no undue risk to the public and the containment evaluation indicates that the NMP1 containment does not have any unusual characteristics that result in poor containment performance.

The NRC in the Severe Accident Policy Statement[3] (1985) stated that:

> *On the basis of current available information, the Commission concludes that existing plants pose no undue risk to the public health and safety and sees no present basis for immediate action on generic rule making or other regulatory changes for these plants because of severe accident risk.*

The IPEEE has determined that there are no plant specific or unique features of NMP1 that would alter this generic conclusion.

1.1 Background and Objectives

The NMP1 IPEEE was undertaken in response to Generic Letter 88-20, Supplement 4[2] "Individual Plant Examination for External Events for Severe Accident Vulnerabilities - 10CFR§50.54(f)," dated June 28, 1991. This letter requested that all licensees perform a systematic evaluation of plant risk. Upon subsequent release of NUREG-1407[3] "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," dated June 1991, Niagara Mohawk Power Corporation (NMPC) committed to perform an IPEEE for NMP1 by August 30, 1996. This commitment noted that NMPC would be using the Seismic Margins Methodology (SMA)[11] for the assessment of seismic risk, the FIVE Methodology[25] for the assessment of fire risk, and the NRC progressive screening approach for others evaluation.

The goals of this project were to:

- Meet the NRC commitment relating to Generic Letter 88-20, Supplement 4
- Understand the underlying risks to nuclear plant safety and key sources of uncertainty
- Identify areas where cost effective risk improvement opportunities exist
- Supplement the IPE which was developed as a tool to quantify nuclear safety and support a comprehensive risk management program
- Supplement the in-house risk analysis capability developed from the IPE for application to plant decision-making
- Develop models capable of extension to shutdown risk assessment

In order to meet the first of the above goals, the generic letter suggested four main objectives similar to the IPE process:

- Develop an appreciation of severe accident behavior
- Understand the most likely severe accident sequences that could occur at the plant under full operating conditions
- Gain a qualitative understanding of the overall probabilities of core damage and radioactive material release
- If necessary, reduce the overall likelihood of core damage and radioactive material release by modifying hardware and procedures that help prevent or mitigate severe accidents

In order for NMPC to meet the above goals and objectives, a detailed project plan was developed in early 1991. This plan called for the formation of a team of 6 analysts, a support network of more than 12 members of various plant organizations, an in-house review group, and external

consultants. The analysts and the external consultants were primarily involved in the day to day development. The individuals in the IPEEE support organization represented engineering (structural, mechanical, electrical), fire protection, operations, maintenance, training, and technical support (system engineers). They were not involved in the actual analysis but provided crucial information on plant operation in the form of answering questions and participating on plant walkdowns.

1.2 Plant Familiarization

Nine Mile Point Nuclear Station Unit 1 (NMP1) is operated by Niagara Mohawk Power Corporation (NMPC). The plant is located on the southeast shore of Lake Ontario, approximately 6.2 miles (10 km) northeast of the city of Oswego. Nine Mile Point Nuclear Station Unit 2 (NMP2), also operated by NMPC, is immediately to the East and shares the site with NMP1. The James A. Fitzpatrick Nuclear Power Plant, operated by the New York Power Authority (NYPA), is immediately east of the Nine Mile Point site.

NMP1 is a General Electric designed Boiling Water Reactor (BWR) Type 1 BWR 2. The rated thermal power level is 1850 MWt corresponding to a 615 MWe power level. The containment is a Mark I type utilizing a torus suppression design with multiple downcomers connecting the drywell to the torus (suppression pool).

The unit has two onsite emergency diesel generators each with its own dedicated raw water pump for cooling. NMP1 has 2 emergency condenser trains that fail safe into operation satisfying pressure, inventory, and heat removal functions as long as there is no LOCA condition. The core spray system has two trains and each train has two redundant pumping trains and injection MOV trains. The containment spray heat removal system contains 4 trains each with its own dedicated heat exchanger and raw water pump. In addition, NMP1 has a hardened containment vent.

The plant could be classified as a relatively "old" plant having initiated commercial operation in 1969. Given the age of the plant, it is expected that the overall risk from external events would be comparable if not greater than internal initiators based on findings at other plants. The plant was constructed before the general design criteria and other design standards, including the standard review plan (SRP)[7], were developed.

To collect up-to-date information and give the analysts a more complete understanding about NMP1, three categories of plant walkdowns were performed for the IPEEE.

1. Seismic (described in Section 3.1.1)
2. Fire (described in Section 4.2)
3. Other hazards (described in Section 5)

1.3 Overall Methodology

The objective of the NMP1 IPEEE is to perform the equivalent of a Level II PRA for external events. As with the NMP1 IPE, initiating events (in this case external hazards), impacts on the plant, and the modeling and quantification of core damage frequency is required. The overall methodology is very similar to the IPE and is summarized below:

1. Initiating Events - external event hazards analyses provide the initiating events for the IPEEE or external events PRA. For external hazards, the initiating event may have to be assessed for a spectrum of hazard intensities in the form of frequency of exceedance curves or tables. In the case of fires, the frequency is first developed for locations in the plant using the EPRI FIVE[25] methodology. Then, if the initial screening does not demonstrate low risks for the locations, the fire hazard may be evaluated in greater detail by considering different sources (i.e., intensity) and their frequencies.

2. Initiating Event Impacts - as with the IPE, the impact of the hazard on structures, systems, and components (SSCs) is crucial to the assessment. For the seismic and fire hazards, this requires the identification of safe shutdown success paths from the IPE and the SSCs needed to support the success paths. Then, the seismic fragility (failure probability versus seismic intensity) of the SSCs is evaluated and this provides the seismic impact on the plant. The fire analysis is similar, except fire hazard impact is assessed at each plant location.

3. Plant Model & Quantification - the unavailability of plant equipment not impacted by the hazard is included in the analysis of core damage frequency by using the IPE model. The hazards are run through the IPE model as initiating events. The event tree top events are requantified and event tree quantification rules are changed to ensure that the hazard impact on the plant is modeled. Other event tree top events not impacted by the hazard still have their normal IPE unavailability modeled. The results are core damage frequency for the seismic and fire initiating events.

4. Containment Performance - this is considered in items 1 through 3 and by comparing quantitatively the potential contribution of external hazards to the IPE results.

The overall methodology is further summarized below for each external hazard:

Seismic Analysis

The NMP1 IPEEE used the EPRI SMA method for seismic risk assessment. In this method, High Confidence Low Probability of Failure (HCLPF) values are determined for components designated in safe shutdown trains. This identification of components and determining their HCLPF provides most of the information needed to satisfy items 2 through 4 above in a seismic PRA. The HCLPF determination can be extended to provide seismic fragility's in support of PRA, similar to Unit 2, since most of the work necessary to define fragility's was already completed.

EPRI[17] and NRC[18] seismic hazards are available for the NMP site, therefore, they can be used for the initiating event portion of the seismic IPEEE (item 1 above). The most significant effort involved the assessment of seismic impacts on SSCs (items 2 and 4 above) which is described in

Section 3.1 (seismic margins method). The results of items 1 and 2 can be utilized along with the IPE to complete items 3 and 4 and derive quantitative insights with regard to seismic risk. This is discussed further in Section 1.4.

Fire Analysis

The NMP1 IPEEE used the FIVE method for fire risk assessment including the NRC recommended revisions to the FIVE methodology. Again, an EPRI[25] data base was available, thus, a limited amount of work was required to establish initial hazard frequencies (item 1 above). Some effort was required to partition the raw data throughout the plant locations. Partitioning considered building type and ignition sources within the location, including equipment. As with the seismic analysis, the most significant effort is associated with determining the impact of fires at each location (item 2 above). In the case of fires, determining the location of cables and then the impact of cable failures is a major part of the analysis. If the location did not screen out using conservative assumptions (i.e., all impacts occur given a fire), the location of cables, conduits, cable trays, and equipment relative to fire sources was required to perform more detailed modeling. Use of the IPE (items 3 and 4) above to model fire initiators in the screening analysis and derive quantitative insights was a relatively minor effort in comparison to determining impacts.

Others Analysis

The methodology used to screen high winds, floods, transportation, and nearby facility accidents as insignificant to risk is based on NRCs standard review plans (SRPs), an estimate of hazard frequencies, and/or performing bounding analysis. This approach is outlined in NUREG-1407 and is similar to the methodology described above. The underlying basis for compliance with the SRP includes consideration of hazard frequency (item 1 above) and plant design (item 2 above).

The methodology utilized for each hazard is described further in Sections 3, 4, and 5.

1.4 Summary of Major Findings

The major findings for each hazard are summarized below:

Seismic Analysis

The review level earthquake (RLE) used for seismic screening is a 0.3g HCLPF (high confidence low probability of failure) as recommended by NUREG-1407. The seismic margins assessment (Section 3.1) concluded that structures, systems, and components (SSCs) identified in the simplified success path will have a 0.3g HCLPF once the improvements identified in Sections 3.0 are completed. A detailed PRA model was not necessary to derive quantitative insights because it was obvious from the IPE that emergency diesels are the most important components relative to nonseismic unavailability. Other support systems and key front line systems such as electromatic relief valves (ERVs), core spray, and containment spray are clearly more reliable. A scenario involving seismic loss of offsite power and nonseismic failure of the emergency diesels (EDGs) is judged to dominate in a PRA model with respect to the nonseismic contributions present in the IPE model.

The seismic analysis results can be put into a quantitative perspective with respect to core damage frequency (CDF) as follows:

- The mean annual frequency of a 0.3g HCLPF earthquake can be estimated by converting the HCLPF to a fragility and combining it with the seismic hazard at the NMP site. A 0.3g HCLPF has a median capacity of approximately 0.64g. As shown in the table below, this value is between 1E-6 and 4.5E-6/yr for the EPRI[17] and NRC[18] seismic hazards, respectively.

- The contribution due to events less severe than the 0.3g earthquake described above can be estimated as shown in the table below where the loss of offsite power (LOSP) fragility was taken from a seismic PRA[19] and the nonseismic unavailability is assumed to be 0.1 for each diesel consistent with the NMP1 IPE (i.e. 0.01 for both EDGs).

Seismic Failure	Hazard Mean Annual Frequency		Conditional Failures	CDF (event/yr)	
	EPRI[17]	NUREG[18]		EPRI	NUREG
0.3g HCLPF (≈ 0.64 median)	1.0E-6	4.5E-6	1.0	1.0E-6	4.5E-6
LOSP 0.1g HCLPF (≈ 0.3g median)	9.9E-6	3.0E-5	0.01 (EDGs)	9.9E-8	3.0E-7
			Total	1.1E-6	4.8E-6

The above provides important insights regarding seismic risk at NMP1. The results indicate a relatively low risk for seismic events; in order to reduce this risk, a HCLPF value greater than 0.3g would have to be developed for all SMA components. The costs associated with doing this, including potential modifications, are judged to exceed the potential benefits. In addition, the above calculation is potentially conservative (i.e., converting the 0.3g HCLPF to a fragility did not account for differences in peak spectral values relative to the reference peak ground acceleration (PGA)) and the estimation of HCLPFs is biased conservatively. Also; other success paths not credited in the IPEEE have a non-zero failure rate over a spectrum of potential earthquake magnitudes. In terms of seismic ruggedness, equipment associated with some of these potential success paths have been reviewed under the A-46 program. Formally crediting these success paths, in addition to those included in the current IPEEE, would lead to lower calculated risk values. Considering these conservatisms, NMPC believes that these results provide an upper bound once the improvements described in Sections 3.0 and 7 are completed.

Containment performance was included in the seismic evaluation which considered the primary containment structure, penetrations, piping and valves, as well as LOCAs outside containment. Most of these components, including valves, are judged to have a HCLPF much greater than 0.3g. The containment isolation function is reliable and even relay chatter alone can not cause containment bypass at NMP1. Considering that the containment and associated equipment has a HCLPF likely greater than 0.3g, nonseismic reliability of containment isolation is high, and the conservatism's discussed above, a 0.5 per demand unavailability is assigned to early large release from the containment given an earthquake induced core damage event. As such, NMPC believes the best estimate for large early release frequency (LERF) is approximately 5E-7/yr once the improvements described in Sections 3.0 and 7 are completed.

Premodification Seismic Risk

The improvements described in Sections 3.0 and 7 are included in the above results (e.g., the 0.3g HCLPF) and are not considered to be vulnerabilities. This conclusion is based on the judgment that none of the components have a HCLPF lower than what would be used for LOSP in the above table (i.e., all premodification HCLPFs are judged to be greater than 0.1g). A 0.1g HCLPF has a median capacity of approximately 0.3g. As shown in the above table, this provides an upper bound CDF of 9.9E-6 to 3.0E-5/yr for the EPRI and NUREG hazards, respectively.

LERF for the premodification case is judged to be about an order of magnitude less than CDF. This is based on the judgment that early core damage is about an order of magnitude less likely. Emergency condensers are likely to survive the 0.1g HCLPF and delay core damage (i.e., the likelihood of a small LOCA is less at 0.1g HCLPF value, and the probability of a LOCA condition due to a stuck open ERV or seal LOCA is on the order of 0.1).

Fire Analysis

Of the 62 fire locations evaluated, 19 did not pass the initial screening analysis that conservatively assumed everything in the location failed due to the fire. The analysis took this conservative impact and the total frequency of a fire in the location and used the IPE to evaluate core damage frequency. Of the 19 locations requiring detailed analysis, 5 did not pass the 1E-6/yr core damage frequency screening value. As shown in the table below, four of the locations are marginal with a core damage frequency estimate close to 1E-6/yr. The fifth location has an estimated core damage frequency slightly greater than 1E-5/yr.

Detailed Analysis Results (Locations With CDF ≥ 1E-6/yr)					
			Annual Freq		
Area	Zone	Location	CDF	LERF	CDF Contributors
5	T3B	Turbine bldg El 261 South	1.3E-5	1.4E-7	Dry transformer (7E-6) Power cable tray (3E-7) Panel (5E-6)
7	T2B	Turbine bldg El 250 South & West	1E-6	1.4E-7	Transient fires
10	C1	Cable spreading area	2E-6	3E-7	Transient (1E-6) Power cable tray (1E-6)
11	C2	Auxiliary control room	1.1E-6	5.9E-7	Specific cabinets and all fires
11	C3	Main control room	1.4E-6	8.5E-7	Panel A and all fires
		Total	2E-5	2E-6	

All 5 of these locations are associated with what could be considered the "control building" portion of the plant because practically every plant system can be impacted. These 5 critical locations include main control room, auxiliary control room, cable spreading room, and the adjoining area in the turbine building where cables must enter the auxiliary control room and cable spreading room. It should be noted that the above results credit improvement it training with regard to procedure N1-SOP-14 "Loss of Instrumentation", discussed below.

Containment performance was also evaluated. Consistent with the IPE, containment isolation was determined to be reliable and the potential for LOCAs outside containment is unlikely. It was concluded that the likelihood of an early large release can be conservatively approximated by estimating the frequency of early core damage (e.g., no credit for containment withstanding

phenomenological effects of core melt). Based on this conservative assumption, the frequency of early large release (i.e. LERF) was estimated at approximately 2E-6/yr as shown above. The same locations discussed above contribute to this value.

Premodification Fire Risk

The above results for CDF and LERF rely on an assumption regarding current NMP1 capabilities for station blackout mitigation. The frequency of a long-term unrecoverable station blackout is relatively important (i.e., emergency condensers available, but DC power is exhausted in the long term leading to loss of instrumentation in the control room). The analysis takes credit for operators monitoring RPV level from the East and West instrument rooms while using the emergency condensers and/or the diesel fire water pump to maintain inventory. N1-SOP-14 "Loss of Instrumentation" provides the appropriate procedure, but its use under the dominant fire IPEEE scenarios has not been reinfoirced via training. Thus, the IPEEE team has recommended that this topic be added to operator trining. Without the improvement, risk can be estimated by setting long term blackout operators actions to 1.0. One exception for this sensitivity is the scenario where normal AC is available. This action has been raised from 0.05 to 0.5, instead of 1.0, to credit additional capabilities considered within operators "skills of the trade." Requantification of the scenarios results in a premodification CDF of 8.2E-5 per year. Consistent with the above, this corresponds to a LERF of 8.2E-6 per year.

Other Hazards Analysis

All hazards, except high wind/tornado, screened as contributing less than 1E-6/yr to core damage frequency. Similar to the fire analysis, this conclusion relies on an assumption regarding current NMP1 capabilities during station blackout scenarios where AC power may not be recovered for some time (see N1-SOP-14 improvement discussed above and in Section 7). Tornado risk was determined to be 1.6E-6 per year CDF and 7.6E-7 per year LERF. Other than the N1-SOP-14 initiative, there were no cost-beneficial improvements identified which would substantially reduce this risk.

2.0 Examination Description

Nine Mile Point Unit 1 (NMP1) IPEEE was undertaken in response to Generic Letter 88-20, Supplement 4[2]. This Generic Letter, issued June 28, 1991, requested all licensees to perform a systematic evaluation of plant risk caused by external events. From the Generic Letter, the general purpose of the IPEEE is to:

- develop an understanding of severe accident behavior
- understand the most likely severe accident sequences that could occur at its plant under full operating conditions
- gain a qualitative understanding of the overall likelihood of core damage and radioactive material release
- and; if necessary, reduce the overall likelihood of core damage and radioactive material releases by modifying hardware and procedures that would help prevent or mitigate severe accidents.

The scope of work is part of the NRC scope for severe accident issue closure[57]. In this regard, the IPEEE is a follow-on effort to the recently completed Individual Plant Examination (IPE). As an analysis, IPEEE is essentially an addition in scope over IPE such that events external to the plant are evaluated. Following the IPEEE, in terms of severe accident closure, is the program to develop Accident Management capabilities.

2.1 Introduction

The IPEEE is an evaluation that focuses on nuclear plant risk caused by external events. External events are, in general terms, events that originate outside the plant which may affect structures and components within the plant. In Generic Letter 88-20, supplement 4, NRC defined the external events requiring analysis as:

- Seismic events
- Internal fires
- High winds and tornadoes
- External floods
- Transportation and nearby facility accidents.

Note that internal fires were included with IPEEE rather than IPE even though it would more properly be classified as an internally initiated event.

The generic letter requested that the IPEEE be completed by June 28, 1995 and be performed using the guidance in NUREG-1407[3]. Because of the resources required to perform an IPEEE for both plants and the desire to maximize the use of in-house personnel, NMPC committed to

completing the IPEEE for Unit 1 by August, 1996 (Nine Mile Point Unit 2 was submitted first in June 1995).

2.2 Conformance with Generic Letter and Supporting Material

The NMP1 IPEEE has been completed in accordance with Generic Letter 88-20, Supplement 4 and NUREG-1407. Methods endorsed in these documents were used as discussed in the following section and, in more detail, in Sections 3, 4 and 5. NMPC formed a diverse IPEEE team comprised primarily of NMPC staff to perform the analysis . Due to the high degree of involvement by NMPC staff, NMPC expects to derive the maximum benefit from the analysis. Technical adequacy and the IPEEE review process are discussed in Section 6.

Individual interpretations of Generic Letter 88-20 and NUREG-1407 guidance are noted throughout the submittal, where appropriate.

2.3 General Methodology

The list of external events above was broken into three groups: seismic, fire, and others. Each of these groups was assessed using a different analytical methodology. For seismic, the EPRI SMA was used. For fire, a fire PRA was performed utilizing the Fire Induced Vulnerability Evaluation (FIVE)[25] methodology as a reference. For the others, the screening approach from NUREG-1407 was used. Each of these will be discussed in more detail in the remainder of this section and in greater detail as appropriate in Sections 3, 4, and 5.

2.3.1 Fire Methodology Overview

As part of the original response to Generic Letter 88-20 Supplement 4, NMPC committed to perform a FIVE analysis. However, in performing the FIVE assessment on Unit 2, NMPC became aware that a fire PRA was necessary. While NMPC has completed the scope of the FIVE analysis, per our commitment, it was deemed necessary to complete a fire PRA in order to complete the scope of the fire IPEEE. This occurred due to a number of reasons.

Once the FIVE was underway on NMP2 (preceding the NMP1 analysis), it became evident that the qualitative screening criteria of FIVE was potentially non-conservative due to its treatment of initiating events and non-safety related equipment. NMPC was concerned about screening fire areas without safe shutdown equipment. The principle concern with this was the potential for these areas to contain significant plant initiating events. As such, the qualitative screening phase of FIVE became simply an information collection exercise and no areas were screened without identifying the location of non-Appendix R cables that could cause a plant initiating event. Concerns similar to these were raised by NRC during its FIVE review and improvements were made in Revision 1 of FIVE. The latest revision of FIVE was used by NMPC.

The above considerations led NMPC to conclude that quantitative analysis, using the IPE, should be the basis for screening. The IPE contains all the success paths but required augmentation in terms of fire impacts on IPE scope components. For NMP1, all areas were quantitatively evaluated with the IPE during the initial screening analysis. Prior to screening, a database had to be developed for both Appendix R safe shutdown equipment and non Appendix R equipment in the IPE.

Of further benefit, the fire PRA provides a quantitative tool which enables NMPC to efficiently deal with future fire risk related issues. This is not to suggest that FIVE is not a valuable tool. The FIVE methodology was used extensively for information collection activities, fire hazard analyses, walkdowns, fire growth and propagation analyses, fire detection and suppression assessment, and other fire IPEEE tasks.

Overall, the NMP1 fire PRA is developed similar to other fire PRAs and FIVE analyses. The first phase is an information collection phase: fire areas are delineated and the plant effect for each fire area is determined. The fire areas were initially delineated in the same manner as used for the Appendix R analysis, but the fire PRA documented plant affects by fire zone. While this was a simple undertaking, the plant effect of a fire in each fire area was difficult to determine. The listing of equipment that may be damaged in a fire area was straight forward but determining the effect of cable damage within a fire area required some effort. In order to fully determine the effect of a fire in a given fire area, each of the cables in the area must be studied. This is necessary since a piece of equipment, even if it is not in the given area, may have an associated cable routed through the area. This task required the development of a cable routing database that took cable routing information and mapped it according to fire zone.

Using this database, the plant effect of a fire in each fire zone was determined (fire area functional consequence equated to IPE impact). Based on plant walkdowns, the frequency of a fire in each fire area was determined. This calculation was based on the amount of fixed and transient combustibles in each area. This probability was multiplied by a conditional core damage frequency that was calculated from the IPE using the above-determined fire area functional consequence. If this value was less than 1E-6 per year and shown to be qualitatively conservative, the area was screened. For areas that did not screen, a more detailed analysis was performed.

The detailed analysis considered the location of ignition sources, combustibles, and targets (critical components) in the area, and fire detection and suppression capabilities. This information was used in that above-mentioned PRA calculation to perform a more detailed assessment of individual fire area core damage contribution.

More detailed discussion of the fire IPEEE approach is in Section 4.

2.3.2 Seismic Methodology Overview

NMPC performed a SMA for the seismic portion of the IPEEE. The basis of the SMA is to demonstrate survivability of a set of equipment necessary to reach and maintain a safe shutdown condition following a given magnitude earthquake. Success paths and structures, systems and components (SSCs) necessary to support plant success following an earthquake are identified. Survivability must be demonstrated for 72 hours. Those components required to mitigate a small break LOCA (SLOCA) during a review level earthquake (RLE) are considered. A RLE is the specified earthquake magnitude set by NRC in GL 88-20.

The SMA analysis can be broken into six phases. These phases are as follows:

1. Preparatory Assessment
2. SSC Identification
3. Seismic Capability Walkdown
4. Review Walkdown
5. SMA Evaluation
6. Documentation

Phase 1: Preparatory Assessment

The first step in Phase 1 is to become familiar with the SMA techniques. Analysts review appropriate methodology reports, communicate with the two EPRI demonstration plants, and receive training as appropriate.

The second step is to review important plant functions and identify SMA scope system including support systems. From these systems, at least two safe shutdown paths are selected. These paths are documented as success paths using a success path logic diagram (SPLD).

Phase 2: SSC Identification

Based on the safe shutdown paths, an equipment list is generated that includes the equipment necessary to maintain the success path. This list becomes the basis for equipment that will require walkdown and analysis.

This identification is based on IPE modeling and includes a limited number of walkdowns to confirm success path logic. Walkdowns involve the IPEEE Team making observations and collecting information during tours of the plant. The next step is to perform the seismic capability walkdowns.

Phase 3: Seismic Capability Walkdown

The main purposes of the seismic capability walkdowns are to:

- Screen components that can be shown to have seismic capability above the RLE

- Clearly define failure modes
- Perform preliminary vulnerability assessments

The seismic capability is measured by the High Confidence Low Probability of Failure (HCLPF) measure.

Phase 4: Review Walkdowns
Review walkdowns are performed to investigate additional success paths, collect additional information, or verify previous analysis. These walkdowns are conducted on a case-by-case basis.

Phase 5: SMA Evaluation
Based on the walkdowns, a substantially reduced list of review elements remains for detailed review. For each review element it is necessary to perform a demand and capacity evaluation. The demand evaluation determines the level of motion expected at the component and includes the magnification of the earthquake at upper elevations of the plant. The capacity evaluation determines the ability of components to withstand an earthquake. The demand estimates can be determined either using a scaling approach or by performing new, less conservative, building response analyses.

This demand is then compared to the seismic qualification rating. Components that do not meet comparison limits can have less conservative demand evaluations performed.

Phase 6: Documentation
All calculations, assumptions, walkdowns, and analyses are documented according to the direction in the SMA methodology report. These Tier II reports are the basis for the IPEEE Tier I submittal to the NRC. Tier II reports, as specified in NUREG-1407, contain background information retained at NMPC. This report represents the Tier I information which is submitted to the NRC to describe the overall evaluation and results..

2.3.3 Others Analysis Overview

High winds, floods, and transportation and nearby facility accidents are handled using the screening approach outlined in NUREG-1407[3], which is a progressive screening approach based on probability and consequences. This screening starts with a review of the UFSAR and licensing basis and includes a review of changes made since the issuance of the operating license.

Screening and walkdowns begin on a case by case basis starting with the 1975 Standard Review plan (SRP) criteria[7]. For cases where the SRP criteria are not met, a probabilistic evaluation is made. NMP1 was designed and licensed prior to the issuance of SRPs. As such, for the IPEEE it was judged most efficient and useful to assume the SRPs were not met and thus, proceed to the detailed analysis without an intensive review against SRPs. This assumption is viewed as meeting the NRC suggested screening approach methodology. For the detailed analysis, if frequency of

occurrence is less than 1×10^{-5} and conditional core damage is less than 0.1, then the issue can be screened. If the issue is not screened, then a more formal PRA evaluation is needed. This is based on the IPE[1] and direction given in NUREG CR-2300.[4] If contribution to core damage frequency is less than 1×10^{-6} then the issue is screened. Cost-benefit based on core damage frequency reduction can be used to determine specific corrections for issues that are not screened by the PRA evaluation.

2.4 Information Assembly

The principle plant information source for the NMP1 IPEEE was the NMP1 UFSAR[6]. A number of other plant documents were used including: drawings, calculations, procedures, and plant operational records. These are referenced, where appropriate, throughout the Tier I and Tier II IPEEE reports.

This report comprises the Tier I documentation. Tier II documents are classified as those NMP1 IPEEE related documents retained at NMPC as reference to the information in the Tier I document. The Tier II documents include: walkdown notes, computer databases, computer models, calculations, and reports.

The IPEEE represents a "snapshot" of plant risk due to external events. Efforts made to make this analysis representative of current design and operation include:

- Using the most recent UFSAR information
- Using most recent versions of drawings, calculations, procedures, etc. to supplement UFSAR information
- Performing plant walkdowns to verify collected information and collect data on the current plant configuration and operation.

Walkdowns were performed for seismic, fire, and other analyses. Multiple walkdowns for each type of analysis were performed by a multidisciplined team comprised of NMPC staff and contractors. Details of the walkdowns and specific team composition are presented in the discussion of each analysis (Sections 3, 4, and 5).

3.0 Seismic Analysis

In response to Generic Letter 88-20, Supplement 4[2], NMPC committed to the EPRI seismic margins assessment[11] (SMA) method with NMP1 being assigned to the 0.3 g Focused Scope category. The review level earthquake (RLE) used for screening was 0.3g, as recommended by NUREG-1407[3]. The SMA was coordinated with and utilized the USI A-46 evaluation [10] submitted to NRC in response to Generic Letter 87-02.

The NMP1 IPE [1] was used to support development of success paths and the identification of associated components. All equipment and structures in the SMA success path will have a high confidence low probability of failure (HCLPF) of 0.3g peak ground acceleration (PGA) or greater except for the following:

Components	HCLPF (PGA)	Governing Failure Mechanism
Battery boards 11 and 12	0.27g	Base cinch anchors
Containment spray raw water pumps	0.29g	Bearing pressure

These components are judged to be reasonably close to the 0.3g screening value and do not warrant additional analysis or modification.

The components in the IPEEE success path that currently have a HCLPF less than 0.3g PGA are shown in the following table. Improvement initiatives are underway such that these components will have a HCLPF greater than 0.3g. These improvements are scheduled for completion by the end of the 1999 refueling outage. The improvements are discussed in more detail in Section 7.0.

Components	Assumed Modification
Control room ceiling	Diffusers need to be secured to T-bars in ceiling
Control panels F through N	Top cross-ties
Power boards 16 & 17 (A&B)	Base fillet welding
Power boards 102 & 103	Base fillet welding
Relay room cabinets (various)	Base fillet welds
Relay room cabinets (various)	Positive anchorage to prevent systems interaction
Aux feed breakers 102 & 103	Additional anchorage
Cable trays - single run in TB261	Missing rods on two (2) supports*
Relay chatter - diesel generator	Testing and possible replacement
Relay chatter - Cardox	Replacing certain relays with Mercury type contacts

*With the exception of this single run, other trays with cast iron inserts have a HCLPF >0.3g based on the assumption that proper thread engagement is achieved. A sampling of threaded rod inserts is being checked to verify proper thread engagement.

3.1 Seismic Margins Method

As discussed above, a SMA was performed for the seismic portion of the NMP1 IPEEE using the EPRI SMA methodology, EPRI NP-6041[11]. This analysis requires the development of a seismic success path. This success path represents a set of equipment that is capable of allowing the plant to safely respond to a particular seismic event. The SMA requires that a high confidence low probability of failure (HCLPF) value be assessed for every component in the success path. The HCLPF basically represents the maximum earthquake for which the particular component is expected to have a 95% confidence of remaining functional. Per NRC guidance, a HCLPF of 0.3g represents an acceptable margin against seismic events.

The following provides a brief description of the approach and tasks associated with the SMA described in this section:

1. Functional success paths and then progressively more detailed system level success paths were defined. Success paths are basically collections of functions and associated systems necessary for the plant to safely mitigate an earthquake. The system level success paths considered all front-line and support systems necessary for the success of the key mitigation functions of the plant. The components required to support these systems as well as the structures that house these components were identified. Section 3.1.2 describes this analysis, including consideration of non-seismic, human actions, dependencies, systems interactions, and relay chatter. The components and structures identified were included in the seismic capability analysis (item 3 below) and walkdown (item 4 below).

2. Containment performance (Section 3.1.5) and other seismic interactions or issues (Section 3.2) were also evaluated and considered during the walkdowns to ensure that the equipment list for the seismic capability analysis was complete.

3. Structures, systems, and components identified above were reviewed for seismic capabilities including seismic qualification, analysis and test information that would support the screening criteria of NP-6041. Calculations were performed as necessary to support screening against the criteria. Sections 3.1.3 and 3.1.4 discuss the analysis of the seismic capabilities of structures and components in the success paths.

4. Seismic walkdowns were conducted to support the seismic capability analysis as described in Section 3.1.1.

3.1.1 Review of Plant Information, Screening, and Walkdown

A significant amount of plant information was reviewed and used in the analysis. This includes the UFSAR[6], NMP1 IPE[1], and numerous other documents such as drawings, procedures, and seismic analysis, including the A-46 evaluation[10]. These additional documents are referenced in the NMP1 seismic Tier II documents.

The NMP1 site exhibits low seismicity and the original design basis is based on a statistical evaluation of seismic history. As part of the NMP1 seismic reevaluation program, an upgraded design basis ground response spectrum (GRS) was developed for a safe shutdown earthquake (SSE) with a 0.13g peak ground acceleration. This is considered a "realistic, median-centered" GRS per Generic Implementation Procedure (GIP)[12] Section II.4.2, according to NRC. Major structures (reactor and turbine buildings) at NMP1 are founded on rock; therefore, liquefaction was not considered an issue for the IPEEE analysis. The UFSAR and A-46 evaluations provide additional information on geology, seismology, and geotechnical engineering.

The seismic capability analysis of components and structures, including walkdown notes are documented in NMP1 Tier II documents and Screening Evaluation Work Sheets (SEWS). The same SEWS are part of the A-46 evaluation and are similar to those developed by the seismic qualification utility group (SQUG)[12].

Although a number of seismic walkdowns were performed as part of the A-46 evaluation, additional walkdowns were performed in support of the IPEEE. The IPEEE scope included passive components and structures, containment isolation and performance, and seismic interactions. Walkdowns are documented in Tier II reports and the SEWS in accordance with EPRI NP-6041[11] and SQUG[12]. The Seismic Review Team (SRT) for the IPEEE included the following individuals who performed seismic walkdowns, reviewed the SEWS, are SQUG trained and certified, and were part of the A-46 evaluation team:

Carmen Agosta - Niagara Mohawk Power Corporation
Walter Djordjevic - Stevenson & Associates

The following individuals also supported the SRT walkdown:

Pete Francisco - Niagara Mohawk Power Corporation
Leroy Kassakatis - Niagara Mohawk Power Corporation
Robert Kirchner - Niagara Mohawk Power Corporation
Thomas Casey - J H Moody Consulting, Inc.
James Moody - J H Moody Consulting, Inc.

These individuals participated in almost all aspects of IPE and IPEEE development at NMP1, including seismic IPEEE evaluations & walkdowns and fire IPEEE evaluations & walkdowns. They provided the coordination of these analyses and between external event teams.

Numerous walkdowns were performed during the seismic evaluation (i.e., to support the block wall screening analysis and using an ultrasonic detection system to confirm the existence of a horizontal beam in the common diesel building block wall). Major walkdowns with the SRT are summarized below along with a summary of major observations:

- On March 7 and 8, 1995, major structures and components were walked down. Emphasis was placed on IPEEE scope not within the A-46 evaluation scope. With the exception of anchorage, equipment walked down and accepted for the A-46 evaluation was judged to

screen at 0.3g. Outliers due to anchorage from the A-46 assessment and some new IPEEE scope structures and components were noted as requiring further analysis, HCLPF calculations, or modification. Seismic systems interactions were also considered. For example, block walls were identified as requiring additional evaluation (Section 3.1.2.3.3). Flooding (Section 3.1.2.3.1) - fire water deluge valves and their associated fire water headers were noted to have very good support and screened at >0.3g. However, some local fire water piping concerns were noted for further evaluation. Fires (Section 3.1.2.3.2) - the hydrogen control station header and piping was investigated and screened. The main generator seal oil vacuum tank was also screened.

- On May 10, 1995, additional seismic system interactions were walked down. Prior to the walkdown, fire water systems were evaluated to determine which portions of the piping might cause flooding. This piping was walked down and screened at >0.3g. Three oil storage areas were walked down. One area screened because the room would contain the oil and success path components were not in close proximity of the room. Another room also screened for similar reasons; small tanks with a lower capacity would be contained in the room and larger tanks screened. The third room was deferred to the block wall evaluation because the room was constructed totally of masonry blocks.

- On August 28-30, 1995, Robert P. Kennedy performed the peer review walkdown and initial documentation reviews. Key calculations and outlier resolutions still being resolved were identified as requiring further review by Mr. Kennedy. All comments and suggestions [79 and 80] have been resolved to Mr. Kennedy's satisfaction.

3.1.2 Systems Analysis

3.1.2.1 Identification of Structures, Systems & Components

This section documents the evaluations conducted to identify structures, systems and components to be included in the seismic capability screening and analysis. The EPRI methodology [11] was used as guidance along with previous seismic probabilistic risk assessments (PRA)[19] and the NMP1 IPE [1]. The end product from the evaluation includes the following:

- A functional success logic diagram, Figure 3.1-1, which identifies systems required for each safe shutdown success path, given a seismic initiating event. The necessary support systems for each front line function or system in the success diagram is also provided in the figure (underneath the front line system or function block).

- A list of structures, systems, and components and their locations are identified in Tables 3.1-1A and B for further seismic capability screening and analysis.

The active components identified in Table 3.1-1B are in a database that allows components to be sorted by system, component type or class, location, and cabinet. This allowed grouping of components for the seismic screening and walkdown. In addition, the IPEEE system designation

used in Table 3.1-1B ("System" column) is identified in the functional success diagram, Figure 3.1-1.

The identification of success paths and components is based on minimal credit for operator actions. This ensures that the identification of components starts out conservatively. During the seismic capability screening and evaluation, conservatism with regard to not taking credit for operators recovering equipment failures will be reconsidered, as appropriate. The success diagram was developed to show the differences between assuming a small Loss of Coolant Accident (LOCA) initiating event versus no small LOCA event. If the small LOCA success path can be shown to be seismically rugged and reliable, there is no need to consume resources evaluating components inside containment with the intent of justifying a low probability for small LOCA. Also, this strategy will reduce the number of systems that have to be seismically evaluated. The small LOCA assumption means that the emergency condensers and control rod drive pumps can not be utilized as a success path since they are assumed to be inadequate under LOCA conditions. Also, shutdown cooling is assumed unavailable under LOCA conditions (the IPE did not credit SDC when water LOCA conditions exist). Eliminating these front line systems from the success diagram means that certain support systems may not have to be considered. The condensate storage tank (CST), condensate transfer, diesel fire water, reactor building closed loop cooling (RBCLC), and service water systems are not required to support the small LOCA success paths (the IPE concluded that RBCLC and service water were not critical to room cooling). In addition, the equipment list includes a minimal set of instruments required for the operators to maintain inventory control and heat removal functions. Finally, success is defined as maintaining at least hot shutdown conditions for 72 hours.

Relays and contactors that must function in order for success diagram systems to actuate are included in the equipment list developed here. Relay or contactor chatter which could prevent system operation or cause other consequential impacts are evaluated later in this section.

The "class" column in Table 3.1-1B is used to identify whether the component was in the A-46 scope (A-46) or new to the IPEEE scope (IPEEE). Also, a "/C" indicates that the component was evaluated as part of the cabinet where it is located. Components in Table 3.1-1B can be sorted or grouped by any of the columns to support walkdowns and seismic capability screening and analysis. For example, those components that are new since A-46 (IPEEE in the "class" column) were sorted by "Bldg" and "Elev" in preparation for the walkdown.

The following summarizes the approach utilized in this evaluation:

- Functional success paths were developed with the aid of the IPE (PRA) event tree models. The IPE event tree logic models contained in the NMP1 Individual Plant Evaluation (IPE) were directly applicable to this task and the Appendix R safe shutdown analysis was reviewed as well as operating procedures.

- Support system requirements for the above functional success paths were identified. Again, the IPE model was utilized because it documented these dependencies (including dependency

tables) as well as the success logic for the front line functions in terms of support system requirements.

- Operator actions and instrumentation & controls required to support the functional success paths and other support systems were evaluated and identified. The IPE and operating procedures were utilized.

- Based on support system dependencies, past seismic PRA experience, and IPE insights, some success paths were eliminated from further consideration. For example, all systems dependent on normal offsite AC power were excluded due to the low seismic capacity of offsite AC power.

- A list of components was developed for each system with an indication of the component location. Again, the IPE models were used initially, and then piping & instrument drawings, electrical drawings, and Appendix R safe shutdown analysis were reviewed to ensure completeness in the equipment list. The location of equipment was used to ensure that the list of structures was complete for seismic capability screening and analysis.

- The success paths and related equipment identified above are associated with providing safe shutdown (no core damage). Containment performance was also assessed to assure that those structures, systems, and components essential to maintaining primary containment integrity, including interfacing LOCA scenarios, were considered.

- Seismic spatial systems interactions were considered to prepare for the walkdowns and to address their potential influence on seismic risk.

- Non-seismic failures and human actions were considered relative to the success diagram to assure that their potential influence on seismic risk is considered.

- The equipment list developed for the A-46 evaluation was reviewed as a check and to ensure consistency and/or understanding of differences in scope.

3.1.2.1.1 Identification of Functions & Front line Systems

A simplified success diagram can be considered based on satisfying those safety functions necessary to assure a safe stable shutdown condition. Consistent with the IPE, the following functions must be satisfied:

- Reactivity Control

- Reactor Pressure Vessel (RPV) Pressure Control

- RPV Inventory Control

- Decay Heat Removal (Containment Pressure Control)

For each of the above functions, potential system level success paths were defined from the IPE for each function and the simplified success diagram in Figure 3.1-1 displays the results of this evaluation. Then, the basis for eliminating certain systems was documented based on initial seismic capability considerations. Note that the success diagram also includes the main control room & instrumentation as a separate common function that is necessary to support the above major functions.

The simplified success diagram in Figure 3.1-1 was developed considering both transient and small LOCA initiators due to the earthquake. The highlighted path in Figure 3.1-1 assumes a small LOCA occurs and is considered the primary success path. Those systems that are unlikely to support success during LOCA conditions were not evaluated for the following reasons:

- The additional effort involved in demonstrating low probability of no LOCA could be significant and may not even be successful.

- If a no LOCA condition could be demonstrated and the secondary success paths were included, a significant number of additional components would have to be evaluated. However, given the redundancy (reliability) in the ADS, core spray, and containment spray systems, in combination with the low probability of an earthquake (i.e., large enough to cause loss of offsite power, balance of plant, and a small LOCA), these additional success paths are unnecessary to demonstrate low risk unless the seismic capacity of the primary success path is inadequate.

The A-46 evaluation scope does include the secondary success paths excluded from the IPEEE scope, but the above logic could support a decision to not make modifications in this scope.

As shown in Figure 3.1-1, the emergency condensers and control rod drive (CRD) pump makeup alone are not considered sufficient to maintain RPV inventory control under small LOCA conditions. Shutdown cooling as a heat removal system is not considered adequate given water LOCA conditions. By not including shutdown cooling in the success path, service water and RBCLC, two major support systems, were also excluded. Emergency diesels and containment spray heat exchangers have their own dedicated raw water pumps and as described in the IPE and this report RBCLC is not critical with regard to providing room cooling. Also, vapor suppression is assumed to be required in response to a small LOCA initiator. Medium and large LOCAs were not considered because the seismic capability of piping and reactor coolant pressure boundary components is considered very high relative to large leaks based on past generic analyses. Thus, the likelihood of medium or large LOCAs is assumed to be small. This is verified in the seismic capability screening and analysis. Also, the success criteria for medium and large LOCAs requires a subset of the systems in Figure 3.1-1. Therefore, the functional success diagram was judged to include the required systems.

The following summarizes the results of the functional evaluation:

Reactivity Control - The reactor protection system (SCRAM function) is the normal reactivity control system. This is a highly reliable fail-safe design and is expected to have a high seismic capacity.

Given that the electrical portion of the SCRAM function fails, recirculation pump trip and alternate rod insertion provide an alternate success path. Given that the mechanical portion of the SCRAM function fails (or electrical portion and alternate rod insertion fails), liquid poison injection, recirculation pump trip, alternate rod insertion, and feedwater trip provide an alternate success path. Although liquid poison and these other systems may be seismically acceptable, operator actions are somewhat more demanding than a transient or small LOCA with SCRAM success. Also, the design of the RPS is fail-safe and is expected to have a high seismic capacity. For these reasons, ATWS mitigation systems were not considered for further evaluation.

RPV Pressure Control - There are 6 electromatic relief valves that provide sufficient reliability to provide pressure control and their seismic capability to open on demand is expected to be high from past seismic PRAs. Note that these same valves are required to depressurize the RPV (ADS/emergency RPV depressurization) when low pressure inventory makeup to the RPV is required.

There are 9 safety valves that provide pressure control backup to the relief valves. These valves are excluded because the 6 relief valves are judged adequately reliable, to have sufficient seismic capacity, and the relief valves are probably necessary to support low pressure inventory makeup (see RPV inventory control below).

The emergency condensers are also a backup to the relief valves in that they would provide pressure relief. The emergency condensers are not included for the same reasons discussed above for the safety valves.

The main condenser and its support systems depend on normal offsite AC power. Since the seismic capability of offsite power is known to be low, the main condenser was not considered for further evaluation.

RPV Inventory Control - The following inventory control success paths are in Figure 3.1-1:

1. Automatic depressurization of RPV (ADS) and the core spray systems are highly reliable (sufficient redundancy) and provide successful inventory control for LOCA as well as non-LOCA scenarios.

2. Emergency condensers with CRD pump makeup are highly reliable (sufficient redundancy), but only provide success for non-LOCA scenarios. Note that the ECs can also provide RPV pressure control and heat removal functions. This success path is not being evaluated due to the resources required to demonstrate that a small LOCA is unlikely.

Condensate & feedwater (including HPCI function) depend on normal offsite AC power. Since the seismic capability of offsite power is known to be low, condensate & feedwater was not considered for further evaluation.

Aligning fire water (e.g., diesel fire water pump) to the feedwater injection path was not included because the fire water system is not expected to have a high seismic capacity and the availability of the diesel fire water pump is not high. This alignment also requires operator actions in the turbine building.

Aligning containment spray raw water to the core spray injection path was not included. Raw water is already included with containment spray as described later under heat removal and the core spray injection path is included with core spray above. The additional MOVs required to support this alignment could be included as a backup to the core spray pumps.

Heat Removal (Containment Pressure Control) - The following describes the systems and heat removal success paths in Figure 3.1-1:

1. Vapor suppression is assumed to be required in the short term to support primary containment pressure control during small LOCA scenarios. Although the operators have at least 30 minutes to mitigate vapor suppression failure for a small LOCA, this is neglected.

2. The containment spray system, including containment spray raw water, is the primary heat removal system and applies to LOCA as well as non-LOCA scenarios. This system is a highly reliable system with four pump trains. Although torus cooling is the primary means of providing containment heat removal in the EOPs, "Intermittent Sprays" is also shown because torus cooling depends on instrument air and containment spray heat removal is more representative of the original design which utilized the sprays as the heat removal path. However, the present procedures have the operators stop containment spray at 12 psig and initiate at 3 psig, thus the term "intermittent sprays." Because of the torus cooling dependency on instrument air, this path was not evaluated.

3. Containment venting applies to small LOCA as well as non-LOCA scenarios. This system depends on instrument air to open a torus purge valve, therefore, this path was not evaluated.

4. The emergency condensers can provide the heat removal function as long as makeup can be provided in the long term. This was only allowed to be a success for non-LOCA scenarios. Also, the condensate transfer pumps and CST <u>or</u> diesel fire water would be required to supply long term makeup to the emergency condensers. These are all new systems and since this path only applies to non-LOCAs, it was not evaluated.

5. The shutdown cooling system can provide heat removal for non-LOCA scenarios. However, two new systems have to be added to support this function, RBCLC and service water. For these reasons, it was not evaluated.

As described above under RPV pressure control, the main condenser and its support systems depend on normal offsite AC power. Since the seismic capability of offsite power is known to be low, the main condenser was not considered for further evaluation.

In summary, vapor suppression and the containment spray system are suggested as the primary systems to provide heat removal. These systems have high reliability, add fewer additional support dependencies, were originally part of safety design, and are expected to be seismically acceptable.

3.1.2.1.2 Identification of Support Systems

Systems required to support the front line systems defined in the previous section were identified from the IPE (detailed dependency tables) and checked by reviewing the UFSAR, operating procedures and drawings. This evaluation assumes that reactivity control, RPV pressure control and RPV inventory control must initially function automatically without the operator. Long term operator control and recovery actions are assumed to be required and are allowed. Heat removal is not automatic and requires the operators for the long term requirement. Instrumentation requirements to support RPV inventory control and heat removal are identified.

Figure 3.1-1 only shows the front line system direct support dependencies. Support system dependencies on other support systems are not shown in the figure, but are described below.

Reactor protection system and SCRAM function

The reactor protection system input signals are de-energize to actuate and are therefore fail-safe on loss of 120V AC. The scram signal will cause electrical power to be interrupted to the scram pilot solenoid valves on each CRD hydraulic control unit, and all control rods will be rapidly inserted into the reactor core. The scram pilot solenoid valves fail-safe on loss of support system (instrument air and power). No additional systems were added to the success diagram to support the reactivity control function.

Control Room & Instrumentation

Besides the instrumentation required to support actuation of systems, instrumentation is required for the operators to maintain inventory control and heat removal functions. These instruments depend on RPS buses (120V AC) and are identified.

Electromatic Relief Valves

There are 6 relief valves that depend on 125V DC power. Since this function is only required in the short term response, the batteries should be sufficient and dependencies on AC power were not assumed. This is different for the ADS function described later.

Vapor Suppression

The torus to drywell vacuum relief valves have to be functional, but there are no support system dependencies.

RPV Depressurization (ADS)

When feedwater, CRD pumps, and emergency condensers are unable to maintain RPV inventory control, the automatic depressurization system (ADS) and the core spray system are required. ADS depends on 125V DC to open the valves, RPS buses (120V AC) for actuation, automatic actuation signals (Lo-Lo-Lo RPV level coincident with Hi drywell pressure) and 4KV to power the automatic ADS logic (4KV to 120V transformer is the power source for the logic which provides permissive). Manual actuation is a possible backup to the RPS buses and signals.

Note that only the direct support dependencies are shown in Figure 3.1-1. Since it is assumed that the relief valves would have to remain open for the 72 hour success criteria, emergency AC power and the static chargers are also necessary to keep the relief valves open. AC power requires emergency diesels and their support systems for success, as well as the screenwell intake.

Core Spray

Core spray depends on emergency AC power, DC power, and automatic actuation signals. Loss of RPS buses provides fail safe signals to actuate core spray, therefore these systems are not considered dependencies for core spray actuation. Failure of automatic actuation instruments that provide Lo-Lo RPV level or Hi drywell pressure signals can be recovered by manual actuation. However, failure of a coincident <365 RPV pressure instrument for the injection MOVs to open can not be recovered, therefore, core spray injection valves can not be opened.

Again, emergency AC depends on the screenwell intake for diesel cooling.

Containment Spray

The containment spray system, including containment spray raw water, depends on emergency AC power, 125V DC power, and the screenwell intake as the ultimate heat sink for the containment spray raw water system.

Containment spray is automatically actuated and the logic requires both Lo-Lo RPV level and Hi drywell pressure. However, raw water to the containment spray heat exchangers is manually initiated. There is significant time for the operators to initiate containment heat removal and the actuation logic is fail safe on loss of RPS buses. Therefore, these are not considered dependencies for containment spray heat removal..

As shown in Figure 3.1-1, there are two ways to provide heat removal with the containment spray system. Torus cooling is preferred, but this adds additional support systems, including Power Board 167 and instrument air which depends on RBCLC. It may be difficult to evaluate a system like instrument air because this system piping supplies a number of plant areas and demonstrating no piping failures could be burdensome. The second method is to utilize containment spray intermittently as required by the EOPs. It is referred to as intermittently because the EOPs require the operators to terminate sprays when drywell pressure is less than 3.5 psig and initiate when pressure is greater than 12 psig or drywell temperature is greater than 300 F.

From a seismic analysis point of view, the use of sprays to control containment pressure and heat removal in the long term is considered the preferred path. This limits the amount of equipment that must be evaluated and it represents the original design basis.

Containment Venting
Containment venting depends on 125V DC, Power Board 167 (from emergency AC), and instrument air. Containment venting also depends on operator actions, but there is significant time. As described for torus cooling above, it may be difficult to evaluate a system like instrument air because this system piping supplies a number of plant areas and demonstrating no piping failures could be burdensome. Therefore, this is not considered in the primary success path and was not evaluated.

Emergency Condensers
The emergency condensers only require Lo-Lo RPV level or Hi RPV pressure instruments for automatic actuation. All other support system failures cause actuation of the emergency condensers (instrument air, 125V DC, and RPS buses). The IPE treated loss of RPS buses as a failure because indication and alarms were lost with regard to controlling the EC makeup supply. Note that the emergency condensers probably can not maintain RPV level above the top of active fuel without makeup (CRD makeup is assumed required in the success diagram). In addition, the ECs are not adequate under LOCA conditions. Therefore, this is not considered in the primary success path and was not evaluated.

CRD Pump Makeup
The CRD pumps depend on 125V DC, emergency AC, and the CST. With the emergency condensers, a CRD pump can maintain RPV inventory control as long as their is no LOCA condition. Therefore, this is not considered in the primary success path and was not evaluated.

Long Term EC Makeup
In order for the emergency condensers to provide heat removal for 72 hours, long term makeup is required from either the CST via the condensate transfer pumps or the screenwell intake via the diesel fire pump. The condensate transfer pumps depend on emergency AC power. Since emergency condensers are not evaluated, this is not considered in the primary success path and was not evaluated.

Shutdown Cooling
Shutdown cooling depends on 125V DC, emergency AC power, RPS bus 12, RBCLC, and emergency service water. Also, no credit was given to shutdown cooling in the IPE under water LOCA conditions. Therefore, this is not considered the primary success path and was not evaluated.

3.1.2.1.3 Evaluation of 72 Hour Success Criteria

The seismic evaluation requires safe shutdown conditions for 72 hours rather than the 24 hours used in the IPE. As a result, those support system dependencies in the IPE that were potentially sensitive to time were identified and evaluated. The following summarizes these considerations:

- Condensate storage tank: This tank supports RPV makeup from the feedwater (HPCI) system and CRD pumps, and is a source of emergency condenser makeup. Considering RPV makeup without the emergency condensers, this tank is judged inadequate to last 72 hours. With the emergency condensers and no LOCA condition, the tank may be adequate for 72 hours. Since feedwater and the emergency condenser and CRD pump makeup path was not retained as a primary success path, the CST was not evaluated.

- 125V DC Power: Since emergency AC power is required, the batteries need only survive the earthquake and be available on demand to support emergency diesel starting and other initial start loads. As long as the static charger and AC power are available after this battery demand, the batteries are not required in the long term. Note that the batteries can not supply DC loads for 72 hours without AC power support.

- Emergency Diesel Fuel Supply: The diesel fuel supply will last for 72 hours.

- Room Cooling: The only areas of concern in the IPE were the two emergency diesel areas (roof fans and the roll door in each room). All other areas were judged to have slow heatup rates and/or maximum temperatures were low enough. Those areas screened out in the IPE were reviewed to ensure that there are no new components that should be added.

3.1.2.1.4 Non-seismic Failure and Human Action Considerations

The evaluation of seismic risk requires consideration of non-seismic failures and human actions. The following systems in the success diagram (Figure 3.1-1) have the highest non-seismic unavailability:

- The emergency diesels are the most important support system. The unavailability of diesel generators is higher than redundant components that depend on them and offsite power is not expected to be available due to its low seismic capacity. Seismic failure of offsite power (nonrecoverable) and non-seismic failure of the emergency diesels (recoverable) would result in a station blackout. However, this frequency can be shown to be relatively low.

  Given a station blackout, the availability of emergency condensers would allow for some recovery time depending on whether there are LOCA conditions and the success of operator actions such as shedding DC loads and providing long term makeup to the ECs and the RPV with the diesel fire pump. However, the emergency condensers are not included in the scope since the effort to ensure no LOCA conditions would be significant and long term makeup capabilities are questionable. Even with successful operator actions, the plant was not allowed

to survive for 24 hours in the IPE without AC power recovery.

- The diesel fire pump availability is also not very high in the IPE, but could be important during station blackout sequences. However, it is judged unlikely that the pump would have a seismic capacity as high as the emergency diesels and these components are not included in the primary success path.

Potential Significance of Non Seismic Failures

The emergency condensers are judged to have a higher seismic capacity than offsite power. It is uncertain whether diesel fire water would have a higher capacity than offsite power, but it could be slightly higher. In addition, the HCLPF for a small LOCA is judged to be higher than offsite power. Thus, in a seismic probabilistic risk assessment, the estimated HCLPF for these systems (ECs, fire water, and small LOCA) could be important for scenarios where the diesels fail due to non-seismic causes or even seismic causes. As an example, if the HCLPF for a small LOCA, ECs and fire water is greater than the HCLPF for offsite power, there is a range of earthquakes where the EDGs survive the earthquake but fail due to non-seismic causes and the plant can cope with this situation for a long time. At NMP1, the ECs with a diesel fire water pump for EC makeup and RPV makeup can provide a safe stable shutdown state given if a LOCA condition does not exist. Actually, with a LOCA condition, fire water can provide inventory makeup if the RPV is depressurized with the relief valves. Heat removal becomes a long term concern as does DC power (i.e., when DC runs out the relief valves will close). Even if fire water does not survive, the ECs alone provide time for recovery if a LOCA condition does not exist. Because of the potential importance of these in estimating the seismic risk at NMP1, attempts could be made to estimate the HCLPF of these systems based on expert opinion (expending major resources to obtain this judgment may not be justified).

Human Actions

The success diagram development and the identification of components is based on minimal credit for human actions (automatic actuation is included in the seismic assessment). The following operator actions are required to support the primary success path in Figure 3.1-1:

- Establishing the heat removal function requires the operators to start and align containment spray raw water to containment spray heat exchangers. The operators have several hours to perform this action, it is proceduralized, and the actions can be accomplished from the control room.

- Shedding diesel loads during LOCA conditions is required and was modeled in the IPE. Given loss of offsite power and LOCA conditions, this would be required if the operators successfully reset lockout relays and started a number of pumps (i.e., CRD, RBCLC, service water and Power Board 16A/B-17A/B tie breakers) which are not required to support the primary success path. LOCA conditions would be synonymous with core spray, containment spray and raw water pumps running. This action is proceduralized and expected to be reliable because if the operators reset relays and start equipment which would have to be available after the seismic event to overload the diesel, they also would be expected to control diesel loading.

The following actions would be required to support the secondary success paths in Figure 3.1-1:

- Torus cooling and containment venting are shown in the success diagram, but these backup paths are not included in the scope because containment spray can provide containment heat removal, is sufficiently reliable, and is expected to have an adequate seismic capacity. Still, the operators have several hours to utilize these success paths even without support systems.

- Given loss of normal AC power, the operators have to reset lockout relays in the control room before RBCLC, service water, shutdown cooling, and instrument air can be restarted. These systems are included in the secondary success paths.

- Other operator actions associated with long term EC control & makeup, SDC alignment, restarting CRD pumps, and other support systems (i.e., RBCLC, service water, instrument air compressors) are associated with secondary success paths.

The IPE modeled an operator action to manually depressurize the RPV at top of active fuel when high pressure injection systems are unavailable. It was assumed that the operators correctly inhibited ADS per the EOPs, thus requiring this operator action to provide successful low pressure injection. If the operators correctly inhibit ADS after an earthquake, there is no reason to believe that they would not depressurize the RPV at top of active fuel per the EOPs. This assumption reinforces the importance of level instrumentation. Also, the equipment necessary to actuate ADS automatically is included in Table 3.1-1B.

Other potential operator actions that may be considered, in any future IPEEE updates, dependent on the seismic capability of components include the following:

- If the fragility of the vapor suppression function is low, the operators can mitigate this failure by initiating containment spray, emergency depressurizing the RPV, or venting containment, if available.

- If the fragility of room cooling equipment is low, the operators have time to open doors and perform actions identified in the IPE.

- If automatic actuation of systems, including ADS, has a low fragility, manual initiation of systems could be considered.

3.1.2.2 Component List Development

Table 3.1-1 represents the final list of components required to maintain the safety functions and systems identified in Figure 3.1-1 (primary success path). Table 3.1-1A includes a list of structures and passive components. Table 3.1-1B includes a list of active mechanical and electrical components. Note that manual switches, valves, check valves, and valves with actuators that do not have to change state are excluded from Table 3.1-1B. However, their pressure boundary

capability must be considered along with piping in Table 3.1-1A. Instrumentation, relays and contactors required to support system actuation and the operators are included in Table 3.1-1B. Relay and contactor chatter is not included in these tables, but is evaluated later. Also, the evaluation of non-seismic failures and human actions is discussed above. Containment performance and systems interactions are assessed later in this section.

The success diagram and subsequent development of the component tables were developed initially from the IPE. Table 3.1-2 identifies those IPE systems and event tree top events that are included in the primary success path. The fault trees and drawings developed for the IPE were used to identify the components included in Table 3.1-1. Table 3.1-2 also identifies those event tree top events from the IPE that were not included in the primary seismic success path although some of these may be shown as alternate paths in Figure 3.1-1. The following summarizes why these top events are not included:

- Station Blackout Top Events - the seismic success diagram does not allow station blackout recovery. This model is operator action intensive and the probability of recovering AC power after a relatively large earthquake is very uncertain and therefore, is neglected in this analysis.

- ATWS Top Events - The SCRAM function is reliable and is expected to have a high seismic capacity as the electrical portion is fail-safe. In addition, the ATWS model requires operator actions and therefore, is neglected in this analysis.

- Normal AC Power Dependent Top Events - Systems and top events that depend on normal AC power are excluded. As described in the previous sections, normal offsite AC power is known to have a low seismic capacity.

- Level 2 top events are not included, but containment performance is considered in a later section.

- Fire water crosstie to feedwater and containment spray raw water crosstie to core spray are not included because most of the equipment is already included and these capabilities include additional operator actions.

- The condensate storage tank is not included because inventory is not expected to last 72 hours as required for seismic success criteria except possibly if LOCA conditions do not exist and emergency condensers are available.

- Alternate success paths are not evaluated as explained previously due to difficulties in demonstrating that small LOCAs will not occur and because the primary path is expected to be reliable and have adequate seismic capabilities.

- Several operator actions are neglected such as AC power recovery.

To ensure completeness in the component lists, system piping and instrumentation diagrams, electrical diagrams, and other electrical & mechanical equipment location data were reviewed. In

addition, the Appendix R safe shutdown analysis, UFSAR and operating procedures were reviewed. Identifying the location of components in the tables is required for the seismic capability analysis and served as another check on the list of structures.

The remainder of this section documents notes on the systems review.

3.1.2.2.1 Scram Function

In the IPE, a simplified model was used because the reactor protection system input signals are de-energize to trip and the scram inlet and outlet valves fail open on loss of support systems. If both hydraulic control unit (HCU) scram valves fail due to a seismic event, the potential exists for common cause failure to scram (i.e., CRD pumps are assumed to be lost and accumulators leak and depressurize). These valves are included as part of the HCUs in Table 3.1-1A. Mechanical failure of reactor internals, CRD housings & supports are also included in Table 3.1-1A.

If offsite power is available and/or other support systems are available during a seismic event, fail-safe signals can not be assumed. In this case, the input signal failure mode would have to prevent all signal parameters in at least two scram channels in the same RPS trip system from providing a scram signal. Several diverse input signals would have to fail and no spurious signals from the earthquake could occur. This is considered very unlikely and is not modeled in the success diagram.

3.1.2.2.2 Pressure Relief

The six relief valves, including instrumentation, relays, and other components required to provide automatic pressure relief were identified and included in Table 3.1-1B as part of the ADS system (see ADS section below).

3.1.2.2.3 Instrumentation Requirements

The instrumentation needed to respond to a seismic event should include those instruments used to start and run the selected front line systems, their support systems, and perform the expected EOP directed actions. The instruments required to start and run systems in the success diagram are identified for each system and included in Table 3.1-1B.

A minimum set of instrumentation was identified for the operators to maintain inventory control and heat removal functions. The IPE and EOPs were used to define the equipment. The parameters identified as most important for seismic capability screening analysis include reactor vessel level and pressure, torus pool level and temperature, and drywell pressure and temperature. The applicable components, power supplies, and locations are included in Table 3.1-1B.

Other parameters such as torus pressure, hydrogen and oxygen concentrations, and radiation levels were considered less important and were not evaluated. In addition, the support system requirements, component types and locations are very similar to the parameters chosen.

One potential systems interaction concern has to do with the possibility that failure of some instrumentation could lead the operator to perform undesired actions. For example, failure of several rod position indicators and failure of APRMs could force the operator to consider liquid poison and power control via reduced RPV water level. Therefore, APRMs and their indicating device are included in Table 3.1-1B.

3.1.2.2.4 Vapor Suppression

Vapor suppression function initial success requires integrity of the downcomer pipes, the drywell to torus interface structures, and the vacuum breaker check valves must stay closed. Thus, these components are included in Table 3.1-1A. The vacuum breakers for the electromatic relief valves are not included because vapor suppression failure requires a stuck open relief valve <u>and</u> a failed open relief valve tail pipe vacuum breaker path <u>and</u> a failed open torus to drywell downcomer vacuum breaker path.

3.1.2.2.5 Automatic Depressurization System (ADS)

The IPE did not model automatic ADS actuation because it was conservative to assume that the operators inhibited ADS and then were required to manually initiate ADS at top of active fuel. The necessary components for automatic initiation were identified and are included in Table 3.1-1B. The ADS valves are the same 6 relief valves described above for pressure relief.

3.1.2.2.6 Core Spray

Core spray components, including those required to automatically actuate the system, were identified and are included in Table 3.1-1B.

3.1.2.2.7 Containment Spray

Containment spray and containment spray raw water components were identified and are included in Table 3.1-1B. Heat removal with raw water requires manual actions and there is significant time to manually initiate sprays, therefore, automatic actuation of containment spray was not evaluated or included in Table 3.1-1B.

The torus cooling path depends on instrument air and is not evaluated or included.

3.1.2.2.8 Containment Venting

The containment venting path depends on instrument air and is not evaluated or included.

3.1.2.2.9 125V DC Power

Those components associated with providing 125V DC power at battery boards 11 and 12, and valve boards 11 and 12 were identified and are included in Table 3.1-1B.

3.1.2.2.10 Emergency AC Power

Those components associated with providing 4KV and 600V AC power at power boards 102 and 103, 16B and 17B and MCC 161 and 171 were identified and are included in Table 3.1-1B. The diesel generators and their support systems, such as the raw water pump, roof fans, rollup door & motor, and air are included. Also, power board 167 was added to Table 3.1-1B as a result of the containment performance evaluation described in Section 3.1.5.

3.1.2.2.11 Reactor Protection System (RPS) Buses

Those components associated with providing 120V AC power at RPS buses 11 and 12 were identified and are included in Table 3.1-1B.

3.1.2.2.12 Screenwell Intake

The screenwell intake and discharge tunnel from the lake, the gates, and associated piping and structures are included in Table 3.1-1A. These components are required to support, relative to the IPEEE success path, emergency diesel cooling and containment heat removal. Each diesel has a raw water pump for cooling which is included in the AC power system above and each containment spray heat exchanger has a raw water pump which is included in the containment spray system above.

3.1.2.2.13 Signals

Input signals and components required for automatic actuation of ADS and core spray systems were identified and are included in Table 3.1-1B.

3.1.2.2.14 Other Systems

Other systems shown in Figure 3.1-1 and considered as alternate success paths have not been evaluated and included in Table 3.1-1. These systems include emergency condensers, control rod drive as RPV makeup, long term EC makeup, condensate storage tank, condensate transfer, shutdown cooling, instrument air, RBCLC, emergency service water, diesel fire water pump, and power boards 167 (included for containment isolation), 16A and 17A. These may be credited in any future IPEEE updates should a reduction in conservatism be desired.

3.1.2.3 Spatial Seismic Systems Interactions Potential

The potential for spatial system interactions was considered during seismic walkdowns. System interaction issues are considered and noted on the screening and evaluation walkdown sheets for IPEEE. The following provides examples of what was considered either previously as part of A-46 walkdowns and/or as part of the IPEEE:

- Proximity: The proximity of structures to components and components to components was considered during walkdowns. For example, the proximity of valve operators to structures and other components was considered. It was noted during the walkdowns that the capacity of block walls near important equipment would have to be evaluated.

- Seismic II over I: Examples include consideration of instrument lines and the proximity of block walls to equipment (see proximity of block walls above).

- Seismic Spray & Flooding: The possibility of water spray and flooding impact on systems was considered during the walkdown. It was noted during the walkdown that cable tray water spray piping was supported by the cable trays. The potential exists for piping failures due to movement of the trays and piping during a seismic event. A systems evaluation of potential flooding impact on the success path is discussed further below.

- Seismic Fires: The capacity of hydrogen piping and other fire hazards was considered as well as proximity to important equipment. This is discussed further below.

3.1.2.3.1 Flooding Interactions

The internal flood analysis in the IPE was reviewed to assess the potential for seismically caused flood impacts on the success paths. The IPE identified the following major flood sources:

Source	HCLPF	Explanation
Circulating water	yes	Flooding only/need HCLPF>>LOSP
Emergency service water	yes	Flooding only
Normal service water	yes	Flooding only/need HCLPF>>LOSP
Fire water	yes	Flooding only
Cont spray raw water	yes	Needed to support success path
Diesel raw water	yes	Needed to support success path
Condensate storage tanks	no	Not needed/not significant flood source
Torus-suppression pool	yes	Needed to support success path
RBCLC & TBCLC	no	Not needed/not significant flood source

The above table indicates those systems where a HCLPF would be helpful in demonstrating a low frequency of flooding. The table also indicates when a HCLPF is required because the system is needed to support the success path analysis. For those systems supplied by normal AC power, it is only necessary to show that the non-safety piping HCLPF is much greater than the loss of offsite power HCLPF (LOSP) to justify screening (i.e., probability of offsite power success and pipe failure is low).

Based on the IPE, RBCLC and TBCLC are limited volume systems and would not flood safety related equipment. Loss of condensate storage tanks was evaluated in the IPE and it was determined that the tank volume would drain to lower elevations of the turbine building and not impact safety equipment. The Torus and its connections to ECCS, diesel raw water, and containment spray raw water are considered to be in the seismic scope and are included in Table 3.1-1. Therefore, these systems are not considered further.

Non-safety systems connected to Lake Ontario (circulating water, service water and fire water) are potentially important flood sources that are not included in the seismic success path scope. Based on past PRAs and seismic analysis, non-safety piping typically has a relatively high capacity in comparison to normal offsite power which would have to be available for a non-safety system to cause flooding (i.e., normal offsite power would be required to pump Lake Ontario water into the plant). The pumps are located in the screen house above the lake level. Also, the pump seismic capacity would have to be greater than the piping which is questionable. Thus, it is judged unlikely that a seismic event would cause a significant flood with normal offsite power and pumps available. Still, non-safety piping is included in Table 3.1-1 for seismic capacity considerations.

Even if there were leaks in these non-safety systems and pumps were running, based on the plant layout, there would be significant time available for the operators to stop pumps and/or isolate flood sources. The following summarizes the arrangement:

- Screen House - Circulating water pumps, service water pumps, and fire water pumps are located here as well as emergency diesel cooling pumps and containment spray raw water pumps. However, floods are unlikely to reach the pump motors which are above the lake level and internal flooding would drain back to the intake.

- Turbine Building - Circulating water, service water, raw water, diesel cooling, and fire water piping communicate here, however, the lower basement and elevations of the building must flood up to elevation 261' to impact success path equipment. This would take a significant time, allowing for the operators to stop pumps and/or isolate the source. In addition, there are several doors to outside and other non-safety buildings making it very difficult for floods to accumulate at elevation 261'.

- Reactor Building - Service water, raw water, and fire water piping communicate here. Most service water piping is safety related here and is expected to have a high capacity. Even non-safety piping in the reactor building is typically seismically supported and analyzed. In addition, flooding would drain to the basement corner rooms which contain the core spray and containment spray pumps. However, it would take a significant time to flood all these pumps and there are flood alarms and the EOPs address response to these alarms.

- Electrical Rooms in Turbine Building - The raw water piping which supplies cooling to the diesel is included in the seismic scope and success diagram.

Four types of water-based fire suppression systems are installed at NMP1, as follows:

- Wet Pipe Sprinkler Systems - These systems employ automatic sprinklers attached to a piping system that contains water under pressure at all times. When a fire occurs, individual sprinklers are actuated by the heat generated by the fire, and water flows through the sprinklers immediately.

  Operation of individual sprinklers due to an actual fire results in very little flooding potential. Seismic failure of this piping can cause a larger flooding potential.

- Dry Pipe Sprinkler Systems - These systems have automatic sprinklers attached to piping that contains air under pressure. When a sprinkler is opened by heat from a fire, the pressure is reduced to the point where water pressure on the supply side of the dry pipe valve can force open the valve. Water then flows into the system and out any opened sprinklers.

  Operation of individual sprinklers due to an actual fire results in very little flooding potential. Seismic failure of this piping can cause a larger flooding potential.

- Preaction Sprinkler Systems - These are systems in which there is air in the piping that may or may not be under pressure. When a fire occurs, a supplementary fire detecting device in the protected area is actuated. This opens a water control valve, which permits water to flow into the piping system before a sprinkler is activated. When sprinklers are subsequently opened by the heat of the fire, water flows through the sprinklers.

Operation of individual sprinklers due to an actual fire results in very little flooding potential, but the deluge (water control) valve must also open. Seismic failure of this piping will not cause larger flooding potential unless the deluge valve opens. Seismically induced spurious operation of a deluge valve is possible if the trim piping is breached or if the fire relay is sealed-in because of the vibratory motion. Actuation of the fire relay will exist only for the brief period of strong motion, i.e., for several seconds because the relay is not sealed in. The deluge may open briefly but not enough to cause significant flooding.

- Water Spray Systems - These systems are equipped with open sprinklers connected to a piping system which is normally dry. A fire detection system actuates in the event of a fire, which opens a water control valve and permits water to flow into the piping system and immediately out of all the sprinkler nozzles simultaneously. Note that Foam-Water Systems in the turbine building function similarly to Water Spray Systems.

  Seismic failure of this piping will not cause larger flooding potential unless the deluge valve opens. Seismically induced spurious operation of a deluge valve is possible if the trim piping is breached or if the fire relay is sealed-in because of the vibratory motion. Actuation of the fire relay will exist only for the brief period of strong motion, i.e., for several seconds because the relay is not sealed in. The deluge may open briefly but not enough to cause significant flooding.

The systems installed at NMP1 are found in the following locations, by system type:

Wet Pipe Systems -	Radwaste Building Administration Building Offgas Building Screenwell Bldg - Diesel Fire Pump Room & Oil Storage Room Turbine Building - Not Cable Trays
Dry Pipe Systems -	Radwaste Buildings - Track, Truck and Access Ways Reactor Building - Track Bay Administration Building - Truck Bay
Preaction Systems -	Reactor Building - Cable Trays El 237' and 261' Control Building - East Cable Trays El 250' and Cable Spreading Turbine Building - Cable Trays Radwaste Building - Dow System Administration Building - Old Document Control Room El 277'
Water Spray Systems-	Turbine Building - Not Cable Trays Reactor Building - Ventilation Charcoal Filters Radwaste Buildings Administration Building - Penthouse Charcoal Filters Reserve, Service and Main Transformer Areas

Cable tray sprays, which were noted as a potential concern during the walkdown, are of the preaction type. Thus, the potential failure of these pipes supported to the cable trays is not important because even if relay chatter does open the deluge valve, it is not expected to stay open. The deluge valves and their associated fire water header stations were noted to have very good support during the first walkdown on 5/7-8/95 (i.e., HCLPF>0.3g).

Since both the preaction and water spray systems require a deluge valve to stay open and this is considered unlikely, these systems should pose the least risk. Piping failures in either the wet or dry pipe systems could lead to flooding. The only buildings of concern in the seismic success path are the Screenwell, Reactor, Control, and Turbine Buildings.

The reactor building dry pipe system is limited to the track bay at El 261'. There is no seismic success path equipment in this location and the potential for flooding due to this system is limited.

The screenwell wet pipe system is limited to the diesel fire pump room and oil storage room. There is no seismic success path equipment in this location and flooding of adjacent areas housing the service water and raw water pumps is not a concern as water will run back to the intake.

The turbine building wet pipe system is limited to the following (UFSAR page 10A-107):

El 261 Equipment Decon & Lab Areas, Col B_G-E/Row 15-17 and Col B_A-B_G/Row 16-17

El 291, Col E-F/Row 10-12 and El 305 Col E-F/Row 10-12 (storage areas)

El 291, Col C-E/Row 1-3 (elevation below oil storage tanks)

El 351 & 333, Col G-J/Row 10-12 (paint storage & dress out clothing areas)

These wet pipe systems were walked down on 5/10/95. They were judged to have sufficient capacity (i.e., HCLPF>0.3g). Still, as discussed previously it is considered unlikely that the turbine building would be flooded up to El 261' from this system for a number of reasons. A fire water pump would have to survive the seismic event and then not be tripped by the operators in the long term, given that this piping failed. There are several door openings from elevation 261' to the outside and other buildings, therefore, it would be very difficult to impact equipment.

In summary, the risk from internal floods is judged to be low based on the seismic capacity of piping and plant arrangement. Still, this piping is included in Table 3.1-1A to document seismic capacity.

3.1.2.3.2 Fire Interactions

During the first walkdown (3/7-8/95), the following fire sources were inspected:

- Hydrogen piping and hydrogen control station header (El 261') in the turbine building. This control station and piping has adequate support (HCLPF>0.3g).

- Seal oil vacuum tank (El 277') in the turbine building. This tank and piping has adequate support (HCLPF>0.3g).

Hydrogen piping within the plant is not a relevant hazard since this piping is not normally pressurized. Hydrogen is dispensed from outside storage tanks on an as-needed batch basis and the supply valves are closed unless dispensing is being performed. This reduces the probability that hydrogen is being dispensed at the time of an earthquake. In addition, an excess flow valve is installed to limit hydrogen flow in the event of piping rupture and the main generator is equipped with emergency hydrogen dump capability. The hydrogen piping system is confined to the west end of the turbine building which is somewhat removed from the location of success path equipment and the control building. Also, the likelihood that piping failure occurs in the turbine building with the tanks and turbine building walls surviving the seismic event such that significant accumulation of hydrogen can occur and impact important equipment is considered unlikely. This hydrogen arrangement is an acceptable alternative to resolve Generic Safety Issue 106, "Piping and the Use of Highly Combustible Gases in Vital Areas" as discussed in NRC Generic Letter 93-06. The probability of seismically induced fires from this source causing core damage is considered very small.

Additional major sources of flammable liquids were identified in the emergency diesel areas, the diesel fire pump area, and the turbine building. The emergency diesels are included in the seismic success path, and are therefore, included in the seismic capability scope. The diesel fire pump area is separated from the service water and raw water pumps area by a 3 hour rated wall and the fire water pump room has a cofferdam inside the door to prevent leakage out of the room. The following three additional areas in the turbine building were identified and walked down on 5/10/95:

- Turbine building El 261' - flammable (i.e., paint, oil, etc.) storage room near the stack. This room has 2 hour rated walls. This was determined to be a potential fire hazard regardless of whether the block wall survives. The impact of a fire in this general area was assessed as part of the block wall evaluation discussed in Section 3.1.2.3.3.

- Turbine building El 261' - turbine oil storage room. This room has 3 hour rated walls bordering fire zone T3A an important equipment area. The large tanks in this room were screened (HCLPF>0.3g). Smaller tanks were noted to have a lower capacity, but the room would easily contain any spillage from these tanks.

- Turbine building El 305' - turbine oil storage room. This room has 3 hour rated walls and entrance to the room is 4.5 feet above the floor elevation. Also, seismic success path equipment is not located at this end of the building. The bottom portion of this room below the door entrance is reinforced concrete and will contain the contents of both tanks [capacity of both tanks is 30,000 gallons based on UFSAR Rev 13 page 10A-116 which is equivalent to 4010 cubic feet. Room dimensions are 22.5 ft * 43 ft * 4.5ft = 4353 cubic feet based on

drawing C-18819-C Rev 2]. Therefore, the seismic capacity of these tanks and the upper block walls are not analyzed.

3.1.2.3.3 Masonry Block Wall Interactions[22]

This section summarizes the screening and evaluation of masonry block walls at NMP1 with regard to their seismic capability and potential impacts on seismic safe shutdown equipment. All block walls were screened by demonstrating seismic capability (HCLPF > 0.3g) or no impact on seismic safe shutdown equipment. NMP1 masonry walls are identified in drawings[23]:

The first drawing (3 sheets) provides a summary table identifying the walls by number, building, elevation, wall thickness, construction summaries, calculation, and other drawings. The other 7 drawings identify the walls (by number from the previous table) on arrangement drawings. The first three columns of Table 3.1-3 provide a subset of the information from Reference 23. These columns are "Wall", "Location" (combination of building and floor elevation), and "Structure" (combination of wall thickness, type, category, and reinforcing). Table 3.1-3 is sorted by building and elevation; the "Location" column.

An initial screening evaluation was performed to identify those walls that require a more detailed analysis of their capacity and/or impact. Table 3.1-3 summarizes the screening evaluation results. As shown in the table, two different methods were utilized in the wall evaluation:

- Impact - if the impact of wall collapse was assessed to have an insignificant impact (i.e., no impact on the seismic success path), it was screened.

- HCLPF - calculations were performed to determine a wall screening size and specific wall HCLPFs from a screening spreadsheet. A 12 inch thick wall about 18.5 feet by 18.5 feet had a HCLPF >0.3g at turbine building elevation 300. This input was used to make screening judgments which were later checked.

The steps utilized in the screening evaluation are summarized below and in Table 3.1-3:

1. Note 1 in the "Impact" column - with one exception, walls located in the auxiliary building (AB), offgas building (OG), radwaste building (RW), waste disposal building (WD), and Security were screened out because there are no seismic success path components located in these buildings. The exception was any wall that interfaced with buildings that house seismic success path components.

2. Note 2 in the "HCLPF" column indicates the wall was screened by drawing review based on a generic HCLPF calculation - a 12 inch thick, 18.5 feet by 18.5 feet wall on turbine building elevation 277 to 300 has a HCLPF at approximately 0.3g using a screening spreadsheet calculation[73]. The height of walls was estimated by considering the distance between floor elevations (i.e., a wall on elevation 250 of the turbine building is about 10 feet high, El 261 minus El 250 and floor thickness). The width of a wall was estimated knowing that typical

distance between wall columns is about 20 feet. Turbine building walls below elevation 300 which are 12 inches or greater in thickness and less than 20 feet by 20 feet were screened.

3. Note 3 or a HCLPF value in the "HCLPF" column indicates that the wall was walked down to assess the dimensions of the wall. Note 3 in the "Impact" column indicates the wall was walked down to assess potential impacts of wall collapse. In some cases, both wall dimensions and impacts were noted even though both were not needed. Thus, note 3 and/or a HCLPF value may be shown in both columns to summarize the walkdown notes.

   With regard to impact judgments, sensitive electrical equipment close to the wall (within 1/2 the height) were considered when identified as susceptible to failure. Also, electrical penetrations through the wall were considered susceptible to failure. Cable trays running near the wall were considered, but in most cases the trays were up high (i.e., top half of the wall) and it was judged difficult for wall failures to significantly impact the cable trays. Angle braces at the top of a wall are noted since they add some retaining capability and reduce the chances of walls tipping onto trays. Piping systems near the wall and/or penetrating the wall were inspected, but judged unlikely to fail unless constrained near the wall (no such cases were identified).

4. Note 4 in the table identifies walls that were not easily accessible (either one or both sides of the wall were not observed) during the walkdown, but were screened because they were judged not to have seismic success path components at the location. This was based on knowledge of success path equipment locations and the general routing of cables. In one case, Wall 126 (TB277), the wall provides two sides of a vertical cable chase in a corner which runs between TB277 and TB300 (about 20 feet). This wall may screen out seismically, but it was judged unlikely the wall would fall into the vertical chase and impact cables; therefore, no further evaluation was necessary.

After the walkdown, additional HCLPF screening calculations were performed using a screening spreadsheet[24] calculation. The results are shown in the "HCLPF" column of Table 3.1-3. Those walls that did not pass this initial screening are shaded in the table and summarized below:

Wall#	Location	Thick	Size	HCLPF	Description
22	RX261	16"	18' high by 28'	0.21	evaluate impact & detailed HCLPF
34	SH256	12"	16' high by 31' "Unreinforced"	0.25(1)	diesel cooling water pumps potential impact. More detailed HCLPF
23 & 24	TB261	8"	13' high by 55'	0.21	common wall with elevator is only concern. Check structural/construction drawings first to see if elevator separates the 55' wall. Check impact.
27	TB261	12"	15' high by 60'	0.18	North & South walls have no visible columns on aux CR side. Need detailed HCLPF
29 & 53	TB261 TB277	12"	38' high by 22' 22' high by 52'	0.12 0.09	Could impact both diesels. Detailed HCLPF needed. Evaluate East walls, do columns prevent failure into DG room? At TB277 no visible columns. Evaluate TB impacts
33	TB261	8"	8' high by 19'	>1	room walls may not be restrained at top. Also, have to evaluate fire impact
35	TB261 TBEXT	12"	30' high by 137'	0.03	evaluate impact first and more detailed HCLPF probably needed.
47, 48 & 49	TB277	8"	22' high by 29' 15' high by 10' 22' high by 27'	0.13 >0.3 0.13	Common wall with elevator appears to be separated by elevators with the dimensions shown. Evaluate impacts and more detailed HCLPF probably needed.
52	TB277	12"	22' high by 20'	0.15	evaluate impacts and more detailed HCLPF probably needed.
32 & 104	WD261 WD271 TBEXT	8"	30' high by 120'	0.03	walls appear common. Check drawings to see if 30' high wall is real and evaluate impacts

(1) Wall 34 HCLPF is based on reinforced wall calculation

Those walls that did not screen during the initial screening evaluation summarized above were evaluated in greater detail. The following summarizes the evaluation steps:

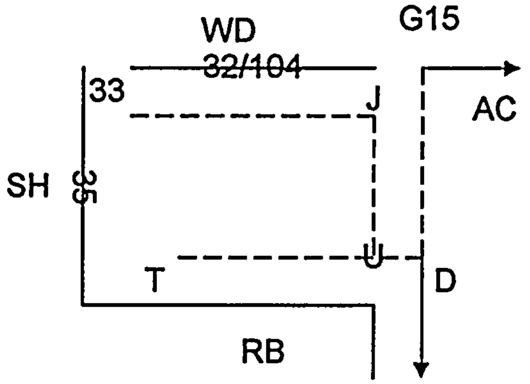
1. The impact of wall failure on seismic success path equipment was evaluated. When there is potential impact, this was documented and step 2 below was continued. If there was no impact, no further evaluation was necessary.

2. For those walls that can potentially impact seismic success path equipment, calculations and drawings listed in Drawing No. F-45030-C[23] were obtained. Then, more detailed HCLPF calculations are performed[71 & 73].

As described below, walls 32, 33, 35 and 104 screened out based on no impact. The remaining walls were determined to have potential impacts on seismic success path equipment and were

evaluated for seismic capacity in greater detail. These calculations[71 & 73] demonstrated a HCLPF > 0.3g for the remaining walls.

Walls 33, 35, and 32/104 were completely screened out by evaluating the potential impact of their failure. Cables required to support seismic success path components are not routed near walls 32/104 or wall 33 (this room contains a fire hazard). Cables routed to the screenhouse are protected from wall 35 because they penetrate below elevation 261. Wall 35 starts at elevation 261.



The cable trays identified near walls 32/104 during the walkdown were evaluated to determine whether they contained cables required for seismic success path components. The IPEEE fire cable database was used. Only tray 12TK. contained impacts. The layout of 12TK. is shown with the dashed lines in the sketch. The routing sequence of cables in the cable database were reviewed and the location of cable sections determined from cable tray drawings. None of the cables of interest are routed to node J (see sketch). Also, cables to the containment spray raw water pumps and diesel generator cooling water pumps in the screen house were identified from the IPEEE fire cable database, including their routing. These cables are routed to the screenhouse below elevation 261 and are protected from wall 35 collapse on both sides. Since there are no seismic success path components or cables near the oil storage room (wall 33), this potential fire hazard is not judged to be important. These observations were checked in the field.

Wall 24 (Foam Room Side) was inspected and the only wall of concern is the North wall which is a common wall with the turbine building (14 ft high by 30 ft long). The other walls are smaller (about 20 ft long) and DC valve board 11 is on the opposite South wall and is not likely to be impacted. The portion of the wall next to the valve board is steel construction. The foam room appears to be of similar construction as the turbine building (steel beams and columns). No impact on valve board 11 is assumed; the building was evaluated by the seismic review team as described in Section 3.1.3.

Wall 23&24 (TB261) - static chargers 171A & B and cable trays 12TD, 12TC, and 12TB are near these walls and can impact the seismic success path equipment.

Wall 27N (TB261 side) - cable trays 12TBB and 12TAW, including 12TAW2, run next to this wall. Also, there are 3 trays that cross the corridor from wall 27N to wall 29S (diesel area) and two vertical trays next to each other on wall 27N. The potential exists for impact on seismic success path equipment.

Wall 27S (TB261 side) - cable trays 12TD, 12TC, and 12TB run near the wall. The potential exists for impact on seismic success path equipment.

Wall 27N&S (Aux Control Room Side) - potential for significant damage.

Wall 52N (TB277) - cable trays 13TAV and 13TAR run near the wall. The IPEEE fire cable database was used to determine whether there is any potential impact on the seismic success path from cables in these trays. No impact was found in tray 13TAR. The potential exists for impact on seismic success path equipment for the other trays.

Wall 53 (TB277 side) - cable trays 13TAP, 13TAS, and 13TAT are along this wall, as well as I&C Bus 130A, MG141 protective relay cabinet, and remote shutdown panel. Identifying impacts of cables contained the cable trays also identifies the impact from cabinet failure since cables from the cabinets and buses feed into the cable trays. The potential exists for impact on seismic success path equipment.

Wall 29&53 (Diesel Side) - potential to lose both diesel generators.

Wall 34 (SH256) - potential loss of at least one diesel generator cooling water pump.

Wall 47/48/49 (TB277) - UPS172 and MG172 are in this area as well as cable trays and conduits. Most of the wall height has cabinets, then a tray (13TBA), then a large duct, then cable trays above the duct near the ceiling. Appears difficult to impact equipment because of congestion, but potential exists.

Wall 22 (RB261) - cable trays 12RC (section AK-CC) and 12RH (section AL-CB) run near the east end wall which did not screen. The potential exists for impact on seismic success path equipment.

As summarized previously, all walls were screened based on no impact on seismic success path equipment or seismic capability (HCLPF > 0.3g).

3.1.2.4 Relay Chatter Evaluation

The IPEEE relay chatter evaluation utilized the A-46 Evaluation[10] results and findings. Three types of evaluations were performed in support of the IPEEE and A-46 evaluations:

- Outliers from the A-46 evaluation were assessed relative to their functional impact and recoverability[9].
- The potential for seismic induced system interactions was considered[9].
- Differences in the IPEEE versus A-46 scope were assessed as discussed below.

With regard to the assessment of A-46 outliers described in the A-46 submitttal[10], the following summarizes the results and conclusion, and the evaluation is described further below:

- Relay 31D-X, one associated with each diesel, can impact the availability of diesels and is not easily recovered. Further evaluation is being performed to determine whether replacement is required.

- Relays 67NI, 87DG-2, 86, 51G, and 50/51 (one set associated with each diesel) impact the availability of emergency diesels generators (EDG). Relay 51B can impact the availability of the EDG but only if none of the other relays are actuated by chatter. However, actuation of these relays is easily diagnosed and recovered in the control room. Further evaluation is being performed to determine whether replacement or procedure changes are required.

- The remaining relays have no impact. There are a few reasons for concluding no impact. Some relays have additional relays in series that must also chatter to cause an impact, but these relays are not outliers. Other relays were found to have an impact only after a time delay, during a specific sequence of events for the closed contacts case; the open contacts case is not an outlier situation. Both of these cases are discussed further below. Also, some relay impacts are associated with equipment not in the IPEEE seismic success path. This could be used as input to resolution of A-46 outliers. Also, there is significant time for recovery.

With regard to potential seismic systems interactions, several types of relays associated with the fire protection system have an unknown seismic capacity. These relays are identified as 1H9 and 10 for hazard, 74A-9 and 10 for alarm, 45X-9 and 10 for fire detection signal, and the 2 series for timers. These relays were not evaluated in the initial A-46 evaluation, but were identified during the IPEEE. Actuation of these relays initiates the CO_2 system in some or all areas covered by the Cardox system (i.e. in EDG102, EDG103, PB102, PB103 and the auxiliary control room). It can also shut down the diesel generator room cooling for both diesels by closing the rollup doors and stopping the fans. Relays that potentially impact the diesels are being evaluated, tested, or replaced.

The difference in scope (components in IPEEE, but not in A-46) includes mostly structures and other passive components, with the exception that IPEEE included a few new instruments and containment isolation valves to assess containment performance. The results of this evaluation are presented in Table 3.1-4.

With regard to the outlier evaluation, it was assumed that the seismic event could last for 30 seconds. During this time frame, vessel level may be decreasing because of a small LOCA, but triple low vessel water level can not occur this fast unless it is due to relay chatter (i.e., false indication). There is no design basis requirement for the plant to demonstrate survival from the earthquake and a large design basis LOCA simultaneously. LOCA mitigating systems must be able to function after an earthquake because a seismic event can occur during the LOCA recovery period. In addition, the IPEEE is demonstrating that such an event is a low risk based on low probability (i.e., reactor coolant pressure boundary HCLPF > 0.3g). Because the relays are

considered outliers and potentially have low capacities, it is assumed offsite power may or may not be available during the event.

Table 3.1-5 documents the evaluation with the following columns:

- Relay Id - identifies the relay as shown in USI A-46 Relay Evaluation Report, MPR-1450 Rev 1, April 1994
- Component - identifies the major component the relay supports (i.e., diesel generator)
- Relay Type - identifies the manufacturer and model
- Status - indicates the normal status of the relay as either energized (E) or deenergized (D), and the contactor as either closed (C) or open (O). For example, a normally deenergized relay with the contactor normally open, is shown as D/O in the table.
- Function - describes the function of the relay
- Chatter Impact - describes the potential impact of relay chatter. "No Impact -" is provided first if the conclusion of the evaluation is relay chatter causes no impact on shutdown capability.
- Recovery - if there is no impact in the previous column, this column is irrelevant and "not required" may be provided in this column. However, in some cases recovery actions were noted during the evaluation and provided even if not required. For the cases where relay chatter can cause an impact, the recovery actions are described.

The following summarizes the results:

<u>No Impact Example Cases</u>

1. The timer contacts in the ADS circuit (2-1, 2-2) can seal-in as a result of relay chatter. This will bypass the 125 sec time delay such that the operator can not reset/bypass the auto-ADS actuation. However, triple low level and high drywell pressure signals have to exist for ADS to actuate. If 4KV power is lost at any time during this evolution, the timer will reset. It can only be sealed-in and remain sealed-in if 4KV power is available. If offsite power is lost during a seismic event as may be expected, chatter of these relays will not result in a relay seal-in. However, even if offsite power is assumed available, for ADS to actuate, two additional relays (16K207 or 16K208 and R21A,B,C or D) must actuate. These relays are seismically adequate and are not expected to chatter and actuation of these relays requires triple Lo vessel water level and high drywell pressure conditions or relay chatter of both. Also, the these demand conditions (Lo-Lo-Lo vessel level and hi drywell pressure) will not occur for several minutes after the seismic event, if they occur at all. For these reasons, no spurious actuation of ADS is expected and if required, this chatter does not prevent success.

2. Relays 2X-1 and 2X-2 (EDG load sequencer) are normally deenergized and have both normally open and closed contacts. These relays were assessed to have a seismic capacity of 3g (ref MPR-1450 Rev 1 April 1994) based on the normally closed contacts. A review of the circuits where these relay contacts are wired revealed that the normally closed contacts block the immediate start of the containment spray pump if the core spray or core spray topping pumps were sequenced on. The containment spray pumps will start if there is a Lo-Lo vessel level and high drywell pressure and only after a 50 sec time delay after the core spray pump has started. If the core spray or core spray topping pumps have started these relays are then energized and have a generic equipment ruggedness spectra (GERS) of 15g from EPRI NP-7147-SL page B-18. By the time that a real containment spray pump start occurs, the seismic event is over even if there is a real actuation signal in the first few minutes of the event.

   The normally open contacts are required to be free of chatter to prevent spurious actuation of the EDG sequencer. The seismic demand for these contacts is 3.8g (ref MPR-1450 Rev 1 April 1994) and the seismic capacity is 7.5g from EPRI NP-7147-SL page B-18. The relay capacity is greater than the demand, thus the normally open contacts will not chatter.

Examples of Recovery Cases

The differential current relay 87DG-2 in the EDG breaker controls can chatter and actuate the 86DG-2. This relay trips the EDG breaker if it is closed or blocks breaker closure if it is open. Operation of the 86DG-2 relay is alarmed in the control room and this relay can be reset at the operator control console (Panel E) in the control room. If there is an undervoltage condition, the EDG breaker will auto close when the 86DG-2 is reset. Assuming that all seismically weak EDG relays are actuated (both are alarmed) during the seismic event, only two operator actions at Panel E are needed to recover the DG, resetting the 86DG-2 and resetting the 86 lockout relay by turning the breaker control switch, for PB101 feeder breaker to the emergency 4KV bus, to the trip position.

Relay 51B can trip the EDG breaker if the breaker was closed . If the trip occurs while the breaker anti-pump relay is actuated , then recovery of the EDG breaker is accomplished by turning the EDG breaker control switch located on E Panel in the control room to the tripped position to reset the anti-pump relay. If either 86DG-2 or the 86 lockout relays are actuated in addition to the 51B, there is no need to reset the anti-pump relay to recover the breaker. In this case, resetting of the tripped lockout relays at E Panel will enable auto EDG breaker closure. If the 51B relay is actuated after the anti-pump relay is depowered, then the breaker will trip and auto-reclose.

Non-recoverable Chatter Cases

The 31D-X DG voltage sensing relay is actuated when the DG terminal voltage has reached or exceeded a preset level. When this relay actuates, the 31D relay is depowered and relay 31D-2X is actuated. The 31D relay cuts off the DC battery field flash to the EDG while the 31D-2X permits closure of the EDG output breaker R1022 or R1032. Chatter of the 31D contacts may cause excessive contact pitting/burning resulting in a degradation or loss of the battery field flash capability.

The initiating event is the earthquake and a small LOCA since all piping systems connected to the RCS were not seismically evaluated. At this point it is conservatively assumed that a Hi Drywell Pressure condition can exist. This condition is one of the two auto-start signals that start the core spray pumps via the sequencer. It is also assumed that 4KV to 120V control power voltage to the EDG sequencer is sufficient to operate the sequencer and the sequencer starts to sequence the EDG loads.

Even if there is no damage to the 31D contacts, then chatter of relay 31D-2X Normally Open contacts (while the EDG voltage is low) can cause the EDG feeder breaker to close. The sequencer will be operable and the sequenced loads will trip on undervoltage as they are sequenced on. Recovery of these loads requires that the individual pump control switches are turned to the trip position to clear the anti-pump relay at which point the pump starts. If the operator does not reset these relays in the proper sequence with the appropriate time delays between resets, the EDG can be overloaded and the EDG breaker will trip. The EDG sequencer will reset when 4KV power is lost. The EDG breaker will reclose after the strong ground motion subsides and the sequencer will sequence loads on if there is a Lo-Lo vessel level signal or a high drywell pressure signal.

3.1.3 Analysis of Structure Response

The ground response spectra for the NMP1 IPEEE is the NUREG/CR-0098[20] 50% spectral shape according to NUREG-1407[3] for seismic margin evaluations. The floor response spectra are developed and based on reference 72.

Major structures for the NMP1 site considered in the SMA are the reactor and turbine buildings that are founded on mat foundations embedded in rock. These buildings were re-evaluated to the 7th and 8th editions of the ACI and the AISC codes by S&A for design basis loads. The new dynamic and static models were developed between 1986 and 1993 using current day techniques in accordance with NUREG-0800[7]. The screenhouse substructure, including intake and discharge tunnels is seismic category I and the superstructure is category II and has been seismically designed to a 0.2g horizontal and 0.1g vertical to AISC. It was designed to UBC 1967 (&1963) code provisions.

The plant was designed in the late 1960's. The Class I Structures were designed for a horizontal seismic input of 0.11g for the design basis earthquake (DBE, also referred to as SSE). A vertical seismic acceleration equal to 2/3 of the horizontal ground acceleration was considered simultaneously with the larger horizontal acceleration (from the two horizontal directions). Generally, the seismic analysis of the structures used the response spectrum method. Seismic loads were considered in the design of Class II Structures such as the screenhouse superstructure and the intake and discharge tunnels. Thus, in effect these structures have the seismic capacity of Class I structures.

The following documents established the methods, material properties and allowable stresses used in the design:

- American Society of Mechanical Engineers, Boiler and Pressure Vessel Code
- American Concrete Institute Code ACI 318-63
- American Institute of Steel Construction, Specification for the Design, Fabrication and Erection of the Structural Steel for Buildings, Sixth Edition
- Uniform Building Code, 1964 Edition
- American Welding Institute Code AWS D1.0

The buildings at NMP1 are founded on bedrock (Reference 3, Section 3), so the CR-0098 rock spectrum applies.

The SME is derived as follows:

1. The peak ground acceleration is defined to be 0.3g.
2. Per Reference 2, Section 7.2:
   $v/a = 36$ in/sec/g, therefore peak velocity $= 0.3 \times 36 = 10.8$ in/s
   $ad/v^2 = 6.0$, therefore peak displacement $= 6.0 \times 10.8^2 / 0.3 / 386 = 6.04$ in
3. Using the values from Reference 2, Table 3, the median, 5% damped, response spectrum peak values are:
   acceleration $= 2.12 \times 0.3 = 0.636$g
   velocity $= 1.65 \times 10.8 = 17.8$ in/s
   displacement $= 1.39 \times 6.04 = 8.40$ in
4. The frequency control points occur where the displacement and velocity match, and where the velocity and acceleration match:
   $f_1 = v / 2\pi d = (17.8) / (2\pi \times 8.40) = 0.34$ Hz
   $f_2 = a / 2\pi v = (0.636 \times 386) / (2\pi \times 17.8) = 2.2$ Hz
5. The vertical response spectral amplitudes are taken as 2/3 of the corresponding unreduced values in the horizontal direction across the entire frequency range.

Details on the SME floor response spectra can be found in Reference 72.

Structures were screened using the first column of Table 2-3 in EPRI NP-6041[11]. The screening approach utilizes the experience gained in performing seismic margin assessments to screen components out of a seismic PRA. Meeting the caveats for these structures ensures that the structures may be represented by a surrogate element with a median peak 5-percent damped

spectral acceleration capacity of 0.8g (peak ground acceleration of 0.3g) with a combined logarithmic standard deviation, b_c, value of 0.30.

3.1.4 Evaluation of Seismic Capabilities of Components and Plant

The evaluation considered two basic categories of plant equipment described in the following sections: (1) civil structures (passive components) and (2) mechanical electrical (both active and passive components). Table 3.1-1A contains passive components (civil structures and mechanical electrical) and Table 3.1-1B contains active components (mechanical electrical).

3.1.4.1 Civil Structures

Table 3.1-1A describes the type of components considered under the civil/structural review. This type of component generally functions to remain intact and provide physical support for mechanical and electrical components.

Containment

The containment (drywell) is a freestanding steel structure in the shape of an inverted light bulb, surrounded by a reinforced concrete biological shield wall. There is a 2" air gap between the drywell and the biological shield walls The base of the drywell is welded to a steel skirt. The skirt sits on a massive reinforced concrete pedestal rising up from the reactor building foundation. Concrete was poured both inside and around the skirt, so the skirt is essentially integral with the reactor building foundation. Additional load transfer between the base of the drywell and the foundation is provided by an array of steel studs projecting from the bottom of the drywell into the concrete. The drywell also has four lateral seismic restraints (stabilizer) at the top of the drywell.

The drywell was assigned a seismic capacity of 0.50g pga. Per Table 2-3 of NP-6041[11], the Nine Mile Unit 1 drywell meets the requirement for the second earthquake level - the steel pressure boundary is keyed to the base mat to prevent slipping.

Suppression Chamber (Torus)

The suppression chamber is a toroidal steel structure supported by sixteen (16) vertical saddles sitting on the reactor building base mat. The saddle base plates are free to slide to allow for thermal expansion. A sway rod assembly at the outside columns provides lateral support for the suppression chamber. The seismic sway rods consist of 3.5" diameter sway rods and 3.75" diameter turnbuckles to provide restraint for movement along the torus centerline resulting form lateral loads acting on the suppression chamber. The sway rods are joined to the 1.5" thick wing plate at the top of the support columns by 4" diameter pins. The lower ends of the sway rods are joined to 2" thick seismic tie plate at the column base.

Per Table 2-3 of NP-6041, Mark I toris requires evaluation for any earthquake exceeding the design basis.

The Nine Mile Unit 1 torus was evaluated under the Mark I Containment program. This evaluation included normal operating loads (dead weight, pressure, temperature), seismic loads (OBE and DBE), and hydrodynamic loads (SRV discharge, pool swell, condensation oscillation, and chugging), including those for large-break and intermediate-break LOCAs. Numerous load cases were considered; results are presented only for the controlling load combination for each component evaluated. The controlling load combinations almost always include one of the major hydrodynamic loads - pool swell, condensation oscillation, or chugging due to large or intermediate break LOCAs.

Appendix K of NP-6041 discusses hydrodynamic loads as they apply to the Seismic Margins Assessment. Per this appendix, the simultaneous occurrence of an earthquake and an intermediate or large break LOCA is not credible. A simultaneous earthquake and a small break LOCA is considered credible, but the only hydrodynamic load associated with a small break LOCA is chugging, and that will occur after the earthquake has ended. The only hydrodynamic load than can credibly be expected to occur simultaneously with the earthquake is SRV discharge, and these loads can be combined by the square root of the sum of the squares (SRSS'd) with the earthquake loads.

The torus evaluation (Cal No. 95C2873-C-006[75]) does not provide results for individual load cases, only for the controlling load cases. It is the SRT's experience that seismic loads are not usually a major load case in torus evaluations. Based on this, it was decided to base the torus' seismic capacity on the sway bar seismic restraint system. The governing load case is Chugging + SRV + SSE (with the individual loads added, not SRSS'd). The seismic capacity based on the SME pga is therefore 0.32g.

Note that this value is conservative because (1) the load case includes chugging, (2) the individual loads were summed, not SRSS'd, and (3) the above scales all three loads, not only the seismic loads.

Reactor Building

The reactor building is a reinforced concrete structure from the foundation up to the refueling floor. All required equipment and plant systems are below the refueling floor. Per the UFSAR, the reactor building is a Class I structure and is designed for a 0.20g Safe Shutdown Earthquake (SSE).

The reactor building was assigned a seismic capacity of 0.30g pga. Per Table 2-3 of NP-6041, the Nine Mile Unit 1 reactor building meets the requirement for the first earthquake level - it is a reinforced concrete frame designed for an SSE of 0.1g or greater.

Turbine Building Complex

The entire turbine building complex is a reinforced concrete structure except for the turbine hall superstructure (note that this area does not house SMA components).

Although the Turbine building is a Class II structure, for seismic design the entire turbine building complex was evaluated as a Class 1 structure. Based on the results of a dynamic analysis of this model, the Class I structures were evaluated for the 0.13g design basis earthquake.

The turbine building complex was assigned a seismic capacity of 0.30g pga. Per Table 2-3 of NP-6041, the areas of the complex housing SMA components meet the requirement for the first earthquake level - they are reinforced concrete frames designed for an SSE of 0.1g or greater.

Other Structures and Structural Issues

All structures including the screenhouse were screened using the first column in Table 2-3 in EPRI Report NP-6041. The screening approach utilizes the experience gained in performing seismic margin assessments (SMAs) to screen components out at the RLE level of 0.3g, PGA.

All caveats of Table 2-3 were dispositioned including the concrete containment requirements, separations between structures, reinforcement detailing, and penetrations including associated requisite piping flexibility.

The control room ceiling is a T-bar system supported by threaded rods which are suspended from a light metal strut gridwork. The gridwork is, in turn, attached to structural steel by beam clamps. The support system is adjudged seismically adequate and is assigned a seismic capacity of 0.30g pga. However, modifications are recommended to better restrain the panels per Table 7-1.

The NMP1 foam room contains valve board 11 and recently experienced a structural failure which did not affect the valve board. Based on the design of the repair a HCLPF of 0.3g was assigned[75].

The plant stack can reach success path equipment should it fall. A HCLPF of 0.3g was assigned to the stack[74].

Masonry block walls were evaluated. Those that could not impact success path equipment were screened. Those remaining walls were determined to have a HCLPF of 0.3g. This issue is discussed in more detail in Section 3.1.2.

3.1.4.2 Mechanical/Electrical Components

Mechanical and electrical components are generally those that provide an active function or are otherwise considered within the scope of success path systems.

Active components identified in Table 3.1-1B screened out with a HCLPF greater than 0.3g (some have a HCLPF based on a planned modification as shown on page 3.1-1) except for a few components estimated to have a HCLPF in the 0.27 to 0.29g range as shown on page 3.1-1. The analysis relied heavily on the A-46 evaluation. During initial walkdowns and screening, additional analysis and/or testing was identified for certain active components as summarized below:

- A number of components with Lead Cinch anchors were analyzed and found to have a HCLPF of 0.3g based on a tightness check of all accessible anchors; two failures in 154 tests

was judged to adequately support no discount factor on the HCLPF calculations. Some Cinch anchors still need to be checked in the MSIV room and aux feeder cabinets 102 and 103.

- Diesel generator cooling water pump casings exceeded 20 foot limit; analysis supported a HCLPF > 0.3g.

- Marginally anchored cabinets and panels (see page 3.1-1) require additional anchorage.

- Relay chatter - Mercury switch type relays associated with the Cardox system were found to be a potential seismic systems interaction (i.e., stops fans and closes rollup doors in EDG rooms). Relays that can potentially impact the emergency diesel generators are being replaced (see page 3.1-1).

- Relay chatter - relays that could potentially impact the availability of the emergency diesel generators are being tested; if testing does not demonstrate ruggedness, replacement or procedural changes will be considered (see page 3.1-1).

- CRD/Reactor Internals - NRC has concluded that reactor internals can be screened and CRD housings can be screened per Table 2-4 of EPRI NP-6041, if there is a lateral support. Since NMP1 does not have a lateral support, a HCLPF was calculated[76] to show a value greater than 0.3g

- Cable Trays - Q-decking and cast iron inserts were noted as requiring further analysis and/or testing. Supports were analyzed; with one isolated exception (a single run of cable tray in the turbine building; see Page 3.1-1) they pass the GIP Section 8 rules (screen out at 0.3g)[77 and 78]. A sampling of cast iron rod inserts are being inspected to ensure proper thread engagement.

- Piping - fire water piping was identified as a potential flooding systems interaction, having a system HCLPF generally less than 0.3g. As described in Section 3.1.2.3.1, the fire water headers and critical areas that could cause flooding were identified and screened out.

The margins assessment of the equipment considered:

- the seismic capacity of the equipment itself, exclusive of anchorage, and

- the seismic capacity of the anchorage,

A seismic capacity - in terms of the peak ground acceleration (pga) of the seismic margins earthquake (SME) - was established for each of these factors. The overall seismic capacity of each item of equipment is the minimum of the capacities.

Equipment Seismic Capacity

Table 3.1-6 summarizes the equipment assessment. The table lists all of the equipment assessed, ranked in ascending order of overall seismic capacity; equipment of the same overall seismic capacity are listed alphabetically by ID. The assessment of IPEEE electrical and mechanical

equipment was based on the Generic Implementation Procedure[12] (GIP), which is the procedure used for the resolution of USI A-46. The assessment of each item of equipment was documented on a Screening Evaluation Worksheet (SEWS). The seismic capacity for the equipment is based on Table 2-4 of NP-6041. For a number of classes of equipment - horizontal pumps is an example - an equipment that passes a GIP evaluation also satisfies the requirements for the second earthquake level in Table 2-4. Except for atmospheric storage tanks and equipment supported on vibration isolators, if an item of equipment passed the GIP evaluation, then it was assigned a seismic capacity of either of 0.30g pga (first earthquake level), or if Table 2.4 does not require further evaluation, 0.50g pga (second earthquake level). Note that all classes of equipment, except passive valves, would require further evaluation to meet the requirements of the third earthquake level.

Anchorage Seismic Capacity

An anchorage seismic capacity was evaluated for all equipment and is shown in the Anchorage field in Table 3.1-6, except:

- in-line equipment - valves, temperature elements, and dampers,
- equipment whose anchorage capacity is obviously high (e.g., a small circuit breaker panel anchored to an r/c wall with four expansion anchors),

The anchorage calculations followed GIP procedures (Section II.4.4 and Appendix C of Reference 14) with the following exceptions:

- The SME floor response spectra were used. These are what the GIP calls "realistic, median-centered", but the 1.25 factor of conservatism specified in GIP Table 4-3 was not applied.
- The GIP allows the use of 1.5x the ground response spectrum as the floor response spectrum under certain conditions. This option was not used in these calculations; only the SME floor response spectra were used (the unfactored ground response spectra was used as the floor response spectrum for the basement of the reactor building).
- The GIP requires that reduction factors be applied to anchor bolt capacities under certain conditions. All of these reduction factors were applied, where needed, except for the essential relay reduction factor for concrete expansion anchors.
- The GIP requirements for bolt tightness checks were not applied.

NSSS Primary Coolant System

The NSSS primary coolant system was assigned a seismic capacity of 0.50g. Per Table 2-4 of NP-6041, this equipment can be assigned a seismic capacity equal to the second earthquake level with no evaluation except for piping with intergranular stress corrosion cracking (IGSCC).

A program that controls the effects of IGSCC in NSSS piping welds is in effect at NMP1. This program is sufficient to address the IGSCC issue for the Structural Margins Assessment.

NSSS Supports

The NSSS supports were assigned a seismic capacity of 0.30g. Per Table 2-4 of NP-6041, this equipment can be assigned a seismic capacity equal to the first earthquake level with no evaluation if the supports are designed for combined loadings of SSE and pipe break. Per the UFSAR, the reactor pressure vessel and its supports have been analyzed for seismic loads combined with pipe rupture loads.

Reactor Internals

Generic Letter 88-20 Supplement 5[40] removed the evaluation of reactor internals from the scope of the seismic IPEEE for focused scope plants.

Control rod drive housing and mechanisms

The control rod drive (CRD) housing and mechanisms were assigned a seismic capacity of 0.30g. Per Table 2-4 of NP-6041, this equipment can be assigned a seismic capacity equal to the first earthquake level if the control rod drive housing is laterally supported.

The typical longer control rod drive housing cylinders project about 13' below the bottom of the reactor vessel. At their bottom, the cylinders are supported in a steel gridwork that is suspended from steel beams with threaded rods. No documentation was found substantiating that the gridwork is laterally restrained to the inside wall of the reactor vessel pedestal. Therefore, it was decided to evaluate the CRD housing for lateral bending due to the cantilever bending deformation of the CRD housing.

Category I Piping

Category I piping was assigned a seismic capacity of 0.50g. Per Table 2-4 and Appendix A of NP-6041, piping systems in nuclear power plants have capacities greater than 0.5g, but certain details need to be investigated by a walkdown.

A piping walkdown was performed. The walkdown criteria followed Section 5 and Appendix A of EPRI NP-6041. Specifically, the walkdown looked for:

- threaded or mechanically coupled (Victaulic type) connections
- cast iron bodies
- inflexible branch lines
- long unsupported spans
- insufficient "rattle space" and close proximity of valve operators to interferences
- "unzipping" of threaded supports
- shock isolators
- sufficient flexibility of piping across structural joints (between buildings)

The critical portions of the diesel generator cooling water and service water piping were walked down. Other safety related piping throughout the plant was "walked-by". Adequate flexibility

was found at building interfaces. No issues as listed above were identified for safety related piping.

In the seismic margins assessment (SMA), only seismically designed piping is being relied upon. Some portions of fire protection piping, non-safety (non-critical) portions of main steam and service water piping are also considered. All of these systems were walked down to assess their vulnerability. The fire protection system is judged to fail at relatively low seismic levels due to the loss of offsite power and the anchorage of the fire pump diesel fuel day tanks. The system is assigned the same fragility as loss of offsite power.

The critical, thus seismically designed portions, of the main steam and service water piping are judged rugged and may be screened at 0.5g HCLPF. ECCS piping was chosen as the system for a detailed walkdown in accordance with NP-6041 requirements. The loop in the SE corner room and the loop into the Torus compartment were walked down from end to end. Both systems are extremely well supported with obvious seismic supports. No anomalies were found.

Some drain lines were observed to have Victualic couplings, but these lines are normally not over safety-related equipment, nor are they normally full of water.

In conclusion, all seismically designed piping is screened at a 0.5g HCLPF.

HVAC Ducting and Dampers

HVAC ducting and dampers was assigned a seismic capacity of 0.30g. Per Table 2-4 and Appendix A of NP-6041, HVAC ducting can be assigned a 0.3g seismic capacity pending a walk down.

The ductwork throughout the safety-related areas of the plant was walked down and found to be adequately supported by either threaded rod trapeze supports anchored to embedded strut or light metal straps anchored by 1/4" diameter concrete expansion anchors. Both support systems are ductile, and given the light weight of ductwork, anchorage failure was judged not credible.

Cable Trays and Electrical Conduit

The cable and conduit raceway review performed at the NMP1 follows the Generic Implementation Procedure (GIP). If the raceway system meets the GIP caveats and limited analytical review (LAR) evaluations, it is screened for the RLE at a 0.30g HCLPF.

The raceway review was performed as specified in GIP Section 8. Raceway systems were walked-down, checked against the Inclusion Rules and Other Seismic Performance Concerns as specified in Section 8.2 of the GIP, and examined for seismic spatial interactions with adjacent equipment and structures. Twelve(12) representative, worst-case raceway supports were selected and as-built. These supports then received a Limited Analytical Review per GIP Section 8.3 of the GIP.

Seismically Induced Flooding

Seismically induced flooding was evaluated by first assembling a list of potential flooding sources in the areas of the plant containing IPEEE equipment, then performing a walk down to assess whether the sources are both significant hazards and seismically vulnerable.

3.1.5 Analysis of Containment Performance

The containment pressure boundary, including structures, piping, valves and penetrations are included in Table 3.1-1A. These components are expected to have high seismic capacities above the 0.3g screening value.

The containment penetration screening analysis in the IPE was reviewed. The following summarizes typical containment isolation valve alignments and the associated seismic capability scope:

Containment Isolation Alignment	Seismic Capability Scope
Closed & no auto open signal	penetration, isolation valves, and piping between valves (1) and penetration
open - auto closure signal (non-ECCS)	same as closed plus isolation valve actuators, signal, and support systems (2)
open - no closure signal (ECCS) or closed - auto open signal (ECCS)	same as closed plus ECCS piping and system pressure (3)

1. A closed system inside or outside containment may provide backup to valve disc rupture.
2. A closed system inside or outside containment may provide backup to isolation valve failure to close.
3. Operator action as a backup is neglected.

The containment isolation system is normally energized and the loss of electrical support results in a containment isolation signal. In addition, many normally open isolation valves fail closed on loss of their actuator support (i.e., instrument air, 125V DC power and nitrogen). Other normally open paths are associated with closed systems or emergency core cooling and containment systems. The seismic capability of these closed systems is high as with piping systems above. The following valve types are included to assure that containment isolation capability is considered in the seismic capacity assessment:

- MSIV MOVs and AOVs (01-01 through 04) are included and listed in Table 3.1-1B although they were neglected in the IPE. The high reliability of these valves to close in combination with additional redundancy (i.e. turbine stop and control valves) and the low probability of pipe break outside containment allowed these valves to be neglected in the IPE. The IPE was more interested in having the valves open to utilize the main condenser for heat removal. The MSIVs are included in the seismic scope because they are expected to have a high seismic

capacity and this limits the scope of piping and systems outside containment that have to be considered.

- Emergency condenser steam line isolation MOVs (39-07R through 10R) were included in the IPE and are included in the seismic scope because they are expected to have a high seismic capacity and this limits the scope of piping and systems outside containment that have to be considered (the ECs are not included in the success path because a LOCA is assumed). This isolation system is separate from the containment isolation system in that it is energize to actuate with different input signals. These valves, sensors, and relays are included in Table 3.1-1B.

- Drywell equipment and floor drain MOVs and AOVs (83.1-9 through 12) were included in the IPE and are included here. These MOVs are powered by PB167. The relays, sensors, and power supplies are included in Table 3.1-1B.

- Reactor water cleanup (RWCU) isolation MOVs (33-02R, 33-04 and 33-01R) were not included in the IPE due to high pressure design and redundancy. These valves are included in the seismic scope because they are expected to have a high seismic capacity and this limits the scope of piping and systems outside containment that have to be considered. These valves and their controls are included in Table 3.1-1B.

The above valves are considered representative relative to assessing the importance of containment performance. Other paths through the containment tend to be as reliable if not more reliable. For example, each feedwater penetration has a check valve in series with a remote manually controlled AC powered MOV. The containment vent & purge penetrations are normally closed with a fail closed AOV in series with an AC powered MOV. Other penetrations may have two check valves in series, check valve in series with MOV or AOV, normally closed valve, and/or a closed piping system.

In addition, penetration configurations and the potential for spatial interactions were considered during the walkdown.

The containment isolation function was found to be very reliable in the IPE and the same is true for seismic events as summarized below for each of the above penetration types:

- MSIVs - Isolation failure requires a fail closed AOV in each path to stay open (assuming emergency AC is unavailable to the MOV and it fails as-is, open) <u>and</u> either piping fails outside containment or another fail closed valve (i.e., turbine stop and control valves) fails to close. These scenarios can be shown to be quantitatively very low.

- ECs - Failure of a steam line requires both an AC powered MOV and a DC powered MOV to fail open, as well as a pipe failure outside containment. Loss of offsite power and DC power would lead to loss of all support systems to the MOVs. If it is assumed that the seismic capacity of DC power and instrumentation needed to close the DC MOV is high (these components are included in Table 3.1-1B), the most likely scenario for both MOVs failing to

close should be seismic loss of offsite power and nonseismic failure of DC. Other scenarios such as nonseismic failure of the diesel and the DC MOV would have similar or lower frequencies. These scenarios can be shown to be quantitatively very low.

Failure of an EC condensate return line requires a check valve failure and an AOV (fails open and requires air to close) failure, as well as a pipe failure outside containment. Since instrument air is not being evaluated, it is assumed that the AOV can not be closed. Even if only the check valve is considered, these scenarios can be shown to be quantitatively very low.

- Drywell Drains - These lines require failure of two valves; a fail-as-is MOV and a fail closed AOV. Again, these scenarios can be shown to be quantitatively very low.

- RWCU - Two fail-as-is MOVs in the suction path are more likely to be open due to a station blackout versus the discharge path that has a fail-as-is MOV and a check valve in series. Still, the piping system must fail outside containment. This could be the dominant path for containment isolation failure since the RWCU piping system outside containment was not included in the scope.

Similar arguments can be made for other penetrations such as feedwater and containment vent & purge. Based on the above, containment isolation failure is considered unlikely.

The potential for causing a LOCA outside containment is also unlikely as long as the containment isolation function is seismically rugged (i.e., MSIV closure, EC isolation, feedwater check valves and associated piping). The potential for causing a seismic caused interfacing systems LOCA was also considered from the IPE. The following summarizes the conclusions:

- The shutdown cooling system is normally isolated by double isolation valves and the system piping is designed for 1200 psig, therefore the potential for a LOCA outside containment through this system is judged unlikely. Even spurious operation of MOVs due to relay chatter is judged unlikely to result in a LOCA due to piping design.

- Reactor water cleanup, ECs, and MSIVs are included in the containment isolation scope.

- The core spray injection paths are also unlikely to lead to a LOCA outside containment because there is a normally closed MOV and check valve in each potential path. Even spurious operation of a MOV due to relay chatter is judged unlikely to result in a LOCA due to the check valve.

Table 3.1-1A
Passive Structures, Systems, & Components

- Primary containment
  - drywell & pressure suppression structures (torus)
  - downcomer vent pipes & structures
  - vacuum breaker line AOVs (68-08, 09 & 10)
  - vacuum breaker lines
  - vacuum breaker check valves (68-01 through 07)
  - penetrations including piping

- Reactor vessel and supports

- Reactor coolant pressure boundary
  - reactor recirculation pumps & supports
  - main steam & feedwater piping
  - recirc loop piping
  - safety relief valves
  - main steam isolation valves
  - feedwater isolation valves
  - relief valve piping to the suppression pool
  - relief valve tail pipe vacuum breakers
  - connecting piping to ECCS

- Reactor internals

- CRD housing, supports & HCUs

- Instrument lines including reference leg condensing pots (part of NSSS)

- Secondary containment structures
  - Reactor building
  - spent fuel pool
  - block walls

- Turbine Building
  - Battery Rooms
  - Emergency Diesel & Board Rooms
  - Control Room
  - Relay Room
  - Main Steam Tunnel
  - block walls

Table 3.1-1A
Passive Structures, Systems, & Components

- Screen & Pump House including block walls, intake and discharge tunnels, piping & gates
- Pipe Tunnels
- Electrical Tunnels
- Safety piping outside containment
- Non-safety piping outside containment
- Fire water piping
- Valves (pressure boundary)
- Check Valves
- Cable trays
- Fuses
- Main control panels & ceiling
- Expansion joints
- Switches
- Current Transformers
- Potential Transformers
- Plant Stack (potential to fall on diesel & other important equipment)

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
AC	1S16	Aux Control Room Cabinet 1S16	cabinet	1S16	A-46	TB	261	ACR
AC	1S17	Aux Control Room Cabinet 1S17	cabinet	1S17	A-46	TB	261	ACR
AC	1S52	Aux Control Room Cabinet 1S52	cabinet	1S52	A-46	TB	261	ACR
AC	1S56	Aux Control Room Cabinet 1S56	cabinet	1S56	A-46	TB	261	ACR
AC	1S59	Aux Control Room Cabinet 1S59	cabinet	1S59	A-46	TB	261	ACR
AC	1S60	Aux Control Room Cabinet 1S60	cabinet	1S60	A-46	TB	261	ACR
AC	1S62	Aux Control Room Cabinet 1S62	cabinet	1S62	A-46	TB	261	ACR
AC	1S63	Aux Control Room Cabinet 1S63	cabinet	1S63	A-46	TB	261	ACR
AC	1S64	Aux Control Room Cabinet 1S64	cabinet	1S64	A-46	TB	261	ACR
AC	1S65	Aux Control Room Cabinet 1S65	cabinet	1S65	A-46	TB	261	ACR
AC	1S73	Aux Control Room Cabinet 1S73	cabinet	1S73	A-46	TB	261	ACR
AC	1S74	Aux Control Room Cabinet 1S74	cabinet	1S74	A-46	TB	261	ACR
AC	1S75	Aux Control Room Cabinet 1S75	cabinet	1S75	A-46	TB	261	ACR
AC	ATS A	Analog Trip System A	cabinet	ATS A	A-46	RB	281	N5
AC	ATS B	Analog Trip System B	cabinet	ATS B	A-46	RB	281	N5
AC	ATS C	Analog Trip System C	cabinet	ATS C	A-46	RB	281	K11
AC	ATS D	Analog Trip System D	cabinet	ATS D	A-46	RB	281	K11
AC	BKR R1012	Breaker - supply to PB102 trans 101S	breaker	R1012	IPEEE	TB	277	A7
AC	BKR R1013	Breaker - supply to PB103 trans 101N	breaker	R1013	IPEEE	TB	277	A4
AC	BKR R1020	DG neutral breaker	breaker	DG102	A-46/C	TB	261	DG 102 RM
AC	BKR R1021	Breaker - PB102 to 4KV/600V trans	breaker	PB102	A-46/C	TB	261	D18
AC	BKR R1022	DG breaker	breaker	PB103	A-46/C	TB	261	E18
AC	BKR R1030	DG neutral breaker	breaker	DG103	A-46/C	TB	261	DG 103 RM
AC	BKR R1032	DG breaker	breaker	PB103	A-46/C	TB	261	E18
AC	BKR R1043	Breaker - 4KV/600V trans to PB16B	breaker	PB16	A-46/C	RB	281	L4
AC	CAB #23091-B	Electrical Cabinet	cabinet	CAB #23091-B	A-46	RB	237	M6
AC	CAB #23093-B	Electrical Cabinet	cabinet	CAB #23093-B	A-46	RB	237	M6
AC	CARDOX CAB DG 102	CARDOX Cabinet DG 102 Room	cabinet	CARDOX	IPEEE	TB	261	DG 102 RM
AC	CARDOX CAB DG 103	CARDOX Cabinet DG 103 Room	cabinet	CARDOX	IPEEE	TB	261	DG 103 RM
AC	CP161	Control Panel 161	control panel	CP161	A-46	TB	261	A8
AC	CP171	Control Panel 171	control panel	CP171	A-46	TB	261	A11
AC	DC102	DG 102 DC Control Panel	DC control panel	DC102	A-46	TB	261	DG 102 RM
AC	DC103	DG 103 DC Control Panel	DC control panel	DC103	A-46	TB	261	DG 103 RM
AC	DE102	DG 102 Engine Control Panel	eng control panel	DE102	A-46	TB	261	DG 102 RM
AC	DE103	DG 103 Engine Control Panel	eng control panel	DE103	A-46	TB	261	DG 103 RM
AC	DG102	Diesel generator 102	diesel engine/gen	DG102	A-46	TB	261	DG 102 RM
AC	DG103	Diesel generator 103	diesel engine/gen	DG103	A-46	TB	261	DG 103 RM
AC	FN 209-03	DG 102 - Room Exhaust Fan	fan	none	IPEEE	TB	261	DG 102 RM

Table 3.1-1B Active Components								
System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
AC	FN 209-04	DG 102 - Room Exhaust Fan	fan	none	IPEEE	TB	261	DG 102 RM
AC	FN 209-05	DG 103 - Room Exhaust Fan	fan	none	IPEEE	TB	261	DG 103 RM
AC	FN 209-06	DG 103 - Room Exhaust Fan	fan	none	IPEEE	TB	261	DG 103 RM
AC	LS LSS2-56-DG102	level switch F.O day tank	level switch	DG102	A-46/C	TB	261	DG 102 RM
AC	LS LSS2-56-DG102	level switch F.O day tank	level switch	DG102	A-46/C	TB	261	DG 102 RM
AC	LS LSS2-56-DG103	level switch F.O day tank	level switch	DG103	A-46/C	TB	261	DG 103 RM
AC	LS LSS2-56-DG103	level switch F.O day tank	level switch	DG103	A-46/C	TB	261	DG 103 RM
AC	PB102	Power board 102	elec bus	PB102	A-46	TB	261	D18
AC	PB103	Power board 103	elec bus	PB103	A-46	TB	261	E18
AC	PB161B	Power board 161B	elec bus	PB161B	A-46	RB	261	M4
AC	PB16B	Power board 16B	elec bus	PB16	A-46	RB	281	L4
AC	PB171B	Power board 171B	elec bus	PB171B	A-46	RB	261	M12
AC	PB17B	Power board 17B	elec bus	PB17	A-46	RB	281	Q10
AC	PMP 79-53-DG102	DG102 raw water cooling pump	pump	none	A-46	TB	261	DG 102 RM
AC	PMP 79-54-DG103	DG103 raw water cooling pump	pump	none	A-46	TB	261	DG 103 RM
AC	PMP 79-43-DG102	DG102 engine cooling water pump	pump	DG102	A-46/C	TB	261	DG 102 RM
AC	PMP 79-44-DG102	DG102 engine cooling water pump	pump	DG102	A-46/C	TB	261	DG 102 RM
AC	PMP 79-45-DG103	DG103 engine cooling water pump	pump	DG103	A-46/C	TB	261	DG 103 RM
AC	PMP 79-46-DG103	DG103 engine cooling water pump	pump	DG103	A-46/C	TB	261	DG 103 RM
AC	PMP 82-40-DG102	fuel oil transfer pump DG102	pump	none	IPEEE	TB	261	DG 102 RM
AC	PMP 82-41-DG103	fuel oil transfer pump DG103	pump	none	IPEEE	TB	261	DG 103 RM
AC	PMP F.O. BPMP-DG103+B354	600V fuel booster pump	pump	DG103	A-46/C	TB	261	DG 103 RM
AC	PMP F.O. BPMP-DG102+B355	600V fuel booster pump	pump	DG102	A-46/C	TB	261	DG 102 RM
AC	PMP F.O.-DG102	fuel oil pump	pump	DG102	A-46/C	TB	261	DG 102 RM
AC	PMP F.O.-DG103	fuel oil pump	pump	DG103	A-46/C	TB	261	DG 103 RM
AC	PNL E	Main Control Room Panel E	control room panel	PNL E	A-46	TB	277	CR
AC	PNL F	Main Control Room Panel F	control room panel	PNL F	A-46	TB	277	CR
AC	PNL G	Main Control Room Panel G	control room panel	PNL G	A-46	TB	277	CR
AC	PNL K	Main Cotrol Room Panel K	control room panel	PNL K	A-46	TB	277	CR
AC	PNL L	Main Control Room Panel L	control room panel	PNL L	A-46	TB	277	CR
AC	PNL M	Main Control Room Panel M	control room panel	PNL M	A-46	TB	277	CR
AC	BKR R1031	Breaker - PB103 to 4KV/600V trans	breaker	PB103	A-46/C	TB	261	E18
AC	BKR R1053	Breaker - 4KV/600V trans to PB17B	breaker	PB17	A-46/C	RB	281	Q10
AC	REG DG102	DG voltage regulator	voltage reg	DC102	A-46/C	TB	261	DG 102 RM
AC	REG DG103	DG voltage regulator	voltage reg	DC103	A-46/C	TB	261	DG 103 RM
AC	RLY 12X-DE102	stop relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 12X-DE103	stop relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 14-1X-DE102	DG 102 start relay	relay	DE102	A-46/C	TB	261	DG 102 RM

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
AC	RLY 14-1X-DE103	DG 103 start relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 14-2X-DE102	DG 102 aux relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 14-2X-DE103	DG 103 start relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 18-DE102	DG 102 start relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 18-DE103	DG 103 start relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 18X-DE102	DG 102 time delay relay TDPU 2 min	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 18X-DE103	DG 103 time delay relay TDPU 2 min	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 2-1-DE102	DG time delay relay TDDO 98 sec	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 2-1-DE103	DG time delay relay TDDO 98 sec	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 2-2-DE102	DG time delay relay TDPU 5 sec	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 2-2-DE103	DG time delay relay TDPU 5 sec	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 2-3-DE102	DG time delay relay TDPU 45 sec	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 2-3-DE103	DG time delay relay TDPU 45 sec	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 2-4-DE102	DG time delay relay TDDO 45 sec	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 2-4-DE103	DG time delay relay TDDO 45 sec	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 27-1-PB102	under voltage sensing relay	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27-1-PB103	under voltage sensing relay	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27-1A-PB102	under voltage sensing relay	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27-1A-PB103	under voltage sensing relay	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27-1AX-PB102	under voltage sensing relay	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27-1AX-PB103	under voltage sensing relay	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27-1X-PB102	under voltage sensing relay	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27-1X-PB103	under voltage sensing relay	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27-2-DC102	DG 102 control circuit undervoltage relay	relay	DC102	A-46/C	TB	261	DG 102 RM
AC	RLY 27-2-DC103	DG 103 control circuit undervoltage relay	relay	DC103	A-46/C	TB	261	DG 103 RM
AC	RLY 27-2-PB102	under voltage sensing relay	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27-2-PB103	under voltage sensing relay	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27-2A-PB102	under voltage sensing relay	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27-2A-PB103	under voltage sensing relay	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27-2AX-PB102	under voltage sensing relay	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27-2AX-PB103	under voltage sensing relay	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27-2X-PB102	under voltage sensing relay	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27-2X-PB103	under voltage sensing relay	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27-3-PB102	under voltage sensing relay	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27-3-PB103	under voltage sensing relay	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27-3A-PB102	under voltage sensing relay	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27-3A-PB103	under voltage sensing relay	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27-3AX-PB102	under voltage sensing relay	relay	PB102	A-46/C	TB	261	D18

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
AC	RLY 27-3AX-PB103	under voltage sensing relay	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27-3X-PB102	under voltage sensing relay	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27-3X-PB103	under voltage sensing relay	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27X1-PB102	loss of voltage or degaded voltage	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27X1-PB103	loss of voltage or degaded voltage	relay	PB103	A-46/C	TB	261	E18
AC	RLY 27X2-PB102	loss of voltage or degaded voltage	relay	PB102	A-46/C	TB	261	D18
AC	RLY 27X2-PB103	loss of voltage or degaded voltage	relay	PB103	A-46/C	TB	261	E18
AC	RLY 3-DC102	DG 102 start relay	relay	DC102	A-46/C	TB	261	DG 102 RM
AC	RLY 3-DC103	DG 103 start relay	relay	DC103	A-46/C	TB	261	DG 103 RM
AC	RLY 31D-2X-DC102	DG 102 field flash relay	relay	DC102	A-46/C	TB	261	DG 102 RM
AC	RLY 31D-2X-DC103	DG 103 field flash relay	relay	DC103	A-46/C	TB	261	DG 103 RM
AC	RLY 31D-DC102	DG 102 field flash relay	relay	DC102	A-46/C	TB	261	DG 102 RM
AC	RLY 31D-DC103	DG 103 field flash relay	relay	DC103	A-46/C	TB	261	DG 103 RM
AC	RLY 31D-X-DC102	DG 102 field flash relay	relay	DC102	A-46/C	TB	261	DG 102 RM
AC	RLY 31D-X-DC103	DG 103 field flash relay	relay	DC103	A-46/C	TB	261	DG 103 RM
AC	RLY 31D-X-DG102	voltage sensitive relay	relay	DC102	A-46/C	TB	261	DG 102 RM
AC	RLY 31D-X-DG103	voltage sensitive relay	relay	DC103	A-46/C	TB	261	DG 103 RM
AC	RLY 38D-X-DE102	stop relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 38D-X-DE103	stop relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 3A-DC102	DG 102 aux relay	relay	DC102	A-46/C	TB	261	DG 102 RM
AC	RLY 3A-DC103	DG 103 start relay	relay	DC103	A-46/C	TB	261	DG 103 RM
AC	RLY 3D-DE102	stop relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 3D-DE103	stop relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 42-1-DE102	DG 102 start relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 42-1-DE103	DG 103 start relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 42-2-DE102	DG 102 aux relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 42-2-DE103	DG 103 aux relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 48-DE102	DG 102 aux relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 48-DE103	DG 103 aux relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 48A-DE102	DG 102 aux relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 48A-DE103	DG 103 aux relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 48X-DE102	DG start relay TDPU 2 sec	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 48X-DE103	DG start relay TDPU 2 sec	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 52W-DC102	DG 102 aux relay	relay	DC102	A-46/C	TB	261	DG 102 RM
AC	RLY 52W-DC103	DG 103 aux relay	relay	DC103	A-46/C	TB	261	DG 103 RM
AC	RLY 53D-DC102	DG 102 aux relay	relay	DC102	A-46/C	TB	261	DG 102 RM
AC	RLY 53D-DC103	DG 103 aux relay	relay	DC103	A-46/C	TB	261	DG 103 RM
AC	RLY 53D-X-DC102	DG 102 aux relay	relay	DC102	A-46/C	TB	261	DG 102 RM

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
AC	RLY 53D-X-DC103	DG 103 aux relay	relay	DC103	A-46/C	TB	261	DG 103 RM
AC	RLY 5D-DE102	stop relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 5D-DE103	stop relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 5DE-DE102	emergency stop relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 5DE-DE103	emergency stop relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 65-DE102	DG 102 aux relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 65-DE103	DG 103 aux relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 65X-DE102	DG 102 aux relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 65X-DE103	DG 103 aux relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 71X-H DE102	DG 102 aux relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 71X-H DE103	DG 103 aux relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 71X-L DE102	DG 102 aux relay	relay	DE102	A-46/C	TB	261	DG 102 RM
AC	RLY 71X-L DE103	DG 103 aux relay	relay	DE103	A-46/C	TB	261	DG 103 RM
AC	RLY 74A10	Contactor for DG 103 Room Exhaust Fan	relay	CARDOX	IPEEE	TB	261	DG 103 RM
AC	RLY 74A9	Contactor for DG 102 Room Exhaust Fan	relay	CARDOX	IPEEE	TB	261	DG 102 RM
AC	RLY 86-16-PB102	PB16 lockout relay	relay	PNL K	A-46/C	TB	277	CR
AC	RLY 86-16-PB103	PB16 lockout relay	relay	PNL K	A-46/C	TB	277	CR
AC	SOL 20D-DG102	air start solenoid	solenoid	DG102	A-46	TB	261	DG 102 RM
AC	SOL 20D-DG103	air start solenoid	solenoid	DG103	A-46	TB	261	DG 103 RM
AC	SSC1	Shutdown Supervisory Cabinet 1	cabinet	SSC1	A-46	RB	281	K5
AC	SSC2	Shutdown Supervisory Cabinet 2	cabinet	SSC2	A-46	RB	281	K11
AC	TNK 82-43	DG 103 Fuel Oil Storage Tank	tank	none	IPEEE	NA	NA	NA
AC	TNK 82-44	DG 102 Fuel Oil Storage Tank	tank	none	IPEEE	NA	NA	NA
AC	TNK 82-92	DG 103 Fuel Oil Storage Day Tank	tank	none	IPEEE	TB	261	DG 103 RM
AC	TNK 82-96	DG 102 Fuel Oil Storage Day Tank	tank	none	IPEEE	TB	261	DG 102 RM
AC	TNK 96-04	DG 102 - Air Start Tank	tank	none	IPEEE	TB	261	DG 102 RM
AC	TNK 96-05	DG 102 - Air Start Tank	tank	none	IPEEE	TB	261	DG 102 RM
AC	TNK 96-06	DG 102 - Air Start Tank	tank	none	IPEEE	TB	261	DG 102 RM
AC	TNK 96-07	DG 102 - Air Start Tank	tank	none	IPEEE	TB	261	DG 102 RM
AC	TNK 96-08	DG 102 - Air Start Tank	tank	none	IPEEE	TB	261	DG 102 RM
AC	TNK 96-31	DG 103 - Air Start Tank	tank	none	IPEEE	TB	261	DG 103 RM
AC	TNK 96-32	DG 103 - Air Start Tank	tank	none	IPEEE	TB	261	DG 103 RM
AC	TNK 96-33	DG 103 - Air Start Tank	tank	none	IPEEE	TB	261	DG 103 RM
AC	TNK 96-34	DG 103 - Air Start Tank	tank	none	IPEEE	TB	261	DG 103 RM
AC	TNK 96-35	DG 103 - Air Start Tank	tank	none	IPEEE	TB	261	DG 103 RM
AC	XF AHTR DG102	xmfr for volt reg DG102	transformer	DC102	A-46/C	TB	261	DG 102 RM
AC	XF AHTR DG103	xmfr for volt reg DG102	transformer	DC103	A-46/C	TB	261	DG 103 RM
AC	XF EXCITER DG102	exciter 120/208 V xfmr	transformer	DG102	A-46/C	TB	261	DG 102 RM

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
AC	XF EXCITER DG103	exciter 120/208 V xfmr	transformer	DG103	A-46/C	TB	261	DG 103 RM
AC	XF ISOL XMFR DG102	isolation xmfr for volt adjust	transformer	DG102	A-46/C	TB	261	DG 102 RM
AC	XF ISOL XMFR DG103	isolation xmfr for volt adjust	transformer	DG103	A-46/C	TB	261	DG 103 RM
AC	XF XFMR T-17B	Trans - 4KV/600V from PB103 to PB17B	power xmfr	PB17	A-46/C	RB	281	Q10
AC	XF XMFR T-16B	Trans - 4KV/600V from PB102 to PB16B	power xmfr	PB16	A-46/C	RB	281	L4
AC	ZS 14-1-DG102	engine speed switch closes @ 200 rpm	speed switch	DG102	A-46/C	TB	261	DG 102 RM
AC	ZS 14-1-DG103	engine speed switch closes @ 200 rpm	speed switch	DG103	A-46/C	TB	261	DG 103 RM
AC	ZS 14-2-DG102	engine speed switch closes @ 750 rpm	speed switch	DG102	A-46/C	TB	261	DG 102 RM
AC	ZS 14-2-DG103	engine speed switch closes @ 750 rpm	speed switch	DG103	A-46/C	TB	261	DG 103 RM
AC	Roll Door - DG102	DG 102 Rm roll door & motor	door & motor	none	IPEEE	TB	261	DG 102 RM
AC	Roll Door - DG103	DG 103 Rm roll door & motor	door & motor	none	IPEEE	TB	261	DG 103 RM
AC	CAB #19720-T	DG 102 Rm fan & roll door control	cabinet	CAB #19720-T	IPEEE	TB	261	DG 102 RM
AC	CAB #19720-S	DG 103 Rm fan & roll door control	cabinet	CAB #19720-S	IPEEE	TB	261	DG 103 RM
AC	CAB #22445-A	DG 102 Rm roll door controller	cabinet	CAB #22445-A	IPEEE	TB	261	DG 102 RM
AC	CAB #22445-B	DG 103 Rm roll door controller	cabinet	CAB #22445-B	IPEEE	TB	261	DG 103 RM
ADS	CS CS-O -111	manual RV actuation (01-102A)	control switch	PNL F	A-46/C	TB	277	CR
ADS	CS CS-O -112	manual RV actuation (01-102B)	control switch	PNL F	A-46/C	TB	277	CR
ADS	CS CS-O -113	manual RV actuation (01-102E)	control switch	PNL F	A-46/C	TB	277	CR
ADS	CS CS-O -121	manual RV actuation (01-102C)	control switch	PNL F	A-46/C	TB	277	CR
ADS	CS CS-O -121-F	manual RV actuation (01-102D)	control switch	PNL F	A-46/C	TB	277	CR
ADS	CS CS-O -123-F	manual RV actuation (01-102F)	control switch	PNL F	A-46/C	TB	277	CR
ADS	DPT 36-05A	Lo-Lo-Lo vessel level xmtr	delta P transmitter	inst rack west	IPEEE	RB	281	W INST RM
ADS	DPT 36-05B	Lo-Lo-Lo vessel level xmtr	delta P transmitter	inst rack west	IPEEE	RB	281	W INST RM
ADS	DPT 36-05C	Lo-Lo-Lo vessel level xmtr	delta P transmitter	inst rack east	IPEEE	RB	284	E INST RM
ADS	DPT 36-05D	Lo-Lo-Lo vessel level xmtr	delta P transmitter	inst rack east	IPEEE	RB	284	E INST RM
ADS	RLY 11K21-M	Lo-Lo-Lo vessel level channel 11-1	relay	PNL M	A-46/C	TB	277	CR
ADS	RLY 11K22-M	Lo-Lo-Lo vessel level channel 12-1	relay	PNL M	A-46/C	TB	277	CR
ADS	RLY 12K21-M	Lo-Lo-Lo vessel level channel 11-2	relay	PNL M	A-46/C	TB	277	CR
ADS	RLY 12K22-M	Lo-Lo-Lo vessel level channel 12-2	relay	PNL M	A-46/C	TB	277	CR
ADS	RLY 16K207-1S59	ADS auto actuation channel 11-2	relay	1S59	A-46/C	TB	261	ACR
ADS	RLY 16K208-1S60	ADS auto actuation channel 12-2	relay	1S60	A-46/C	TB	261	ACR
ADS	RLY 2-1-1S59	ADS timing relay channel 11-1	TDDO relay	1S59	A-46/C	TB	261	ACR
ADS	RLY 2-2-1S60	ADS timing relay channel 12-2	TDDO relay	1S60	A-46/C	TB	261	ACR
ADS	RLY 21A-SSC1	confirmatory logic channel 11	relay	SSC1	A-46/C	RB	281	K5
ADS	RLY 21B-SSC2	confirmatory logic channel 12	relay	SSC2	A-46/C	RB	281	K11
ADS	RLY 4-111-JB11	manual RV actuation (01-102A)	relay	CAB #23091-B	A-46/C	RB	237	M6
ADS	RLY 4-112-JB11	manual RV actuation (01-102B)	relay	CAB #23091-B	A-46/C	RB	237	M6
ADS	RLY 4-113-JB11	manual RV actuation (01-102E)	relay	CAB #23091-B	A-46/C	RB	237	M6

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
ADS	RLY 4-121-JB12	manual RV actuation (01-102C)	relay	CAB #23093-B	A-46/C	RB	237	N10
ADS	RLY 4-122-JB12	manual RV actuation (01-102D)	relay	CAB #23093-B	A-46/C	RB	237	N10
ADS	RLY 4-123-JB12	manual RV actuation (01-102F)	relay	CAB #23093-B	A-46/C	RB	237	N10
ADS	RLY R23A-SSC1	manual RV reset (01-102B)	relay	SSC1	A-46/C	RB	281	K5
ADS	RLY R23A-SSC1	manual RV reset (01-102E)	relay	SSC1	A-46/C	RB	281	K5
ADS	RLY R23A-SSC1	manual RV reset (01-102A)	relay	SSC1	A-46/C	RB	281	K5
ADS	RLY R23D-SSC2	manual RV reset (01-102C)	relay	SSC2	A-46/C	RB	281	K11
ADS	RLY R23D-SSC2	manual RV reset (01-102D)	relay	SSC2	A-46/C	RB	281	K11
ADS	RLY R23D-SSC2	manual RV reset (01-102F)	relay	SSC2	A-46/C	RB	281	K11
ADS	RLY-11K21A-ATS A	Lo-Lo-Lo vessel level channel 11-1	relay	ATS A	A-46/C	RB	281	N5
ADS	RLY-11K22A-ATS C	Lo-Lo-Lo vessel level channel 11-2	relay	ATS C	A-46/C	RB	281	K11
ADS	RLY-11K25A-ATS A	hi drywell pressure channel 11-1	relay	ATS A	A-46/C	RB	281	N5
ADS	RLY-11K26A-ATS C	hi drywell pressure channel 11-2	relay	ATS C	A-46/C	RB	281	K11
ADS	RLY-12K21A-ATS D	Lo-Lo-Lo vessel level channel 12-2	relay	ATS D	A-46/C	RB	281	K11
ADS	RLY-12K22A-ATS B	Lo-Lo-Lo vessel level channel 12-1	relay	ATS B	A-46/C	RB	281	N5
ADS	RLY-12K25A-ATS D	hi drywell pressure channel 12-2	relay	ATS D	A-46/C	RB	281	K11
ADS	RLY-12K26A-ATS B	hi drywell pressure channel 12-1	relay	ATS B	A-46/C	RB	281	N5
ADS	RLY-K16A-ATS A	Lo-Lo-Lo vessel level channel 11-1	relay	ATS A	A-46/C	RB	281	N5
ADS	RLY-K16B-ATS B	Lo-Lo-Lo vessel level channel 12-1	relay	ATS B	A-46/C	RB	281	N5
ADS	RLY-K16C-ATS C	Lo-Lo-Lo vessel level channel 11-2	relay	ATS C	A-46/C	RB	281	K11
ADS	RLY-K16D-ATS D	Lo-Lo-Lo vessel level channel 12-2	relay	ATS D	A-46/C	RB	281	K11
ADS	SOL 20-111	manual RV actuation (01-102A)	solenoid	at valve	A-46	DW	259	220 AZ
ADS	SOL 20-112	manual RV actuation (01-102B)	solenoid	at valve	A-46	DW	259	220 AZ
ADS	SOL 20-113	manual RV actuation (01-102E)	solenoid	at valve	A-46	DW	259	220 AZ
ADS	SOL 20-121	manual RV actuation (01-102C)	solenoid	at valve	A-46	DW	259	170 AZ
ADS	SOL 20-122	manual RV actuation (01-102D)	solenoid	at valve	A-46	DW	259	170 AZ
ADS	SOL 20-123	manual RV actuation (01-102F)	solenoid	at valve	A-46	DW	259	170 AZ
ADS	VLV 01-102A	power assisted relief valve	ERV	RV	A-46	DW	259	220 AZ
ADS	VLV 01-102B	power assisted relief valve	ERV	RV	A-46	DW	259	220 AZ
ADS	VLV 01-102C	power assisted relief valve	ERV	RV	A-46	DW	259	170 AZ
ADS	VLV 01-102D	power assisted relief valve	ERV	RV	A-46	DW	259	170 AZ
ADS	VLV 01-102E	power assisted relief valve	ERV	RV	A-46	DW	259	220 AZ
ADS	VLV 01-102F	power assisted relief valve	ERV	RV	A-46	DW	259	170 AZ
CNTRL	N INST RM RACK	Rack - North Instrument Room	rack	NIR RACK	A-46	RB	281	N INST RM
CNTRL	APRM 11	averaging module	sig processor	PNL E	A-46/C	TB	277	CR
CNTRL	DPT 36-03A	H/L level transmitter column 11	delta P transmitter	inst rack west	A-46	RB	281	W INST RM
CNTRL	DPT 36-03D	H/L level transmitter column 12	transmitter	inst rack east	A-46	RB	284	E INST RM
CNTRL	DPT 36-05C	Lo Lo-Lo level xmtr column 12	transmitter	inst rack east	IPEEE	RB	284	E INST RM

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
CNTRL	DPT XMTR LT 36-24A	Core range level xmtr column 11	transmitter	inst rack north	IPEEE	RB	237	N INST RM
CNTRL	DPT XMTR LT 36-24B	Core range level xmtr column 12	transmitter	inst rack north	IPEEE	RB	237	N INST RM
CNTRL	E INST RM RACK	Rack - East Instrument Room	rack	EIR RACK	A-46	RB	281	E INST RM
CNTRL	IND APRM	neutron flux indicator	panel indicator	PNL G	A-46/C	TB	277	CR
CNTRL	IND LI 36-09	H/L level indicator column 11	panel indicator	PNL F	A-46/C	TB	277	CR
CNTRL	IND LI 36-10	H/L level indicator column 12	panel indicator	PNL F	A-46/C	TB	277	CR
CNTRL	IND LI 36-19	Lo-Lo-Lo level indicator column 12	panel indicator	PNL F	A-46/C	TB	277	CR
CNTRL	IND LI 36-20	Lo-Lo-Lo level indicator column 11	panel indicator	PNL F	A-46/C	TB	277	CR
CNTRL	IND LI 36-43	Core range level indicator	panel indicator	PNL F	A-46/C	TB	277	CR
CNTRL	IND LI 36-44	Core range level indicator	panel indicator	PNL F	A-46/C	TB	277	CR
CNTRL	IND LI-58-05A	torus pool level indicator	panel indicator	PNL K	A-46/C	TB	277	CR
CNTRL	IND PI 201.2-483A	Drywell pressure Indicator	panel indicator	PNL L	A-46/C	TB	277	CR
CNTRL	IND PI 201.2-484A	Drywell pressure Indicator	panel indicator	PNL L	A-46/C	TB	277	CR
CNTRL	IND PI 36-31A	RPV pressure indicator column 11	panel indicator	PNL F	A-46/C	TB	277	CR
CNTRL	IND PI 36-32A	RPV pressure indicator column 12	panel indicator	PNL F	A-46/C	TB	277	CR
CNTRL	IND TI-201.2-519	torus pool temperature indicator	panel indicator	PNL K	A-46/C	TB	277	CR
CNTRL	LT 58-05	torus pool level	level xmtr	local	IPEEE	RB	198	SE CORNR
CNTRL	NM LPRM-28-49	neutron monitor	ion chamber	local	IPEEE	DW		
CNTRL	PT 201.2-483	Drywell pressure transmitter	press xmtr	inst rack west	IPEEE	RB	281	W INST RM
CNTRL	PT 36-31	RPV pressure xmtr column 11	press xmtr	inst rack west	IPEEE	RB	281	W INST RM
CNTRL	PT 36-32	RPV pressure xmtr column 12	transmitter	inst rack east	A-46	RB	284	E INST RM
CNTRL	PT XMTR 201.2-484	Drywell pressure transmitter	transmitter	none	IPEEE	DW		
CNTRL	TT TE-201.2-491	torus pool temperature	temp xmtr	local	A-46	TRS	198	AZ 72
CNTRL	W INST RM RACK	Rack - West Instrument Room	rack	WIR RACK	A-46	RB	281	W INST RM
CS	81-05	Pump 121 filter	filter	none	IPEEE	RB	198	SE CORNR
CS	81-06	Pump 122 filter	filter	none	IPEEE	RB	198	SE CORNR
CS	81-11	PSV - pump recirc 12	relief vlv	none	A-46	RB	237	SE CORNR
CS	81-207	Pump 121 motor cooler	heat exch	none	IPEEE	RB	198	SE CORNR
CS	81-208	Pump 122 motor cooler	heat exch	none	IPEEE	RB	198	SE CORNR
CS	81-209	Pump 111 motor cooler	heat exch	none	IPEEE	RB	198	SW CORNR
CS	81-210	Pump 112 motor cooler	heat exch	none	IPEEE	RB	198	SW CORNR
CS	81-25	Pump 111 filter	filter	none	IPEEE	RB	198	SW CORNR
CS	81-26	Pump 112 filter	filter	none	IPEEE	RB	198	SW CORNR
CS	81-31	PSV - pump recirc 11	relief vlv	none	A-46	RB	237	SW CORNR
CS	81-53	PCV - pump 111 cooling	press reg vlv	none	A-46	RB	198	SW CORNR
CS	81-54	PCV - pump 112 cooling	press reg vlv	none	A-46	RB	198	SW CORNR
CS	81-55	PCV - pump 121 cooling	press reg vlv	none	A-46	RB	198	SE CORNR
CS	81-56	PCV - pump 122 cooling	press reg vlv	none	A-46	RB	198	SE CORNR

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
CS	BKR 81-03-PB102	core spray pump 121	4KV breaker	PB102	A-46/C	TB	261	D18
CS	BKR 81-04-PB103	core spray pump 122	4KV breaker	PB103	A-46/C	TB	261	E18
CS	BKR 81-23-PB102	core spray pump 111	4KV breaker	PB102	A-46/C	TB	261	D18
CS	BKR 81-24-PB103	core spray pump 112	4KV breaker	PB103	A-46/C	TB	261	E18
CS	BKR 81-49-PB103	core spray topping spray pump 112	4KV breaker	PB103	A-46/C	TB	261	E18
CS	BKR 81-50-PB102	core spray topping spray pump 111	4KV breaker	PB102	A-46/C	TB	261	D18
CS	BKR 81-51-PB102	core spray topping spray pump 121	4KV breaker	PB102	A-46/C	TB	261	D18
CS	BKR 81-52-PB103	core spray topping spray pump 122	4KV breaker	PB103	A-46/C	TB	261	E18
CS	PMP 81-03	core spray pump 121	pump	none	A-46	RB	198	SE CORNR
CS	PMP 81-04	core spray pump 122	pump	none	A-46	RB	198	SE CORNR
CS	PMP 81-23	core spray pump 111	pump	none	A-46	RB	198	SW CORNR
CS	PMP 81-24	core spray pump 112	pump	none	A-46	RB	198	SW CORNR
CS	PMP 81-49	core spray topping spray pump 112	pump	none	A-46	RB	237	SW CORNR
CS	PMP 81-50	core spray topping spray pump 111	pump	none	A-46	RB	237	SW CORNR
CS	PMP 81-51	core spray topping spray pump 121	pump	none	A-46	RB	237	SE CORNR
CS	PMP 81-52	core spray topping spray pump 121	pump	none	A-46	RB	237	SE CORNR
CS	RLY 2-1-1S63	core spray pmp (81-23) auto start	timing relay	1S63	A-46/C	TB	261	ACR
CS	RLY 2-1-1S73	core spray pmp (81-24) auto start	timing relay	1S73	A-46/C	TB	261	ACR
CS	RLY 2-2-1S63	core spray pmp (81-03) auto start	timing relay	1S63	A-46/C	TB	261	ACR
CS	RLY 2-2-1S73	core spray pmp (81-04) auto start	timing relay	1S73	A-46/C	TB	261	ACR
CS	RLY 2X-1-1S63	core spray pmp (81-23) auto start	aux relay	1S63	A-46/C	TB	261	ACR
CS	RLY 2X-1-1S73	core spray pmp (81-24) auto start	aux relay	1S73	A-46/C	TB	261	ACR
CS	RLY 2X-2-1S63	core spray pmp (81-03) auto start	aux relay	1S63	A-46/C	TB	261	ACR
CS	RLY 2X-2-1S73	core spray pmp (81-04) auto start	aux relay	1S73	A-46/C	TB	261	ACR
CS	VLV 40-01	core spray injec vlv 121	valve	none	A-46	DW	261	M9
CS	VLV 40-09	core spray injec vlv 122	valve	none	A-46	DW	261	M9
CS	VLV 40-10	core spray injec vlv 112	valve	none	A-46	DW	261	M7
CS	VLV 40-11	core spray injec vlv 111	valve	none	A-46	DW	261	M7
DC	BAT11	Battery 11	battery	BAT11	A-46	TB	277	BAT RM 11
DC	BAT12	Battery 12	battery	BAT12	A-46	TB	277	BAT RM 12
DC	BB11	Battery board 11	elec bus	BB11	A-46	TB	261	A9
DC	BB12	Battery board 12	elec bus	BB12	A-46	TB	261	A10
DC	BKR BB11/F02	Breaker - battery supply to BB11	breaker	BB11	A-46/C	TB	261	A9
DC	BKR BB11/G02	Breaker - supply to BB11 from chargers	breaker	BB11	A-46/C	TB	261	A9
DC	BKR BB12/F02	Breaker - supply to BB12 from chargers	breaker	BB12	A-46/C	TB	261	A10
DC	BKR BB12/G03	Breaker - battery supply to BB12	breaker	BB12	A-46/C	TB	261	A10
DC	BKR PB16B/012C	Breaker - supply to chargers from PB16B	breaker	PB16B	A-46/C	TB	281	L4
DC	BKR PB17B/003+B291C	Breaker - supply to chargers from PB17B	breaker	PB17B	A-46/C	RB	281	Q10

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
DC	SC161A	Static battery charger 161A	ss charger	SC161A	A-46/C	TB	261	A8
DC	SC161B	Static battery charger 161B	ss charger	SC161B	A-46/C	TB	261	A8
DC	SC171A	Static battery charger 171A	ss charger	SC171A	A-46/C	TB	261	A12
DC	SC171B	Static battery charger 171B	ss charger	SC171B	A-46/C	TB	261	A12
DC	RLY 27AB-SC161A/B	under voltage relay for static charger	relay	CP161	A-46/C	TB	261	A8
DC	RLY 27AB-SC171A/B	under voltage relay for static charger 171	relay	CP171	A-46/C	TB	261	A11
DC	RLY 27BC-SC161A/B	under voltage relay for static charger	relay	CP161	A-46/C	TB	261	A8
DC	RLY 27BC-SC171A/B	under voltage relay for static charger 171	relay	CP171	A-46/C	TB	261	A11
ISOL	01-01	MSIV inboard MOV	AC MOV	none	A-46	DW	259	210 AZ
ISOL	01-02	MSIV inboard MOV	AC MOV	none	A-46	DW	259	160 AZ
ISOL	01-03	MSIV outboard AOV	AOV	none	A-46	TB	261	MSIV RM
ISOL	01-04	MSIV outboard AOV	AOV	none	A-46	TB	261	MSIV RM
ISOL	01-PV1	Shuttle Valve MSIV	shuttle valve	MSIV RACK	A-46/C	TB	261	MSIV RM
ISOL	01-PV2	Shuttle Valve MSIV	shuttle valve	MSIV RACK	A-46/C	TB	261	MSIV RM
ISOL	01-PV3	Shuttle Valve MSIV	shuttle valve	MSIV RACK	A-46/C	TB	261	MSIV RM
ISOL	01-PV4	Shuttle Valve MSIV	shuttle valve	MSIV RACK	A-46/C	TB	261	MSIV RM
ISOL	83.1-09	Drywell equip drain inboard MOV	AC MOV	none	IPEEE	DW	240	70 AZ
ISOL	83.1-10	Drywell equip drain outboard AOV	AOV	none	IPEEE	RB	240	L10
ISOL	83.1-11	Drywell floor drain inboard MOV	AC MOV	none	IPEEE	DW	240	45 AZ
ISOL	83.1-12	Drywell floor drain outboard AOV	AOV	none	IPEEE	RB	240	M10
ISOL	CS 39-07R-PNL K	manual close switch (39-08R)	control switch	PNL K	A-46/C	TB	277	CR
ISOL	CS 39-07RC	manual close switch (39-07R)	control switch	PNL K	A-46/C	TB	277	CR
ISOL	CS 39-09R PNL K	manual close signal (39-09R)	control switch	PNL K	A-46/C	TB	277	CR
ISOL	CS 39-10R-K	manual close signal (39-10R)	control switch	PNL K	A-46/C	TB	277	CR
ISOL	DPT 39-06A	hi steam line flow sensor (EC-12)	delta P transmitter	W INST RM	A-46/C	RB	281	W INST RM
ISOL	DPT 39-06B	hi steam line flow sensor (EC-12)	delta P transmitter	W INST RM	A-46/C	RB	281	W INST RM
ISOL	DPT 39-06C	hi steam line flow sensor (EC-11)	diff press xmtr	E INST RM	A-46/C	RB	284	E INST RM
ISOL	DPT 39-06D	hi steam line flow sensor (EC-11)	diff press xmtr	E INST RM	A-46/C	RB	284	E INST RM
ISOL	MTR STR 39-07R	operates 39-07R	DC motor stator	DC vlv brd 11	A-46/C	TB	261	A11
ISOL	MTR STR 39-08R	operates 39-08R	DC motor stator	DC vlv brd 12	A-46/C	TB	291	J5
ISOL	MTR STR 39-09R	operates 39-09R	AC motor stator	PB 171B	A-46/C	RB	261	M12
ISOL	MTR STR 39-10R	operates 39-10R	AC motor stator	PB 161B	A-46/C	RB	261	M4
ISOL	PB DC VALVE BD 11	DC power board for isolation valves	125 VDC MCC	DC vlv brd 11	A-46	TB	261	A11
ISOL	PB DC VALVE BD 12	DC power board for isolation valves	125 VDC MCC	DC vlv brd 12	A-46	TB	291	J5
ISOL	PB167	power board for vlvs 83.1-09 &11	480 VAC MCC	PB 167	A-46	RB	281	Q7
ISOL	RK #C-27053-C	Rack - MSIV SOV and Air Shuttle Valves	rack	MSIV RACK	A-46	TB	261	MSIV RM
ISOL	RLY 36B-SSC1	auto close signal (39-10R)	relay	SSC1	A-46/C	RB	281	K5
ISOL	RLY 36C-SSC2	auto close signal (39-09R)	relay	SSC2	A-46/C	RB	281	K11

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
ISOL	RLY 37A-SSC1	auto close signal (39-10R)	relay	SSC1	A-46/C	RB	281	K5
ISOL	RLY 37D-SSC2	auto close signal (39-09R)	relay	SSC2	A-46/C	RB	281	K11
ISOL	RLY 4-11A-1S75	auto close signal (39-09R)	relay	1S75	A-46/C	TB	261	ACR
ISOL	RLY 4-11B-1S62	closes 33-04 on low-low level	fail safe relay	1S62	A-46/C	TB	261	ACR
ISOL	RLY 4-11B-1S65	auto close signal (39-07R)	relay	1S65	A-46/C	TB	261	ACR
ISOL	RLY 4-11C-1S62	closes 33-02R on low-low level	fail safe relay	1S62	A-46/C	TB	261	ACR
ISOL	RLY 4-11G-1S75	auto close signal (39-09R)	relay	1S75	A-46/C	TB	261	ACR
ISOL	RLY 4-11H-1S65	auto close signal (39-07R)	relay	1S65	A-46/C	TB	261	ACR
ISOL	RLY 4-12A-1S65	auto close signal (39-10R)	relay	1S65	A-46/C	TB	261	ACR
ISOL	RLY 4-12B-1S75	auto close signal (39-08R)	relay	1S75	A-46/C	TB	261	ACR
ISOL	RLY 4-12G-1S65	auto close signal (39-10R)	relay	1S65	A-46/C	TB	261	ACR
ISOL	RLY 4-12H-1S75	auto close signal (39-08R)	relay	1S75	A-46/C	TB	261	ACR
ISOL	RLY CX1-C-DC SSC2	manual close signal (39-09R)	relay	SSC2	A-46/C	RB	281	K11
ISOL	RLY CX1-C-SSC1	manual close signal (39-10R)	relay	SSC1	A-46/C	RB	281	K5
ISOL	RLY CX1-C-VLV BD 11	manual close signal (39-07R)	relay	DC vlv brd 11	A-46/C	TB	261	A11
ISOL	RLY CX1-C-VLV BD 12	manual close signal (39-08R)	relay	DC vlv brd 12	A-46/C	TB	291	J5
ISOL	RLY K17A	hi steam line flow (EC 12)	relay	ATS A	A-46/C	RB	281	N5
ISOL	RLY K17B	hi steam line flow (EC-12)	relay	ATS D	A-46/C	RB	281	K11
ISOL	RLY K17C	hi steam line flow (EC-11)	relay	ATS C	A-46/C	RB	281	K11
ISOL	RLY K17D	hi steam line flow (EC-11)	relay	ATS D	A-46/C	RB	281	K11
ISOL	RLY R36A-SCC1	auto close signal (39-08R)	relay	SSC1	A-46/C	RB	281	K5
ISOL	RLY R36D	auto close signal (39-07R)	relay	SSC2	A-46/C	RB	281	K11
ISOL	RLY R37B-SCC1	auto close signal (39-08R)	relay	SSC1	A-46/C	RB	281	K5
ISOL	RLY R37C	auto close signal (39-07R)	relay	SSC1	A-46/C	RB	281	K5
ISOL	SOV 01-3C	SOV - MSIV 01-03	solenoid	MSIV RACK	A-46/C	TB	261	MSIV RM
ISOL	SOV 01-3D	SOV - MSIV 01-03	solenoid	MSIV RACK	A-46/C	TB	261	MSIV RM
ISOL	SOV 01-3E	SOV - MSIV 01-03	solenoid	MSIV RACK	A-46/C	TB	261	MSIV RM
ISOL	SOV 01-4C	SOV - MSIV 01-04	solenoid	MSIV RACK	A-46/C	TB	261	MSIV RM
ISOL	SOV 01-4D	SOV - MSIV 01-04	solenoid	MSIV RACK	A-46/C	TB	261	MSIV RM
ISOL	SOV 01-4E	SOV - MSIV 01-04	solenoid	MSIV RACK	A-46/C	TB	261	MSIV RM
ISOL	VLV 33-01R	inboard RWCU return line MOV	AC MOV	none	A-46	DW	259	70 AZ
ISOL	VLV 33-02R	inboard RWCU suction line MOV	AC MOV	none	A-46	DW	259	N8
ISOL	VLV 33-04	outboard RWCU suction line MOV	DC MOV	none	A-46	RB	261	N9
ISOL	VLV 39-07R	isolation vlv for EC 111 & 112	DC MOV	none	A-46	RB	298	ECIV RM
ISOL	VLV 39-08R	isolation vlv for EC 121 & 122	DC MOV	none	A-46	RB	298	ECIV RM
ISOL	VLV 39-10R	isolation vlv for EC 121 &122	AC MOV	none	A-46	RB	261	M4
ISOL	VLV 39-09R	isolation vlv for EC 111 & 112	AC MOV	none	A-46	RB	261	M12
ISOL	XFRSW 167	transfer switch for PB 167	auto xfr switch	PB167	A-46/C	RB	281	Q7

Table 3.1-1B Active Components								
System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
RPS	BKR 42-1-PRC162	contactor 42-1 for UPS162A/B	contactor	PRC162	A-46/C	TB	277	A7
RPS	BKR 42-1-PRC172	contactor 42-1 for UPS172A/B	contactor	PRC172	A-46/C	TB	277	D2
RPS	BKR 42-2-PRC162	contactor 42-2 for UPS162A/B	contactor	PRC162	A-46/C	TB	277	A7
RPS	BKR 42-2-PRC172	contactor 42-2 for UPS172A/B	contactor	PRC172	A-46/C	TB	277	D2
RPS	BKR PB16B/012B	Breaker - supply to UPS from PB16B	breaker	PB161B	A-46/C	RB	261	M4
RPS	BKR PB17B/003B	Breaker - supply to UPS from PB17B	breaker	PB171B	A-46/C	RB	261	M12
RPS	PRC162	Protective Relay Cabinet for UPS 162	cabinet	PRC162	A-46/C	TB	277	A7
RPS	PRC172	Protective Relay Cabinet for UPS 172	cabinet	PRC172	A-46/C	TB	277	D2
RPS	RLY 27AB-UPS162A/B	under voltage relay for UPS 162A/B	relay	PRC162	A-46/C	TB	277	A7
RPS	RLY 27AB-UPS162A/B	under voltage relay for MG 167	relay	PRC162	A-46/C	TB	277	A7
RPS	RLY 27AB-UPS172A/B	under voltage relay for UPS 172A/B	relay	PRC172	A-46/C	TB	277	D2
RPS	RLY 27AB-UPS172A/B	under voltage relay for MG 167	relay	PRC172	A-46/C	TB	277	D2
RPS	RLY 27BC-UPS162A/B	under voltage relay for UPS 162A/B	relay	PRC162	A-46/C	TB	277	A7
RPS	RLY 27BC-UPS162A/B	under voltage relay for MG 167	relay	PRC162	A-46/C	TB	277	A7
RPS	RLY 27BC-UPS172A/B	under voltage relay for UPS 172A/B	relay	PRC172	A-46/C	TB	277	D2
RPS	RLY 27BC-UPS172A/B	under voltage relay for MG 167	relay	PRC172	A-46/C	TB	277	D2
RPS	RLY 42X-1-PRC162	aux relay for RPS bus contactor	relay	PRC162	A-46/C	TB	277	A7
RPS	RLY 42X-1-PRC172	aux relay for RPS bus 12 contactor	relay	PRC172	A-46/C	TB	277	D2
RPS	RLY 42X-2-PRC162	aux relay for RPS bus contactor	relay	PRC162	A-46/C	TB	277	A7
RPS	RLY 42X-2-PRC172	aux relay for RPS bus 12 contactor	relay	PRC172	A-46/C	TB	277	D2
RPS	RLY 59-1-UPS162A/B	over voltage relay UPS162A/B	relay	PRC162	A-46/C	TB	277	A7
RPS	RLY 59-1-UPS172A/B	over voltage relay UPS172A/B	relay	PRC172	A-46/C	TB	277	D2
RPS	RLY 59-2-UPS162A/B	over voltage relay UPS162A/B	relay	PRC162	A-46/C	TB	277	A7
RPS	RLY 59-2-UPS172A/B	over voltage relay UPS172A/B	relay	PRC172	A-46/C	TB	277	D2
RPS	RLY 81H/L-UPS162A/B	abnormal frequency for UPS 162A/B	relay	PRC162	A-46/C	TB	277	A7
RPS	RLY 81H/L-UPS162A/B	abnormal frequency for MG 167	relay	PRC162	A-46/C	TB	277	A7
RPS	RLY 81H/L-UPS172A/B	abnormal frequency for UPS 172A/B	relay	PRC172	A-46/C	TB	277	D2
RPS	RLY 81H/L-UPS172A/B	abnormal frequency for MG 167	relay	PRC172	A-46/C	TB	277	D2
RPS	RPS11	RPS bus 11	elec bus	RPS11	A-46	TB	261	ACR
RPS	RPS12	RPS bus 12	elec bus	RPS12	A-46	TB	261	ACR
RPS	UPS162A	UPS 162A	UPS	UPS162A	A-46	TB	277	D2
RPS	UPS162B	UPS 162B	UPS	UPS162B	A-46	TB	277	D2
RPS	UPS172A	UPS 172A	UPS	UPS172A	A-46	TB	277	D2
RPS	UPS172B	UPS 172B	UPS	UPS172B	A-46	TB	277	D2
SIGNALS 11	201-27B	Channel 11 Temperature Indicator	temp ind	PNL L	A-46/C	TB	277	CR
SIGNALS 11	201-50A	Channel 11 Drywell Temperature Data	thermocouple	none	A-46	DW		
SIGNALS 11	201-64	Channel 11 Drywell Temperature Data	thermocouple	none	A-46	DW		
SIGNALS 11	201-65	Channel 11 Drywell Temperature Data	thermocouple	none	A-46	DW		

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
SIGNALS 11	201-69	Channel 11 Signal Processor	signal processor	1S16	A-46/C	TB	261	ACR
SIGNALS 11	DPT 36-04A	Low Low Rx vessel level	delta P transmitter	inst rack west	A-46	RB	281	W INST RM
SIGNALS 11	DPT 36-04C	Low Low Rx vessel level	delta P xmtr	inst rack east	A-46	RB	284	E INST RM
SIGNALS 11	PT 201.2-476A	Hi Drywell Pressure	press xmtr	inst rack west	IPEEE	RB	281	W INST RM
SIGNALS 11	PT 201.2-476C	Hi Drywell Pressure	press xmtr	inst rack west	IPEEE	RB	281	W INST RM
SIGNALS 11	PT 36-08A	reactor pressure xmtr	press xmtr	inst rack west	IPEEE	RB	281	W INST RM
SIGNALS 11	PT 36-08C	reactor pressure xmtr	press xmtr	inst rack east	IPEEE	RB	284	E INST RM
SIGNALS 11	RLY 11K19B	Low Low Rx vessel level relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 11	RLY 11K20A	Low Low Rx vessel level relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 11	RLY 11K20B	Low Low Rx vessel level relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 11	RLY 11K81	core spray 11 pump start	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 11	RLY 11K82	core spray 11 pump start	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 11	RLY 11K83	core spray inj vlv open permit	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 11	RLY 11K84	core spray inj vlv open permit	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 11	RLY 12K10	Hi Drywell Pressure relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 11	RLY 12K19A	Low Low Rx vessel level relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 11	RLY 12K25	Hi Drywell Pressure relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 11	RLY 12K26	Hi Drywell Pressure relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 11	RLY 12K9	Hi Drywell Pressure relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 11	RLY 1K83-ATS A	core spray inj vlv open permit	relay	ATS A	A-46/C	RB	281	N5
SIGNALS 11	RLY 1K84-ATS C	core spray inj vlv open permit	relay	ATS C	A-46/C	RB	281	K11
SIGNALS 11	RLY 4-111A-1S52	core spray inj vlv open permit	relay	1S52	A-46/C	TB	261	ACR
SIGNALS 11	RLY 4-111B-1S52	core spray inj vlv open permit	relay	1S52	A-46/C	TB	261	ACR
SIGNALS 11	RLY 4-111C-1S52	core spray inj vlv open permit	relay	1S52	A-46/C	TB	261	ACR
SIGNALS 11	RLY 4-111D-1S52	core spray inj vlv open permit	relay	1S52	A-46/C	TB	261	ACR
SIGNALS 11	RLY 4-121A-1S52	core spray inj vlv open permit	relay	1S52	A-46/C	TB	261	ACR
SIGNALS 11	RLY 4-121B-1S52	core spray inj vlv open permit	relay	1S52	A-46/C	TB	261	ACR
SIGNALS 11	RLY 4-121C-1S52	core spray inj vlv open permit	relay	1S52	A-46/C	TB	261	ACR
SIGNALS 11	RLY 4-121D-1S52	core spray inj vlv open permit	relay	1S52	A-46/C	TB	261	ACR
SIGNALS 11	RLY K121A-ATS C	core spray inj vlv open permit	relay	ATS C	A-46/C	RB	281	K11
SIGNALS 11	RLY K121B-ATS A	core spray inj vlv open permit	relay	ATS A	A-46/C	RB	281	N5
SIGNALS 11	RLY K121C-ATS A	core spray inj vlv open permit	relay	ATS A	A-46/C	RB	281	N5
SIGNALS 11	RLY K121D-ATS C	core spray inj vlv open permit	relay	ATS C	A-46/C	RB	281	K11
SIGNALS 11	RLY K13A-ATS A	Low Low Rx vessel level relay	relay	ATS A	A-46/C	RB	281	N5
SIGNALS 11	RLY K13C-ATS C	Low Low Rx vessel level relay	relay	ATS C	A-46/C	RB	281	K11
SIGNALS 11	RLY K15A-ATS A	reactor pressure relay	relay	ATS A	A-46/C	RB	281	N5
SIGNALS 11	RLY K15C-ATS C	reactor pressure relay	relay	ATS C	A-46/C	RB	281	K11
SIGNALS 11	RLY K5A-ATS A	Hi Drywell Pressure relay	relay	ATS A	A-46/C	RB	281	N5

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
SIGNALS 11	RLY K5C-ATS C	Hi Drywell Pressure relay	relay	ATS C	A-46/C	RB	281	K11
SIGNALS 11	XF 4160-120V-PB 102	power supply to 11 ADS/CS logic	transformer	PB102	A-46/C	TB	261	D18
SIGNALS 12	201-338	Channel 12 Temperature Indicator	temp ind	PNL L	A-46/C	TB	277	CR
SIGNALS 12	201-51A	Channel 12 Drywell Temperature Data	thermocouple	none	A-46	DW		
SIGNALS 12	201-65	Channel 12 Drywell Temperature Data	thermocouple	none	A-46	DW		
SIGNALS 12	201-66	Channel 12 Drywell Temperature Data	thermocouple	none	A-46	DW		
SIGNALS 12	201-68	Channel 12 Signal Processor	signal processor	1S17	A-46/C	TB	261	ACR
SIGNALS 12	DPT 36-04B	Low Low Rx vessel level	delta P transmitter	insr rack west	A-46	RB	281	W INST RM
SIGNALS 12	DPT 36-04D	Low Low Rx vessel level	delta P xmtr	inst rack east	A-46	RB	284	E INST RM
SIGNALS 12	PT 201.2-476B	Hi Drywell Pressure	press xmtr	inst rack east	IPEEE	RB	284	E INST RM
SIGNALS 12	PT 201.2-476D	Hi Drywell Pressure	press xmtr	inst rack east	IPEEE	RB	284	E INST RM
SIGNALS 12	PT 36-08B	reactor pressure xmtr	press xmtr	insr rack west	IPEEE	RB	281	W INST RM
SIGNALS 12	PT 36-08D	reactor pressure xmtr	press xmtr	inst rack east	IPEEE	RB	284	E INST RM
SIGNALS 12	RLY 12K10	Hi Drywell Pressure relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K19A	Low Low Rx vessel level relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K19B	Low Low Rx vessel level relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K20A	Low Low Rx vessel level relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K20B	Low Low Rx vessel level relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K25	Hi Drywell Pressure relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K26	Hi Drywell Pressure relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K81	core spray 12 pump start	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K82	core spray 12 pump start	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K83	core spray inj vlv open permit	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K83	core spray inj vlv open permit	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K84	core spray inj vlv open permit	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K84	core spray inj vlv open permit	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 12K9	Hi Drywell Pressure relay	relay	PNL M	A-46/C	TB	277	CR
SIGNALS 12	RLY 2K83-ATS D	core spray inj vlv open permit	relay	ATS D	A-46/C	RB	281	K11
SIGNALS 12	RLY 2K84-ATS B	core spray inj vlv open permit	relay	ATS B	A-46/C	RB	281	N5
SIGNALS 12	RLY 4-112A-1S56	core spray inj vlv open permit	relay	1S56	A-46/C	TB	261	ACR
SIGNALS 12	RLY 4-112B-1S56	core spray inj vlv open permit	relay	1S56	A-46/C	TB	261	ACR
SIGNALS 12	RLY 4-112C-1S56	core spray inj vlv open permit	relay	1S56	A-46/C	TB	261	ACR
SIGNALS 12	RLY 4-112D-1S56	core spray inj vlv open permit	relay	1S56	A-46/C	TB	261	ACR
SIGNALS 12	RLY 4-122A-1S56	core spray inj vlv open permit	relay	1S56	A-46/C	TB	261	ACR
SIGNALS 12	RLY 4-122B-1S56	core spray inj vlv open permit	relay	1S56	A-46/C	TB	261	ACR
SIGNALS 12	RLY 4-122C-1S56	core spray inj vlv open permit	relay	1S56	A-46/C	TB	261	ACR
SIGNALS 12	RLY 4-122D-1S56	core spray inj vlv open permit	relay	1S56	A-46/C	TB	261	ACR
SIGNALS 12	RLY K122A-ATS D	core spray inj vlv open permit	relay	ATS D	A-46/C	RB	281	K11

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
SIGNALS 12	RLY K122B-ATS B	core spray inj vlv open permit	relay	ATS B	A-46/C	RB	281	N5
SIGNALS 12	RLY K122C-ATS B	core spray inj vlv open permit	relay	ATS B	A-46/C	RB	281	N5
SIGNALS 12	RLY K122D-ATS D	core spray inj vlv open permit	relay	ATS D	A-46/C	RB	281	K11
SIGNALS 12	RLY K13B-ATS B	Low Low Rx vessel level relay	relay	ATS B	A-46/C	RB	281	N5
SIGNALS 12	RLY K13D-ATS D	Low Low Rx vessel level relay	relay	ATS D	A-46/C	RB	281	K11
SIGNALS 12	RLY K15B-ATS B	reactor pressure relay	relay	ATS B	A-46/C	RB	281	N5
SIGNALS 12	RLY K15D-ATS D	reactor pressure relay	relay	ATS D	A-46/C	RB	281	K11
SIGNALS 12	RLY K5B-ATS B	Hi Drywell Pressure relay	relay	ATS B	A-46/C	RB	281	N5
SIGNALS 12	RLY K5D-ATS D	Hi Drywell Pressure relay	relay	ATS D	A-46/C	RB	281	K11
SIGNALS 12	XF 4160-120V-PB 103	power supply to 12 ADS/CS logic	transformer	PB103	A-46/C	TB	261	E18
SPRAY	80-09	Filter - spray pump 121	filter	none	IPEEE	RB	198	NE CORNR
SPRAY	80-10	Filter - spray pump 111	filter	none	IPEEE	RB	198	NW CORNR
SPRAY	80-13	Spray heat exchanger 122	heat exch	none	IPEEE	RB	318	N7
SPRAY	80-14	Spray heat exchanger 112	heat exch	none	IPEEE	RB	318	P7
SPRAY	80-15	AOV - spray isolation valve	air operated vlv	none	A-46	RB	281	L8
SPRAY	80-15C	SOV - spray isolation valve	solenoid	none	A-46	RB	281	L8
SPRAY	80-15D	SOV - spray isolation valve	solenoid	none	A-46	RB	281	L8
SPRAY	80-16	AOV - spray isolation valve	air operated vlv	none	A-46	RB	281	P8
SPRAY	80-16C	SOV - spray isolation valve	solenoid	none	A-46	RB	281	P8
SPRAY	80-16D	SOV - spray isolation valve	solenoid	none	A-46	RB	281	P8
SPRAY	80-29	Filter - spray pump 112	filter	none	IPEEE	RB	198	NW CORNR
SPRAY	80-30	Filter - spray pump 122	filter	none	IPEEE	RB	198	NE CORNR
SPRAY	80-33	Spray heat exchanger 121	heat exch	none	IPEEE	RB	318	P8
SPRAY	80-34	Spray heat exchanger 111	heat exch	none	IPEEE	RB	318	P8
SPRAY	80-35	AOV - spray isolation valve	air operated vlv	none	A-46	RB	281	N7
SPRAY	80-35C	SOV - spray isolation valve	solenoid	none	A-46	RB	281	N7
SPRAY	80-35D	SOV - spray isolation valve	solenoid	none	A-46	RB	281	N7
SPRAY	80-36	AOV - spray isolation valve	air operated vlv	none	A-46	RB	281	L7
SPRAY	80-36C	SOV - spray isolation valve	solenoid	none	A-46	RB	281	L7
SPRAY	80-36D	SOV - spray isolation valve	solenoid	none	A-46	RB	281	L7
SPRAY	80-40	AOV - spray crosstie valve	air operated vlv	none	A-46	RB	298	P7
SPRAY	80-40B	SOV - spray crosstie valve	solenoid	none	A-46	RB	298	P7
SPRAY	80-41	AOV - spray crosstie valve	air operated vlv	none	A-46	RB	298	P7
SPRAY	80-41B	SOV - spray crosstie valve	solenoid	none	A-46	RB	298	P7
SPRAY	80-44	AOV - spray crosstie valve	air operated vlv	none	A-46	RB	298	N7
SPRAY	80-44B	SOV - spray crosstie valve	solenoid	none	A-46	RB	298	N7
SPRAY	80-45	AOV - spray crosstie valve	air operated vlv	none	A-46	RB	298	P7
SPRAY	80-45B	SOV - spray crosstie valve	solenoid	none	A-46	RB	298	P7

Table 3.1-1B Active Components

System	Primary Component ID	Description / Function	Comp Type	Cabinet	Class	Bldg	Elev.	Room
SPRAY	80-118	Torus cooling FCV - MOV	valve	none	A-46	RB	298	P7
SPRAY	93-01	Spray raw water pump 112	pump	none	A-46	SH	256	T14A
SPRAY	93-02	Spray raw water pump 111	pump	none	A-46	SH	256	T14A
SPRAY	93-03	Spray raw water pump 122	pump	none	A-46	SH	256	T14A
SPRAY	93-04	Spray raw water pump 121	pump	none	A-46	SH	256	T14A
SPRAY	93-05	Filter - raw water pump 121	filter	none	IPEEE	SH	256	T14A
SPRAY	93-06	Filter - raw water pump 112	filter	none	IPEEE	SH	256	T14A
SPRAY	93-07	Filter - raw water pump 122	filter	none	IPEEE	SH	256	T14A
SPRAY	93-08	Filter - raw water pump 111	filter	none	IPEEE	SH	256	T14A
SPRAY	BKR 80-03-PB102	cont spray pmp 112 bkr	4KV breaker	PB102	A-46/C	TB	261	D18
SPRAY	BKR 80-04-PB102	cont spray pmp 111 bkr	4KV breaker	PB102	A-46/C	TB	261	D18
SPRAY	BKR 80-23-PB103	cont spray pmp 122 bkr	4KV breaker	PB103	A-46/C	TB	261	E18
SPRAY	BKR 80-24-PB103	cont spray pmp 121 bkr	4KV breaker	PB103	A-46/C	TB	261	E18
SPRAY	PMP 80-03	cont spray pmp 112	pump	none	A-46	RB	198	NW CORNR
SPRAY	PMP 80-04	cont spray pmp 111	pump	none	A-46	RB	198	NW CORNR
SPRAY	PMP 80-23	cont spray pmp 122	pump	none	A-46	RB	198	NE CORNR
SPRAY	PMP 80-24	cont spray pmp 121	pump	none	A-46	RB	198	NE CORNR
SPRAY	RLY 2-3-1S64	cont spray pmp (80-04/24) auto start	timing relay	1S64	IPEEE	TB	261	ACR
SPRAY	RLY 2-3-1S74	cont spray pmp (80-03/23)auto start	timing relay	1S74	IPEEE	TB	261	ACR
SPRAY	RLY 2X-3-1S64	cont spray pmp (80-04/24)auto start	aux relay	1S64	IPEEE	TB	261	ACR
SPRAY	RLY 2X-3-1S74	cont spray pmp (80-03/23)auto start	aux relay	1S74	IPEEE	TB	261	ACR

Table 3.1-2 Review of IPE Systems and Event Tree Top Events				
No.	System	Description	Top Events in Seismic Success Path	Top Events Not in Seismic Success Path
1	DC	DC Power	DA, DB, D1, D2: Battery boards 11 & 12	Operator actions to shed DC loads during station blackout (O15 & O30)
2	AC RPS	AC Power	A2, A3: Power boards 11 & 12 R1, R2: RPS buses 11 & 12 OL: Operator resets 86 lockout relays LS: Operator sheds diesel loads (LOCA) LK: Screenhouse gates (intake & discharge) required for emergency diesel raw water	Normal AC (OG, KA, KB, B1, B2) Power boards 16, 17, 167 (A4, A5, A67)
3	Signals	Actuation Signals	P1: Lo-Lo RPV level P2: Hi drywell press P3: Hi RPV press	P4: ATWS signals ME: Manual actuation
4	FPW	Fire Protection Water	none	FP: Fire protection water
5	SW	Service Water	LK: Screenhouse gates (intake & discharge) required for diesel raw water and containment spray raw water	S1, S2: Normal service water SA, SB: Emergency service water OS: Operator starts service water pump
6	SPRAY	Containment Spray	C1, C2, C3, C4: Containment spray W1, W2, W3, W4: Spray Raw Water OH: Operator - cont. heat removal LK: Screenhouse gates (intake & discharge) required for containment spray raw water	TC: Torus cooling path
7	RBCLC	RBCLC	none	RW: RBCLC
8	TBCLC	TBCLC	none	TW: TBCLC
9	Air	Instrument Air	none	AS: Instrument Air
10	Nitrogen		none	Nitrogen not modeled in IPE

Table 3.1-2 Review of IPE Systems and Event Tree Top Events

No.	System	Description	Top Events in Seismic Success Path	Top Events Not in Seismic Success Path
11	COND	Circ Water & Condenser	none	CN: Main Condenser OM: Operator re-opens MSIVs MS, MO: ATWS, operator actions
12	HPCI	Condensate & Feedwater	none	FW: HPCI IN: Feedwater injection path TA: Condensate storage tanks FL: Feedwater level control
13	ADS	Main Steam	RO: Electromatic relief valves open (press response) RV: Electromatic relief valves (ADS) OD: Operator emergency depressurizes	RC, SO, SC, SR: Pressure response including ATWS AI: ATWS - Operator ADS inhibit OEH, OEL - ATWS - Operator depressurizes
14	EC	Emergency Condensers	none	EC1, EC2: EC shells LC1, LC2: EC makeup LT, OU: EC makeup long term OMU: SBO - operator control EC makeup EC: ATWS - ECs with makeup
15	CS	Core Spray	LA, LB, IA, IB: Core spray pumps and injection paths	OR1, OR2: Operator aligns raw water to core spray or fire water to feedwater injection path
16	CRD	CRD Injection	none	CR1, CR2: CRD 11 & 12 OC: Operator aligns CRD
17	SD	Shutdown Cooling	none	SD: Shutdown cooling
18	LP	Liquid poison	none	LP: Liquid poison
19	SCRAM	Reactor Protection	QM: Reactor SCRAM mechanical QE: Reactor SCRAM electrical	RQ: Reactor SCRAM both mech & elec RI, RT, FT, CH, IM, UL, WL: ATWS resp
20	VENT	Containment Venting	none	CV: Containment venting
21	VS	Vapor Suppression	VS: Vapor Suppression	OV: Operator initiates spray (VS=F)

Table 3.1-2 Review of IPE Systems and Event Tree Top Events

No.	System	Description	Top Events in Seismic Success Path	Top Events Not in Seismic Success Path
22	ISOL	Containment Isolation	IS: evaluated relative to containment performance	IS: Containment Isolation (Level 2)
23	HVAC	Ventilation	none	No ventilation dependencies in IPE model
24	CT	Condensate Transfer	none	Included top event LT (See EC above)
25	CONT	Containment	none	CI, CF: continued injection given severe containment conditions (Level 2)
26	REC	Recovery	none	OGR, OSP: Normal AC power recovery EDG: Emergency EDG recovery (SBO) REC: Cont heat removal recovery
27	-	Event Tree Switches	-	-
28	SEAL	Reactor Recirc Pump Seal	none	NSL: No RRP seal failure

Table 3.1-3 NMP1 Block Wall Screening					
Block Wall Summary			Screening Evaluation Summary		
Wall	Location	Structure	HCLPF(g)	Impact	Comments
129	AB248			note 1	
137	AB248			note 1	
6	AB250			note 1	
127	AB261			note 1	
128	AB261			note 1	
139	AB261			note 1	
152	AB261			note 1	
154	AB261			note 1	
151	AB277			note 1	
78	OG229			note 1	
79	OG229			note 1	
80	OG229			note 1	
81	OG229			note 1	
89	OG247			note 1	
90	OG247			note 1	sr
31	OG261	12"RH/S#4@16/12"	note 3	note 3	PB room small wall, others no impact
145	RW244			note 1	
146	RW244			note 1	
147	RW252			note 1	
144	RW275			note 1	
143	RW281			note 1	
142	RW292			note 1	
1	RX237	8"RH#4@32"	0.49		20' high by 11'
2	RX237	8"RH#4@48"	0.35		22' high by 14'
4	RX237	36"RS#4@18"	>1	note 3	20' high by 9'
5	RX237	36"RS#4@16"	note 3		4' high by 3' and 5' (wall 4 envelopes)
107	RX237	12/33"RS	>1		8' high by 9' and 7'
108	RX237	12/24"RS		note 4	no impact
131	RX237	24"RS	>1	note 3	8' high by 2' and 4'
3	RX250	12"RS#4@16"	>1		8' high by 8'
18	RX261	8"RH#4@32"	0.68		18' high by 10'
19	RX261	8"RH#4@48"	note 3		smaller than wall 18
20	RX261	8"RH#4@48"	note 3		smaller than wall 18
21	RX261	42"RS#4@16"	note 3		15' high by 15'
22	RX261	16"RS#4@16"	0.17		18' high by 28' with top angle brace
116	RX261	12"R#4@16"		note 4	no impact
117	RX261	12"R#4@16"		note 4	no impact
134	RX261	12"RS#4@16"		note 4	no impact
42	RX281	8"RH#4@32"	0.66		14' high by 7' and 5' (steel column)
43	RX281	8"RH#5@40"	0.36	note 3	12' high by 19' and 5' no impact
44	RX281	12"RS#3@16"	0.46		11' high by 25'
45	RX281	8"RH#4@32"	0.40		10' high by 25'
46	RX281	12"RH#4@32"	0.37		12.5' high by 27'
57	RX298	8"RH#4@32"		note 3	no impact

Table 3.1-3 NMP1 Block Wall Screening					
Block Wall Summary			Screening Evaluation Summary		
Wall	Location	Structure	HCLPF(g)	Impact	Comments
58	RX298	8"RH#5@40"		note 3	no impact
59	RX298	12/24"RS#3@16"		note 3	no impact
60	RX298	8"RH#4@32"		note 3	no impact
149	RX298	24"RS#4@16"		note 3	no impact
64	RX318	8"RH#4@32"		note 3	no impact
65	RX318	8"RH#5@40"		note 3	no impact
66	RX318	18"RS#3/4@16"		note 3	no impact
73	RX340	8"RH#4@32"		note 4	no impact
74	RX340	8"RH#4@48"		note 4	no impact
75	RX340	8"UH		note 4	no impact
130	RX356	8"RH#4@32"		note 4	no impact
150	security			note 1	
34	SH256	12"UH	0.17		16' high by 31' diesel cooling
8	TB250	12"UH	note 2		
9	TB250	12"UH	note 2		
11	TB250	12"UH	note 2		
12	TB250	12"UH	note 2		
13	TB250	12"UH	note 2		
14	TB250	12"UH	note 2		
15	TB250	12"UH	note 2		
16	TB250	12"UH	note 2		
112	TB250	18"RS	note 2		
113	TB250	18"RS	note 2		
124	TB250	12"UH	note 2		
125	TB250	12"RH#4@32"	note 2		
136	TB250	12"UH	note 2		
148	TB250	12"UH	note 2		
7	TB250	8"RHG#4@48"	note 3		9' high by 15 ' & angle brace (wall 10)
10	TB250	8/12"UH	1.1		9' high by 18 ' & angle brace
17	TB250	8"UHG	note 3		9' high by 9 ' & angle brace (wall 10)
109	TB250	8"RHG#4@48"	note 3		9' high by 8 ' & angle brace (wall 10)
40	TB255	36"RS#4@12"		note 4	no impact, could see outside wall
26	TB261	18/V"RS/UB#4@16"		note 4	no impact, could see area from distance
28	TB261	12"UH		note 3	no impact
30	TB261	12"RH#4@32"	note 2		
132	TB261	16"RS#4@16"	note 2		
133	TB261	36"RS#4@12"	note 2		
138	TB261	12"		note 3	no impact
23	TB261	8/12"U/RH#4@16"	0.25		does elevator separate walls 23&24
24	TB261	8"RH#4@48"	0.25		13' high by total of both walls is 55'
25	TB261	8/12"RH#4@32"	note 3	note 3	8' high, no impact
27	TB261	12"RH#4@32/48"	0.19		15' high by 60' (N & S walls)
29	TB261	12"RH#4@32"	0.12		38' high by 22' diesels (see 53)
33	TB261	8"RH#4@32"	>1		8' high by 9.5' and 19.5' (fire)
35	TB261	12"RH#4@32"	0.03		30' high by 137'

Table 3.1-3 NMP1 Block Wall Screening

Block Wall Summary			Screening Evaluation Summary		
Wall	Location	Structure	HCLPF(g)	Impact	Comments
36	TB261	8"RS#3@16"		note 3	8' high and no impact
37	TB261	8"RH#4@32"	>1	note 3	15' high by 13', vertical straps
38	TB261	36"RS#4@16"	note 3	note 3	8' high by 9' no impact
39	TB261	8"RH#4@48"		note 3	no impact (F-G, 1-2)
41	TB261	36"RS#4@12"		note 4	no impact, could see outside wall
114	TB261	36"		note 3	no impact
115	TB261	11"UB		note 3	no impact
118	TB261	24"US		note 3	no impact
120	TB270	12"H		note 3	no impact (above 118)
153	TB277	8"RH#4@32"		note 3	no impact
47	TB277	8/12"RH#4@32"	0.15		22' high by 29' connects to wall 48
48	TB277	8"RH#4@32"	0.97		15' high by 10'
49	TB277	8"RH#5@24"	0.15		22' high by 27' connects to wall 48
50	TB277	8"RH#4@32"	>1	note 3	7' high by 23' and 15' no impact
51	TB277	36"RS#3@16"		note 3	no impact
52	TB277	12"RH#4@32"	0.15		22' high by 20' between columns
53	TB277	12"RH#4@32"	0.08		22' high by 52' no visible columns
54	TB277	8"RH#4@32"		note 3	no impact
55	TB277	8"RH#4@32"	0.65		15' high by 13', vertical straps
56	TB277	36"RS#4@12"		note 4	no impact, could see outside wall
119	TB277	8/12"RH#4@32"	note 2		
126	TB277	18"UHG		note 4	no impact on vertical cable trays
61	TB291	8"RH#4@32"	0.50		15' high by 13', vertical straps
62	TB291	8"RH#4@48"		note 3	no impact
63	TB291	8"RH#4@48"		note 3	no impact
67	TB300	8"RH#5@24"		note 3	no impact, 16' high by 20' & 12'
68	TB300	12"RH#5@32"		note 3	no impact, 20' by 20 ' sections
69	TB300	16"RS#4@16"		note 3	no impact, 7' high wall
121	TB300	36"		note 4	no impact, outside wall
122	TB300	36"		note 4	no impact, outside wall
70	TB305	8"RH#4@32"		note 3	no impact
71	TB305	8"RH#4@48"		note 3	no impact, 7' high
72	TB305	8/12"UH		note 3	no impact
76	TB320	8"RH#4@48"		note 3	no impact
77	TB333/393	8"RH#4@32"		note 3	no impact
82	WD229			note 1	
83	WD229			note 1	
84	WD229			note 1	
85	WD229			note 1	
85	WD229			note 1	
87	WD229			note 1	
88	WD229			note 1	
123	WD229			note 1	
140	WD236			note 1	
141	WD236			note 1	

Table 3.1-3 NMP1 Block Wall Screening

Block Wall Summary			Screening Evaluation Summary		
Wall	Location	Structure	HCLPF(g)	Impact	Comments
91	WD247			note 1	
92	WD247			note 1	
93	WD247			note 1	
95	WD247			note 1	
110	WD247			note 1	
111	WD247			note 1	
94	WD248			note 1	
95	WD248			note 1	sr
97	WD248			note 1	
98	WD261			note 1	
99	WD261			note 1	
100	WD261			note 1	
101	WD261			note 1	
102	WD261			note 1	
103	WD261			note 1	
135	WD261			note 1	
32	WD261	8/12"RS/H#4@12/32"	0.03		Are walls 32 and 104 continuous
104	WD261/271	8/12"RS/H#4@12/32"	0.03		30' high by 120'
105	WD277			note 1	
106	WD277	8/12"RH#4@32"		note 3	no impact

1. Note 1 in the "Impact" column - walls located in the auxiliary building (AB), offgas building (OG), radwaste building (RW), waste disposal building (WD), and Security were screened out because there are no seismic success path components located in these buildings.

2. Note 2 in the "HCLPF" column indicates the wall was screened by drawing review based on a generic HCLPF calculation.

3. Note 3 or a HCLPF value in the "HCLPF" column indicates that the wall was walked down to assess the dimensions of the wall. Note 3 in the "Impact" column indicates the wall was walked down to assess potential impacts of wall collapse. In some cases, both wall dimensions and impacts were noted even though both were not needed. Thus, note 3 and/or a HCLPF value may be shown in both columns to summarize the walkdown notes.

4. Note 4 in the table identifies walls that were not easily accessible (either one or both sides of the wall were not observed) during the walkdown, but were screened because they were judged not to have seismic success path components at the location.

Table 3.1-4 IPEEE Scope Review

Comp Id	Comp Type	Function	Elementary Diag.	Chatter Impact
83.1-09	MOV	Drywell Equip Drain Isolation	C19438	Valve closes & performs safety function
83.1-10	AOV	Drywell Equip Drain Isolation	C19859 Sh 15	Valve closes & performs safety function
83.1-11	MOV	Drywell Equip Drain Isolation	C19438	Valve closes & performs safety function
83.1-12	AOV	Drywell Equip Drain Isolation	C19859 Sh 15	Valve closes & performs safety function
33-37A	SOV	RWCU letdown Isolation	C19859 Sh12, C19951 Sh 8	Valve closes & performs safety function
33-37B	SOV	RWCU letdown Isolation	C19859 Sh12, C19951 Sh 8	Valve closes & performs safety function
28-49	Neutron monitor	Monitor neutron flux level		No impact, analog output
36-05A-D	Pressure Transmitter	provides Lo-Lo-Lo vessel trip signal	C22005 Sh 6	Possible signal actuation
36-08A-D	Pressure Transmitter	provides reactor pressure hi-hi pressure trip and core spray injection valve open permissive interlock, 1 out of 2 twice logic	C22005 Sh 6	Possible signal actuation core spray pumps starts and injection valve opens, reactor trips
36-24A,B	Level Transmitter	Monitor vessel level including fuel zone		No impact, no trip function; analog output
39-06A-D	Pressure Transmitter	Isolates Emergency Condenser steamline on hi steam flow	C22005 Sh 6	Isolates ECs, however, ECs are not modeled in seismic success path
201.2-476A-D	Drywell Pressure Transmitter	Actuate ECCS on 1 out of 2 twice hi drywell pressure	C22005 Sh 5	No adverse impact, performs intended function

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
2-1	ERV #3	EAGLE H054	D/O	ADS time delay - E/C after time delay and seals-in	No Impact - there are two additional series contacts for relays 16K207 and R21A that must close for an ADS actuation; these relays are seismically adequate, thus no spurious ADS	not required
2-2	ERV #3	EAGLE H054	D/O	ADS time delay - E/C after time delay and seals-in	No Impact - there are two additional series contacts for relays 16K207 and R21A that must close for an ADS actuation; these relays are seismically adequate, thus no spurious ADS	not required
The above are repeated for ERV #1, 2, 4, 5, and 6. No Impact on all 6 ERVs for the same reasons explained above.						
51B	R1022	GE IAC51A	D/O	Backup time overcurrent protection - Energizes on overload/fault	Possible Impact - If EDG breaker trips while anti-pump relay is energized and almost instantly receives a close signal; then the bkr control switch must be placed in the trip position to reset the anti-pump relay. EDG breaker closes on undervoltage condition. Else no impact.	Breaker operation alarmed in control room & breaker anti-pump relay can be reset at Panel E in the control room
67NI	R1022 and DG102	GE CJCG15	D/O	Directional Overcurrent - E/C to trip DG breaker if DG is being motored	Can momentarily actuate the relay causing the 86DG-2 relay to trip both the breaker and engine. Engine will start on undervoltage.	Operation of 86DG-2 alarmed in control room. After resetting the 86DG-2 at E panel, the DG breaker will auto close on undervoltage

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
87DG-2	R1022 and DG102	GE CDF12	D/O	Differential protection - E/C on an internal fault in the generator to trip breaker and prevents engine from starting	Can momentarily actuate the relay causing the 86DG-2 relay to trip both the breaker and engine. Engine will start on undervoltage.	Operation of 86DG-2 alarmed in control room. After resetting the 86DG-2 at E panel, the DG breaker will auto close on undervoltage
86	R1022, R1012 and DG102	GE HFA154	D/O	Lockout Relay - E/C on electrical transients or faults	Can energize the relay to trip offsite power to PB102 and prevents DG breaker closure until relay is reset. If offsite power is available then bkr R1012 can be manually closed. If offsite power is lost, the EDG will start on undervoltage.	DG breaker can be closed by resetting (turn R1012 control switch to trip) the 86 at E Panel. After resetting the 86 relay, the DG breaker will auto close on undervoltage.
51G	R1022, R1012	GE IAC 0178A	D/O	Ground fault protection - E/C to trip R1012 and block DG breaker closure	Can energize the relay to trip offsite power to PB102 and prevents DG breaker closure until relay is reset. Engine will start on undervoltage.	DG breaker can be closed by resetting (turn R1012 control switch to trip) the 86 at E Panel. After resetting the 86 relay, the DG breaker will auto close on undervoltage.
50/51	R1022, R1012	GE IAC0127 A	D/O	Overload protection - E/C to trip R1012 and block DG breaker closure	Can energize the relay to trip offsite power to PB102 and prevents DG breaker closure until relay is reset. Engine will start on undervoltage.	DG breaker can be closed by resetting (turn R1012 control switch to trip) the 86 at E Panel. After resetting the 86 relay, the DG breaker will auto close on undervoltage.
51N	R1020	GE IAC51B	D/O	E/C to trip DG102 ground breaker	No Impact - Can trip ground breaker for DG 102 but DG can operate with breaker open	Breaker can be closed at E panel

Table 3.1-5 Functional Evaluation of A-46 Outliers						
Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
51N	R1020	GE IAC51A	D/O	E/C to trip DG102 ground breaker	No Impact - can trip ground breaker for DG 102 but DG can operate with breaker open	Breaker can be closed at E panel
51B	R1032	GE IAC51A	D/O	Backup time overcurrent protection - E/C on overload/fault	Possible Impact - If EDG breaker trips while anti-pump relay is energized and almost instantly receives a close signal; then the bkr control switch must be placed in the trip position to reset the anti-pump relay. EDG breaker closes on undervoltage condition. Else no impact.	Breaker operation alarmed in control room & breaker anti-pump relay can be reset at Panel E in the control room
67NI	R1032 and DG103	GE CJCG15	D/O	Directional Overcurrent - E/C to trip DG breaker if DG is being motored	Can momentarily actuate the relay causing the 86DG-3 relay to trip both the breaker and engine. Engine will start on undervoltage.	Operation of 86DG-3 alarmed in control room. After resetting the 86DG-3 at E panel, the DG breaker will auto close on undervoltage
87DG-3	R1032 and DG103	GE CDF12	D/O	Differential protection - E/C on an internal fault in the generator to trip breaker and prevents engine from starting	Can momentarily actuate the relay causing the 86DG-3 relay to trip both the breaker and engine. Engine will start on undervoltage.	Operation of 86DG-3 alarmed in control room. After resetting the 86DG-3 at E panel, the DG breaker will auto close on undervoltage
86	R1032, R1013 and DG103	GE HFA154	D/O	Lockout Relay - E/C on electrical transients or faults	Can energize the relay to trip offsite power to PB103 and prevents EDG breaker closure until relay is reset. If offsite power is available then bkr R1013 can be manually closed. If offsite power is lost, the EDG will start on undervoltage.	DG breaker can be closed by resetting (turn R1013 control switch to trip) the 86 at E Panel. After resetting the 86 relay, the DG breaker will auto close on undervoltage.

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
51G	R1032, R1013	GE IAC 0178A	D/O	Ground fault protection - E/C to trip R1013 and block DG breaker closure	Can energize the relay to trip offsite power to PB103 and prevents DG breaker closure until relay is reset. Engine will start on undervoltage.	DG breaker can be closed by resetting (turn R1013 control switch to trip) the 86 at E Panel. After resetting the 86 relay, the DG breaker will auto close on undervoltage.
50/51	R1032, R1013 and DG103	GE IAC0127-A	D/O	Overload protection - E/C to trip R1013 and block DG breaker closure	Can energize the relay to trip offsite power to PB103 and prevents DG breaker closure until relay is reset. Engine will start on undervoltage.	DG breaker can be closed by resetting (turn R1013 control switch to trip) the 86 at E Panel. After resetting the 86 relay, the DG breaker will auto close on undervoltage.
51N	R1030	GE IAC51B	D/O	E/C to trip DG103 ground breaker	No Impact - can trip ground breaker for DG 103 but DG can operate with breaker open	Breaker can be closed at E panel
51N	R1030	GE IAC51A	D/O	E/C to trip DG103 ground breaker	No Impact - can trip ground breaker for DG 103 but DG can operate with breaker open	Breaker can be closed at E panel
42 OL	210-61	NEMA 2 contactor	D/C	Thermal overload - E/O on overload condition and stop fan	No Impact - can open contacts and stop fan, but control room HVAC is not necessary for safe shutdown in the IPE/IPEEE. There is significant time for operator recovery.	Fan can be restarted after thermal overload has been reset at PB1671, fan control switch is located on N panel
42 OL	210.1-36	NEMA 2 contactor	D/C	Thermal overload - E/O on overload condition and stop fan	No Impact - can open contacts and stop chilled water pump, but control room HVAC is not necessary for safe shutdown in the IPE/IPEEE. There is significant time for operator recovery.	Pump can be restarted after thermal overload has been reset at PB1671, fan control switch is located on N panel

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
42 OL	210.1-37	NEMA 2 contactor	D/C	Thermal overload - E/O on overload condition and stop fan	No Impact - can open contacts and stop chilled water pump, but control room HVAC is not necessary for safe shutdown in the IPE/IPEEE. There is significant time for operator recovery.	Pump can be restarted after thermal overload has been reset at PB1671, fan control switch is located on N panel
63/53-13	28-15	DAW-43	D/O	Pressure switch - Closes to trip CRD pump	No Impact - can trip CRD pump which is not credited in IPEEE seismic safe shutdown model	Pump trip on low suction pressure alarmed in control room, pump can be restarted at F panel
63/53-14	28-17	DAW-43	D/O	Pressure switch - Closes to trip CRD pump	No Impact - can trip CRD pump which is not credited in IPEEE seismic safe shutdown model	Pump trip on low suction pressure alarmed in control room, pump can be restarted at F panel
42 contactor	33-04	NEMA 1	D/O	Motor starter - D/C to operate RWCU isolation valve	No Impact - chatter can open a closed valve or close an open valve. Valve normally open and closes on low-low vessel level. After chatter, valve will close itself according to the status of the 4-11/33 relay. Valve 33-02R is redundant to 33-04 and is seismically adequate.	not required
4-11H/39X	39-05G	GE CR120B	E/C	Auxiliary relay	No Impact - valve normally closed; no impact on EC isolation and relay 4-11B/39X must also chatter for valve to open (EC actuation), but 4-11B/39X is seismically adequate to prevent spurious open.	not required

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
4-11G/39X	39-05H	GE CR120B	E/C	Auxiliary relay	No Impact - valve normally closed; no impact on EC isolation and relay 4-11A/39X must also chatter for valve to open (EC actuation), but 4-11A/39X is seismically adequate to prevent spurious open.	not required
4-12G/39X	39-06G	GE CR120B	E/C	Auxiliary relay	No Impact - valve normally closed; no impact on EC isolation and relay 4-12A/39X must also chatter for valve to open (EC actuation), but 4-12A/39X is seismically adequate to prevent spurious open.	not required
4-12H/39X	39-06H	GE CR120B	E/C	Auxiliary relay	No Impact - valve normally closed; no impact on EC isolation and relay 4-12B/39X must chatter for valve to open (EC actuation), but 4-12B/39X is seismically adequate to prevent spurious open.	not required
4-11H/39X	39-07R	GE CR120B	E/O	Auxiliary relay	No Impact - valve normally open; no impact on EC actuation and relay R37C or R36D must chatter for valve to close, but R37C or R36D are seismically adequate	not required
4-12H/39X	39-08R	GE CR120B	E/O	Auxiliary relay	No Impact - valve normally open; no impact on EC actuation and relay R37A or R36B must chatter for valve to close, but R37A or R36B are seismically adequate	not required

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
4-11G/39X	39-09R	GE CR120B	E/O	Auxiliary relay	No Impact - valve normally open; no impact on EC actuation and relay R37C or R36D must chatter for valve to close, but R37D or R36C are seismically adequate	not required
4-12G/39X	39-10R	GE CR120B	E/O	Auxiliary relay	No Impact - valve normally open; no impact on EC actuation and relay R37A or R36B must chatter for valve to close, but R37A or R36B are seismically adequate	not required
4-12/60-18D	LCV 60-18	GE HGA111 AC	D/O	Auxiliary relay	No Impact - can cause SOV 60-18D to energize transferring level control to the remote shutdown panel; however power is not available to this SOV until RSP is manned and keylock switch SS_EMERG/RSP-12 actuated	not required
4-12/60-18E	LCV 60-18	GE HGA111 AC	D/O	Auxiliary relay	No Impact - can cause SOV 60-18E to energize transferring level control to the remote shutdown panel; however power is not available to this SOV until RSP is manned and keylock switch SS_EMERG/RSP-12 actuated	not required
42	70-92	NEMA 1	D/O	contactor	No Impact - can close valve isolating RBCLC flow to drywell coolers; however this function is not required for seismic safe shutdown	valve position signal on mimic board; valve can be reopened at H panel in the control room

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
42	70-94	NEMA 1	D/O	contactor	No Impact - can close valve isolating RBCLC flow to recirc pump coolers; however this function is not required for seismic safe shutdown	valve position signal on mimic board; valve can be reopened at H panel in the control room
2-3	80-03	EAGLE HO54	D/O	timing relay contact	No Impact - operation of relay 2-3 contact has no impact since the normally open series contact of relay 2-3X has adequate seismic capacity	not required
2-3	80-04	EAGLE HO54	D/O	timing relay contact	No Impact - operation of relay 2-3 contact has no impact since the normally open series contact of relay 2-3X has adequate seismic capacity	not required
2-3	80-23	EAGLE HO54	D/O	timing relay contact	No Impact - operation of relay 2-3 contact has no impact since the normally open series contact of relay 2-3X has adequate seismic capacity	not required
2-3	80-24	EAGLE HO54	D/O	timing relay contact	No Impact - operation of relay 2-3 contact has no impact since the normally open series contact of relay 2-3X has adequate seismic capacity	not required
2-2	81-03	EAGLE HO54	D/O	timing relay contact	No Impact - operation of relay 2-2 contact has no impact since the normally open series contact of relay 2-2X has adequate seismic capacity	not required
2-2	81-04	EAGLE HO54	D/O	timing relay contact	No Impact - operation of relay 2-2 contact has no impact since the normally open series contact of relay 2-2X has adequate seismic capacity	not required

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
2-1	81-23	EAGLE HO54	D/O	timing relay contact	No Impact - operation of relay 2-1 contact has no impact since the normally open series contact of relay 2-1X has adequate seismic capacity	not required
2-1	81-24	EAGLE HO54	D/O	timing relay contact	No Impact - operation of relay 2-1 contact has no impact since the normally open series contact of relay 2-1X has adequate seismic capacity	not required
2-1	81-49	EAGLE HO54	D/O	timing relay contact	No Impact - operation of relay 2-1 contact has no impact since the normally open series contact of relay 2-1X has adequate seismic capacity	not required
2-1	81-50	EAGLE HO54	D/O	timing relay contact	No Impact - operation of relay 2-1 contact has no impact since the normally open series contact of relay 2-1X has adequate seismic capacity	not required
2-2	81-51	EAGLE HO54	D/O	timing relay contact	No Impact - operation of relay 2-2 contact has no impact since the normally open series contact of relay 2-2X has adequate seismic capacity	not required
2-2	81-52	EAGLE HO54	D/O	timing relay contact	No Impact - operation of relay 2-2 contact has no impact since the normally open series contact of relay 2-2X has adequate seismic capacity	not required

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
31D-X	EDG102	W SV	D/C	Voltage sensitive relay with NO/NC contacts	relay normally deenergized enables Gen field flashing; when Gen output voltage increases to acceptable level the DC power to field coil is cutoff. If NO relay contact chatters during DG start, DG bkr will close and trip DG102. If NC contact chatters, the field flash contactor 31D will chatter while passing the field current; this is expected to fail the contactor preventing recovery of the generator	No recovery possible- relay is a "bad actor"
31D-X	EDG103	W SV	D/C	voltage sensitive relay with NO/NC contacts	relay normally deenergized enables Gen field flashing; when Gen output voltage increases to acceptable level the DC power to field coil is cutoff. If NO relay contact chatters during DG start, DG bkr will close and trip DG103. If NC contact chatters, the field flash contactor 31D will chatter while passing the field current; this is expected to fail the contactor preventing recovery of the generator	No recovery possible- relay is a "bad actor"
50/51	R1021	GE IAC51B	D/O	relay and NO contacts	can trip breaker to depower PB16B	breaker trip alarmed in control room, operator can reclose breaker from control room at Panel E
50/51	R1031	GE IAC51B	D/O	relay and NO contacts	can trip breaker to depower PB17B	breaker trip alarmed in control room, operator can reclose breaker from control room at Panel E

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
2-1	DG102 load sequencer	Eagle HO54	D/O	timing relay coil	No Impact - an interposing series relay contact (2X-1) does not chatter	not required
2-2	DG102 load sequencer	Eagle HO54	D/O	timing relay coil	No Impact - an interposing series relay contact (2X-2) does not chatter	not required
2-3	DG102 load sequencer	Eagle HO54	D/O	timing relay coil	No Impact - an interposing series relay contact (2X-3) does not chatter	not required
2X-1	DG102 load sequencer	GE HFA151	D/O and D/C	aux relay coil and NO/NC contacts	No Impact - NC contacts may open but there is no impact on sequencer because the function of these contacts is to open during the initial states of DG sequencing, NO contacts have a higher GERs and will not chatter	not required
2X-2	DG102 load sequencer	GE HFA151	D/O and D/C	aux relay coil and NO/NC contacts	No Impact - NC contacts may open but there is no impact on sequencer because the function of these contacts is to open during the initial states of DG sequencing, NO contacts have a higher GERs and will not chatter	not required
2-1	DG103 load sequencer	Eagle HO54	D/O	timing relay coil	No Impact - an interposing series relay contact (2X-1) does not chatter	not required
2-2	DG103 load sequencer	Eagle HO54	D/O	timing relay coil	No Impact - an interposing series relay contact (2X-2) does not chatter	not required
2-3	DG103 load sequencer	Eagle HO54	D/O	timing relay coil	No Impact - an interposing series relay contact (2X-3) does not chatter	not required

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
2X-1	DG103 load sequencer	GE HFA151	D/O or C	aux relay coil and NO/NC contacts	No Impact - NC contacts may open but there is no impact on sequencer because the function of these contacts is to open during the initial states of DG sequencing, NO contacts have a higher GERs and will not chatter	not required
2X-2	DG103 load sequencer	GE HFA151	D/O or C	aux relay coil and NO/NC contacts	No Impact - NC contacts may open but there is no impact on sequencer because the function of these contacts is to open during the initial states of DG sequencing, NO contacts have a higher GERs and will not chatter	not required
43X	MG 167	GE HGA111 DC	D/O, coil energized in the DC Run mode	aux relay coil and open contact	No Impact - AC motor trips; restarts when PB16 (17) voltage and frequency is restored	not required
83BX	MG 167	GE HGA111 DC	D/O, coil energized in Battery Charge mode	aux relay coil and open contact	No Impact - can cause NO contacts in DC motor start circuit to momentarily close but DC motor does not start because the 86-1 contact (in series with the 83BX contact) is open and the 86-1 is seismically rugged	not required
12	MG 167	speed switch	contacts normally open	switch actuates on MG overspeed	No Impact - can trip the DC motor however the AC motor will restart when PB16 (17) voltage and frequency is restored	not required

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
12X	MG 167	GE IC 2820	normally deenergized relay with open contacts	relay actuates on overspeed or chatter, relay seals-in	No Impact - can trip the DC motor however the AC motor will restart when PB16 (17) voltage and frequency is restored	not required
1H-9	DG 102 room cooling	Cardox 45H	normally deenergized relay with open contacts	relay actuates on overspeed or chatter, relay seals-in	Additional analysis is required to resolve the issues concerning initiation of the Cardox system to multiple fire areas	Additional analysis is required to resolve the issues concerning initiation of the Cardox system to multiple fire areas
74A-9	DG 102 room cooling	Cardox 47H	normally deenergized relay with open contacts	relay actuates on overspeed or chatter, relay seals-in	Additional analysis is required to resolve the issues concerning initiation of the Cardox system to multiple fire areas	Additional analysis is required to resolve the issues concerning initiation of the Cardox system to multiple fire areas
45X-9	fire detected relay	AT-8	normally deenergized relay with open contacts	relay actuates and seals-in the corresponding 1HA-9 relay	Additional analysis is required to resolve the issues concerning initiation of the Cardox system to multiple fire areas	Additional analysis is required to resolve the issues concerning initiation of the Cardox system to multiple fire areas
2	timer	Cardox 512	normally deenergized with some contacts open and some closed	times out various functions related to the application of CO_2	Additional analysis is required to resolve the issues concerning initiation of the Cardox system to multiple fire areas	Additional analysis is required to resolve the issues concerning initiation of the Cardox system to multiple fire areas

Table 3.1-5 Functional Evaluation of A-46 Outliers

Relay Id	Component	Relay Type	Status	Function	Chatter Impact	Recovery
2A	timer	q	normally deenergized with some contacts open and some closed	times out various functions related to the application of CO_2	Additional analysis is required to resolve the issues concerning initiation of the Cardox system to multiple fire areas	Additional analysis is required to resolve the issues concerning initiation of the Cardox system to multiple fire areas

Table 3.1-6 Success Path Equipment HCLPF Values

ID	Description	HCLPF			Notes
		Equip	Anch	Min	
DG102#	AP/DG 102 NEUTRAL BREAKER CUBICLE	.3g	>.3g	.3g	1
DG103#	AP/DG 103 NEUTRAL BREAKER CUBICLE	.3g	>.3g	.3g	1
TRANS 16A*	AP/4160 TO 600 V TRANSFORMER	.3g	>.3g	.3g	1
TRANS 16B*#	AP/4160 TO 600 V TRANSFORMER	.3g	>.3g	.3g	1
TRANS 17A*	AP/4160 TO 600 V TRANSFORMER	.3g	>.3g	.3g	1
TRANS 17B*#	AP/4160 TO 600 V TRANSFORMER	.3g	>.3g	.3g	1
57-11	CTS/CONDENSATE TRANSFER PUMP #12	.3g	>.3g	.3g	1
57-12	CTS/CONDENSATE TRANSFER PUMP #11	.3g	>.3g	.3g	1
NC08A	CRDH/CONTROL ROD DRIVE PUMP #11	.3g	>.3g	.3g	1
NC08B	CRDH/CONTROL ROD DRIVE PUMP #12	.3g	>.3g	.3g	1
80-03	CS/CONT SPRAY PUMP #121	.3g	>.3g	.3g	1
80-04	CS/CONT SPRAY PUMP #111	.3g	>.3g	.3g	1
80-23	CS/CONT SPRAY PUMP #122	.3g	>.3g	.3g	1
80-24	CS/CONT SPRAY PUMP #112	.3g	>.3g	.3g	1
81-03	CRS/CORE SPRAY PUMP #121	.3g	>.3g	.3g	1
81-04	CRS/CORE SPRAY PUMP #122	.3g	>.3g	.3g	1
81-23	CRS/CORE SPRAY PUMP #111	.3g	>.3g	.3g	1
81-24	CRS/CORE SPRAY PUMP #112	.3g	>.3g	.3g	1
01-03	MS/MAIN STEAM OUTSIDE ISO VLV #3	.3g	NA	.3g	1
01-04	MS/MAIN STEAM OUTSIDE ISO VLV #4	.3g	NA	.3g	1
01-102A	MS/MAIN STEAM EMERGENCY ELECTROMATIC RV #3	.3g	NA	.3g	1
01-102B	MS/MAIN STEAM EMERGENCY ELECTROMATIC RV #1	.3g	NA	.3g	1
01-102C	MS/MAIN STEAM EMERGENCY ELECTROMATIC RV #2	.3g	NA	.3g	1
01-102D	MS/MAIN STEAM EMERGENCY ELECTROMATIC RV #4	.3g	NA	.3g	1
01-102E	MS/MAIN STEAM EMERGENCY ELECTROMATIC RV #5	.3g	NA	.3g	1
01-102F	MS/MAIN STEAM EMERGENCY ELECTROMATIC RV #6	.3g	NA	.3g	1
80-15	CS/CONT SPRAY INLET ISO VLV #121	.3g	NA	.3g	1
80-16	CS/CONT SPRAY INLET ISO VLV #111	.3g	NA	.3g	1
80-35	CS/CONT SPRAY INLET ISO VLV #122	.3g	NA	.3g	1
80-36	CS/CONT SPRAY INLET ISO VLV #112	.3g	NA	.3g	1
80-40	CS/CONT SPRAY LOOP #111 BYPASS ISO VLV TO TORUS	.3g	NA	.3g	1
80-41	CS/CONT SPRAY TEST LINE ISO VLV	.3g	NA	.3g	1
80-44	CS/CONT SPRAY LOOP #112 BYPASS ISO VLV TO TORUS	.3g	NA	.3g	1
80-45	CS/CONT SPRAY LOOP #112 BYPASS ISO VLV	.3g	NA	.3g	1
81-11	CRS/PUMP RECIRC #12 PRESSURE SAFETY VLV	.3g	NA	.3g	1
81-31	CRS/PUMP RECIRC #11 PRESSURE SAFETY VLV	.3g	NA	.3g	1
81-53	CRS/MOTOR #111 SEAL COOLING PRESS. REGULATOR	.3g	NA	.3g	1
81-54	CRS/MOTOR #112 SEAL COOLING PRESS. REGULATOR	.3g	NA	.3g	1
81-55	CRS/MOTOR #121 SEAL COOLING PRESS. REGULATOR	.3g	NA	.3g	1
81-56	CRS/MOTOR #122 SEAL COOLING PRESS. REGULATOR	.3g	NA	.3g	1
96-15	DSA/DG #102 START AIR TANK #1 RELIEF VLV	.3g	NA	.3g	1
96-16	DSA/DG #102 START AIR TANK #2 RELIEF VLV	.3g	NA	.3g	1
96-17	DSA/DG #102 START AIR TANK #3 RELIEF VLV	.3g	NA	.3g	1
96-18	DSA/DG #102 START AIR TANK #4 RELIEF VLV	.3g	NA	.3g	1
96-19	DSA/DG #102 START AIR TANK #5 RELIEF VLV	.3g	NA	.3g	1
96-20	DSA/DG #102 AIR INLET RELIEF VLV	.3g	NA	.3g	1
96-28	DSA/DG #102 AIR INLET PRESSURE REGULATING VLV	.3g	NA	.3g	1
96-42	DSA/DG #103 START AIR COMPRESSOR RELIEF VLV	.3g	NA	.3g	1
96-43	DSA/DG #103 START AIR COMPRESSOR RELIEF VLV	.3g	NA	.3g	1
96-44	DSA/DG #103 START AIR TANK #1 RELIEF VLV	.3g	NA	.3g	1

Table 3.1-6 Success Path Equipment HCLPF Values

ID	Description	HCLPF			Notes
		Equip	Anch	Min	
96-45	DSA/DG #103 START AIR TANK #2 RELIEF VLV	.3g	NA	.3g	1
96-46	DSA/DG #103 START AIR TANK #3 RELIEF VLV	.3g	NA	.3g	1
96-47	DSA/DG #103 START AIR TANK #4 RELIEF VLV	.3g	NA	.3g	1
96-48	DSA/DG #103 START AIR TANK #5 RELIEF VLV	.3g	NA	.3g	1
96-49	DSA/DG #103 AIR INLET RELIEF VLV	.3g	NA	.3g	1
96-50	DSA/DG #103 START AIR COMPRESSOR RELIEF VLV	.3g	NA	.3g	1
96-51	DSA/DG #103 START AIR COMPRESSOR RELIEF VLV	.3g	NA	.3g	1
96-52	DSA/DG #103 AIR INLET PRESSURE REGULATING VLV	.3g	NA	.3g	1
96-60	DSA/DG #102 START AIR COMPRESSOR RELIEF VLV	.3g	NA	.3g	1
96-61	DSA/DG #102 START AIR COMPRESSOR RELIEF VLV	.3g	NA	.3g	1
96-62	DSA/DG #102 START AIR COMPRESSOR RELIEF VLV	.3g	NA	.3g	1
96-63	DSA/DG #102 START AIR COMPRESSOR RELIEF VLV	.3g	NA	.3g	1
01-01	MS/MAIN STEAM INSIDE ISO VLV #1	.3g	NA	.3g	1
01-02	MS/MAIN STEAM INSIDE ISO VLV #2	.3g	NA	.3g	1
01-03C	MS/MAIN STEAM OUTSIDE ISO VLV #3 PILOT	.3g	NA	.3g	1
01-03D	MS/MAIN STEAM OUTSIDE ISO VLV #3 PILOT	.3g	NA	.3g	1
01-03E	MS/MAIN STEAM OUTSIDE ISO VLV #3 PILOT	.3g	NA	.3g	1
01-04C	MS/MAIN STEAM OUTSIDE ISO VLV #4 PILOT	.3g	NA	.3g	1
01-04D	MS/MAIN STEAM OUTSIDE ISO VLV #4 PILOT	.3g	NA	.3g	1
01-04E	MS/MAIN STEAM OUTSIDE ISO VLV #4 PILOT	.3g	NA	.3g	1
117#	CRD/TRAIN 11 SCRAM VLV PILOTS (129 TOTAL)	.3g	NA	.3g	1
118#	CRD/TRAIN 12 SCRAM VLV PILOTS (129 TOTAL)	.3g	NA	.3g	1
39-07R	EC/LOOP #11 STEAM OUTLET OUTSIDE ISO VLV	.3g	NA	.3g	1
39-08R	EC/LOOP #12 STEAM OUTLET OUTSIDE ISO VLV	.3g	NA	.3g	1
39-09R	EC/LOOP #11 STEAM OUTLET INSIDE ISO VLV	.3g	NA	.3g	1
39-10R	EC/LOOP #12 STEAM OUTLET INSIDE ISO VLV	.3g	NA	.3g	1
40-01	CRS/CORE SPRAY INLET INNER ISO VLV	.3g	NA	.3g	1
40-02	CRS/CORE SPRAY INLET OUT ISO VLV	.3g	NA	.3g	1
40-05	CRS/CORE SPRAY TEST ISO VLV	.3g	NA	.3g	1
40-06	CRS/CORE SPRAY TEST ISO VLV	.3g	NA	.3g	1
40-09	CRS/CORE SPRAY INLET INNER ISO VLV	.3g	NA	.3g	1
40-10	CRS/CORE SPRAY INLET INNER ISO VLV	.3g	NA	.3g	1
40-11	CRS/CORE SPRAY INLET INNER ISO VLV	.3g	NA	.3g	1
40-12	CRS/CORE SPRAY INLET OUT ISO VLV	.3g	NA	.3g	1
40-30	CRS/CORE SPRAY VENT INSIDE ISO VLV	.3g	NA	.3g	1
40-31	CRS/CORE SPRAY VENT INSIDE ISO VLV	.3g	NA	.3g	1
40-32B	CRS/OUTSIDE IV #11-CORE SPRAY LOOP HI POINT VENT PILOT	.3g	NA	.3g	1
40-32C	CRS/OUTSIDE IV #11-CORE SPRAY LOOP HI POINT VENT PILOT	.3g	NA	.3g	1
40-33B	CRS/OUTSIDE IV #12-CORE SPRAY LOOP HI POINT VENT PILOT	.3g	NA	.3g	1
40-33C	CRS/OUTSIDE IV #12-CORE SPRAY LOOP HI POINT VENT PILOT	.3g	NA	.3g	1
80-01	CS/CONT SPRAY PUMP #111 SUCTION ISO VLV	.3g	NA	.3g	1
80-02	CS/CONT SPRAY PUMP #121 SUCTION ISO VLV	.3g	NA	.3g	1
80-15C	CS/CONT SPRAY INLET ISO VLV PILOT #121	.3g	NA	.3g	1
80-15D	CS/CONT SPRAY INLET ISO VLV PILOT #121	.3g	NA	.3g	1
80-16C	CS/CONT SPRAY INLET ISO VLV PILOT #111	.3g	NA	.3g	1
80-16D	CS/CONT SPRAY INLET ISO VLV PILOT #111	.3g	NA	.3g	1
80-21	CS/CONT SPRAY PUMP #112 SUCTION ISO VLV	.3g	NA	.3g	1

Table 3.1-6 Success Path Equipment HCLPF Values

ID	Description	HCLPF			Notes
		Equip	Anch	Min	
80-22	CS/CONT SPRAY PUMP #122 SUCTION ISO VLV	.3g	NA	.3g	1
80-35C	CS/CONT SPRAY INLET ISO VLV PILOT #122	.3g	NA	.3g	1
80-35D	CS/CONT SPRAY INLET ISO VLV PILOT #122	.3g	NA	.3g	1
80-36C	CS/CONT SPRAY INLET ISO VLV PILOT #112	.3g	NA	.3g	1
80-36D	CS/CONT SPRAY INLET ISO VLV PILOT #112	.3g	NA	.3g	1
80-40B	CS/CONT SPRAY LOOP #111 BYPASS ISO VLV PILOT	.3g	NA	.3g	1
80-41B	CS/CONT SPRAY TEST LINE ISO VLV PILOT	.3g	NA	.3g	1
80-44B	CS/CONT SPRAY LOOP #112 ISO VLV PILOT	.3g	NA	.3g	1
80-45B	CS/CONT SPRAY TEST LINE ISO VLV PILOT	.3g	NA	.3g	1
81-01	CRS/TORUS OUTLET IV-CORE SPRAY PMP #121 SUCT ISO VLV	.3g	NA	.3g	1
81-02	CRS/TORUS OUTLET IV-CORE SPRAY PMP #122 SUCT ISO VLV	.3g	NA	.3g	1
81-21	CRS/TORUS OUTLET IV-CORE SPRAY PMP #111 SUCT ISO VLV	.3g	NA	.3g	1
81-22	CRS/TORUS OUTLET IV-CORE SPRAY PMP #112 SUCT ISO VLV	.3g	NA	.3g	1
93-25	CSRW/CONT SPRAY RAW WTR PMP DISCHG BLOCK VLV #111	.3g	NA	.3g	1
93-26	CSRW/CONT SPRAY RAW WTR PMP DISCHG BLOCK VLV #121	.3g	NA	.3g	1
93-27	CSRW/CONT SPRAY RAW WTR PMP DISCHG BLOCK VLV #122	.3g	NA	.3g	1
93-28	CSRW/CONT SPRAY RAW WTR PMP DISCHG BLOCK VLV #112	.3g	NA	.3g	1
93-71	CSRW/CONT SPRAY RAW WATER FLOW CONTROL VLV #111	.3g	NA	.3g	1
93-72	CSRW/CONT SPRAY RAW WATER ISO VLV #112	.3g	NA	.3g	1
93-73	CSRW/CONT SPRAY RAW WATER ISO VLV #121	.3g	NA	.3g	1
93-74	CSRW/CONT SPRAY RAW WATER FLOW CONTROL VLV #122	.3g	NA	.3g	1
DG102 IB	AP/DG 102 EMERGENCY DC ISOLATION BREAKER CABINET	.3g	>.3g	.3g	1
DG103 IB	AP/DG 103 EMERGENCY DC ISOLATION BREAKER CABINET	.3g	>.3g	.3g	1
SC161A	AP/STATIC BATTERY CHARGER	.3g	>.3g	.3g	1
SC161B	AP/STATIC BATTERY CHARGER	.3g	>.3g	.3g	1
SC171A	AP/STATIC BATTERY CHARGER	.3g	>.3g	.3g	1
SC171B	AP/STATIC BATTERY CHARGER	.3g	>.3g	.3g	1
82-01	FOHS/DG FUEL OIL STORAGE TANK #102	.3g	>.3g	.3g	1
82-02	FOHS/DG FUEL OIL STORAGE TANK #103	.3g	>.3g	.3g	1
EDG102#	AP/EMERGENCY DIESEL GENERATOR #102	.3g	>.3g	.3g	1
EDG103#	AP/EMERGENCY DIESEL GENERATOR #103	.3g	>.3g	.3g	1
202-102	FLOW TRANSMITTER	.3g	>.3g	.3g	1
202-103	FLOW TRANSMITTER	.3g	>.3g	.3g	1
202-49C	FLOW CONTROLLER	.3g	>.3g	.3g	1
202-49D	E/P CONVERTER	.3g	>.3g	.3g	1
202-92C	FLOW CONTROLLER	.3g	>.3g	.3g	1
202-92D	FLOW CONTROLLER	.3g	>.3g	.3g	1
210.1-85	TEMP CONTROLLER	.3g	>.3g	.3g	1
210.1-88	TEMP CONTROLLER	.3g	>.3g	.3g	1
210.1-89	TEMP CONTROLLER	.3g	>.3g	.3g	1

Table 3.1-6 Success Path Equipment HCLPF Values

ID	Description	HCLPF			Notes
		Equip	Anch	Min	
305-11D	CRD/IRM TRANSMITTER	.3g	>.3g	.3g	1
305-15D	CRD/IRM TRANSMITTER	.3g	>.3g	.3g	1
36-03A	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-03B	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-03C	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-03D	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-04A	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-04B	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-04C	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-04D	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-07A	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-07B	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-07C	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-07D	RCS/RCS PRESSURE TRANSMITTER	.3g	>.3g	.3g	1
36-102A	RCS/RCS PRESSURE TRANSMITTER	.3g	>.3g	.3g	1
36-104	RCS/RCS PRESSURE TRANSMITTER	.3g	>.3g	.3g	1
36-31	RCS/RCS PRESSURE TRANSMITTER	.3g	>.3g	.3g	1
36-31B	RCS/RCS PRESSURE INDICATOR	.3g	>.3g	.3g	1
36-32	RCS/RCS PRESSURE TRANSMITTER	.3g	>.3g	.3g	1
36-32B	RCS/RCS PRESSURE INDICATOR	.3g	>.3g	.3g	1
36-76A	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-77	RCS/RCS LEVEL TRANSMITTER	.3g	>.3g	.3g	1
36-90A	MS/MS EMERG ELECTROMATIC RV #111 PRESS INDICAT SWITCH	.3g	>.3g	.3g	1
36-90B	MS/MS EMERG ELECTROMATIC RV #112 PRESS INDICAT SWITCH	.3g	>.3g	.3g	1
36-90C	MS/MS EMERG ELECTROMATIC RV #121 PRESS INDICAT SWITCH	.3g	>.3g	.3g	1
36-90D	MS/MS EMERG ELECTROMATIC RV #122 PRESS INDICAT SWITCH	.3g	>.3g	.3g	1
36-90E	MS/MS EMERG ELECTROMATIC RV #113 PRESS INDICAT SWITCH	.3g	>.3g	.3g	1
36-90F	MS/MS EMERG ELECTROMATIC RV #123 PRESS INDICAT SWITCH	.3g	>.3g	.3g	1
EIRR*	RCS/EAST INSTR. ROOM RACK	.3g	>.3g	.3g	1
WIRR*	RCS/WEST INSTR. ROOM RACK	.3g	>.3g	.3g	1
201.2-491	CONTAINMENT/TORUS AIR TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-492	CONTAINMENT/TORUS AIR TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-493	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-494	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-495	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-496	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-497	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-498	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-499	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-500	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-501	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-502	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-503	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-504	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-505	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-506	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1

Table 3.1-6 Success Path Equipment HCLPF Values

ID	Description	HCLPF			Notes
		Equip	Anch	Min	
201.2-507	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-508	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-509	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-510	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-511	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-512	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-513	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-514	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-515	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-516	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-521A	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
201.2-522A	CONTAINMENT/TORUS TEMPERATURE ELEMENT	.3g	>.3g	.3g	1
1S10	CTRL/AUXILIARY CONTROL CABINET 1S10	.3g	>.3g	.3g	1
1S12	CTRL/AUXILIARY CONTROL CABINET 1S12	.3g	>.3g	.3g	1
1S3	AP/DIESEL GENERATOR #102 RELAY CABINET	.3g	>.3g	.3g	1
1S4	AP/DIESEL GENERATOR #103 RELAY CABINET	.3g	>.3g	.3g	1
1S52	CTRL/AUXILIARY CONTROL CABINET 1S52	.3g	<3g	<3g	1,3
1S69	CTRL/AUXILIARY CONTROL CABINET 1S69	.3g	<3g	<3g	1,3
201.2-517	CONTAINMENT/TORUS TEMPERATURE CONDITIONER & RECORDER	.3g	>.3g	.3g	1
201.2-518	CONTAINMENT/TORUS TEMPERATURE CONDITIONER & RECORDER	.3g	>.3g	.3g	1
201.2-519	CONTAINMENT/TORUS TEMPERATURE INDICATOR	.3g	>.3g	.3g	1
201.2-520	CONTAINMENT/TORUS TEMPERATURE INDICATOR	.3g	>.3g	.3g	1
201.2-521	CONTAINMENT/TORUS TEMPERATURE TRANSMITTER	.3g	>.3g	.3g	1
201.2-521B	CONTAINMENT/TORUS TEMPERATURE INDICATOR	.3g	>.3g	.3g	1
201.2-522	CONTAINMENT/TORUS TEMPERATURE TRANSMITTER	.3g	>.3g	.3g	1
201.2-522B	CONTAINMENT/TORUS TEMPERATURE INDICATOR	.3g	>.3g	.3g	1
36-09	RCS/RCS LEVEL INDICATOR	.3g	>.3g	.3g	1
36-10	RCS/RCS LEVEL INDICATOR	.3g	>.3g	.3g	1
36-102A	RCS/RCS PRESSURE INDICATOR	.3g	>.3g	.3g	1
36-103	RCS/RCS PRESSURE RECORDER	.3g	>.3g	.3g	1
36-25	RCS/RCS PRESSURE INDICATOR	.3g	>.3g	.3g	1
36-26	RCS/RCS LEVEL INDICATOR	.3g	>.3g	.3g	1
36-27	RCS/RCS PRESSURE INDICATOR	.3g	>.3g	.3g	1
36-28	RCS/RCS LEVEL INDICATOR	.3g	>.3g	.3g	1
36-31A	RCS/RCS PRESSURE INDICATOR	.3g	>.3g	.3g	1
36-31C	CTRL/CONTROL COMPONENT (FUNCTION GENERATOR)	.3g	>.3g	.3g	1
36-32A	RCS/RCS PRESSURE INDICATOR	.3g	>.3g	.3g	1
36-32C	CTRL/CONTROL COMPONENT (FUNCTION GENERATOR)	.3g	>.3g	.3g	1
36-34	RCS/RCS PRESSURE INDICATOR	.3g	>.3g	.3g	1
36-76AA	RCS/RCS LEVEL INDICATOR	.3g	>.3g	.3g	1
36-76B	CTRL/CONTROL COMPONENT (MULTIPLIER/DIVIDER)	.3g	>.3g	.3g	1
36-77A	RCS/RCS LEVEL INDICATOR	.3g	>.3g	.3g	1
ATSA	RPS CHANNEL A/ANALOG TRIP SYSTEM CABINET A	.3g	>.3g	.3g	1
ATSB	RPS CHANNEL B/ANALOG TRIP SYSTEM CABINET B	.3g	>.3g	.3g	1
ATSC	RPS CHANNEL C/ANALOG TRIP SYSTEM CABINET C	.3g	>.3g	.3g	1
ATSD	RPS CHANNEL D/ANALOG TRIP SYSTEM CABINET D	.3g	>.3g	.3g	1
CB11B*	CTRL/125 V DC CONTROL AND RELAY BOARD CONTROL BUS 11B	.3g	>.3g	.3g	1

Table 3.1-6 Success Path Equipment HCLPF Values

ID	Description	HCLPF			Notes
		Equip	Anch	Min	
CB12B*	CTRL/125 V DC CONTROL AND RELAY BOARD CONTROL BUS 12B	.3g	>.3g	.3g	1
DC102#	AP/EDG 102 CONTROL CABINET	.3g	>.3g	.3g	1
DC103#	AP/EDG 103 CONTROL CABINET	.3g	>.3g	.3g	1
IA78A	RCS/RCS TEMPERATURE INDICATOR	.3g	>.3g	.3g	1
IA78B	RCS/RCS TEMPERATURE INDICATOR	.3g	>.3g	.3g	1
IA85A	RCS TEMPERATURE MV/I CONVERTER	.3g	>.3g	.3g	1
IA85B	RCS TEMPERATURE MV/I CONVERTER	.3g	>.3g	.3g	1
ID22B#	CTRL/CONTROL COMPONENT (MULTIPLIER/DIVIDER)	.3g	>.3g	.3g	1
ID75#	RCS/RCS PRESSURE RECORDER	.3g	>.3g	.3g	1
NIB11#	AP/NUCLEAR INST BUS #11	.3g	>.3g	.3g	1
NIB12#	AP/NUCLEAR INST BUS #12	.3g	>.3g	.3g	1
PNL 167A	AP/DIST PNL 167A BUS	.3g	>.3g	.3g	1
PRC162#	AP/REACTOR PROTECTION SYS MG SET #162 PROTECT RELAY	.3g	>.3g	.3g	1
PRC167#	AP/COMPUTER POWER SUPPLY MG SET #167 PROTECT RELAY	.3g	>.3g	.3g	1
PRC171#	AP/REACTOR PROTECTION SYS MG SET #171 PROTECT RELAY	.3g	>.3g	.3g	1
PRC172#	AP/REACTOR PROTECTION SYS MG SET #172 PROTECT RELAY	.3g	>.3g	.3g	1
RSP11	CTRL/REMOTE SHUTDOWN PNL #11	.3g	>.3g	.3g	1
RSP12	CTRL/REMOTE SHUTDOWN PNL #12	.3g	>.3g	.3g	1
SSC1#	CTRL/SHUTDOWN SUPV CONTROL CABINET 1	.3g	>.3g	.3g	1
SSC2#	CTRL/SHUTDOWN SUPV CONTROL CABINET 2	.3g	>.3g	.3g	1
VB11-WELD	WELDING of VB11	.3g	>.3g	.3g	1
VB12-WELD	WELDING of VB12	.3g	>.3g	.3g	1
125#	CRD/HYDRAULIC CONTROL UNIT H2O-N2 ACCUM'S (129 TOTAL)	.3g	>.3g	.3g	1
128#	CRD/HYDRAULIC CONTROL UNIT N2 ACCUMULATORS (129 TOTAL)	.3g	>.3g	.3g	1
57-01	*CTSCTS/CONDENSATE SURGE AND STORAGE TANK #11*	*NA*	*NA*	*NA*	*1*
57-02	*CTS/CONDENSATE SURGE AND STORAGE TANK #12*	*NA*	*NA*	*NA*	*1*
80-13#	CS/CONT SPRAY HEAT EXCHANGER #122	.3g	>.3g	.3g	1
80-14#	CS/CONT SPRAY HEAT EXCHANGER #112	.3g	>.3g	.3g	1
80-33#	CS/CONT SPRAY HEAT EXCHANGER #121	.3g	>.3g	.3g	1
80-34#	CS/CONT SPRAY HEAT EXCHANGER #111	.3g	>.3g	.3g	1
80-118	TORUS COOLING MOV	.3g	NA	.3g	2
80-40 thru 80-45B	CNTSPRAY CROSS-TIE SOV/MOVs	.3g	NA	.3g	2
81-11	CS RELIEF VALVE	.3g	NA	.3g	2
81-31	CS RELIEF VALVE	.3g	NA	.3g	2
83.1-09 to -12	DRYWELL EQUIP DRAIN MOVs	.3g	NA	.3g	2
All Block Walls Adjacent to A-46 & SMA Equip		.3g	NA	.3g	4
Buildings		.3g	NA	.3g	2,9
CRD/Reactor Internal		.3g	NA	.3g	2
Cab # 19720-S		.3g	>.3g	.3g	2
Cab # 19720-T		.3g	>.3g	.3g	2
Cab # 22443-NN		.3g	>.3g	.3g	2
Cab # 22443-PP		.3g	>.3g	.3g	2
Cab # 22445-A		.3g	>.3g	.3g	2

Table 3.1-6 Success Path Equipment HCLPF Values

ID	Description	HCLPF			Notes
		Equip	Anch	Min	
Cab # 22445-B		.3g	>.3g	.3g	2
DG Room Fans	EDG HVAC	.3g	>.3g	.3g	2
Fire Piping	FLOOD SOURCE	.1-.2g	.1-.2g	.1-.2g	2
Fire Protection Panel	EDG HVAC ISOLATION	.3g	>.3g	.3g	2
JB11		.3g	>.3g	.3g	2
JB12		.3g	>.3g	.3g	2
LT36-24A&B		.3g	>.3g	.3g	2
LT58-05		.3g	>.3g	.3g	2
"MCB""A"""		.3g	>.3g	.3g	2
Piping		.3g	>.3g	.3g	2
Rollup Door-DG Rooms	EDG HVAC	.3g	>.3g	.3g	2
Seal Oil Vacm Tank		.3g	>.3g	.3g	2
Torus		.3g	>.3g	.3g	2,9
UPS162,172A&B		.3g	>.3g	.3g	2
XMTR201.2-476A-D		.3g	>.3g	.3g	2
XMTR201.2-483		.3g	>.3g	.3g	2
XMTR201.2-484		.3g	>.3g	.3g	2
XMTR36-05A-D		.3g	>.3g	.3g	2
XMTR36-08A-D		.3g	>.3g	.3g	2
XMTR39-06A-D		.3g	>.3g	.3g	2
HCU	HYDRAULIC CONTROL UNITS	.3g	>.3g	.3g	5,6
161A#	AP/600 V POWERBOARD #161A	.3g	>.3g	.3g	5
161B#	AP/600 V POWERBOARD #161B	.3g	>.3g	.3g	5
171A#	AP/600 V POWERBOARD #171A	.3g	>.3g	.3g	5
171B#	AP/600 V POWERBOARD #171B	.3g	>.3g	.3g	5
16A#	AP/600 V POWERBOARD #16A	.3g	<.3g	<.3g	3,5
16B#	AP/600 V POWERBOARD #16B	.3g	<.3g	<.3g	3,5
17A#	AP/600 V POWERBOARD #17A	.3g	<.3g	<.3g	3,5
17B#	AP/600 V POWERBOARD #17B	.3g	<.3g	<.3g	3,5
102#	AP/4160 V POWERBOARD #102	.3g	>.3g	.3g	3,5
103#	AP/4160 V POWERBOARD #103	.3g	>.3g	.3g	3,5
AUXFEED102	AUX FEEDER 102	.3g	.18g	.18g	3,5
AUXFEED103	AUX FEEDER 103	.3g	.18g	.18g	3,5
PB11-3-3	AP/4160V POWERBOARD 11	.3g	<.3g	<.3g	3,5
PB12-1-12	AP/4160V POWERBOARD 12	.3g	<.3g	<.3g	3,5
TRANS 167A*	AP/600 TO 120/208 V TRANSFORMER	.3g	.28g	.28g	5,6
81-49	CRS/CORE SPRAY TOPPING PUMP #112	.3g	>.3g	.3g	5,7
81-50	CRS/CORE SPRAY TOPPING PUMP #111	.3g	>.3g	.3g	5,7
81-51	CRS/CORE SPRAY TOPPING PUMP #121	.3g	>.3g	.3g	5,7
81-52	CRS/CORE SPRAY TOPPING PUMP #122	.3g	>.3g	.3g	5,7
72-54	DGCW/DG COOLING WATER PUMP #103	.3g	>.3g	.3g	5,6
72-62	DGCW/DG COOLING WATER PUMP #102	.3g	>.3g	.3g	5,6
93-01	CSRW/CONT SPRAY RAW WATER PUMP #112	.29g	>.3g	.29g	5,7
93-02	CSRW/CONT SPRAY RAW WATER PUMP #111	.29g	>.3g	.29g	5,7
93-03	CSRW/CONT SPRAY RAW WATER PUMP #122	.29g	>.3g	.29g	5,7
93-04	CSRW/CONT SPRAY RAW WATER PUMP #121	.29g	>.3g	.29g	5,7
BB11	AP/125 V DC BATTERY BOARD #11	.3g	.27g	.27g	5,7
BB12	AP/125 V DC BATTERY BOARD #12	.3g	.27g	.27g	5,7
RC102#	AP/DG 102 RELAY RESISTOR (NEUTRAL GROUND)	.3g	>.3g	.3g	5,6
RC103#	AP/DG 103 RELAY RESISTOR (NEUTRAL GROUND)	.3g	>.3g	.3g	5,6

Table 3.1-6 Success Path Equipment HCLPF Values

ID	Description	HCLPF			Notes
		Equip	Anch	Min	
MSIVIR*	AP/MAIN STEAM ISO VLV INSTRUMENT RACK	.3g	>.3g	.3g	5,7
1S34	CTRL/AUXILIARY CONTROL RELAY CABINET 1S34	.3g	<.3g	<.3g	3,5
1S35	CTRL/AUXILIARY CONTROL RELAY CABINET 1S35	.3g	<.3g	<.3g	3,5
1S36	CTRL/AUXILIARY CONTROL RELAY CABINET 1S36	.3g	<.3g	<.3g	3,5
1S51	CTRL/AUXILIARY CONTROL CABINET 1S51	.3g	<.3g	<.3g	3,5
1S53	CTRL/AUXILIARY CONTROL CABINET 1S53	.3g	<.3g	<.3g	3,5
1S54	CTRL/AUXILIARY CONTROL CABINET 1S54	.3g	<.3g	<.3g	3,5
1S55	CTRL/AUXILIARY CONTROL CABINET 1S55	.3g	<.3g	<.3g	3,5
1S56	CTRL/AUXILIARY CONTROL CABINET 1S56	.3g	<.3g	<.3g	3,5
1S57	CTRL/AUXILIARY CONTROL CABINET 1S57	.3g	<.3g	<.3g	3,5
1S59	CTRL/AUXILIARY CONTROL CABINET 1S59	.3g	<.3g	<.3g	3,5
1S60	CTRL/AUXILIARY CONTROL CABINET 1S60	.3g	<.3g	<.3g	3,5
1S62	CTRL/AUXILIARY CONTROL CABINET 1S62	.3g	<.3g	<.3g	3,5
1S63	CTRL/AUXILIARY CONTROL CABINET 1S63	.3g	<.3g	<.3g	3,5
1S65	CTRL/AUXILIARY CONTROL CABINET 1S65	.3g	<.3g	<.3g	3,5
1S70	CTRL/AUXILIARY CONTROL CABINET 1S70	.3g	<.3g	<.3g	3,5
1S70-EMBED	1S70 EMBED CHANNEL	.3g	>.3g	.3g	3,5
1S73	CTRL/AUXILIARY CONTROL CABINET 1S73	.3g	<.3g	<.3g	3,5
1S75	CTRL/AUXILIARY CONTROL CABINET 1S75	.3g	<.3g	<.3g	3,5
1S80	CTRL/AUXILIARY CONTROL CABINET 1S80	.3g	<.3g	<.3g	3,5
1S82	CTRL/AUXILIARY CONTROL CABINET 1S82	.3g	<.3g	<.3g	3,5
1S84	CTRL/ANNUNCIATOR CABINET 1S84	.3g	<.3g	<.3g	3,5
1S85	CTRL/AUXILIARY CONTROL CABINET 1S85	.3g	<.3g	<.3g	3,5
1S86	CTRL/AUXILIARY CONTROL RELAY CABINET 1S86	.3g	<.3g	<.3g	3,5
1S87	CTRL/AUXILIARY CONTROL RELAY CABINET 1S87	.3g	<.3g	<.3g	3,5
1S88	CTRL/AUXILIARY CONTROL RELAY CABINET 1S88	.3g	<.3g	<.3g	3,5
CP161#	AP/BATTERY CHARGER MG SET #161 CONTROL CABINET	.3g	>.3g	.3g	5,7
CP162#	AP/REACTOR PROTECTION SYS MG SET #162 CONTROL CABINET	.3g	>.3g	.3g	5,7
CP171#	AP/BATTERY CHARGER MG SET #171 CONTROL PNL	.3g	>.3g	.3g	5,7
CP172#	AP/REACTOR PROTECTION SYS MG SET #172 CONTROL PNL	.3g	>.3g	.3g	5,7
E#	CTRL/CONSOLE E CONTL RM ELECT CONTROL CONSOLE	.3g	<.3g	<.3g	3,5,6
F#	CTRL/CONTROL BOARD PNL F	.3g	<.3g	<.3g	3,5,6
G#	CTRL/CONTROL BOARD PNL G	.3g	<.3g	<.3g	3,5,6
H#	CTRL/CONTROL BOARD PNL H	.3g	<.3g	<.3g	3,5,6
K#	CTRL/CONTROL BOARD PNL K	.3g	<.3g	<.3g	3,5,6
L#	CTRL/CONTROL BOARD PNL L	.3g	<.3g	<.3g	3,5,6
M#	CTRL/CONTROL BOARD PNL M	.3g	<.3g	<.3g	3,5,6
N#	CTRL/CONTROL BOARD PNL N	.3g	<.3g	<.3g	3,5,6
VB11	CTRL/125 V DC VLV BOARD #11	.3g	>.3g	.3g	5,6
VB12	CTRL/125 V DC VLV BOARD #12	.3g	>.3g	.3g	5,6
96-04	DSA/DG #102 START AIR TANK #1	.3g	>.3g	.3g	5,7
96-05	DSA/DG #102 START AIR TANK #2	.3g	>.3g	.3g	5,7
96-06	DSA/DG #102 START AIR TANK #3	.3g	>.3g	.3g	5,7
96-07	DSA/DG #102 START AIR TANK #4	.3g	>.3g	.3g	5,7
96-08	DSA/DG #102 START AIR TANK #5	.3g	>.3g	.3g	5,7
96-31	DSA/DG #103 START AIR TANK #1	.3g	>.3g	.3g	5,7
96-32	DSA/DG #103 START AIR TANK #2	.3g	>.3g	.3g	5,7

Table 3.1-6 Success Path Equipment HCLPF Values

ID	Description	HCLPF			Notes
		Equip	Anch	Min	
96-32	DSA/DG #103 START AIR TANK #2	.3g	>.3g	.3g	5,7
96-33	DSA/DG #103 START AIR TANK #3	.3g	>.3g	.3g	5,7
96-35	DSA/DG #103 START AIR TANK #4	.3g	>.3g	.3g	5,7
96-36	DSA/DG #103 START AIR TANK #5	.3g	>.3g	.3g	5,7
CB-TB-261*	CABLE TRAYS-TURBINE BUILDING- ELEVATION 261'	<.3g	<.3g	<.3g	5,8
All Cable Trays Except TB El. 261'		.3g	>.3g	.3g	5,8

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* After anchorage modification, the HCLPF will equal or exceed 0.3g pga

Notes:

Items in Italics are not on the SMA equipment list

1. Screened out in A-46 program with anchorage factor of safety >1.85 which results in a $HCLPF_{SME}$ > 0.30g PGA (see A46 SEWS).

2. IPEEE (non-A46) Item - see NMP1 *GIPPER* database[38].

3. Current HCLPF anchorage capacity < 0.30g PGA - After modification, HCLPF will exceed 0.30g PGA, see Table 7-1.

4. Block wall capacities explicitly calculated in Calc. Nos. 95C2873-C-001[24], -004[71] & -005[73].

5. GIP Outlier - see SEWS[21] for resolution.

6. See Calc. No. 93C2771-C-007[76].

7. See Calc. No. 95C2873-C-003[74].

8. See Calc. Nos. 95C2873-C-006[75] & 93C2771-C-008[77].

9. See Calc. No. 95C2873-C-006 for Foam Building and Torus HCLPF Evaluation.

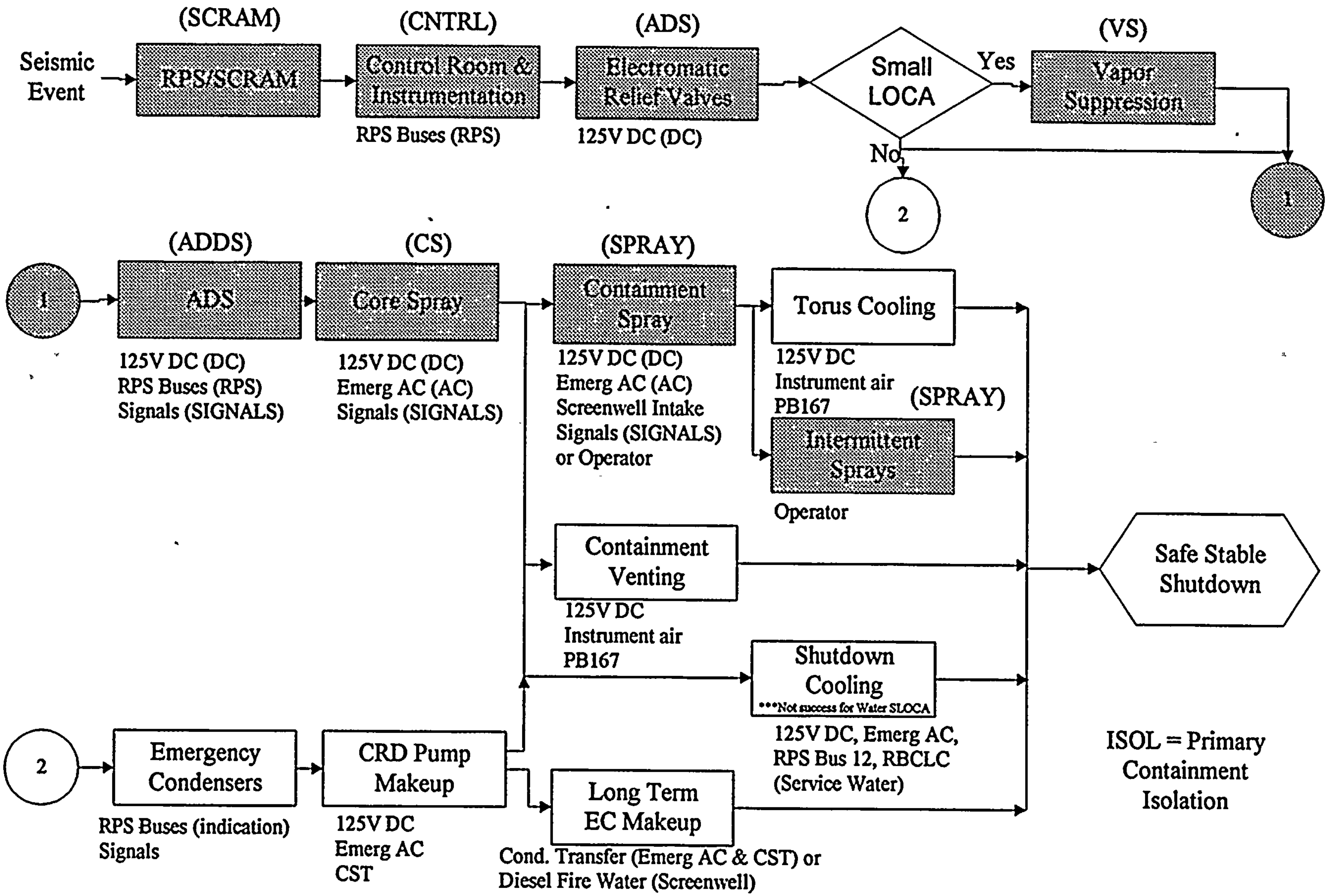

FIGURE 3.1-1 NMP1 FUNCTIONAL SUCCESS DIAGRAM

Note: Shaded paths represent redundant IPEEE success paths, non-shaded paths represent possible success paths not credited in the IPEEE

3.2 USI A-45, GI-131, and Other Seismic Safety Issues

USI A-45 Shutdown Decay Heat Removal Requirements

No weaknesses were identified in the SMA analysis in Section 3.1 with regard to decay heat removal (USI A-45) or any other seismic issues. A plant HCLPF of 0.3g can be associated with the containment spray heat removal system and its support systems. Also, two other capabilities exist at NMP1 which were not analyzed as part of the success path (see Figure 3.1-1):

- If there is no LOCA condition, emergency condensers and/or shutdown cooling could provide decay heat removal. The A-46 evaluation considered these systems and therefore, as a minimum, these systems provide substantial reliability for HCLPFs approaching 0.3g without a LOCA condition.

- Torus cooling and containment venting can be manually aligned in the long term. Although there are no hand wheels on the necessary air operated valves, it is possible to operate these valves with air bottles, etc. This is acknowledged as a potential improvement in Section 7.

Thus, a more detailed fragility analysis and evaluation of decay heat removal capabilities would likely show that the heat removal function is reliable up to the 0.3g screening value; a HCLPF greater than 0.3g is also likely.

USI A-40 Seismic Design Criteria and A-46 Verification of Seismic Adequacy of Equipment

The SMA was coordinated with and utilized the USI A-46 evaluation[10] submitted to NRC in response to Generic Letter 87-02. The seismic analysis in Sections 3.1 further supports the resolution of these issues at NMP1.

USI A-17 Systems Interactions in Nuclear Power Plants

Unanalyzed spatial interactions as well as interaction due to relay chatter were considered in the seismic analysis (Section 3.1).

Control system interactions that can propagate via the electrical and control systems due to a seismic event were considered. The process involved both a deductive and inductive evaluation. Control system devices, relays, sensors, thermal overloads, electrical contactors and breakers were considered.

Also, systems interactions were considered during the walkdown as documented in the SEWS[10]. Sections 3.1.2.3 and 4.8 provide additional documentation on the evaluation of potential spatial systems interactions considered in the seismic analysis.

Eastern U.S. Seismicity Issue

This issue is resolved by this IPEEE per Generic Letter 88-20, Supplement 4. The work carried out by NRC, LLNL and EPRI were considered and taken into account in determining the review level earthquake.

4.0 Internal Fire Analysis

The analysis of internal fire risk utilizes both the EPRI FIVE[25] methodology and fire PRA methods[26]. The FIVE methodology recognizes that the IPE should be used both to screen fire areas and provide the basis for more detailed analysis of potential vulnerabilities. In a fire PRA, areas would have to be screened based on quantitative insights from the PRA that includes the potential for plant trip initiating events and the impact on systems modeled in the PRA (IPE). Thus, the FIVE methodology is not significantly different from a fire PRA except that FIVE is slightly more prescriptive with regard to analysis steps and procedures. Also, it was recognized that the combined unavailability of the Appendix R safe shutdown paths may not be sufficient to screen out areas without knowledge of other shutdown paths. Thus, all areas were screened and evaluated utilizing the IPE[1], which considered the potential for plant initiators and the impact on equipment and systems modeled in the IPE.

The overall methodology is similar to that used in risk analysis of other hazards, such as seismic or tornadoes, where the hazard becomes the initiating event for the risk model. Specifically, a fire PRA is typically developed by defining plant and boundaries, identifying the location of equipment modeled in the internal events PRA (IPE) within these areas, and assessing the impact on plant operation caused by a fire in each area (i.e., potential initiating event and damage to systems modeled in the IPE). The frequency of core damage can be quantified using the same internal events PRA model. Fire initiating events are defined by location, impact of the fire initiator is modeled by assuming failure of components and systems affected by the fire event, and the IPE model includes the unavailability of components and systems not affected by the fire initiator. Thus, the IPE can be used to quantify the frequency of core damage and release damage states given that the fire analysis has properly defined the frequency and impact of fires by location.

The following summarizes the approach and methods used in this analysis:

1. Utilizing the FIVE methodology, compartment boundaries were evaluated and fire ignition frequencies were developed for each fire zone[27]. Also, Appendix R exemptions and deviations were assessed to assure that their potential impacts on the IPEEE analysis were understood. A plant walkdown was included as part of this analysis.

2. A computerized spatial database[28] was developed such that all plant cables and components in a fire zone could be identified by raceway. This was necessary to accurately identify the impacts of a fire on systems and components in each area. The spatial database was first developed for the Appendix R systems[6] and then further developed to include non Appendix R systems such as offsite power supplies, main feedwater, main condenser, and their support systems. This provides additional success paths and results in improved plant reliability for screening and evaluating areas. The IPE was used to identify the systems and dependencies necessary to support these key functions. Cable block diagrams were developed, identifying critical cables. With these cables and their impact on the IPE identified, the spatial database was utilized to determine the fire zones where these critical cables were located.

3. The spatial database was used to identify component and system impacts on the IPE due to a fire in each area. Initial screening assumes the fire fails all cables and components in the area. Fire impact includes consideration of initiating events (plant trip or immediate shutdown) and unavailability of systems modeled in the IPE.

4. Based on the impact and frequency of a fire in the area, a screening process[29] was used to determine whether a fire in the area represents an insignificant contribution to core damage frequency or whether detailed analysis should be performed. The IPE is used to support both quantitative and qualitative screening judgments. This task was equivalent to accomplishing the FIVE qualitative and conservative quantitative screening.

5. Those areas that did not screen out during the initial screening analysis (item 4 above) were evaluated in greater detail[29] to establish realistic scenario frequencies or to screen the areas out. This analysis considered each unscreened area in greater detail including proximity of important cables, fire severity, fire causes and suppression. At this point in the analysis, fire modeling aspects of FIVE (i.e., identifying targets & sources, combustible loading, damage thresholds and suppression) were used as necessary to support the evaluation[30]. Plant walkdowns were an important part of the detailed analysis strategy for screening areas.

6. Containment performance, fire risk scoping issues[32], and USIs were assessed with regard to impact on public safety[27, 29].

This initial screening analysis is described in Section 4.6.1 and the results of the initial screening analysis is provided in Table 4.0-1. Those compartments with a screening core damage frequency greater than 1E-6/yr are evaluated further in Section 4.6.2 and the results are summarized in Table 4.0-2. With the exception of the turbine building El 250' & 261' South, main control room, auxiliary control room, and cable spreading room, all locations were screened out below the 1E-6/yr screening criteria in FIVE.

As shown in Table 4.0-2, there are 5 locations that did not meet the screening criteria. Four of the areas are marginal; CDF greater than 1E-6/yr, but less than 1E-5/yr. Improvements to existing programs (i.e., transient combustible control, Thermography, training) are being considered for these critical areas as potentially cost beneficial. One area is estimated to have a CDF value at about 1E-5/yr and programmatic improvements may not suffice since a dry transformer dominates. This is being evaluated further to determine whether it could be easily moved.

Table 4.0-1 Summary of Initial Screening Impacts and Results (page 1 of 2)

Area	Zone	Location	Freq	Initiator	Screening	OG	D1	D2	A1	A2	A3	A67	A4	A5	R1	R2	FP	S1	S2	SA
1	R1A	Reactor bldg El 198 Northeast	1.3E-2	MSIV	8.0E-7/yr						X									
		Reactor bldg El 237 East		-	-															
1	R1C	Reactor bldg El 237-340 Southeast	9.8E-4	none	<1E-7/yr															X
1	R1D	Reactor bldg El 198-237 Southeast	3.0E-3	PLOF	<1E-7/yr															
1	R2A	Reactor bldg El 261 East	6.9E-3	MSIV	2.1E-4/yr			AC			X	103				AC				X
1	R3A	Reactor bldg El 281 East	2.2E-2	MSIV	1.4E-4/yr	B2					X	X		X		AC				
1	R4A	Reactor bldg El 298 East	5.2E-3	none	<1E-7/yr															
1	R5A	Reactor bldg El 318 East	3.8E-4	none	<1E-7/yr															
1	R6A	Reactor bldg El 340 East	1.8E-3	none	<1E-7/yr															
2	R1B	Reactor bldg El 198 Northwest	3.7E-3	MSIV	2.1E-6/yr					X										X
		Reactor bldg El 198 Southwest		-	-															
		Reactor bldg El 237 West		-	-															
2	R2B	Reactor bldg El 261 West	5.7E-3	MSIV	3.0E-5/yr	B1	AC			X		102			AC					X
2	R2C	Reactor bldg El 261 West (SDC)	1.9E-3	none	<1E-7/yr							102								X
2	R3B	Reactor bldg El 281 West	1.3E-2	MSIV	1.0E-4/yr	B1	AC			X			X		AC					
2	R4B	Reactor bldg El 298 West	5.5E-3	RWX	<1E-7/yr															
2	R5B	Reactor bldg El 318 West	9.2E-4	none	<1E-7/yr															
2	R6B	Reactor bldg El 340 West	1.2E-3	none	<1E-7/yr															
1/2	R4C	EC isolation valve room El 298	9.1E-5	none	<1E-7/yr															
Yard	R2D	Reactor bldg track bay El 261	1.3E-3	none	<1E-7/yr															
3	R1	Drywell	na	na	Note 1															
4	F1	Foam room	5.1E-4	none	<1E-7/yr															
5	OG1	Offgas bldg	1E-2	A3X	<1E-7/yr						X									
5	T1A	MSIV room	1.1E-4	MSIV	<1E-7/yr															
5	T1	Turbine generator bay	1.6E-2	MSIV	2.9E-6/yr					EDG										
5	T3A	Turbine bldg El 261 East	2.3E-2	MSIV	<2.3E-2	B1,B2	X	X	X	X	X				AC	AC	E	X		X
5	T3B	Turbine bldg El 261 West	1.5E-2	MSIV	<1.5E-2	X	X	X	X	X	X				X	X		X	X	X
5	T4A	Turbine bldg El 277 East	4.4E-3	MSIV	<4.4E-3	B2	X	AC	X		X					AC	E			
5	T4B	Turbine bldg El 277 West	9.2E-3	A2X	<9.2E-3	B1,B2	X	AC	X	X	X				X	X	E			
5	T4C	H2 seal oil unit room, El 277	5.2E-4	none	<1E-7/yr															
5	T4D	NSR battery room, El 277	8.9E-4	TT	<1E-7/yr															
5	T5A	Turbine bldg El 291 Northeast	2.6E-3	RWX	2.9E-7/yr	B2														
5	T6A	Turbine bldg El 305 North	8.6E-3	none	<1E-7/yr															
5	T6B	Turbine bldg El 300 East	2.3E-3	none	<1E-7/yr		X													
5	T6C	Turbine bldg El 300 South	3.4E-3	TLOF	1.1E-7/yr		X													
5	T6D	Turbine bldg El 300 Southwest	4.9E-4	none	<1E-7/yr															
5	T7A	Turbine bldg El 320 South	1.1E-3	none	<1E-7/yr															
5	T8A	Turbine bldg El 333-369 East	9.1E-5	none	<1E-7/yr															
5	T8B	Turbine bldg El 369 West	2.3E-4	none	<1E-7/yr															
6	T2A	Turbine bldg El 250 Northeast	3.4E-3	MSIV	<3.4E-3	B1,B2		X		EDG	X						E	X	X	X
7	T2B	Turbine bldg El 250 South & West	4.9E-3	MSIV	<4.9E-3	X	X			X	X				X		E	X	X	X
7	T2E	UPS battery room El 250	4.1E-3	none	<1E-7/yr															
8	-	incorporated into FA 9	na	na	na															
9	T2C	Offgas tunnel, El 250	1.1E-4	TLOF	<1E-7/yr						X									
9	T2D	Turbine bldg El 250 East	1.4E-3	MSIV	<1.4E-3	B1,B2		X		X	X						E		X	
10	C1	Cable spreading area	5.0E-4		<5E-4		Almost all systems can be impacted - detailed analysis required													
11	C2	Aux control room	3.7E-3		<3.7E-3		Almost all systems can be impacted - detailed analysis required													
11	C3	Main control room	9.8E-3		<9.8E-3		Almost all systems can be impacted - detailed analysis required													
12	A1	Admin bldg ships & stores	1E-2	none	<1E-7/yr	KB														
12	A2	Admin bldg addition	1E-2	none	<1E-7/yr															
13	S1	Screenhouse	9.9E-3	LOC	3.6E-4/yr					EDG	EDG						E	X	X	X
14	S2	Diesel fire pump room	4.1E-3	none	<1E-7/yr												D			
15	-	Waste disp & radwaste solid bldg	1E-2	none	<1E-7/yr															
16A	B1A	Battery board room 12, El 261	3.1E-3	A3X	<1E-7/yr			X			X									
16B	B1B	Battery board room 11, El 261	3.1E-3	A2X	<1E-7/yr		X			X										
17A	B2A	Battery room 12, El 277	8.9E-4	none	<1E-7/yr			DB												
17B	B2B	Battery room 11, El 277	8.9E-4	none	<1E-7/yr		DA													
18	D3	DG 102 missile shield, El 275	1.4E-4	A2X	8.1E-7/yr					X	EDG									
19	D1A	DG 103 foundation, El 250	9.6E-5	none	<1E-7/yr						EDG									
19	D2A	DG 103 room, El 261	3.2E-2	none	<1E-7/yr						EDG									
20	D1C	DG 102 cableway, El 250	9.1E-5	none	<1E-7/yr					EDG										
21	D1D	Area under PB 102 & 103, El 250	9.1E-5	A3X	<1E-7/yr					X	X									
22	D1B	DG 102 foundation, El 250	9.1E-5	none	<1E-7/yr					EDG	EDG									
22	D2B	DG 102 room, El 261	3.2E-2	A2X	1.4E-6/yr					X										
23	D2C	PB 102 room, El 261	3.1E-3	A2X	1.4E-7/yr					X										
24	D2D	PB 103 room, El 261	3.1E-3	A3X	<1E-7/yr						X									

Table 4.0-1 Summary of Initial Screening Impacts and Results (page 2 of 2)

Area	Zone	SB	TW	RW	AS	W1	W2	W3	W4	W1A	W1B	CN	FW	LC	LT	CR1	CR2	C1	C2	C3	C4	RV	IA	LA	IB	LB	TC	SD	CV	ADS
1	R1A	X		12	12							X	12		12	X	X		X	X	X	12	A3	A3	X	X		X	11	X
1	R1C															X														
1	R1D												1/3													X				
1	R2A	X		12	12	X	X	X	X		X	X	12	12	12	X	X	X	X	X	X	12	A3	A3	A3	X		X	X	X
1	R3A			X		X	X	X	X		X	X	X	12				X		X		12	A3		A3		M	X	12	X
1	R4A					X	X	X	X		X																M		12	
1	R5A					X	X	X	X					X																
1	R6A													X																
2	R1B			11,13	11	X	X					X	11	11	11	X		X	X	X	X	11	A2	X	A2	A2		X		X
2	R2B			11,13	11	X	X			X		X	11	X	11	X		X	X	X	X	11	A2	X	A2	A2	M	X	M	X
2	R2C															X												X		
2	R3B			X						X		X	11	X	11				X		X	11	A2		A2			X		X
2	R4B			X						X				11													M			
2	R5B									X				11																
2	R6B													11																
1/2	R4C																													
Yard	R2D																													
3	R1																						X		X			X		
4	F1																													
5	OG1				13							12																		
5	T1A											X																		
5	T1											X	X																	
5	T3A	X	X	X	12,13	X	X	X	X		X	X	X		X	X		X	X	X		12		A2		A2		X	X	
5	T3B		X	11,13	X	X	X			X		X	X	X	11	X			X			X						X		
5	T4A		X	X	13							X	X	12															X	
5	T4B		X	X									X	X																
5	T4C																													
5	T4D																													
5	T5A			X									X																	
5	T6A																													
5	T6B																													
5	T6C												X																	
5	T6D																													
5	T7A																													
5	T8A																													
5	T8B																													
6	T2A	X	X	12	12	X	X	X	X			X	X	12	12		X	X	X	X	X	12		X		X	M	X		
7	T2B		X	11,13	11	X	X					X	X	11	11	X	X	X	X		X	11		X		A2		11,13		
7	T2E																													
8	-																													
9	T2C							X	X				2/3							X	X			A3		X				
9	T2D	X	12	12	12	X	X	X	X			X	12	12	12		X	X	X	X	X	12		X		X	M	X		
10	C1							Almost all systems can be impacted - detailed analysis required																						
11	C2							Almost all systems can be impacted - detailed analysis required																						
11	C3							Almost all systems can be impacted - detailed analysis required																						
12	A1		X																											
12	A2																													
13	S1	X				X	X	X	X			X																		
14	S2																													
15	-														12															
16A	B1A																													
16B	B1B																													
17A	B2A																													
17B	B2B																													
18	D3					X	X				X		X					X	X	X				A2		A2		X	X	
19	D1A																													
19	D2A																													
20	D1C																													
21	D1D					X	X	X	X									X	X	X	X			X		X				
22	D1B																													
22	D2B					X	X				X		X			X		X	X	X				A2		A2		X	X	
23	D2C					X	X						X			X		X	X					A2		A2		X	X	
24	D2D										X		X			X				X				A3					X	

Notes to Table 4.0-1

Note 1: The primary containment was qualitatively screened out. With the exception of instrumentation, four core spray injection MOVs, two of four MSIVs, relief valves, two of three shutdown cooling MOVs, two equipment & floor drain containment isolation MOVs, most sensitive electrical equipment required to respond to an initiator in the drywell is located outside the primary containment. There is separation between redundant components and the primary containment is normally inerted during power operation

Certain portions of IPE systems are not shown in Table 4.0-1 either because the system is not susceptible to the fire hazard or due to the fail-safe nature of their design. These are summarized below:

- Passive Mechanical Systems - screenhouse intake and gates (LK), feedwater injection path (IN), condensate storage tank (TA), vapor suppression function (VS) are passive and/or have no electrical components. The impact of fires and other hazards (except seismic) on these systems are not considered risk significant.

- Fail-Safe Design - the reactor SCRAM function (RQ) was not included in the analysis. This system is a de-energize to actuate system. Fires and hazards are expected to cause a plant SCRAM not prevent SCRAM. Other protection system actuation signals (P1, P2, and P3) for emergency condensers, core spray, containment spray, portions of automatic depressurization, and containment isolation were also neglected because they are de-energize to actuate and considered fail-safe.

Hot Shorts - Spurious ADS actuation, opening of core spray injection MOVs (interfacing LOCA potential), and isolation of emergency condenser steam lines (disables emergency condensers as a means of pressure, heat, and level control) were assessed to be unlikely events and were not evaluated further. All three aspects of plant design were modified as a result of the Appendix R safe shutdown analysis such that two hot shorts are required. These scenarios were assumed to have a small contribution to risk.

The following summarizes the IPE top events in Table 4.0-1, along with an explanation of the impacts shown:

OG - Normal AC Power: failure of 115KV power supplies to the plant are tracked with the following impacts:
X = loss of all 115KV power to the plant
B1 = loss of power board 11
B2 = Loss of power board 12

D1/D2 - DC Battery Boards 11 and 12: impacts are summarized below:
X = loss of DC battery board
AC = loss of AC supply to battery board (battery and battery board are available)
DA/DB = loss of battery (AC supply and battery board are available)

A1 - Power Board 101: failure is indicated by "X".

Notes to Table 4.0-1

A2/A3 - Power Boards 102 and 103: "X" indicates failure of power board and "EDG" indicates that only the emergency diesel is unavailable.

A67 - Power Board 167: the following summarizes impacts:
X = power board is unavailable
102 = power board 102 supply is unavailable to power board 167
103 = power board 103 supply is unavailable to power board 167

A4/A5 - Power Boards 16A and 17A: "X" indicates failure. The cables that A4 and A5 depend upon were assigned to the power supplies (B1, B2, A2, and A3).

R1/R2 - RPS Buses 11 and 12: "X" indicates failure and "AC" indicates loss of only AC power supply (DC is supplying RPS bus).

FP - Fire Protection Water: "E" indicates the electric driven fire pump is unavailable and "D" indicates that diesel driven fire pump is unavailable.

S1/S2 - Normal Service Water Pumps 11 and 12: "X" indicates failure.

SA/SB - Emergency Service Water Pumps 11 and 12: "X" indicates failure.

TW - Turbine Building Closed Loop Cooling: "X" indicates failure and "12" indicates that only pump 12 is unavailable.

RW - Reactor Building Closed Loop Cooling: "X" indicates failure and "11", "12" and/or "13" indicates the respective pump train is unavailable. TCVs 72-146 and 70-137 have mechanical stops to prevent fully closing in the event of loss of support (instrument air and power). Therefore, loss of the cables will not impact system function.

AS - Instrument Air: "X" indicates failure and "11", "12" and/or "13" indicates the respective compressor train is unavailable.

W1/W2/W3/W4 - Containment Spray Raw Water Pumps 111, 112, 121, and 122: "X" indicates failure.

WIA/WIB - Containment Spray Raw Water Crosstie to Core Spray Injection: "X" indicates failure.

CN - Main Condenser: "X" indicates failure and "12" indicates loss of circulating water pump 12.

FW - Feedwater: the following summarizes the impacts:
X = loss of all feedwater
11 = loss of reactor feed pump 11
12 = loss of reactor feed pump 12
1/3 = loss of 1 of 3 condensate and/or 1 of 3 booster feed pumps
2/3 = loss of 2 of 3 condensate and/or 2 of 3 booster feed pumps

Notes to Table 4.0-1

LC - Emergency Condenser Level Control & Makeup Tank Supply: "X" indicates failure, "11" indicates emergency condenser loop 11 has no makeup capability, and "12" indicates emergency condenser loop 12 has no makeup capability.

LT - Long Term Makeup to Emergency Condensers: "X" indicates both condensate transfer pumps are unavailable, "11" indicates condensate transfer pump 11 is unavailable, and "12" indicates condensate transfer pump 12 is unavailable.

CR1/CR2 - CRD Pump 11 and 12: "X" indicates failure.

C1/C2/C3/C4 - Containment Spray Pumps 111, 112, 121, and 122: "X" indicates failure.

RV - Relief Valves (emergency depressurization): "X" indicates failure of all 6 valves, "11" indicates the three valves supplied from DC battery board 11 are unavailable, and "12" indicates the three valves supplied from DC battery board 12 are unavailable.

LA/IA - Core Spray 11 Pumps (LA) and Injection MOVs (IA): "X" indicates failure, "A2" indicates failure of pumps and/or MOVs supplied power from power board 102, and "A3" indicates failure of pumps and/or MOVs supplied power from power board 103.

LB/IB - Core Spray 12 Pumps (LB) and Injection MOVs (IB): "X" indicates failure, "A2" indicates failure of pumps and/or MOVs supplied power from power board 102, and "A3" indicates failure of pumps and/or MOVs supplied power from power board 103.

TC - Torus Cooling (containment spray test return line): "M" indicates failure of MOV 80-118 cables. However, this valve can be operated locally and there is significant time for this operator action (containment heat removal function). Thus, the screening analysis did not fail the valve.

SD - Shutdown Cooling: "X" indicates failure, "11" indicates failure of pump 11, and "13" indicates failure of pump 13.

CV - Containment Vent: "X" indicates failure of both the drywell and torus vent paths. An "11" indicates failure of the Torus vent path, AOV16, and "12" indicates failure of the drywell vent path, AOV32. The AOVs can not be locally operated without a portable air supply. "M" indicates failure of MOV17 (torus vent) and/or MOV31 (drywell vent) cables. However, these valves can be operated locally and there is significant time for this operator action (containment pressure/heat removal function). Thus, the screening analysis did not fail the valves when they are easily recoverable.

ADS - Automatic Depressurization: "X" indicates that ADS can be actuated by a hot short. The screening analysis did not evaluate this scenario, instead this is used as an indication that detailed analysis of these scenarios is required.

Table 4.0-2 Detailed Analysis Results

Area	Zone	Location	Annual Freq CDF	Annual Freq ELR	CDF Contributions
1	R1A	Reactor bldg El 237 East	<1E-7	-	
1	R2A	Reactor bldg El 261 East	<1E-7	-	
1	R3A	Reactor bldg El 281 East	<1E-7	-	
2	R1B	Reactor bldg El 198 West	<1E-7	-	
2	R2B	Reactor bldg El 261 West	<1E-7	-	
2	R3B	Reactor bldg El 281 West	<1E-7	-	
5	T1	Turbine generator bay	<1E-7	-	
5	T3A	Turbine bldg El 261 North	<1E-6	<1E-7	Not evaluated in detail. Trans & equipment judged to be important.
5	T3B	Turbine bldg El 261 South	1.3E-5	1.4E-7	Dry Transformer (7E-6) Cable Tray (3E-7) Panel (5E-6)
5	T4A	Turbine bldg El 277 North	<1E-6	<1E-7	Not evaluated in detail. Trans & equipment judged to be important.
5	T4B	Turbine bldg El 277 South	<1E-6	<1E-7	Not evaluated in detail. Trans & equipment judged to be important.
6	T2A	Turbine bldg El 250 North	<1E-6	<1E-7	Transient & power cable tray fires
7	T2B	Turbine bldg El 250 South & West	1E-6	1.4E-7	Transient fires
9	T2D	Turbine bldg El 250 East	<1E-6	<1E-7	Transient & power cable tray fires
10	C1	Cable spreading area	2E-6	3E-7	Transient (1E-6) Power cable tray (1E-6)
11	C2	Auxiliary control room	1.1E-6	5.9E-7	Specific cabinets and all fires
11	C3	Main control room	1.4E-6	8.5E-7	Panel A and all fires
13	S1	Screenhouse	<1E-7	-	
22	D2B	DG 102 room, El 261	<1E-7	-	

CDF - core damage frequency
ELR - early large release

Table 4.0-3 Summary Comparison of FIVE Methodology Steps Versus NMP1 Evaluation

FIVE METHODOLOGY		EVALUATION METHODS & RESULTS
Phase 1 Fire Area Screen (Qualitative Analysis)		
Step 1	Identify Plant Safe Shutdown Systems	Completed per FIVE (Reference 28 and 29)
Step 2	Identify Fire Areas and Compartments	Completed per FIVE (References 28 & 29), but screening analysis performed at the fire zone level which does not meet strict definition of compartment. This was resolved during the detailed analysis and walkdowns by considering the location of critical components and fire sources.
Step 3	Identify Safe Shutdown Equipment in Each Compartment	Incorporated into the overall methodology (Reference 29) and can be determined from Table 4.0-1 for each fire zone or area.
Step 4	Perform Fire Area vs. Safe Shutdown System Screen	Incorporated into the overall methodology (Reference 29) which included Appendix R safe shutdown systems and non Appendix R systems; the IPE systems were used.
Step 5	Perform Fire Area vs. Safe Shutdown Function Evaluation	Incorporated into the overall methodology (Reference 29) which included Appendix R safe shutdown functions and non Appendix R functions; the IPE was used.
Step 6	Perform Fire Compartment Interaction Analysis	Completed by walkdowns and detailed analysis (Reference 29, see step 2 above)
Phase II Critical Fire Compartment Screen (Quantitative Analysis)		
Step 1	Ignition Source Frequency	Completed per FIVE (Reference 27)
Step 2	Redundant/Alternate Shutdown Path Unavailability	Incorporated into overall methodology using IPE which includes both Appendix R and non Appendix R systems. It was judged that several areas would not screen with only Appendix R safe shutdown reliability especially when assuming loss of offsite power. Fire PRA initiated within FIVE framework (References 27 through 30); IPE is used to perform screening of all areas. To do this, non Appendix R critical cables were identified with impacts on the IPE, the fire areas containing these cables and impacts were identified, and the IPE used to quantitatively screen. Those areas that did not pass initial screening were evaluated in detail as summarized below in Step 3.

Table 4.0-3 Summary Comparison of FIVE Methodology Steps Versus NMP1 Evaluation

FIVE METHODOLOGY		EVALUATION METHODS & RESULTS
Step 3	Fire Hazards Analysis and Combustible Material Evaluation	Detailed fire PRA analysis completed within FIVE Framework (Reference 30). Considered sources, targets, automatic suppression and used walkdowns within a quantitative framework. Generic fire models and specific fire analysis performed per FIVE to support analysis and judgments.
Step 4	Evaluate Potential Fire Vulnerabilities	Completed per FIVE (References 29, 30 and this report). Areas not screened being considered for possible cost beneficial improvement.
Step 5	Evaluate Potential Impact on Containment Heat Removal and Isolation	Completed per FIVE (Reference 29 and this report). Containment heat removal was included in the PRA approach used for screening. Containment performance, including isolation, interfacing LOCA, and other Level 2 PRA considerations were evaluated.
Phase III Plant Walkdown/Verification and Documentation		
Walkdown/Verification		Performed per FIVE and supplemented as needed to support detailed PRA analysis (References 27 through 30).
Documentation		This report contains Tier 1 documentation per NUREG-1407 and generally includes the recommendations in FIVE. Tier 2 documentation is contained in References 27 through 30 and generally includes the recommendations in FIVE.

A1 - Power Board 101: failure is indicated by "X".

Notes to Table 4.0-1

A2/A3 - Power Boards 102 and 103: "X" indicates failure of power board and "EDG" indicates that only the emergency diesel is unavailable.

A67 - Power Board 167: the following summarizes impacts:

X = power board is unavailable
102 = power board 102 supply is unavailable to power board 167
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A4/A5 - Power Boards 16A and 17A: "X" indicates failure. The cables that A4 and A5 depend upon were assigned to the power supplies (B1, B2, A2, and A3).

R1/R2 - RPS Buses 11 and 12: "X" indicates failure and "AC" indicates loss of only AC power supply (DC is supplying RPS bus).

FP - Fire Protection Water: "E" indicates the electric driven fire pump is unavailable and "D" indicates that diesel driven fire pump is unavailable.

S1/S2 - Normal Service Water Pumps 11 and 12: "X" indicates failure.

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LA/IA - Core Spray 11 Pumps (LA) and Injection MOVs (IA): "X" indicates failure, "A2" indicates failure of pumps and/or MOVs supplied power from power board 102, and "A3" indicates failure of pumps and/or MOVs supplied power from power board 103.

LB/IB - Core Spray 12 Pumps (LB) and Injection MOVs (IB): "X" indicates failure, "A2" indicates failure of pumps and/or MOVs supplied power from power board 102, and "A3" indicates failure of pumps and/or MOVs supplied power from power board 103.

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Table 4.0-2 Detailed Analysis Results

			Annual Freq		
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5	T4B	Turbine bldg El 277 South	<1E-6	<1E-7	Not evaluated in detail. Trans & equipment judged to be important.
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11	C2	Auxiliary control room	1.1E-6	5.9E-7	Specific cabinets and all fires
11	C3	Main control room	1.4E-6	8.5E-7	Panel A and all fires
13	S1	Screenhouse	<1E-7	-	
22	D2B	DG 102 room, El 261	<1E-7	-	

CDF - core damage frequency
ELR - early large release

Table 4.0-3 Summary Comparison of FIVE Methodology Steps Versus NMP1 Evaluation

FIVE METHODOLOGY		EVALUATION METHODS & RESULTS
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Step 6	Perform Fire Compartment Interaction Analysis	Completed by walkdowns and detailed analysis (Reference 29, see step 2 above)
Phase II Critical Fire Compartment Screen (Quantitative Analysis)		
Step 1	Ignition Source Frequency	Completed per FIVE (Reference 27)
Step 2	Redundant/Alternate Shutdown Path Unavailability	Incorporated into overall methodology using IPE which includes both Appendix R and non Appendix R systems. It was judged that several areas would not screen with only Appendix R safe shutdown reliability especially when assuming loss of offsite power. Fire PRA initiated within FIVE framework (References 27 through 30); IPE is used to perform screening of all areas. To do this, non Appendix R critical cables were identified with impacts on the IPE, the fire areas containing these cables and impacts were identified, and the IPE used to quantitatively screen. Those areas that did not pass initial screening were evaluated in detail as summarized below in Step 3.

Table 4.0-3 Summary Comparison of FIVE Methodology Steps Versus NMP1 Evaluation

FIVE METHODOLOGY		EVALUATION METHODS & RESULTS
Step 3	Fire Hazards Analysis and Combustible Material Evaluation	Detailed fire PRA analysis completed within FIVE Framework (Reference 30). Considered sources, targets, automatic suppression and used walkdowns within a quantitative framework. Generic fire models and specific fire analysis performed per FIVE to support analysis and judgments.
Step 4	Evaluate Potential Fire Vulnerabilities	Completed per FIVE (References 29, 30 and this report). Areas not screened being considered for possible cost beneficial improvement.
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Phase III Plant Walkdown/Verification and Documentation		
Walkdown/Verification		Performed per FIVE and supplemented as needed to support detailed PRA analysis (References 27 through 30).
Documentation		This report contains Tier 1 documentation per NUREG-1407 and generally includes the recommendations in FIVE. Tier 2 documentation is contained in References 27 through 30 and generally includes the recommendations in FIVE.

4.1 Fire Hazard Analysis

Quantification of the ignition sources[27] in the plant and the cumulative fire ignition frequency based on those hazards and the EPRI fire incident database is discussed in the FIVE[25] methodology. Section 4.1.1 discusses how the FIVE mandated plant location designation assignments were made. Section 4.1.2 identifies how the information in FIVE on location specific ignition sources was applied at NMP1. Section 4.1.3 addresses the application of the FIVE methodology for plantwide ignition sources at NMP1.

The total fire ignition frequency developed from the analysis in this section can be seen in Table 4.0-1 for each fire zone. These frequencies were used in the initial screening analysis described in Section 4.6.1. Table 4.1-1 summarizes the contributing ignition sources for each zone developed from this analysis. These individual sources were considered in the detailed analysis (Section 4.6.2) of zones when they could not be screened out using other methods.

The following summarizes how each ignition source frequency in Table 4.1-1 is calculated and the following sections describe the data base development further.

Location Specific Sources

The "Bldg" column in Table 4.1-1 identifies the plant location in FIVE Table 1.2 in which the fire zone was assigned. The "Source" column in Table 4.1-1 identifies the fire ignition/fuel source in FIVE Table 1.2. With this information, the fire frequency in FIVE Table 1.2 can be obtained and multiplied by the quantity of sources in the particular compartment ("Qty" column in Table 4.1-1) and divided by the total number in the overall location ("LT" column in Table 4.1-1). The result is shown in Table 4.1-1 column "Freq". The following provides an example calculation for electrical cabinets in fire area FA1 ("Area" column), fire zone R1A ("Zone" column):

5.0E-2 (BWR RB Elec Cab)*2/20 = 5.00E-3

Where the annual frequency of fires from BWR reactor building (RB) electrical cabinets (Elec Cab) in FIVE Table 1.2 is 5.0E-2. The remaining data is shown in Table 4.1-1.

For some locations, the following overall weighting factor, WF_L, must be included in the above calculation (multiplied times the result):

Plant Location	Number of Rooms	WF_L
Switchgear room	5	0.20
Battery room	4	0.25
Cable spreading room	2	0.50

Development of these weighting factors is discussed in Section 4.1.1.

Plant Wide Sources

In order to calculate the "Frequency" column in Table 4.1-1, the fire frequency in FIVE Table 1.2 is required for each plant wide source. In addition, the total quantity of each source within the plant is needed as summarized in the table below. The following provides an example calculation for transients in FA1 R1A:

1.3E-3 (Transients)*4/57 = 9.12E-5

Where the annual frequency of Transient fires in FIVE Table 1.2 is 1.3E-3. The remaining data is shown in the table below and in Table 4.1-1.

Plant Wide Source	Total Quantity in Plant
Transients	57
Welding	57
N-Q Cable	13,369,620 (X1000 BTU)
JB/Splice	13,369,620 (X1000 BTU)
Ventilation/Fans	22
Elevator Motors	3
Air Compressors	10
MG Sets	5
Fire Protection Panels	17
Transformers	56
Battery Chargers	9

The detailed analysis of the control room, described in Section 4.6.2, required an evaluation of the actual fire events in the database[25]. This was necessary to realistically estimate core damage frequency due to fires in the control room. This investigation also suggests that many of the events in the database may not be severe enough to cause the damage typically assumed in the analysis. For these reasons, the frequencies developed in this section, including weighting factors, are considered to be reasonable and potentially conservative, and no effort was made to identify uncertainties in the above methodology.

4.1.1 Assignment of Plant Location Designations

Table 1.1 of FIVE Attachment 10.3 identifies the plant locations which EPRI determined represented all plant areas (with respect to the available fire incident data). These locations are summarized below:

Auxiliary building (PWR)
Reactor building (BWR)
Diesel generator room
Switchgear room
Battery room
Control room
Cable spreading room
Intake structure
Turbine building
Radwaste building
Transformer yard
Plant-wide components

The first two items listed are mutually exclusive for BWR/PWR plants and the last item is not a plant location but gives the overall weighting factor, WF_L, for components found throughout the plant - see Section 4.1.3.

All of the 57 fire zones identified in analyzing NMP1 were assigned to one of these 10 categories.

The diesel generator missile barrier area (FA18 D3) and the cable spreading room were assigned to the "cable spread rooms" location as the most appropriate designation among the 10 choices.

Initial assignments of plant locations were occasionally changed based on the plant walkdown (i.e., the presence of switchgear and/or MCCs made the area more like a switchgear room than a cable spread room).

The overall weighting factor, WF_L, was assigned for each plant location based on the instructions given in the second column of Reference Table 1.1. For the plant locations where the number of compartments affects the overall weighting factor the number of rooms/compartments is as shown above.

It should be noted that there are some decisions made with respect to the weighting factor which are not obvious from looking at the data in the tables. These are:

- Neutral ground breakers were considered electrical cabinets (FA19 D2A and FA22 D2B).

- The Foam Room (FA4 F1), although separated from the turbine building by a safe shutdown, three hour rated wall, was included as part of the turbine building.

- Resistors were considered the same as transformers (FA5 T3B).

- Amount of diesel fuel (gallons) in the diesel fire pump day tank (FA14 S2) was included with the junction box/splices entry via BTU content.

4.1.2 Location Specific Ignition Sources

Table 1.2 of FIVE Attachment 10.3 lists the fire ignition and/or fuel source associated with the 10 plant locations. In addition, this table lists the methodology for determining the weighting factors associated with each hazard and the baseline fire frequency based on the EPRI fire reporting database (and other sources). The following describes how the information for each ignition/fuel source was applied/determined at NMP1. The results are summarized in Table 4.1-1.

<u>Electrical Cabinets</u>
Electrical cabinets are the most common ignition source in the reference table, being associated with 7 of the 10 plant locations (the exceptions being the Radwaste Building, Battery Rooms and Transformer Yard). For five of the seven plant locations with electrical cabinets as a hazard there is no associated weighting factor, i.e., the ignition frequency is equal in all areas to the frequency found in the data base. (This implies that the distribution of electrical cabinets in these plant locations is uniform.)

<u>Pumps</u>
Pumps are the next most common ignition source, with five types of pumps being listed for three plant locations. The number of pumps in each category was identified as to the plant wide total and where they were located. The ignition source weighting factor was then determined in accordance with the methodology indicated in the third column of FIVE Reference Table 1.2.

<u>Other Sources</u>
All other plant location specific ignition sources were associated with only a single plant location. These sources were:

- Diesel Generators
- Batteries
- Fire Pumps
- Other Pumps in the Intake Structure

- Turbine Generator Excitor
- Turbine Generator Oil
- Turbine Generator Hydrogen
- Main Feedwater Pumps
- Other Pumps in the Turbine Building
- Boiler(s)

The number of components in each category was identified as well as where they are located (i.e., the number in each fire). The ignition source weighting factor was then determined in accordance with the methodology indicated in the third column of FIVE Reference Table 1.2.

4.1.3 Plantwide Ignition Sources

Table 1.2 of FIVE Attachment 10.3 lists the 18 plantwide fire ignition and/or fuel sources. These particular ignition sources were selected because they were identified/identifiable in the EPRI database. In addition, this table lists the methodology for determining the weighting factors associated with each hazard and the baseline fire frequency based on the EPRI fire reporting database (and other sources).

Seven of the 18 ignition/fuel sources were not included in the NMP1 analysis since they were not present. See Section 4.1.3.2 for the justification for each of the 7 items. Sections 4.1.3.1 below describes how the information for each of the 11 included plant wide ignition/fuel sources was applied/determined at NMP1.

4.1.3.1 Plantwide Sources Included

Transformers
A total of 56 transformers were identified during the plant walkdown. Only stand alone transformers were counted. There was no attempt to determine the number of built-in transformers (internal to electrical equipment).

Hot Work Ignition of Transients
Hot work ignition of fixed or transient combustibles was considered credible and was included in the ignition frequency analysis for fire areas that contained weld connection points. The weighting factor was the inverse of the total number of fire areas/compartments in the plant (57).

Transient Ignition Sources
Note D of Reference Table 1.2, found in FIVE Attachment 10.3, lists six potential transient ignition sources. Four of these are procedurally prohibited and/or have never been used at NMP1. These four sources being eliminated from consideration in this analysis are:

- Cigarette Smoking - This is banned in all plant buildings (except for a smoking area for the plant operators) which is not inside the radiologically controlled areas.

- Heaters - The use of heaters is banned in all plant areas except administrative (office) areas since all other plant areas have thermostatically controlled electric resistance heaters and fans in them (in addition to heating elements in the normal forced air ventilation systems).

- Candles - The use of candles is procedurally prohibited in all plant areas.

- Overheating - The FIVE Methodology (Note D in the reference table) indicates that this is meant to address potential combustibles (and presumably high viscosity) items which must be heated before use. The example given is battery terminal grease. The Site Fire Protection Supervisor indicated that none of the preventive maintenance products (greases or other lubricants) requires pre-heating before application. In the unlikely event this were to occur, it would be performed under a hot work permit and a fire watch would be posted during the operation.

Two of the six transient ignition sources are found throughout NMP1, extension cords and hot pipes. As there are no restrictions on the use of extension cords, they are considered to be present in all fire areas/compartments. All areas with steam lines are considered to have the "hot pipe" ignition source, even if the lines are only active occasionally.

The ignition frequency of 1.3×10^{-3} is based on only a single fire incident, while the various weighting factors account for the relative frequency of the 13 fire incidents in the EPRI database caused by transient ignition sources. The weighting factor at NMP1, in accordance with the FIVE instructions, is 4 for most areas and 5 for areas which have steam lines.

Ventilation Subsystem Components (Fans)
A total of 22 fans were identified (observed) during the plant walkdown. Only fans which are components of the general plant ventilation systems were counted. There was no attempt to determine the number of built-in fans (internal to electrical equipment).

NOTE: The thermostat controlled electric resistance heating units (unit heaters) found in most NMP1 areas were not included as the NMP1 Fire Protection Supervisor indicated that there have been no fire incidents (major or minor) involving these units. In addition, the fans in these units are quite small and are much less likely to result in a fire which propagates beyond the unit itself as would be the case for larger fans in area ventilation systems.

Splices/Junction Boxes
In accordance with the FIVE Methodology, Section 10.3, note "E" of Table 1.2, the ignition hazard associated with splices or junction boxes was determined for all areas. The weighting

factor was calculated by dividing the BTU content of cabling and wire insulation in the subject area by the total BTU content in all areas.

NOTE: *BTU content of cabling and wire insulation located within the drywell was not included as this area is inerted during operation and therefore the atmosphere has a limited potential to support combustion.*

Non-Qualified Cable Run
All cabling at NMP1 was considered non-qualified. Ignition hazard was determined similarly as described in Splices/Junction Boxes above.

MG Sets
A total of eight motor generator (MG) sets were identified during the plant walkdown. Although the FIVE Methodology explicitly lists only MG sets for the reactor protection system (RPS), it is assumed the ignition frequency is valid for any operable MG set.

Air Compressors
A total of 10 air compressors were identified during the plant walkdown. Although the FIVE Methodology explicitly lists air compressors, the control room chiller refrigerant compressors (located in turbine building, fire area 5, fire zone T6C) were included in this category.

Elevator Motors
A total of three elevator motors were identified during the plant walkdown, two in the turbine building and one in the reactor building.

Battery Chargers
A total of 9 battery chargers were identified during the plant walkdown. The number of chargers observed during the plant walkdown was verified by review of an NMP1 Master Equipment List (MEL) sort of all battery chargers in the database for the areas inspected during the walkdown.

Fire Protection Panels
A total of 17 fire panels were identified plant wide. Frequency was determined as described in the FIVE Methodology, Table 1.2.

4.1.3.2 Plantwide Sources Not Included in Analysis

The following potential ignition sources listed in the reference table were not included in the NMP1 analysis for the reasons listed.

Splices or Junction Boxes In Rated Cable Runs

These have not been included because the majority of cable installed in the NMP1 power block was not IEEE 383 qualified. Thus, all cable was conservatively considered non-qualified.

Hydrogen Tanks

These have not been included because the hydrogen storage tanks for NMP1 are located outside. Small compressed gas cylinders are located in the plant to test/calibrate instrumentation but are not considered to be the hazard referred to in the FIVE Methodology.

Misc. Hydrogen Fires

This has not been included because the hydrogen piping for NMP1 is not normally pressurized since hydrogen make-up is required only once per day (performed on the back shift).

Gas Turbines

These have not been included because there are no gas turbines at NMP1.

Hot Work Ignition Of Fixed Cables

This category was not used for several reasons. The frequency for cable ignition was accounted for twice in every fire area. Utilizing cable insulation BTU content, two other categories were included in all fire areas; Non-qualified cable and junction boxes/splices. All cable at NMP1 was considered non-qualified. Thus, cable ignition was postulated twice as described above. Adding the cable frequency a third time was considered overly conservative.

Dryers

It is not clear from the EPRI report whether the term "dryers" refers to the electric heating element in laundry type dryers, steam powered or chemical desiccant air dryers, electric motors associated with either type of dryer or some combination. It is assumed the hazard associated with steam dryers is already addressed in the "hot pipe" ignition source frequency and there is no fire hazard associated with chemical desiccants once they are placed in their containers in the air system. The only laundry type dryers associated with NMP1 were relocated outside the plant. Thus, no entries for this category are recorded.

Off-Gas/Hydrogen Recombiner

The off-gas recombiners at NMP1 are located in the offgas building (OG). This building was initially screened and not walked down. Thus, there are no entries from this category.

Table 4.1-1 Fire Ignition Frequency Development Summary

			Location Specific					Plant Wide			Total
Area	Zone	Description	BLDG	Source	QTY	LT	Freq	Source	QTY	Frequency	Frequency
FA1	R1A	237/198 NE	RB	PMP/MOTOR	9	42	5.36E-03	JB/SPLICE	88281	1.06E-05	1.31E-02
				ELEC CAB	2	20	5.00E-03	TRANSIENT	4	9.12E-05	
								WELDING	1	5.44E-04	
								N-Q CABLE	88281	4.16E-05	
								ELEVATOR	1	2.10E-03	
FA1	R1C	237/261 SE	RB	PMP/MOTOR	1	42	5.95E-04	JB/SPLICE	16326	1.95E-06	9.78E-04
								TRANSIENT	4	9.12E-05	
								FIRE PANEL	2	2.82E-04	
								N-Q CABLE	16326	7.69E-06	
FA1	R1D	198/237	RB	PMP/MOTOR	4	42	2.38E-03	TRANSIENT	4	9.12E-05	3.02E-03
								WELDING	1	5.44E-04	
FA1	R2A	261 EAST	RB	ELEC CAB	2	20	5.00E-03	JB/SPLICE	107406	1.29E-05	6.89E-03
				PMP/MOTOR	2	42	1.19E-03	TRANSIENT	4	9.12E-05	
								WELDING	1	5.44E-04	
								N-Q CABLE	107406	5.06E-05	
FA1	R3A	281 EAST	RB	ELEC CAB	7	20	1.75E-02	JB/SPLICE	137759	1.65E-05	2.16E-02
				PMP/MOTOR	5	42	2.98E-03	TRANSIENT	4	9.12E-05	
								WELDING	1	5.44E-04	
								X-FORMERS	3	4.23E-04	
								N-Q CABLE	137759	6.49E-05	
FA1	R4A	298 EAST	RB	ELEC CAB	1	20	2.50E-03	JB/SPLICE	30146	3.61E-06	5.19E-03
				PMP/MOTOR	2	42	1.19E-03	TRANSIENT	4	9.12E-05	
								WELDING	1	5.44E-04	

Table 4.1-1 Fire Ignition Frequency Development Summary

			Location Specific					Plant Wide			Total
Area	Zone	Description	BLDG	Source	QTY	LT	Freq	Source	QTY	Frequency	Frequency
								X-FORMERS	6	8.46E-04	
								N-Q CABLE	30146	1.42E-05	
FA1	R5A	318 EAST	RB					JB/SPLICE	14926	1.79E-06	3.82E-04
								TRANSIENT	4	9.12E-05	
								FIRE PANEL	2	2.82E-04	
								N-Q CABLE	14926	7.03E-06	
FA1	R6A	340 EAST	RB	PMP/MOTOR	2	42	1.19E-03	TRANSIENT	4	9.12E-05	1.83E-03
								WELDING	1	5.44E-04	
FA2	R1B	198/237	RB	PMP/MOTOR	6	42	3.57E-03	JB/SPLICE	118017	1.41E-05	3.73E-03
								TRANSIENT	4	9.12E-05	
								N-Q CABLE	118017	5.56E-05	
FA2	R2B	261 WEST	RB	ELEC CAB	2	20	5.00E-03	JB/SPLICE	118152	1.41E-05	5.70E-03
								TRANSIENT	4	9.12E-05	
								N-Q CABLE	118152	5.57E-05	
								WELDING	1	5.44E-04	
FA2	R2C	261 S/D CLG RM	RB	PMP/MOTOR	3	42	1.79E-03	TRANSIENT	4	9.12E-05	1.88E-03
FA2	R3B	281 WEST	RB	ELEC CAB	5	20	1.25E-02	JB/SPLICE	155569	1.86E-05	1.33E-02
				PMP/MOTOR	1	42	5.95E-04	TRANSIENT	4	9.12E-05	
								N-Q CABLE	155569	7.33E-05	
FA2	R4B	298 WEST	RB	ELEC CAB	1	20	2.50E-03	JB/SPLICE	22599	2.70E-06	5.53E-03
				PMP/MOTOR	4	42	2.38E-03	TRANSIENT	4	9.12E-05	
								WELDING	1	5.44E-04	

Table 4.1-1 Fire Ignition Frequency Development Summary											
			Location Specific					Plant Wide			Total
Area	Zone	Description	BLDG	Source	QTY	LT	Freq	Source	QTY	Frequency	Frequency
								N-Q CABLE	22599	1.06E-05	
FA2	R5B	318 WEST	RB	NONE				JB/SPLICE	8789	1.05E-06	9.22E-04
								TRANSIENT	4	9.12E-05	
								WELDING	1	5.44E-04	
								X-FORMERS	2	2.82E-04	
								N-Q CABLE	8789	4.14E-06	
FA2	R6B	340 WEST	RB	PMP/MOTOR	1	42	5.95E-04	TRANSIENT	4	9.12E-05	1.23E-03
								WELDING	1	5.44E-04	
FA2	R4C	298 ECIV ROOM	RB	NONE				TRANSIENT	4	9.12E-05	9.12E-05
YARD	R2D	261 TRACK BAY	RB	PMP/MOTOR	2	42	1.19E-03	TRANSIENT	4	9.12E-05	1.28E-03
FA4	F1	FOAM ROOM	TB	PUMPS	4	80	3.15E-04	TRANSIENT	4	9.12E-05	5.11E-04
				ELEC CAB	1	126	1.03E-04	JB/SPLICE	2016	2.41E-07	
								N-Q CABLE	2016	9.50E-07	
FA5	T1A	MSIV ROOM	TB	NONE				TRANSIENT	5	1.14E-04	1.14E-04
FA5	T1	250/300 COND/HTR	TB	PMP/MOTOR	7	80	5.51E-04	TRANSIENT	5	1.14E-04	1.56E-02
				FEED PUMP	1	3	4.00E-03	JB/SPLICE	1000351	1.20E-04	
				TG EXCITER	1	1	4.00E-03	N-Q CABLE	1000351	4.71E-04	
				TG H2	1	1	5.50E-03	VENTI/FAN	2	8.64E-04	
FA5	T3A	261 EAST	TB	ELEC CAB	22	126	2.27E-03	TRANSIENT	5	1.14E-04	2.26E-02
				FEED PUMPS	2	3	4.00E-03	JB/SPLICE	1369612	1.64E-04	
				PUMPS	29	80	2.28E-03	WELDING	1	5.44E-04	

Table 4.1-1 Fire Ignition Frequency Development Summary											
			Location Specific					Plant Wide			Total
Area	Zone	Description	BLDG	Source	QTY	LT	Freq	Source	QTY	Frequency	Frequency
				BOILER	1	1	1.60E-03	X-FORMERS	19	2.68E-03	
				TG OIL	1	2	6.50E-03	N-Q CABLE	1369612	6.45E-04	
								VENTI/FAN	2	8.64E-04	
								AIR COMP	1	4.70E-04	
								BATT CHGRS	1	4.44E-04	
FA5	T3B	261/237 WEST	TB	PUMPS	14	80	1.10E-03	TRANSIENT	5	1.14E-04	1.51E-02
				ELEC CAB	17	126	1.75E-03	JB/SPLICE	1285925	1.54E-04	
								WELDING	1	5.44E-04	
								X-FORMERS	9	1.27E-03	
								FIRE PANEL	8	1.13E-03	
								N-Q CABLE	1285925	6.06E-04	
								AIR COMP	3	1.41E-03	
								MG SETS	5	3.44E-03	
								BATT CHGRS	8	3.56E-03	
FA5	T4A	277/288 EAST	TB	PUMPS	1	80	7.88E-05	TRANSIENT	4	9.12E-05	4.38E-03
				ELEC CAB	10	126	1.03E-03	JB/SPLICE	646781	7.74E-05	
								WELDING	1	5.44E-04	
								X-FORMERS	5	7.05E-04	
								N-Q CABLE	646781	3.05E-04	
								VENTI/FAN	2	8.64E-04	
								MG SET	1	6.88E-04	
FA5	T4B	277 SOUTH & WEST	TB	PUMPS	3	80	2.36E-04	TRANSIENT	4	9.12E-05	9.17E-03
				ELEC CAB	50	126	5.16E-03	JB/SPLICE	578916	6.93E-05	
								WELDING	1	5.44E-04	
								X-FORMERS	5	7.05E-04	
								FIRE PANEL	2	2.82E-04	

Table 4.1-1 Fire Ignition Frequency Development Summary

			Location Specific					Plant Wide			Total
Area	Zone	Description	BLDG	Source	QTY	LT	Freq	Source	QTY	Frequency	Frequency
								N-Q CABLE	578916	2.73E-04	
								VENTI/FAN	1	4.32E-04	
								MG SETS	2	1.38E-03	
FA5	T4C	H2 SEAL OIL ROOM	TB	PUMPS	4	80	3.15E-04	TRANSIENT	4	9.12E-05	5.19E-04
				ELEC CAB	1	126	1.03E-04	JB/SPLICE	16506	1.98E-06	
								N-Q CABLE	16506	7.78E-06	
FA5	T4D	BATTERY ROOM #14	BAT	BATTERIES	1	1	8.00E-04	TRANSIENT	4	9.12E-05	8.92E-04
								JB/SPLICE	1800	2.15E-07	
								N-Q CABLE	1800	8.48E-07	
FA5	T5A	291 NORTH	TB					TRANSIENT	4	9.12E-05	2.58E-03
				ELEC CAB	13	126	1.34E-03	JB/SPLICE	299957	3.59E-05	
								WELDING	1	5.44E-04	
								X-FORMERS	3	4.23E-04	
								N-Q CABLE	299957	1.41E-04	
FA5	T6A	305 NORTH	TB	PUMPS	1	80	7.88E-05	TRANSIENT	4	9.12E-05	8.63E-03
				ELEC CAB	4	126	4.13E-04	JB/SPLICE	242289	2.90E-05	
				TG OIL	1	2	6.50E-03	WELDING	1	5.44E-04	
								N-Q CABLE	242289	1.14E-04	
								VENTI/FAN	2	8.64E-04	
FA5	T6B	300 LAYDOWN AREA	TB	PUMPS	4	80	3.15E-04	TRANSIENT	4	9.12E-05	2.31E-03
				ELEC CAB	3	126	3.10E-04	JB/SPLICE	78435	9.39E-06	
								WELDING	1	5.44E-04	
								FIRE PANEL	1	1.41E-04	
								N-Q CABLE	78435	3.70E-05	

Table 4.1-1 Fire Ignition Frequency Development Summary

			Location Specific					Plant Wide			Total
Area	Zone	Description	BLDG	Source	QTY	LT	Freq	Source	QTY	Frequency	Frequency
								VENTI/FAN	2	8.64E-04	
FA5	T6C	300 SOUTH	TB	ELEC CAB	1	126	1.03E-04	TRANSIENT	4	9.12E-05	3.44E-03
								JB/SPLICE	3690	4.42E-07	
								FIRE PANEL	1	1.41E-04	
								N-Q CABLE	3690	1.74E-06	
								VENTI/FAN	5	2.16E-03	
								COMPRESSOR	2	9.40E-04	
FA5	T6D	300 MECH STORAGE	TB	PUMPS	5	80	3.94E-04	TRANSIENT	4	9.12E-05	4.85E-04
FA5	T7A	320 SOUTH	TB	PUMPS	0	80	0.00E+00	TRANSIENT	4	9.12E-05	1.06E-03
				ELEC CAB	1	126	1.03E-04	JB/SPLICE	9072	1.09E-06	
								N-Q CABLE	9072	4.27E-06	
								VENTI/FAN	2	8.64E-04	
FA5	T8A	333/351/369	TB	NONE				TRANSIENT	4	9.12E-05	9.12E-05
FA5	T8B	369 WEST	TB	NONE				TRANSIENT	4	9.12E-05	2.32E-04
								X-FORMERS	1	1.41E-04	
FA6	T2A	250 NORTH	TB	PUMPS	5	80	3.94E-04	TRANSIENT	5	1.14E-04	3.37E-03
								JB/SPLICE	1291910	1.55E-04	
								N-Q CABLE	1291910	6.09E-04	
								ELEVATOR	1	2.10E-03	
FA7	T2B	250 SOUTH/WEST	TB	PUMPS	1	80	7.88E-05	TRANSIENT	4	9.12E-05	4.85E-03
				ELEC CAB	2	126	2.06E-04	JB/SPLICE	2849958	3.41E-04	
								WELDING	1	5.44E-04	

Table 4.1-1 Fire Ignition Frequency Development Summary

			Location Specific					Plant Wide			Total
Area	Zone	Description	BLDG	Source	QTY	LT	Freq	Source	QTY	Frequency	Frequency
								X-FORMERS	1	1.41E-04	
								N-Q CABLE	2849958	1.34E-03	
								ELEVATOR	1	2.10E-03	
FA7	T2E	UPS BATTERY ROOM	BAT	BATTERIES	1	1	8.00E-04	JB/SPLICE	4388	5.25E-07	4.09E-03
								TRANSIENT	4	9.12E-05	
								ELEC CAB	10	3.20E-03	
								N-Q CABLE	4388	2.07E-06	
FA9	T2C	OFFGAS TUNNEL	TB	NONE				TRANSIENT	4	9.12E-05	1.05E-04
								JB/SPLICE	22599	2.70E-06	
								N-Q CABLE	22599	1.06E-05	
FA9	T2D	250 EAST	TB	PUMPS	2	80	1.58E-04	TRANSIENT	4	9.12E-05	1.41E-03
				ELEC CAB	1	126	1.03E-04	JB/SPLICE	876807	1.05E-04	
								WELDING	1	5.44E-04	
								N-Q CABLE	876807	4.13E-04	
FA10	C1	CABLE SPREAD ROOM	CSR	NONE				TRANSIENT	4	9.12E-05	4.96E-04
								JB/SPLICE	684248	8.19E-05	
								N-Q CABLE	684248	3.22E-04	
FA11	C2	CONT COMPLEX 261'	SWG	ELEC CAB	119	119	3.00E-03	TRANSIENT	4	9.12E-05	3.71E-03
								JB/SPLICE	805896	9.64E-05	
								N-Q CABLE	805896	3.80E-04	
								X-FORMERS	1	1.41E-04	
FA11	C3	CONT COMPLEX 277'	CR	ELEC CAB	20	20	9.50E-03	TRANSIENT	4	9.12E-05	9.79E-03
								JB/SPLICE	105143	1.26E-05	

Table 4.1-1 Fire Ignition Frequency Development Summary

			Location Specific					Plant Wide			Total
Area	Zone	Description	BLDG	Source	QTY	LT	Freq	Source	QTY	Frequency	Frequency
								N-Q CABLE	105143	4.95E-05	
								FIRE PANEL	1	1.41E-04	
FA13	S1	SCREENHOUSE	SH	ELEC CAB	35	35	2.40E-03	TRANSIENT	4	9.12E-05	9.87E-03
				PMPS/MTRS	40	40	3.20E-03	JB/SPLICE	63144	7.56E-06	
				FIRE PUMP	1	1	4.00E-03	N-Q CABLE	63144	2.98E-05	
								X-FORMERS	1	1.41E-04	
FA14	S2	DSL FIRE PMP RM	SH	FIRE PUMP	1	1	4.00E-03	TRANSIENT	4	9.12E-05	4.09E-03
								JB/SPLICE	797	9.54E-08	
								N-Q CABLE	797	3.76E-07	
FA16A	B1A	BATT BRD RM #12	SWG	ELEC CAB	1	1	3.00E-03	JB/SPLICE	13066	1.56E-06	3.10E-03
								TRANSIENT	4	9.12E-05	
								N-Q CABLE	13066	6.16E-06	
FA16B	B1B	BATT BRD RM #11	SWG	ELEC CAB	1	1	3.00E-03	JB/SPLICE	13066	1.56E-06	3.10E-03
								TRANSIENT	4	9.12E-05	
								N-Q CABLE	13066	6.16E-06	
FA17A	B2A	BATTERY ROOM #12	BAT	BATTERIES	1	1	8.00E-04	JB/SPLICE	1800	2.15E-07	8.92E-04
								TRANSIENT	4	9.12E-05	
								N-Q CABLE	1800	8.48E-07	
FA17B	B2B	BATTERY ROOM #11	BAT	BATTERIES	1	1	8.00E-04	JB/SPLICE	1800	2.15E-07	8.92E-04
								TRANSIENT	4	9.12E-05	
								N-Q CABLE	1800	8.48E-07	
FA18	D3	MISSILE BARRIER	CSR	NONE				JB/SPLICE	79096	9.47E-06	1.38E-04

Table 4.1-1 Fire Ignition Frequency Development Summary

			Location Specific					Plant Wide			Total
Area	Zone	Description	BLDG	Source	QTY	LT	Freq	Source	QTY	Frequency	Frequency
								TRANSIENT	4	9.12E-05	
								N-Q CABLE	79096	3.73E-05	
FA19	D1A	DG 103 FOUNDATION	DG	NONE				TRANSIENT	4	9.12E-05	9.64E-05
								JB/SPLICE	8789	1.05E-06	
								N-Q CABLE	8789	4.14E-06	
FA19	D2A	DG 103 ROOM	DG	DIESEL GEN	1	1	2.60E-02	JB/SPLICE	2268	2.71E-07	3.16E-02
				ELEC CAB	4	4	2.40E-03	TRANSIENT	4	9.12E-05	
								PMP/MOTOR	1	1.26E-03	
								N-Q CABLE	2268	1.07E-06	
								AIR COMP	2	9.40E-04	
								VENTI/FAN	2	8.64E-04	
FA20	D1C	DG 103 ROUTING RM	DG	NONE				TRANSIENT	4	9.12E-05	9.12E-05
FA21	D1D	102/103 BSMT ROOM	DG	NONE				TRANSIENT	4	9.12E-05	9.12E-05
FA22	D1B	DG 102 FOUNDATION	DG	NONE				TRANSIENT	4	9.12E-05	9.12E-05
FA22	D2B	DG 102 ROOM	DG	DIESEL GEN	1		2.60E-02	JB/SPLICE	81364	9.74E-06	3.16E-02
				ELEC CAB	4	4	2.40E-03	TRANSIENT	4	9.12E-05	
								PMP/MOTOR	1	1.26E-03	
								N-Q CABLE	81364	3.83E-05	
								AIR COMP	2	9.40E-04	
								VENTI/FAN	2	8.64E-04	
FA23	D2C	PB 102 ROOM	SWG	ELEC CAB	1		3.00E-03	JB/SPLICE	63869	7.64E-06	3.13E-03
								TRANSIENT	4	9.12E-05	

Table 4.1-1 Fire Ignition Frequency Development Summary

			Location Specific					Plant Wide			Total
Area	Zone	Description	BLDG	Source	QTY	LT	Freq	Source	QTY	Frequency	Frequency
								N-Q CABLE	63869	3.01E-05	
FA24	D2D	PB 103 ROOM	SWG	ELEC CAB	1		3.00E-03	JB/SPLICE	46292	5.54E-06	3.12E-03
								TRANSIENT	4	9.12E-05	
								N-Q CABLE	46292	2.18E-05	

4.2 Review of Plant Information and Walkdown

The following documents were reviewed and used in this analysis: NMP1 USAR[6], NMP1 IPE[1], various drawings, procedures, design specifications & criteria, and Appendix R analyses. These additional documents are referenced in tier 2 documents[27 thru 30]. Additionally, individuals involved in this analysis had plant specific experience in fire protection, IPE development and applications, fire hazard analysis, equipment qualification, and Appendix R analysis.

Several walkdowns were performed in support of the analysis. An initial walkdown (summarized below) was performed to investigate fire barriers, and the presence of ignition sources. Other walkdowns were performed in support of the screening analysis, detailed analysis, and evaluation of issues associated with the Sandia Risk Scoping Study[32]. Observations and conclusions from the other walkdowns are provided in Section 4.6, as appropriate.

Initial Walkdown

A plant walkdown was performed in February, 1995 during NMP1 refuel outage #13 (RFO13). Subsequent follow-up walkdowns were performed as necessary to more closely examine or confirm data. The purpose of the walkdown was to determine and investigate the following:

- Determine the presence of ignition sources in each fire zone.
- Perform an initial review of fire barriers being credited, barriers between fire zones, the potential for fire zone interactions, and other features which could result in fire propagation through non-rated barriers.

The initial walkdown was conducted by :

C. V. Grippo (NMP1 Fire Protection Engineer)
S. D. Einbinder (NMPC Fire Protection Program Manager)
P. E. Francisco (NMPC Analysis Engineer - IPE/IPEEE Team)
R. F. Kirchner (NMPC Analysis Engineer - IPE/IPEEE Team)
J. H. Moody (NMPC Consultant)

The walkdown methodology consisted of a tour of all accessible plant areas. Walkdowns were not performed in all contaminated or high radiation areas. The presence of components which affect the fire ignition frequency in unvisited areas was determined by a review of fire loading calculations, mater equipment list (MEL) database, appropriate controlled drawings, and discussions with plant personnel.

An information checklist was prepared in advance to ensure that the required information was obtained in each compartment or area. The Radwaste, Offgas, and Administration Buildings were not inspected since they screened out in the Phase I Methodology.

The results recorded on the walkdown checklists were tabulated, entered into the database[27] and are described in Sections 4.1 and 4.8. Many of the field observations are described in the various sections of this report as they were relevant to decisions on NMP1 specific deviations from the FIVE methodology's general approach.

4.3 Fire Growth and Propagation

Fire modeling[30] using the FIVE[25] methodology was employed for the detailed evaluation of various fire scenarios at NMP1. The extent of the required detailed modeling was minimized by employing a generic modeling of typical combustibles (electrical cabinets, motors, transients, etc.). This allowed a screening to be employed during walkdowns of each fire area which was successful in eliminating the need for detailed modeling in a number of areas. Using this methodology enabled the team to focus modeling on only the most demanding scenarios. Modeling was also performed for the purpose of evaluating detection and suppression system response to support the detailed screening process.

Generic evaluations were performed for electrical cabinets, transformers, electric motors and transients utilizing the FIVE worksheets. "In-The-Plume" evaluations for center, corner, and wall fire locations were performed for both damage and ignition scenarios and also for radiant exposure damage scenarios. These evaluations provided critical separation distances, or zone of influence distances, that were used to evaluate the potential involvement of adjacent combustibles from the various ignition sources as identified during plant walkdown of each fire area. The following pre-calculated distances were used to make judgments:

Pre-calculated Critical Heights and Distance (ft) for Damage and Ignition									
Fire Source			Damage Distance (ft)				Ignition Distance (ft)		
			Plume			Rad	Plume		
	HRR	Btu Total	LF1	LF2	LF4		LF1	LF2	LF4
Vented Cabinet - Closed Doors	400	200,000	11.4	15.0	19.8	5.1	6.5	8.5	11.2
Cabinet - Open Doors	850	200,000	15.4	20.3	26.8	7.4	8.7	11.5	15.2
Transformer (Dry Type)	56	65,000	5.5	7.3	9.6	2.1	3.1	4.1	5.4
Motor up to 7 1/2 HP	65	10,000	5.5	7.3	9.6	2.1	3.1	4.1	5.4
Motor up to 25 HP	65	32,500	5.5	7.3	9.6	2.1	3.1	4.1	5.4
Transient	145	130,500	7.6	10.0	13.2	3.1	4.3	5.7	7.5

HRR: heat release rate
LF1: fire location in open
LF2: fire location against a wall
LF4: fire location in corner

A damage temperature of 425 °F for unqualified cable is assumed per FIVE. This is considered conservative especially for those cases where Flamemastic has been used. In addition, more recent modifications at NMP1 have included the use of IEEE qualified cable. An ignition temperature of 750 °F is assumed per industry practice. A damage radiant heat intensity of 0.5 $Btu/sec/ft^2$ is assumed per FIVE.

The heat release rates utilized are taken from published literature and were determined to be representative of values expected for equipment utilized at NMP1.

Using the critical target information which resulted from the circuit review, field walkdowns were utilized to develop unique scenarios for each critical target based on the sources which presented an exposure to the target.

Transient combustibles were considered as an exposure to the cable tray targets above and one scenario for each critical target location generally includes a transient combustible. The heat release rate for transient combustible exposures was taken to be 145 Btu/sec based on the expected contents of a trash bag in a nuclear power plant. This heat release rate was utilized and a basis developed for it in the NMP2 fire IPEEE and it is equally applicable to NMP1.

Other heat release rates for transient combustibles were used for two locations which exhibited higher than expected transient combustible loadings during the plant walkdowns. For these areas, multiples of the standard transient combustible heat release rate were used.

The remaining sources consisted primarily of panels and transformers and one instance of elevator hydraulic fluid.

The target-in-plume, target-outside-plume and radiation exposure worksheets (from FIVE) were then completed as needed for each scenario. When the scenarios failed to screen utilizing these worksheets, a transient analysis was performed to determine whether the fire suppression system in the area, if any, would actuate prior to target damage. For this analysis, the suppression system sprinklers were evaluated in-the-plume and outside-the-plume to demonstrate the probability of the suppression system actuating prior to target damage. For the target-outside-plume analyses, the sprinklers were considered to be the maximum horizontal distance from the plume, based on their spacing (i.e. the point-source fire was placed between adjacent sprinklers). The results of this review could be generalized to conclude that the sprinklers, if capable of actuating prior to target damage at all, would be likely to be in-the-plume approximately 50% of the time. This type of consideration was necessary due to the unique installation of preaction sprinklers to protect cable trays at NMP1. The sprinkler nozzles on the pre-action systems are located in proximity to the protected trays and generally are some distance below the ceiling. Thus, the standard methods of calculating time-to-detector actuation (Sprinkler Actuation) provided in FIVE did not apply directly.

In one location, the sprinklers were spaced so close together due to the cable tray congestion in the area, that they were judged to be capable of always being in-the-plume.

Further, since the sprinklers were designed specifically to protect the cable in the trays, they were considered to be effective so long as they actuated prior to target damage. It was judged that the cooling effect of the water spray on the cables would prevent damage.

Actuation of smoke detectors in the areas can be used to credit manual response of the fire brigade and must occur to actuate the deluge valve of the pre-action sprinkler systems which are installed to provide cable tray protection in most areas evaluated. The systems are provided with

closed-head directional water spray nozzles located at various elevations to spray directly into the trays.

Calculation of smoke detector actuation times was not attempted. The quantitative screening methods in FIVE do not consider the incipient growth stage of fires during which smoke detector actuation would be expected to occur. No credit was taken for manual firefighting by the fire brigade because the time-to-damage for critical targets was relatively short in comparison to the response time for the fire brigade. Therefore, it was not necessary to calculate time-to-smoke detector actuation to fulfill this function. With regard to deluge valve actuation, smoke detector actuation was assumed to occur prior to sprinkler system (nozzle) actuation. This is a valid assumption in light of the method used to determine time-to-suppression actuation and the expected incipient stage of the postulated fires in these areas.

Table 4.3-1 provides a summary of the scenarios considered and their location (fire area). Plant layout drawings were annotated to physically locate the individual numbered scenarios within the plant. These analyses are also referenced in the detailed fire analysis in Section 4.6.2. The following summarizes each of the fire scenarios in Table 4.3-1:

Fire Zone T2B - Turbine Building 250' elevation

The 250' elevation of the Turbine Building consists of a labyrinth of cells that are primarily open to one another via large openings. The cells form long tunnels which circumscribe the condenser area and are used for cable and pipe routing from the Reactor Building to the Control Building. Cable trays are run the length of the areas in stacks. There are frequently side-by-side stacks and in places the stacks are separated by aisles of various widths. Additional circuits enter and exit the tunnels at various locations corresponding to equipment locations in other parts of the plant (i.e. power boards, battery rooms, etc.).

Critical areas in the tunnels were selected where the combinations of cables represented an exposure that resulted in an undesirable CDF if simply discounted. In some cases these conditions exist for long stretches of cable tray runs. In other cases, the critical targets are confined to a small area where cable trays cross or merge.

In order to reduce the contribution of these cables to CDF, the areas were subjected to the quantitative screening analyses provided in FIVE. Field walkdowns were conducted to determine the spatial locations of targets and sources to develop representative and bounding fire scenarios. The scenarios in this area were arbitrarily numbered 1-8, 28 and 29 . The scenarios are described below:

Scenario #1 - This scenario considered the affect of a fire in a transformer on the stacks of cable trays located five feet away (horizontally) and above the equipment. The heat release rate for the dry transformer located near column lines A and 10 was chosen to be 56 Btu/sec for the reason described earlier. The transformer is located against a wall which doubles the effective heat release rate figure used for the analysis (per FIVE). The critical targets were considered to be

cable trays 11TA and 11TB. The target outside plume worksheet identified that the targets would pass the screen (not damaged) and that the critical combustible loading was not available. The radiation exposure worksheet identified that the critical targets were sufficiently separated to pass the screen (not damaged). Cable trays which were closer to the source than the critical target trays were evaluated to ensure they did not ignite and contribute to the heat release rate exposure to the target trays.

Scenario #2 - This scenario considered the effects of a transient combustible fire directly below the critical target trays. The initial focus was to determine whether the transient combustible fire would result in damage to the lowest (elevation) cable tray 11TA. This screen failed due to the target exceeding its presumed damage temperature and a transient analysis (FIVE Worksheet A-1) was performed to determine whether the fire suppression system would actuate prior to target damage temperature being reached. This analysis indicated the time to damage was ~159 seconds and the time to suppression actuation was ~50 seconds when the spray nozzle is in-the-plume, which is estimated to occur 50% of the time due to the relatively close spacing of the nozzles. The actuation of the spray nozzle would provide sufficient cooling to the cables in the trays via direct impingement on the cables to prevent damage.

Scenario #3 - This scenario considered the effect of a self-initiated fire in the power cable tray 11TA and evaluates the impact on the target tray 11TB directly above it. Due to the proximity of the trays, the target-in-plume scenario fails to screen (indicating target damage). A transient analysis indicated that the time to damage was two seconds and so no further effort was expended on this scenario.

Scenario #4 - This scenario evaluated the effects of a floor based transient combustible fire on target trays 11TG and/or 11TK. These trays are in an array of stacked trays on the east side of the "tunnel." The initial concern was that the lowest (elevation) tray (closest to the fire source) would ignite and contribute to the heat release rate exposure to the critical target trays. This concern was validated by the target-in-plume evaluation which indicated ignition temperature of the intervening cable tray was exceeded. A transient analysis was performed to determine if suppression system actuation would be likely to occur prior to ignition of the intervening tray. The results of this evaluation indicated that it was not likely that the suppression system would actuate prior to the intervening tray ignition temperature being exceeded. Thus, a transient combustible fire in this area does not screen out and further consideration is needed.

Scenario #5 - This scenario was originally intended to determine the impact of a self-initiated cable fire on adjacent target cable trays due to the installation of cable which has not been qualified to IEEE-383. After additional consideration, this scenario was not evaluated because a determination was made that the initiating events database for self-initiated fires in non-qualified cable only included cases where power cables were the cause and none of the cable trays in this area contained power cables. Thus, it was concluded that a self-initiated fire in a cable tray containing non-qualified cable would only occur if the cables were power cables. This argument

was used in other plant areas to discount the occurrence of self-initiated cable fires in cable raceways containing non-qualified cable.

Scenario #6 - This scenario considered the effect of a transient combustible fire located in the aisle way between stacks of cable trays and was performed to validate the assumption that cables in both stacks (on each side of the aisle) would successfully screen. The transient combustible was located in a central location (LF1) and the target cable trays 11TB & 11TG were evaluated. Both trays passed the target-outside-plume screen (not damaged). A radiant exposure was also considered and the trays were sufficiently distant that they screened successfully. This scenario validated the previous assumption that critical trays on both sides of the aisle would not be damaged and provided insight into the minimum aisle width that could be accepted while maintaining the criteria of only one side of the aisle being damaged.

Scenario #7 - This scenario considers the effects of a self-initiated fire in the power cable tray 11TA and evaluates the impact on the target tray 11TG above it in the area where the trays cross over one another near column lines AA and 2. The target-in-plume scenario analysis fails to screen and the transient analysis (FIVE Worksheet A-1) indicates time to damage is ~2 seconds. No further effort was expended on this scenario at this time.

Scenario #8 - This scenario involves a spill of the hydraulic fluid associated with the elevator. The targets are cable trays 11TA and 11TB which would be located in the plume above the "pool fire" created by the spilled oil. The target-in-plume scenario fails to screen utilizing a very low heat release rate of 125 Btu/sec. The transient analysis was performed utilizing a range of heat release rates and indicates that over a range of values, the sprinkler system actuation will occur before target damage occurs when the spray nozzle is in-the-plume, which is estimated to occur 50% of the time due to the relatively close spacing of the nozzles. The actuation of the spray nozzle would provide sufficient cooling to the cables in the trays via direct impingement on the cables to prevent damage.

Scenario #28 - No analysis was performed for this scenario. The conditions represented by a transient fire between the trays in the aisle-way where the trays are separated by six feet are demonstrated to be acceptable for screening by the analyses that were done for scenario #6.

Scenario #29 - A compressor oil drain tank is located beneath the floor in this area. The compressor drain tank may contain oil from the compressors but is completely enclosed and is not subject to spills since the liquid level is below the level of the floor. The tank is not directly below critical targets or intervening combustibles, nor is it within a critical distance to this equipment. Thus, no fires were postulated or analyzed with regard to this tank.

Fire Zone C1 - Cable Spreading Room 250' Elevation

The cable spreading room is located at the 250' elevation and is adjacent to the Turbine Building areas discussed above. It is separated from the Turbine Building areas by fire rated construction.

Critical locations within the cable spreading room were selected where the combinations of cables represented an exposure that resulted in an undesirable CDF if simply discounted.

In order to reduce the contribution of these cables to CDF the areas were subjected to the quantitative screening analyses provided in FIVE. Field walkdowns were conducted to determine the spatial locations of targets and sources to develop representative and bounding fire scenarios. The scenarios in this area were arbitrarily numbered 9-12 . The scenarios are described below:

Scenario #9 - This scenario involved consideration of a floor based transient combustible fire located against a wall (LF2). The initial focus was to determine whether the closest cable tray (lowest elevation) would reach ignition temperature and contribute to the exposure of the critical target trays above. Due to the proximity of the trays above, it was recognized that these would not screen if the intervening cable trays exceeded their ignition temperature and had to be added to the exposure of the transient. The target-in-plume screening analysis failed to screen and indicated that the bottom tray, 11NTS, reaches its ignition temperature. A transient analysis (FIVE Worksheet A-1) was performed to determine if suppression actuation would occur prior to ignition temperature being reached. Time to suppression actuation exceeds time to damage (ignition) by a wide margin. No further effort was expended on this scenario at this time.

Scenario #10 - This scenario was not evaluated because there are no power cable trays in the area that could self-ignite. Refer to the discussion of self-ignited cable tray fires under Scenario #5, in the previous fire zone, above.

Scenario #11 - A floor based transient combustible was used in a center location (LF1) for this scenario. The target-in-plume screen failed for both targets (11TB and 11TG) and indicate ignition temperature of cables in tray 11NTS had been exceeded. The transient analysis was performed and it indicated time to damage (ignition) tray 11NTS was 21 seconds which precedes time to suppression actuation by a wide margin (21 vs. 88 seconds). No further effort was expended on this scenario at this time.

Scenario #12 - This scenario was to consider the effect of a self-initiated cable tray fire on the critical targets above. The critical target trays are in close proximity above the cable tray which contains the non-qualified power cable(s) of concern. Following the field walkdown and completion of scenario #11 above, it was concluded that this scenario is obviously worse than #11 above and no additional effort was expended on this scenario at this time.

Fire Zone T3B - Turbine Building 261' elevation

The 261' elevation of the Turbine Building consists of the open area of the turbine building (area surrounding and outside of the condenser shield walls) primarily on the west half of the turbine building. Much of the area is configured such that it resembles long narrow corridors. Cables are run in individual trays and there are stacks of trays through this area.

Critical locations in this area were selected where the combinations of cables represented an exposure that resulted in an undesirable CDF if simply discounted. In some cases these conditions exist for long stretches of cable tray runs. In other cases, the critical targets are confined to a small area where cable trays cross or merge.

In order to reduce the contribution of these cables to CDF the areas were subjected to the quantitative screening analyses provided in FIVE. Field walkdowns were conducted to determine the spatial locations of targets and sources to develop representative and bounding fire scenarios. The scenarios in this area were arbitrarily numbered 13-18, 30 and 32 . The scenarios are described below:

Scenario #13 - This scenario considered the effect of a fire involving a dry transformer. The transformer is attached to a wall and so a wall location fire (LF2) was postulated and the radiation exposure on targets 13TAA, 13TAB, 13TB, 13TC and 13TD was evaluated. All of the trays are sufficiently distant from the transformer to pass the screening methodology.

Scenario #14 - This scenario evaluates a floor based transient combustible fire on the outside corner (outside the auxiliary control room) of the intersection of the corridors. A single trash bag fire was postulated and the effect on targets 13TAB and 13TB were evaluated. These targets bound the other cable trays (targets) in the area. The trays failed the target-in-plume screen and a transient analysis was performed utilizing worksheet A-1 from the FIVE methodology. The transient analysis indicates that target damage occurs in approximately 75 seconds while the directional sprinkler nozzles actuate in approximately 42 seconds when they are in-the-plume. This review assumes that the nozzles are "in-the-plume" since field walkdowns validate this assumption due to the number of spray nozzles in the area and their proximity to the target.

Scenario #15 - This scenario evaluates the impact of a self-initiated cable tray fire in power cables in tray 12TK on adjacent tray (below) 12TD. The radiation exposure screening worksheet was utilized and the target (12TD) failed to screen indicating likely cable tray damage due to the proximity of the target. A transient analysis worksheet was completed and indicated relatively short time-to-damage of 14 seconds. Time to suppression actuation was not calculated because the suppression system was not considered to be effective for limiting damage for this type of exposure fire.

Scenario #16 - This scenario evaluates the impact of a fire in a panel in the corridor north of the battery board rooms. The panel is relatively small and a heat release rate of 100 Btu/sec was used for this screen due to the small size of the panel. A wall location was analyzed which increased the exposure to 200 Btu/sec. The target selected for review was cable tray 12TB. The scenario failed the target-in-plume screen. A transient analysis performed utilizing FIVE Worksheet A-1 indicated time to damage is approximately 36 seconds while time to actuate suppression is approximately 26 seconds when the spray nozzles are "in-the-plume" which is estimated to occur 50% of the time due to the relatively close spacing of the nozzles. The actuation of the spray

nozzle would provide sufficient cooling to the cables in the trays via direct impingement on the cables to prevent damage.

Scenario #17 - A floor based transient combustible fire was utilized to determine the impact on cable trays 12TD and 12TM. The effect of the scenario on other critical targets is bounded by the analysis of these two cable trays. The scenario passed the target-in-plume screen indicating the transient combustible fire would not result in the damage temperature being exceeded for these trays.

Scenario #18 - This scenario was originally intended to determine the impact of a self-initiated cable fire on adjacent target cable trays due to the installation of cable which has not been qualified to IEEE-383. After additional consideration, this scenario was not evaluated because a determination was made that the initiating events database for self-initiated fires in non-qualified cable only included cases where power cables were the cause and none of the cable trays in this area contained power cables. Thus, it was concluded that a self-initiated fire in a cable tray containing non-qualified cable would only occur if the cables were power cables. This argument was used in other plant areas to discount the occurrence of self-initiated cable fires in cable raceways containing non-qualified cable.

Scenario #30 - This scenario was selected to evaluate the effect of a transient combustible fire on the vertical tray 12CAU and overhead trays 12TB, TC and TD. This scenario causes the vertical cable tray to be ignited by the transient combustible fire and spread vertically to the horizontal trays above. This type of fire propagation is beyond the scope of the screening methodologies presented in FIVE and could not be subjected to the screening worksheets. This scenario does not screen and no further effort was expended on this scenario.

Scenario #32 - This scenario evaluates the impact of a small dry transformer mounted on the Turbine Building wall outside the auxiliary control room in fire area T3B. The radiant exposure on trays 12TB, TC and TD was evaluated using the radiant exposure worksheet due to this being the obvious challenge to the target trays from a fire initiating at this transformer. The screen failed because the trays run within six inches (horizontally) of the transformer. No further effort was expended on this scenario.

Fire Zone T4B - Turbine Building 277' elevation

The 277' elevation of the turbine building consists of the open area (area surrounding and outside of the condenser shield walls) primarily on the west half of the building. Much of the area is configured such that it resembles long narrow corridors. Cables are run in individual trays and there are stacks of trays through this area.

Critical locations in this area were selected where the combinations of cables represented an exposure that resulted in an undesirable CDF if simply discounted. In some cases these conditions exist for long stretches of cable tray runs. In other cases, the critical targets are confined to a small area where cable trays cross or merge.

In order to reduce the contribution of these cables to CDF the areas were subjected to the quantitative screening analyses provided in FIVE. Field walkdowns were conducted to determine the spatial locations of targets and sources to develop representative and bounding fire. The scenarios in this area were arbitrarily numbered 21-27 and 31 . The scenarios are described below:

Scenario #21 This scenario considered the effects of a fire initiated in a panel on the 277' elevation of T4B. The critical impact target was considered to be 13TC. Target 13TC was subjected to the target-outside-plume scenario because there is a large duct below the cable trays which effectively shields the trays from being in a fire plume exposure from the panel below. The target passed the target-outside-plume scenario due to the large volume of the Turbine Building available for dissipation of the plume energy and the relatively small energy available for the fire. Trays above 13TC are bounded by this analysis and would also avoid critical damage if subjected to the target-outside-plume scenario.

Scenario #22 - This scenario involves a transient combustible fire in the corridor area of T4B on elevation 277'. Utilizing this fire source, Targets 13TBA, 13TBG, 13TBH, and 13TC were analyzed. The targets all passed the target-in-plume scenario screening considering a "center" location (LF1) for the transient combustible fire.

Scenario #23 - This scenario involves a self-initiated cable fire in the tray due to non-qualified power cable in tray 13TBA. The critical impact target is tray 13TC which is approximately five feet above 13TBA. This scenario was screened utilizing the target-in-plume screening criteria with the additional notation that the tray is completely shielded from the plume by ventilation ductwork which is between the source and the target.

Scenario #24 - This scenario considers the effects of a panel fire in the MCC area of elevation 277' (T4B) west of the battery rooms, on the trays above and on the adjacent panel. The critical impact targets were considered to be 13TBA and the adjacent panel. Tray 13TBA was evaluated utilizing the target-outside-plume screening worksheet and screened successfully. The adjacent panel was evaluated utilizing the radiant-exposure worksheet screen and screened successfully.

Scenario #25 - The effect of a floor-based transient combustible fire on the equipment in the open area west of the battery rooms was considered. The critical impact targets were tray 13TBA, the duct banks and the panels. The tray and the duct banks pass the target-in-plume screen analysis and require no further consideration. The effects of a transient combustible fire on the panel were not evaluated; it was assumed that a transient combustible initiated fire occurring immediately adjacent to the panel would result in damage to the panel.

Scenario #26 - This scenario evaluates the effects of a fire within one of the miscellaneous panels behind the MCC area west of the battery rooms on 277' elevation. The critical impact targets were taken to be tray 13TBA, the MCC panels and the duct banks above. The duct banks were considered to be in-the-plume and passed the target-in-plume screen. Tray 13TBA was subjected

to the target-outside-plume analysis and passed the screen. The MCC panels were considered to be exposed to the radiation from the miscellaneous panels and were subjected to and passed the radiant exposure screen.

Scenario #27 - The area in the southeast corner of 277' elevation of T4B was evaluated considering the exposure due to four trash bags of transient combustibles in the area. This exposure was chosen due to the amount of combustibles that were observed in the area during plant walkdown. The duct banks were analyzed utilizing the target-in-plume exposure and passed the screen successfully.

Scenario #31 - This area is inside the corridor that provides access to the control room. The source was a floor based transient combustible and the target was cable tray 13TBA. This tray was chosen because an analysis of this tray will bound the other targets in the area. The tray failed the target-in-plume screen. The effect of the automatic water spray suppression system was evaluated utilizing the transient analysis worksheet which results in the conclusion that the suppression system will actuate prior to damage when the spray nozzle is "in-the-plume" which is estimated to occur 50% of the time due to the relatively close spacing of the nozzles. The actuation of the spray nozzle would provide sufficient cooling to the cables in the trays via direct impingement on the cables to prevent damage.

Fire Zone T3A - Turbine Building 261' elevation

The 261' elevation of the turbine building evaluated includes the corridor between the auxiliary control room and the diesel generator area.

Critical locations in this area were selected where the combinations of cables represented an exposure that resulted in an undesirable CDF if simply discounted. In some cases these conditions exist for long stretches of cable tray runs. In other cases, the critical targets are confined to a small area where cable trays cross or merge.

In order to reduce the contribution of these cables to CDF the areas were subjected to the quantitative screening analyses provided in FIVE. Field walkdowns were conducted to determine the spatial locations of targets and sources to develop representative and bounding fire. The scenario in this area was arbitrarily numbered 33. The scenario is described below:

Scenario #33 - This scenario involves a floor-based transient combustible in a wall configuration (LF2) which ignites and involves vertical cable tray 11TM in the corridor outside the diesel generators at elevation 261 in turbine building fire zone T3A. The combined exposure was used to evaluate the impact on target cable trays 12TE, TF and TG. The targets failed the target-outside-plume screen and were subjected to a transient analysis which indicated that the time to damage was 181 seconds and the time to suppression actuation was 17 seconds. The time to suppression actuation was performed utilizing the target-outside-plume worksheet and thus the effectiveness can be taken to be 100%. The actuation of the spray nozzle would provide sufficient cooling to the cables in the trays via direct impingement on the cables to prevent damage. The

target trays were subjected to a radiation exposure screen (FIVE Worksheet 3) and passed the screen.

Table 4.3-1 NMP1 Fire Scenario Evaluation Summary

No.	Fire Zone	Source	Target(s)	Comments
1	T2B	Dry Transformer (corner location)	Cable Trays 11TA, 11TB	
2	T2B	Floor Transient	Cable Trays 11TA, 11TB	
3	T2B	Non-Qualified Cable in Tray	Cable Trays 11TA, 11TB	
4	T2B	Floor Transient	Cable Tray 11TG, 11TK	
5	T2B	Non-Qualified Cable in Tray	Cable Tray 11TG	
6	T2B	Floor Transient	Cable Tray 11TG, 11TB	
7	T2B	Non-Qualified Cable in Tray	Cable Tray 11TG	
8	T2B	Elevator Hydraulic Fluid	Cable Trays 11TA, 11TB	
9	C1	Floor Transient	Cable Trays 11TG, 11NTS	
10	C1	Non-Qualified Cable in Tray	Cable Trays 11TG, 11NTS	
11	C1	Floor Transient	Cable Trays 11TG, 11NTS, 11TA, 11TB	
12	C1	Non-Qualified Cable in Tray	Cable Trays 11TG, 11NTS, 11TA, 11TB	
13	T3B	Dry Transformer	Cable Trays 13TAA, 13TAB, 13TB, 13TC, 13TD	
14	T3B	Floor Transient	Cable Trays 13TAA, 13TAB, 13 TN, 13TB, 13TC, 13TD	
15	T3B	Non-Qualified Cable in Tray 12TK	Cable Tray 12TD	
16	T3B	Panel(s)	Cable Trays 12TD, 12TB, 12TC, 12TX, 12TAE, 12TL, 12TM	
17	T3B	Floor Transient	Cable Trays 12TD, 12TB, 12TC, 12TX, 12TAE, 12TL, 12TM	
18	T3B	Non-Qualified Cable in Tray		Deleted - no power cables in trays in this area.

Table 4.3-1 NMP1 Fire Scenario Evaluation Summary				
No.	Fire Zone	Source	Target(s)	Comments
19	deleted			
20	deleted			
21	T4B	Panel(s)	Cable Trays 13TBA, 13TC, 13TBG, 13TBH	
22	T4B	Floor Transient	Cable Trays 13TBA, 13TC, 13TBG, 13TBH	
23	T4B	Non-Qualified Cable in Tray	Cable Trays 13TBA, 13TC, 13TBG, 13TBH	
24	T4B	Panel(s)	Duct Banks, 13TBA, Panel	
25	T4B	Floor Transient	Duct Banks, 13TBA, Panel	
26	T4B	Panel(s)	Duct Banks, 13TBA, Panel	
27	T4B	Floor Transient	Duct Banks	
28	T2B	Floor Transient	Cable Trays 11TA, 11TB, 11TE	
29	T2B	Compressor Drain Tank (Oil)	Cable Trays 11TA, 11TB	Tank not considered a source due to arrangement
30	T3B	Floor Transient	Cable Trays 12TB, 12TC, 12TD, 12CAU	Beyond scope of FIVE screening tools
31	T4B	Floor Transient	Cable Trays 13TAA, 13TAB, 13TBA, 13TC	
32	T3B	Dry Transformer (small)	Cable Trays 12TB, 12TC, 12TD	
33	T3A	Floor Transient (+ vertical tray 11TM)	Cable Trays 12TE, 12TF, 12TG	

4.4 Evaluation of Component Fragilities and Failure Modes

Components were assumed to either fail with a probability of 1.0 if the fire got close enough or they had a chance of success based on reliability and availability models in the IPE[1] (IPE also identifies failure modes). The following summarizes the treatment of component failures:

- In the initial screening analysis (Section 4.6.1), all equipment in the compartment being analyzed was assumed to fail. There was no credit taken for detection or suppression.

- In the detailed analysis (Section 4.6.2), equipment that are fire sources were assumed to fail and target equipment were assumed to fail if in the zone of influence (i.e., plume and hot gases). No explicit credit for manual suppression is used in the analysis. However, the frequency of fires developed for the detailed analysis of a few key areas may implicitly account for the manual suppression of minor fires in the control room and auxiliary control room. Some credit is taken for automatic detection and suppression as described in Sections 4.3 and 4.6.2.

4.5 Fire Detection and Suppression

Section X and Appendices 10A and 10B of the UFSAR[6] describe in detail the fire protection program including detection and suppression capabilities.

Fire detection is provided in most areas evaluated in this analysis. Those areas requiring more detailed analysis in Section 4.6.2 (i.e., did not screen out as part of the initial screening analysis in Section 4.6.1) explicitly discuss detection and suppression capabilities as well as how these systems are credited in the analysis.

Many areas also have automatic suppression systems or manual suppression capabilities. Again, those areas requiring more detailed analysis in Section 4.6.2 (i.e., did not screen out as part of the initial screening analysis in Section 4.6.1) explicitly discuss detection and suppression capabilities as well as how these systems are credited in the analysis.

When explicit credit is taken for detection and suppression for screening compartments in the detailed analysis (Section 4.6.2), an unreliability of 0.05 per demand is used for automatic detection and suppression. A plant specific systems analysis to estimate reliability was not deemed necessary. No significant reliability problems have been observed at NMP1 and the 0.05 value bounds the recommended values from FIVE[25] without redundancy (Table 2 in FIVE Attachment 10.3). No explicit credit is taken for manual suppression of fires in the screening analysis calculations. This was an implicit consideration and is discussed above and in the Section 4.6, as appropriate. For these reasons, access to areas was not explicitly considered or evaluated. However, those areas most important to risk have at least two access paths. Note that the evaluation credited operator actions taken in areas not affected by the fire. Thus some local activities outside the area of the fire were credited whereas actual firefighting or other activities in the area of the fire were not.

Suppression induced damage due to flooding was considered in the design of the plant and fire protection systems (UFSAR[6]). This was also considered in the seismic analysis as described in Sections 3.1.2.3 and 4.8. The potential for a fire to cause damage to other equipment in the compartment due to suppression of the fire is a consideration for those areas where detailed analysis was performed. However, no such scenarios were identified during the analysis or walkdowns. See Section 4.6.2 for a more detailed discussion.

The adequacy of fire fighting procedures, fire brigade training, and equipment is described in Section 4.8.

4.6 Analysis of Plant Systems, Sequences, and Plant Response

Section 4.6.1 summarizes the development of a cable database[28] and the initial screening of fire zones. The results are summarized in Table 4.0-1. Section 4.6.2 documents the detailed analysis of fire zones that did not screen out of the initial screening analysis described in Section 4.6.1. The results of the detailed analysis are summarized in Section 4.0 and Table 4.0-2.

At NMP1, fire zones are detection zones and are a subset of fire areas. Several fire zones evaluated in the initial screening analysis are not synonymous with the definition of fire compartments in the FIVE methodology[25]. The reactor building and turbine buildings are the prime examples and are most important. However, these areas required detailed evaluation as described in Section 4.6.2 (the walkdowns and analysis incorporated considerations of interactions between zones).

4.6.1 Initial Screening Analysis

4.6.1.1 Cable Database Development

To support the IPEEE fire analysis, a cable spatial database[28] was developed early in the project. The database contains the spatial location of IPE[1] components and cables. The following summarizes the approach used in developing the database:

- A cable database was developed from the NMP1 cable raceway system[31]. This initial database contains all cables and raceways in the plant. This database is important because it includes the fire zones in the plant where cable raceways are routed. Thus, once the critical cables are identified (see below), this database allows cable locations within raceways and fire zones to be identified.

- Cables that can impact systems and components in the IPE[1] were identified. Typically, this involved a simplified cable block diagram for a component and indication of impact on the IPE for each cable. This was entered into a table and joined with the cable raceway database discussed above in order to include the spatial location of these failure impacts.

The final database contains cables that can impact components modeled in the IPE and the impact can be evaluated by fire zone and/or raceway. These failure impacts on the IPE are assessed for each fire zone in the quantitative screening analysis. Initially, an Appendix R and a non-Appendix R database were developed and then combined into a single spatial cable database.

Appendix R Database
An Appendix R database was initially developed from the UFSAR[6]. Each component in the Appendix R database was checked by one or both of the following methods:

Method 1
Besides identifying all cables that are electrically connected to the component's circuit, it is just as important to identify cables whose failure does not result in the component failure (i.e., cables

associated with position indication, heaters, etc.). In addition, there may be other wires which are not a part of the component's circuit but whose failure can cause the component to change state. An example of this situation is a relay that is actuated by some parameter and causes a pump to trip. The fire may cause the relay to actuate (via a fire induced short circuit) and trip the pump even though the pump's immediate circuit is free of fire damage.

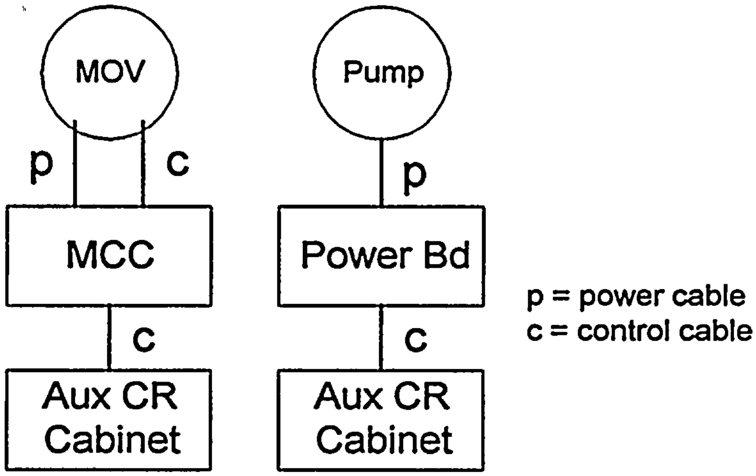
This cable identification process is usually captured by developing a sketch called a cable block diagram. This diagram identifies all cables connected to the component and all intermediate and final termination points.

The process begins with an evaluation of the component's elementary drawing. This drawing identifies all wire numbers and wire termination points including device identification and its location. It is also used to determine if there are other components such as interposing relays with contacts in this circuit and whose wires/cables can adversely impact the component. Then these additional cables must be added to the base component's cable list.

If the initial elementary drawing evaluation revealed that the circuit was simple with only several termination points and a small number of uniquely identified wire numbers, then the computer database was used to determine "cables by component". This was accomplished for components with simple circuits that did not terminate on the analog trip system (ATS) cabinets, shutdown supervisory cabinets or the remote shutdown panels.

Wires that are routed between the auxiliary control room cabinets and the control room cabinets were not all initially identified because the control and auxiliary control rooms would not pass the initial screening analysis, thus requiring a detailed analysis later. These wires were identified as needed during the detailed control and auxiliary control room fire evaluations.

Once the component circuit termination locations were identified, the computer database was queried to identify cables that transited between these termination locations.



Those components with simple control and power circuits, such as the examples in this figure, were identified and then checked using both the original Appendix R database from the UFSAR and the raceway database. The cable raceway database was searched to identify cables as shown in the figure from the component to an auxiliary control room cabinet. Then, it was verified that these cables existed in the Appendix R database. If a cable did not exist in the Appendix R database, it was added after

identifying all applicable raceways and fire zones associated with the cable. If a cable could not be found, it was evaluated and resolved as part of Method 2 below.

Method 2

A more detailed circuit analysis was required for more complex circuits (i.e., ADS and core spray injection MOVs) and when there were difficulties finding cables using Method 1. This involved reviewing electrical drawings and developing simplified cable block diagrams with the critical cables and, when necessary, indication of IPE impact for each cable. Those cables missing from the Appendix R database were entered into a table and joined with the raceway database and then the Appendix R database was updated.

A circuit analysis was required for more complex circuits, circuits that had complex actuation circuits or were routed to several control points. Some circuits have permissives while other circuits have additional circuitry added to harden them against spurious operation caused by the Appendix R fire.

The first phase of cable identification for complex circuits started with an evaluation of the circuit and its actuation logic. From the elementary diagram, device (relay, switch, lamp and contacts) locations were identified as well as any unusual circuit features. Many circuits that were modified for Appendix R concerns have redundant actuation circuits while others have interposing relays located in different fire zones. Typically these circuits have instrument loops that consist of cables that are routed from one of the instrument rooms to either the ATS cabinet or the relay room and then to the shutdown supervisory control cabinet and/or one of the remote shutdown panels and to the relay room and eventually to the control room.

Development of the cable block diagram for these complex circuits required that the actual wire numbers be first identified from the electrical control elementary diagram and instrument interconnection diagram. Once identified, the interconnection diagrams and the connection diagram were reviewed to determine which cables these wires were routed through. In many cases, each uniquely identified wire was routed through many different cables.

The emergency condenser isolation valves have override switches located at the respective remote shutdown panel that can be used to open the EC steamline isolation valves if they spuriously close.

The ADS circuitry is complex as a result of Appendix R modifications. Much of the actuation logic was not modeled because the operators manually inhibit auto actuation and then manually actuate the system when level falls below top of active fuel. Failures in the signal network will not prevent manual actuation of the valves.

Non Appendix R Database

A non Appendix R database was developed that contains cables associated with IPE equipment not included in the Appendix R safe shutdown analysis. Electrical drawings were used to identify critical cables for IPE components similar to Method 2 described above. This information was

documented in a database which includes the impact on the IPE. This database and the Appendix R database were combined to produce the final cable spatial database.

IPE Top Events & Impact Notes

The IPE event tree top events were reviewed to ensure that the cable spatial database is complete for risk analysis. The equipment modeled in the Appendix R safe shutdown analysis was considered relative to the IPE to determine which non-Appendix R equipment and cables in the IPE had to be identified and added to the database. ATWS and large LOCA event tree top events are not included because these scenarios are not considered credible for fire initiators. In addition, operator action top events are not included if there is no electrical equipment in the model. Reference 28 describes in detail the development of the spatial cable database, including impact coding for the IPE.

4.6.1.2 Initial Screening Analysis Summary

All cables and equipment within each fire zone are conservatively assumed to burn and fail in the initial screening analysis. The impact of this assumption is shown in Table 4.0-1 for each fire zone, including the initiator used to quantify core damage frequency (CDF) with the IPE. Notes to Table 4.0-1 explain the impacts. Additional conservatisms in this preliminary analysis include the following:

- The abrupt closure of all MSIVs (MSIV in the initiator column of Table 4.0-1) is assumed whenever the potential for this initiator was identified in a fire zone. In the IPE, this initiator challenges relief valves and is given a high likelihood of over filling the RPV. A stuck open relief valve disables the emergency condensers as a possible success path for RPV pressure control, heat removal and level control. An over filling condition is assumed to cause emergency condenser isolation with some likelihood of recovery modeled. Clearly, the fraction of fires that lead to a "MSIV" initiator is less than 1.0 and will be considered in the detailed analysis.

- Limited credit has been taken for recovery. For late core damage scenarios where containment heat removal is required in the long term to protect primary containment, failure of the torus cooling MOV (80-118) and containment venting MOVs (17 and 31) were not assumed because they can be locally operated. Additional recoveries may be considered in the more detailed analysis, where appropriate.

- Both open circuits and short circuits were considered when the impacts were developed. When only a short circuit causes the impact, this is conservative because the probability of this failure mode was not included.

Those fire zones shaded in the "screening" column of Table 4.0-1 did not meet the screening criteria (CDF<1E-6/yr) and are evaluated in greater detail to more realistically estimate the risk of fires and establish more detailed separation criteria. The following summarizes initial insights and strategies for the more detailed analysis:

Reactor Building Fire Zones R1A, R1B, R2A, R2B, R3A and R3B: The potential for spurious ADS actuation was identified as a potential scenario only in the reactor building. If ADS actuation occurs, it defeats emergency condensers and CRD pumps as a potential success path for shutdown (i.e., similar to large steam LOCA). With regard to transients (the CDF results in Table 4.0-1 apply to transient impacts without a spurious ADS actuation), the potential exists for losing the main condenser (MSIV closure), all of containment spray, shutdown cooling, and other systems.

The detailed analysis documents impacts in a matrix table of impacts versus cable trays. The cable trays and impacts are plotted on arrangement drawings and walkdowns were performed to support the analysis. Several new spatial location scenarios are postulated and evaluated with the IPE to assess the risk of fires more realistically. The scenarios are postulated based on impact (i.e., locations are chosen to maximize impacts) and/or potential fire sources (i.e., electrical cabinet or pump) that would tend to represent a major portion of the total fire frequency for the area.

Turbine Generator Bay Fire Zone T1: This area of the turbine building can be considered a relatively high hazard area (i.e., high frequency and significant fire sources). CDF is dominated by loss of feedwater and the MSIV initiator which leads to a high likelihood of losing the emergency condensers. Results are dominated by human failures to recover emergency condensers and emergency depressurize. CDF can be reduced simply by considering the fraction of fires that lead to an immediate MSIV initiator as the first trip signal. The loss of feedwater initiator screens out below 1E-7/yr. The only safety related impact is EDG 102, but this does not significantly contribute to the result because normal AC power is available. With regard to future electrical separation, other equipment important to safety should not be located in this fire zone.

Turbine Building Fire Zones T2A, T2B, T2D, T3A, T3B, T4A and T4B: There are significant impacts in these zones and they are assessed in the detailed analysis section similar to the reactor building. In certain locations, the likelihood of successful automatic detection and suppression is considered.

Cable Spreading Area Fire Zone C1: There are significant impacts, but the fire hazard is low. The impacts are assessed in the detailed analysis section similar to the reactor building. The likelihood of successful automatic detection and suppression was considered for this area.

Auxiliary Control Room Fire Zone C2: There are significant impacts associated with burning this area. An analysis of cable routing, a cabinet FMEA, and evaluation of detection and suppression was performed.

Main Control Room Fire Zone C3: There are significant impacts associated with burning this area. An analysis of cable routing, a cabinet FMEA, and evaluation of detection and suppression was performed.

Screenhouse Fire Zone S1: The location of fire sources versus important equipment and cable routing is evaluated in the detailed analysis similar to the reactor building discussion above. Loss of condenser initiator dominates CDF because of the abrupt isolation of MSIVs and high likelihood for losing the emergency condensers assessed in the IPE. Thus, determining the conditional frequency of a fire that causes an immediate loss of condenser will reduce CDF.

DG 102 Room Fire Zone D2B: This area was marginal (close to being screened out). The impacts are assessed in the detailed analysis section similar to the reactor building. The likelihood of successful automatic detection and suppression can also be considered for this area.

4.6.2 Detailed Fire Screening Analysis

The detailed screening analysis evaluates each fire zone that did not pass the initial screening analysis in the previous section. The following steps are utilized to more realistically assess the risk of fires:

1. The spatial location of important impacts within the fire zone is mapped out in greater detail. This allows the spatial impacts to be partitioned more realistically and identifies dependencies on the spatial location of fire sources, detection, and suppression.

2. The spatial location of important ignition sources within the fire zone are considered. This allows the fire frequency to be partitioned more realistically by considering ignition source specific initiating events and the relevant impacts near the source.

3. The potential for fire propagation, fire detection, and suppression capabilities are assessed. This allows for detection and suppression, thereby, limiting impact.

4. Based on the above steps, more realistic fire scenarios are postulated. For example, the initial screening scenario for a fire zone may be expanded to several scenarios, each with a different impact and initiating fire frequency, and representing combinations of possible detection & suppression success and failure.

Fire Initiating Event Frequency[25 and 27]
Because of the redundancy and diversity of equipment at NMP1, direct fire impact on major equipment was not identified as a concern anywhere in the plant except for the control room areas. The most likely way to potentially fail numerous components due to a single fire is to impact cable trays and conduits. The frequency of a fire impacting critical cable trays depends on the potential causes. The following summarizes the causes and how they are treated:

1. Equipment sources (i.e., transformer, cabinet, and etc.) - these hazards are identified during walkdowns and damage to cables is evaluated considering distance, configuration, detection, and suppression. The fire frequency depends on the specific type of component and location in the plant.

2. Transients - these hazards are postulated where the impacts are shown to be most significant. Whether damage occurs depends on distance, configuration, detection, and suppression. The fire frequency depends on administrative controls, potential ignition sources, and is multiplied by a spatial factor (a fraction of the total area) when evaluating the most important scenarios. For example, if transient fires can only cause station blackout in 5 percent of the area, the transient fire frequency is multiplied by 0.05 for this specific scenario.

3. Non-qualified cable - again, these hazards are usually postulated where the impacts are shown to be most significant. Damage and ignition of the subject tray and adjacent trays is assumed. Whether further propagation occurs depends on distance, configuration, detection, and suppression. The fire frequency depends on several factors as described below. Usually a spatial factor, similar to the above discussion on transients, is used when evaluating the most important scenarios.

4. Junction boxes and splices in non-qualified cables - these hazards (non-vented boxes) are neglected unless they are observed during walkdowns to be very close (i.e., within a foot) to a cable or conduit. The impact of a fire in one of these boxes is assumed to be localized (i.e., insufficient energy to spread). Generally there are no junction boxes or splices in cable trays, therefore, such situations are neglected. These scenarios were not postulated as being significant to core damage.

5. Welding - this hazard is similar to transients, except usually the presence of plant personnel is essentially guaranteed, thus, providing a high likelihood of immediate detection and suppression. These scenarios were not postulated as being significant to core damage.

At NMP1, the first three causes of fire were the focus of the evaluation.

<u>Non-Qualified Cable Fire in Trays</u>
The contribution from non-qualified cable (item 3 above) to core damage was found to be relatively important. In order to realistically assess this risk, the 8 events related to non qualified cable in the EPRI database[25] were evaluated:

Non Qualified Cable Run Fire Initiator Review			
	Description	Cause	NMP1 Applicability
1	45 pressurizer heater cables at containment penetration and 11 cables in adjacent tray damaged	thermally overloaded 480V cables in an area of restricted ventilation	Power cables but not in a cable tray. No restricted ventilation area at NMP1.
2	fire in 3 overhead cable trays in 480V switchgear room	underrated cables, overloaded trays, and cable bunching	Appears to apply to power cables and cable trays.
3	operator notices smoke coming from switchgear room cable trays	long term overheating of insulation	Possibly control cable, but they are fused at NMP1. Appears to apply to cable trays.

Non Qualified Cable Run Fire Initiator Review			
	Description	Cause	NMP1 Applicability
4	fire in turbine bldg cable trays	unknown	Could be transient, equipment, or anything.
5	Refuel crew notices arcing and smoke from power cable on main fuel handling bridge	unknown, small	Power cables but **not in a cable tray.**
6	fire alarm from switchgear room shortly after Unit supply breaker tripped on transformer current	unknown	Power cables but **not in a cable tray.**
7	a cable ground burned an electrical cable		Could be anything, control cables fused at NMP1.
8	fire in turbine bldg at El 401	bare heat trace wire burned due to arcing of wires.	Power cables, need bare wire, but **not in a cable tray**

It appears from the database that fires have occurred in power cables more than control cables. At NMP1, control circuits are fused such that a relatively low overload condition will open the fuse prior to cable damage. Whereas for power cables, the likelihood of overload and long term damage is greater (i.e., the breaker is sized to protect cable against a fault rather than a long term overload). Additionally, the heat generated by power cables is greater and the proximity of other power cables can compound the aging. Thus, fires in cable trays are only postulated in those that contain non IEEE-383 power cables. Also, 2 of 6 events were judged to occur in a power cable tray (the other two are unknown). Thus, a 1/3 factor was applied to the frequency of fires in cable trays to provide a more realistic initiating event frequency. The following provides a list of cable trays containing power cables:

<u>Cable Trays Carrying 4Kv Power Cables</u>
11TA, TB, TC, TD
11TAP, TAQ, TAR, TAT
13TBA

<u>Cable Trays Carrying 480 & 600 Power Cables</u>
11SA, TE, TM
12TK, TAF, TS
13TH, TW1, TX, TZ
14TA, TC

The trays identified as potentially important in the detailed analysis are as follows:

- C1 (cable spreading area) - 11TA, TB, and TAP cross other important cable trays; fires in these trays were evaluated and included in the estimate of core damage frequency.
- T2B (turbine bldg El 250) - 11TA and TB cross other important cable trays; fires in these trays were evaluated and included in the estimate of core damage frequency.

- T3B (turbine bldg El 261) - 12TK crosses other important cable trays; fires in these trays were evaluated and included in the estimate of core damage frequency.
- T4B (turbine bldg El 277) - 13TBA is in close proximity to other important cable trays; fires in these trays were evaluated and screened the fire impact analysis.

A review of the cables in these trays was performed. The review focused on the specific location (i.e., tray section) identified as potentially important, considered whether there are potentially overloaded cables, and the number of cables in each tray was considered (i.e., compaction and ventilation). Studies and calculations (i.e., Stolpe ampacity calculations) of cable loads were reviewed to identify whether there are potentially overloaded cables at these important locations. These calculations considered Flamemastic and tray cover installations, and are considered conservative even as a design development tool. A more realistic calculation (i.e., load diversity) is required to assess the potential for cable degradation. The following summarizes the results of this review:

C1: There are two cables (11-50 and 12-73) in cable tray 11TA that have a delta of 10 or greater above the Stolpe ampacity and there are only a total of 9 three phase cables in this tray. There is one cable (12-50) in cable tray 11TB that has a delta of 10 or greater above the Stolpe ampacity and there are a total of only 8 cables in this tray. There are no cables in cable tray 11TAP with a delta of 10 or greater above the Stolpe ampacity (there is only one three phase cable in this tray). Based on this review it is difficult to conclude that a fire in any of these trays is likely.

T2B: See discussion above (C1) for trays 11TA and 11TB.

T3B: There are 6 cables (14-164 and H12-9, 41, 63, 116, and 169) in cable tray 12TK (at the intersection with 12TD) that have a delta of 10 or greater above the Stolpe ampacity and there are only a total of about 20 cables in this tray. During a walkdown, this tray was inspected; air gaps could be observed between cables (you could look right up through the cable tray). It is difficult to conclude that a fire in this tray is likely.

T4B: There is only a single three phase power cable in 13TBA and it does not have a delta of 10 or greater above the Stolpe ampacity. It is difficult to conclude that a fire in this tray is likely.

Transient Fires

The frequency of transient fires is important in a few locations and this is considered potentially conservative because EPRI FIVE guidelines (Sections 6.3.7.1 and 2, Steps 3.6 through 3.8)[25] were not utilized to develop more realistic frequencies. Also, programmatic changes could be considered to control this frequency.

Main and Auxiliary Control Room Fires

Because of the major impact associated with utilizing the generic fire frequency, fires assigned to the control room and auxiliary control room in the EPRI database[25] were reviewed. This was done to determine how conservative the initiating event frequency may be relative to the NMP1

configuration and to develop a more realistic frequency. A further description of this review and conclusions are summarized in Section 4.6.2.3.

Emergency Diesel Generator Room Fires
One diesel room did not quite make the initial screening. As a result, fires assigned to the diesel generator rooms in the EPRI database[25] were reviewed. This was done to determine how conservative the initiating event frequency may be relative to the NMP1 configuration. A further description of this review and conclusions are summarized in Section 4.6.2.5.

Fire Impact Assessment[30]
A number of fire scenarios were analyzed (see Section 4.3) to determine whether damage occurs to cables, including consideration of detection and suppression prior to damage. Scenarios were identified during the process of evaluating spatial impacts in detail and performing walkdowns; based on locations where impacts are potentially significant and the distance between important impacts or a potential fire source is within pre-calculated distances. Section 4.3 and the detailed analysis below discusses this further.

4.6.2.1 Reactor Building

Reactor building areas screened at 1E-7/yr. Except for the drywell and track bay, this building is a large single fire area with high ceilings and there is less impact on risk at the top elevations. Cable routing and separation is assessed in such a way that fire zones and areas are only a convenient mechanism for documenting the analysis (i.e., important scenarios within a fire zone or area interface are identified or bounded). For these reasons, fire interaction analyses between fire zones can be considered incorporated within the evaluation.

Cable separation within a fire zone or area was found to be good. In addition, loss of offsite power events were not found in the reactor building and loss of the main condenser was found to be unlikely. Some important cables are embedded in the floor or enter cabinets with minimal routing within the zone. Others that can impact a whole system are kept separated, except in localized areas (i.e., MSIV11 and 12 are, for the most part, separated). This minimizes the spatial location and likelihood of a fire causing loss of a complete function (i.e., MSIV closure and loss of main condenser).

Fire impact assessments to determine whether damage occurs to cables from fire sources was not necessary in this building. The scenarios postulated were conservatively based on walkdowns, considering generic screening distances (see Section 4.3). These distances were developed based on unqualified cables, but critical cable trays in the reactor building contain Flamemastic which could be considered similar to qualified cables.

The remainder of the analysis described below uses the IPE top event codes to describe impacts. These codes are explained as notes in Table 4.0-1.

R1A - Reactor Building EL 237 East

This fire zone screened for transient initiating events in the initial screening analysis. However, the potential for ADS actuation required further detailed analysis. The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. Table 4.6-4 was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The location of fire sources is based on walkdowns. The following summarizes the findings of the analysis:

- Some containment spray impacts were determined not to cause MOV closure (i.e., MOV is in the desired position for accident mitigation). This is based on a circuit evaluation to determine which cables can actually cause MOV closure.
- An "X" in the Table 4.6-4 indicates the impact occurs in the raceway or the conduit. A "D" indicates that channel D is affected. For the core spray injection MOVs, a "C" or "R" indicates that the control room portion and/or the reactor building portion of the circuit is affected. Both circuits have to fail to prevent MOV opening.
- No fire ignition sources were observed near raceway (cable tray) Q11. The CRD pumps are near M12 and 11RG. 11RF is not directly under the CRD pumps and there is a lot of space between 11RF and the ceiling. Panel IQ4B is near L12. The conduits for C2/P (pump) and C4/P are embedded in the El 261 floor slab.

Since the impact at M12 bounds those at 11RG, an ADS actuation scenario was quantified with the IPE utilizing M12 impacts. Spurious ADS actuation was quantified as a LLOCAS (large steam LOCA) with the following impacts:

- FW12 - feedwater pump 12 was failed.
- IBA3 - core spray injection MOV dependent on power board 12 was failed.
- SD - shutdown cooling was failed.
- Other impacts are not relevant to the large LOCA model.

CDF from the above scenario is 2E-7/yr (Class IVA dominates at 1.2E-7). An initiating frequency of 1.3E-2/yr was used which is the total for the zone. This spurious ADS scenario can be screened at <1E-7 with a more realistic fire initiating event frequency. The 2 CRD pumps are near M12 and 11RG; the frequency contribution from the pumps would be about an order of magnitude less than the total for the zone. All other contributions to the total fire zone frequency could also be similarly reduced spatially. Also, there are cables in the same location that can prevent the relief valves from opening (RV impact). Thus, the frequency of a fire at this specific location coupled with the frequency of a hot short causing ADS actuation (and other cables not preventing valve opening before the short and the short must not open a fuse) is estimated to be less than 1E-7/yr in this zone.

R2A - Reactor Building EL 261 East

This fire zone did not screen out during the initial screening analysis. Also, the potential for ADS actuation required further detailed analysis. The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to

show the routing and layout of cable trays. The location of fire sources is based on walkdowns. The following summarizes the findings of the analysis:

- Some containment spray impacts were determined not to cause MOV closure (i.e., MOV is in the desired position for accident mitigation). This is based on a circuit evaluation to determine which cables can actually cause MOV closure.
- An "X" in the Table 4.6-4 indicates the impact occurs in the raceway or the conduit. For ADS, a "C" or "D" indicates that channel C or D is affected. For the core spray injection MOVs, a "C" or "R" indicates that the control room portion and/or the reactor building portion of the circuit is affected. Both circuits have to fail to prevent MOV opening.
- Q9 is in a fire break zone and no fire ignition sources were observed near Q11.
- Conduits 102-13A and 103-13A (C1 & C3) are embedded in the floor. Also, conduit 17-8 (A67/103) is in the floor.
- PB171B is between M12 and L12. Cable tray 12RE is directly above, touching the power board.
- RWCU pumps are near 12RC and 12RH. Also, 12 RD may be close.
- 12RH is about 6 feet from the power board, 8 feet off the floor, and several feet from the ceiling.

For transients, localized fires that impact only one tray or a few conduits can be screened by inspection. The following bounding location scenarios are postulated and evaluated below.

Scenario	Raceway	Impacts on IPE	CDF
1	L12, 12RE, (PB171B)	A3 (PB171B), C3, C4, CV, FW12, LT12, W1B, W3, W4, LB, LAA3, IAA3, IBA3	<1E-7/yr
2	12RH, 12RE, (PB171A)	C3, C4, D2AC, LT12, R2AC, W1B, W3, W4, IAA3, IBA3, LAA3, LBA3	<1E-7/yr
3	12RH, 12RC, (RWCU)	A3, D2AC, SD, W3, W4, LAA3, LBA2	<1E-7/yr
4	Q11, 12RD, 12RH	A3, AS12, CR2, D2AC, R2AC, RW12, SB, SD12	<1E-7/yr
5	M12, 12RE	A3, AS12, C3, C4, LT12, FW12, R2AC, RV12, SD, W1B, W3, W4 LAA3, LBA3, IAA3, IBA3	<1E-7/yr

In order to lose the main condenser, both MSIV11 and MSIV12 impacts must occur, thus the condenser is likely to be available for all scenarios. Scenarios were conservatively quantified by applying the total R2A initiating event frequency (6.9E-3/yr) and loss of PB103 (initiator A3X) was used for all scenarios. Thus, the analysis is conservative.

Spurious ADS actuation was quantified as a LLOCAS (large steam LOCA) with the following combined impacts from M12 and 12RE:

- A3 - power board 12 failed (this top event also fails the following impacts due to modeling dependencies; C3, C4, W3, W4, R2AC, IAA3, LAA3, IBA3, LBA3
- FW12 - feedwater pump 12 was failed
- SD - shutdown cooling was failed
- W1B - containment spray raw water crosstie to core spray failed
- Note that other impacts are not relevant to the large LOCA model

CDF from the above scenario is 5E-7/yr (Class IIIC at 6E-7 and Class IVA at 1E-7 dominate). An initiating frequency of 6.9E-3/yr was used which is the total for the zone. This spurious ADS scenario can be screened at <1E-7 with a more realistic fire initiating event frequency. Since there were no major fire initiating sources (i.e., pumps and panels) directly at M12, the frequency contribution at this localized area can be reduced by eliminating these sources and reducing others spatially. This would provide an order of magnitude reduction. Also, there are cables in the same location that can prevent the relief valves from opening (RV impact). Thus, the frequency of a fire at this specific location coupled with the frequency of a hot short causing ADS actuation (and other cables not preventing valve opening before the short and the short must not open a fuse) is estimated to be less than 1E-7/yr in this zone.

R3A - Reactor Building EL 281 East

This fire zone did not screen out during the initial screening analysis. Also, the potential for ADS actuation required further detailed analysis. The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The location of fire sources is based on walkdowns. The following summarizes the findings of the analysis:

- Some containment spray impacts were determined not to cause MOV closure (i.e., MOV is in the desired position for accident mitigation). This is based on a circuit evaluation to determine which cables can actually cause MOV closure.
- An "X" in the Table 4.6-4 indicates the impact occurs in the raceway or the conduit. For ADS, a "C" or "D" indicates that channel C or D is affected. For the core spray injection MOVs, a "C" or "R" indicates that the control room portion and/or the reactor building portion of the circuit is affected. Both circuits have to fail to prevent MOV opening.
- No fire ignition sources were observed near L12 and M12. Tray 13RA is about 9 feet away from L12 and M12, but passes over power board 17.

For transients, localized fires that impact only one tray or a few conduits can be screened by inspection. The following bounding location scenarios are postulated and evaluated below.

Scenario	Raceway	Impacts on IPE	CDF
1	L12, 13RM, 13RN, 13RA	C3, FW12, W1B, IAA3, IBA3, RV12, R2AC, RW12	<1E-7/yr
2	M12, 13RK, 13RL, 13RA	R2AC, RV12, SD, IAA3, IBA3, C3, RW12,	<1E-7/yr
3	PB17, 13RA	A3, C3, RV12, R2AC, RW12	<1E-7/yr

In order to lose the main condenser, both MSIV11 and MSIV12 impacts must occur, thus the condenser is likely to be available for all scenarios. Scenarios were conservatively quantified applying the total R3A initiating event frequency (2.2E-2) and loss of PB103 (initiator A3X) was used for all scenarios. Thus, the analysis is conservative.

Spurious ADS actuation was quantified as a LLOCAS (large steam LOCA) with the following combined impacts from M12, 13RA, 13RK, and 13RL:

- R2AC - ac power to RPS bus 12 failed
- SD - shutdown cooling was failed.
- C3 - containment spray pump 121 failed
- RW12 - RBCLC pump 12 failed
- IAA3 & IBA3 - core spray injection MOVs supplied by PB103 failed
- Note that other impacts are not relevant to the large LOCA model.

CDF from the above scenario is 4E-7/yr (Class IVA at 3E-7 dominates). An initiating frequency of 2.2E-2/yr was used which is the total for the zone. This spurious ADS scenario can be screened at <1E-7 with a more realistic fire initiating event frequency. Since there were no major fire initiating sources (i.e., pumps and panels) directly at M12 or the trays that cause spurious ADS, the frequency contribution at this localized area can be reduced by eliminating these sources and reducing others spatially. This would provide an order of magnitude reduction. Also, there are cables in the same location that can prevent the relief valves from opening (RV impact). Thus, the frequency of a fire at this specific location coupled with the frequency of a hot short causing ADS actuation (and other cables not preventing the valve from opening before the short and the short must not open a fuse) is estimated to be less than 1E-7/yr in this zone.

R1B - Reactor Building EL 237 West

Core damage frequency in the initial screening analysis is dominated by loss of heat removal. Loss of all containment spray and MSIV closure was caused by the fire in these scenarios. Also, a spurious ADS was found to be possible which requires analysis. The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The location of fire sources is based on walkdowns. The following summarizes the findings of the analysis:

- Some containment spray impacts were determined not to cause MOV closure (i.e., MOV is in the desired position for accident mitigation). This is based on a circuit evaluation to determine which cables can actually cause MOV closure.
- An "X" in the Table 4.6-4 indicates the impact occurs in the raceway or the conduit. For ADS, an "A" or "B" indicates that channel A or B is affected. For the core spray injection MOVs, a "C" or "R" indicates that the control room portion and/or the reactor building portion of the circuit is affected. Both circuits have to fail to prevent MOV opening.
- There are two radwaste trash cans (rubber and cloth) near CR237-N4. Also, CRD pressure control valves and HCUs are nearby.
- Pull box PB19719-A (C1/P) is below El 237. Conduits for C1 and C3 pumps (C1/P and C3/P) are in the EL 261 floor slab.
- The core spray topping pumps are close together; a fire at one can be assumed to impact both pumps (LA). They are also in proximity to L4.
- Cab 23091-B (ADS11) on drywell wall near HCUs; no other impacts near it
- The following four cable trays are near CR237-N4:

Raceway	Impacts on IPE
CR237-N4	W1, W2, LC11, LT11, FW11, C1, C2, C3*, C4, SD, IAA2, LAA2, LBA2, MSIV11, RV11
11RA*	C1, C3
11RB	SD, IAA2, MSIV11, RV11
11RN	none
11RP	none (contains only 1Q (CRD/RPIS) cables)

*C3 and 11RA impacts were later found to be less significant based on circuit evaluation (see above).

For transients, the analysis assumes no spurious ADS, but instead fails the affected relief valves. Since containment spray train 122 (C4), due to AOV 80-35 cable, is only located in CR237-N4 and FLSL261-N4, this location was evaluated.

It was determined that the N4 area and the remaining R1B area could be separated spatially for the fire analysis. The following two location scenarios were developed from the initial screening and the above evaluation:

Scenario	Raceway	Impacts on IPE	CDF
1	-	All R1B impacts in the initial screen except no failure of C4.	<1E-7/yr
2	CR237-N4, 11RA, and 11RB	W1, W2, LC11, LT11, FW11, C1, C2, C3*, C4, SD, IAA2, LAA2, LBA2, MSIV11, RV11	<1E-7/yr

*C3 impact was later found to be less significant based on circuit evaluation (see above)

Scenario 1 assumes C4 is not impacted (R1B without the N4 area), but everything else in R1B is impacted. Scenario 2 models the N4 area impact which does not include MSIV12 (main condenser is not failed).

In order to lose the main condenser, both MSIV11 and MSIV12 impacts must occur, thus the condenser is likely to be available for scenario 2. Scenario 2 was conservatively quantified by applying the initial screening impacts except the main condenser was allowed to be successful (partial loss of feedwater was assumed to be the initiator). The initiating event frequency for both scenarios was 3.7E-3/yr, the total frequency for R1B. Therefore, the analysis is conservative.

For spurious ADS, the same scenario 2 location at N4 bounds the ADS actuation initiator and additional impacts. Thus, scenario 3 is defined as a large steam LOCA (e.g., ADS) initiator with the same impacts as scenario 2 except for impacts that are not relevant to the LLOCA model. The estimated CDF from the IPE model is 3E-7/yr (Class II at 2E-7 dominates). An initiating frequency of 3.7E-3/yr was used which is the total for the zone. This spurious ADS scenario can be screened at <1E-7 with a more realistic fire initiating event frequency. The frequency contribution at this localized area can be reduced by eliminating some sources and reducing others spatially. This would provide an order of magnitude reduction. Also, there are cables in the same location that can prevent the relief valves from opening (RV impact). Thus, the frequency of a fire at this specific location coupled with the frequency of a hot short causing ADS actuation (and other cables not preventing the valve from opening before the short and the short must not open a fuse) is estimated to be less than 1E-7/yr in this zone.

R2B - Reactor Building EL 261 West

The impacts are similar to R1B, except additional heat removal impacts can occur (torus cooling MOV 80-118, containment venting MOVs, and level control to both ECs) and a single conduit (11-19A-3.5) that fails power board 11 was found. Also, a spurious ADS was found to be possible which requires analysis. The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The location of fire sources is based on walkdowns.

For transients, the analysis assumes no spurious ADS, but instead fails the affected relief valves. Torus cooling (TC) and containment venting (CV) MOVs can be locally operated in the long term (several hours) to provide successful containment pressure control. These are also obvious human actions considered in the IPE. Thus, these impacts were not evaluated further since recovery can be made and there is significant time. Loss of level control to both ECs may be less obvious to the operators and may not be easily recovered, depending on the failure mode. Rather than evaluate these failure modes and cables in detail, a strategy similar to R1B was used since level control cables to EC12 (LC2) were found to be located in only CR261-K6 and FLSL281-K6. Containment spray train 122 (C4), due to AOV 80-35 cable, is only located in FLSL261-N4, CR261-N4 and FLSL281-N4. The N4 and K6 locations are independent (i.e., separated by 50 feet). The impact from a fire in these two locations were evaluated and a walkdown of the locations performed to investigate potential ignition sources and other impacts in the proximity, including the PB11 conduit. The following summarizes the walkdown findings:

- Some containment spray impacts were determined not to cause MOV closure (i.e., MOV is in the desired position for accident mitigation). This is based on a circuit evaluation to determine which cables can actually cause MOV closure.
- An "X" in the Table 4.6-4 indicates the impact occurs in the raceway or the conduit. For ADS, an "A" or "B" or "C" or "D" indicates that channel is affected. For the core spray injection MOVs, a "C" or "R" indicates that the control room portion and/or the reactor building portion of the circuit is affected. Both circuits have to fail to prevent MOV opening.
- Power board 161B is next to N4, but it is not vented at the top and there are no other ignition sources. Cable tray 12RA is above PB161 and near N4.
- There is no ignition source or additional cable tray impacts near K6. Core spray vent isolation valves are nearby.
- L4 is next to PB161A
- Conduit 11-19A-3.5 comes into R2B/R3B in the R2B ceiling/R3B floor (K4.6 toward L4 and up into R3B). Since this is a narrow corridor with limited combustibles (cable tray and PB161A), the failure of this cable is assumed to be unlikely and was neglected.

The following location scenarios were developed from the initial screening and the above evaluation:

Scenario	Raceway	Impacts on IPE	CDF
1	-	All R2B impacts in the initial screening except no B1, C4, and LC2	<1E-7/yr
2	CR261-N4 and PB161B	W1, W2, LC11, LT11, FW11, C1, C2, C3*, C4, SD, IAA2, LAA2, LBA2, MSIV11, RV11, and A2 (PB161B)	<1E-7/yr
3	CR261-K6	A2, LC2, LT11, SD, MSIV12	<1E-7/yr

*C3 impact was later found to be less significant based on circuit evaluation (see above)

Electrical drawings and the fire cable database were used to develop the above impacts. In order to lose the main condenser, both MSIV11 and MSIV12 impacts must occur, thus, the condenser is likely to be available for scenarios 2 and 3. Scenario 2 was conservatively quantified by applying the initial screening impacts except the main condenser, LC2, and B1 were allowed to be successful (partial loss of feedwater was assumed to be the initiator). Scenario 3 was not quantified because the frequency is less than scenarios 1 and 2 by inspection. Scenarios 1 and 2 were based on the total R2B frequency which is conservative.

For spurious ADS, the same scenario 2 location at N4 can initiate ADS actuation. Thus, scenario 4 is defined as a large steam LOCA (e.g., ADS) initiator with the same impacts as scenario 2 except for impacts that are not relevant to LLOCAs. The estimated CDF from the IPE model is 7E-7/yr (Class IIIC at 2.8E-7 and Class II at 2.7E-7 dominate). An initiating frequency of 5.7E-3/yr was used which is the total for the zone. This spurious ADS scenario can be screened at <1E-7 with a more realistic fire initiating event frequency. Since there were no major fire initiating sources (i.e., pumps and panels) directly at N4, the frequency contribution at this localized area

can be reduced by eliminating these sources and reducing others spatially. This would likely provide an order of magnitude reduction. Also, there are cables in the same location that can prevent the relief valves from opening (RV impact). Thus, the frequency of a fire at this specific location coupled with the frequency of a hot short causing ADS actuation (and other cables not preventing the valve from opening before the short and the short must not open a fuse) is estimated to be less than 1E-7/yr in this zone.

R3B - Reactor Building EL 281 West

The impacts are similar to R1B and R2B. An additional impact includes loss of all RBCLC. As discussed in R2B, loss of level control to both ECs may not be obvious to the operators and may not be easily recovered, depending on the failure mode. Rather than evaluate these failure modes and cables in detail, a strategy similar to R1B was used. The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The location of fire sources is based on walkdowns. The following summarizes the walkdown findings:

- Some containment spray impacts were determined not to cause MOV closure (i.e., MOV is in the desired position for accident mitigation). This is based on a circuit evaluation to determine which cables can actually cause MOV closure.
- An "X" in the Table 4.6-4 indicates the impact occurs in the raceway or the conduit. For ADS, an "A" or "B" indicates that channel A or B is affected. For the core spray injection MOVs, a "C" or "R" indicates that the control room portion and/or the reactor building portion of the circuit is affected. Both circuits have to fail to prevent MOV opening.
- Power board 16 is close to L4 and about 6 feet from N4. The transformer 16B side is closest to N4 (about 6 feet from N4). An event impacting both the power board and N4 was judged unlikely. Cable tray 13RA passes above and near power board 16 (within plume exposure distance).
- There is no significant ignition source near K6 and cable tray RD is in close proximity.
- There is no significant ignition source near N4 (there is a small electric heater mounted on the wall near N4); cable trays RB and RC are in close proximity.

For transients, localized fires that impact only L4 or RT1 or RA1, for example, can be screened by inspection. Also, the RW impact (conduits 1S-192 and 16-76) is localized and can be neglected. Based on walkdowns, drawing & cable database evaluations, and layout of raceways and equipment, location scenarios are postulated and evaluated below.

Scenario	Raceway	Impacts on IPE	CDF
1	K6, RD, RT, 1K-14	A2, MSIV12, SD, R1AC, LT11, LC2, D1AC, C2, IAA2, IBA2, (A2X initiator)	<1E-7/yr
2	N4, RA, RB, RC	MSIV11, RV11, FW11, C4, LC1, R1AC, RW12, IAA2, IBA2, (PLOF initiator)	<1E-7/yr
3	L4, RA, and PB16A	A4, RW11, RW12, B1, WIA, IAA2, IBA2, (PLOF initiator due to B1)	1.7E-7/yr
4	L4, RA, and PB16B	A2, RW13, RW12, WIA, (A2X initiator)	<1E-7/yr

In order to lose the main condenser, both MSIV11 and MSIV12 impacts must occur, thus the condenser is likely to be available for all scenarios. Scenarios were conservatively quantified by applying the total R3B initiating event frequency. Thus, the analysis is conservative.

For spurious ADS, the same scenario 2 location at N4 can initiate ADS actuation. Thus, scenario 5 is defined as a large steam LOCA (e.g., ADS) initiator with the same impacts as scenario 2 except for impacts that are not relevant to LLOCAs. The estimated CDF from the IPE model is 3E-7/yr (Class IVA at 1.5E-7 and Class IIIC at 1.5E-7 dominate). An initiating frequency of 1.3E-2/yr was used which is the total for the zone. This spurious ADS scenario can be screened at <1E-7 with a more realistic fire initiating event frequency. Since there were no major fire initiating sources (i.e., pumps and panels) directly at N4 or the trays that cause spurious ADS, the frequency contribution at this localized area can be reduced by eliminating these sources and reducing others spatially. This would provide an order of magnitude reduction. Also, there are cables in the same location that can prevent the relief valves from opening (RV impact). Thus, the frequency of a fire at this specific location coupled with the frequency of a hot short causing ADS actuation (and other cables not preventing valve opening before the short and the short must not open a fuse) is estimated to be less than 1E-7/yr in this zone.

4.6.2.2 Turbine Building

The turbine building is an important area with regard to the likelihood of fires or other hazards causing core damage. As summarized in Table 4.0-2, core damage frequency is estimated to vary from 1E-5/yr to <1E-6/yr depending on the specific location. This building is large with high ceilings (except at El 250) and there is less impact on risk at the higher elevations. Also, cable routing and separation is assessed in such a way that fire zones and areas are only a convenient mechanism for documenting the analysis (i.e., important scenarios within a fire zone or area interface are identified or bounded). For these reasons, fire interaction analyses between zones can be considered incorporated within the evaluation.

The likelihood of plant transients that challenge relief valves (i.e., MSIV closure, loss of condenser, loss of offsite power, loss of feedwater, etc.) is greater than in the reactor building. These type of transients increase the likelihood of a stuck open relief valve which leads to loss of emergency condensers and CRD pumps as a means of inventory control and heat removal. The most important scenarios (only in localized areas) are those where a fire can cause loss of both

emergency power boards and sometimes a partial loss of 115KV offsite power, which was not found in the reactor building. For these scenarios, core damage frequency is based on the product of initiating event frequency at the specific location and probability of core damage given the fire impact. The following summarizes the success potential for these dominating scenarios:

- Emergency condensers are available, unless a stuck open relief valve occurs.

- The diesel fire pump is available.

- In most cases at least one feedwater train is available and sometimes the main condenser is available. Containment venting is also available.

- At least one battery board (i.e., BB11 is available if feedwater 11 is available) and associated relief valves are available, but DC power will only last 2 to 8 hours depending on how quickly load shedding is performed.

- Because it is difficult to recover failures due to a fire (i.e., cables burned), it is possible DC power will run out before the emergency power boards are recovered. This would result in loss of instruments in the control room and the relief valves will close if they were open. Since this is likely to occur more than 2 hours after the initial fire, credit was given for the operators utilizing the East and West instrument rooms (procedure N1-SOP-14) to monitor instrument gauges. Also, it is recognized at this point in time that if there is a stuck open relief valve, fire water or feedwater could continue makeup with containment venting. If the relief valves are closed, the ECs are capable of providing level control and heat removal with a reactor vessel that is at normal level and reduced decay heat (i.e., shrinkage not a concern relative to reaching top of active fuel).

The probability of success is developed in the evaluations and depends on the availability of equipment and the likelihood of relief valves being challenged and sticking open.

As described above, there are limited locations where a fire could cause a loss of both emergency power boards. These locations are acceptable in the Appendix R analysis because the emergency condensers are available and give the operators time to invoke damage repair procedures. The following summarizes these special cases:

- Elevation 250 (T2B): portion of cable tray 11TG contains control cables for part of 115KV power and both emergency power sources (power boards 102 and 103); transient fires dominate which may be reduced to a reasonably low frequency with adherence to and/or additional programmatic controls.

- Elevation 261 (T3B): portion of cable tray 12TD contains control cables for both emergency power sources (power boards 102 and 103); Fire sources include transient, dry transformer, small wall cabinets, and power cables in tray 12TK. Transients fires may be reduced to a reasonably low frequency with programmatic controls. The dry transformer could be moved and/or the combustibles inside the transformer evaluated in greater detail (not judged likely to

reduce impact due to close proximity to trays and low heat release rate used in analysis). Thermography of the transformer to assure it is not overheating may be just as effective. The small panels could be evaluated in greater detail with regard to total combustible load inside the panel. Also, some kind of barrier to protect trays above is possible. The specific location where unqualified cables in 12TK can impact 12TD could be checked periodically (i.e., with Thermography) to verify that cables are not heating up to an unacceptable level or a barrier could be placed between them.

- Elevation 277 (T4B): portion of cable tray 13TC contains control cables for both emergency power sources (power boards 102 and 103). Fire sources include transient, UPS cabinets, and power cables in tray. All of these scenarios screened based on large room, trays relatively high from floor sources, and arrangements. This area should still be considered relatively important with regard to controlling combustibles.

T1 - Turbine Generator Bay

This area of the turbine building can be considered a relatively high hazard area (i.e., high frequency, 1.6E-2/yr, and significant fire sources such as hydrogen). The screening analysis CDF, 2.9E-6/yr, is dominated by loss of feedwater and the MSIV initiator which leads to a high likelihood of losing the emergency condensers. Results are dominated by human failures to recover emergency condensers and emergency depressurize. CDF can be reduced simply by considering the fraction of fires that lead to an immediate MSIV initiator as the first trip signal. The loss of feedwater initiator screens out below 1E-7/yr. The only safety related impact is EDG 102, but this is not contributing to the result because normal AC power is available.

The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. Major contributors to the initiating frequency are removed from the cable trays. The cable trays are above El 277, but below El 300 and away from the exciter, feed pump, and TG oil. The initiating fire frequency is reduced an order of magnitude to 1.4E-3, if these were removed from the fire frequency. Also, if the other contributors to the fire frequency were reduced due to spatial considerations, an additional reduction factor is possible. For these reasons, fire zone T1 is screened at 1E-7/yr.

T2A - Turbine Building EL 250 North

The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The location of fire sources is based on walkdowns. The following summarizes the analysis findings:

- There is fire detection and water sprinklers for the cable trays.
- Motors are not near critical cable trays (>6 feet).
- There are 6 cable trays that are grouped together (11TJ, 11TK, and 11TN are stacked on top of each other and right next to 11TF, 11TG, and 11TM also stacked on top of each other). On one end of this zone, there are two other cable trays (11TD and 11TE stacked on top of

each other) which are approximately 10 feet from the group of 6. Cable tray 11TC is on the other side of the room from these other two groups. On another end of this zone, there are two other cable trays (11TA and 11TB stacked on top of each other) which are approximately 10 feet from the group of 6. Tray 11TE is routed between TA/TB and the other group of six.

The fire impact assessment (Section 4.3) indicates a transient fire is unlikely to damage more than one group of trays (i.e., the group of six versus the groups of two discussed above). In fact, it may be unlikely that all cable trays within a group would be impacted before detection and suppression. However, this was assumed for the following location scenarios postulated and evaluated below.

Scenario	Raceway	Impacts on IPE	CDF
1	11TA, TB, TE	A2EDG, B1, B2, C1, C2, CW11, CW12, EFP, FW11, FW12, FW13, S1, S2, TW11, TW12, W1, W2	5E-7/yr
2	11TJ, TK, TN, TF, TG, TM	AS12, C1, C3, C4, CR2, CW11, CW12, D2, LC2, LT12, MSIV11, MSIV12, RV12, RW12, SB, SD, SD12 .	<1E-7/yr
3	11TD, TE	A2EDG, B2, C1, C2, CW11, S1, TW11, W1, W2	5E-7/yr
4	11TC	A3, C3, C4, CW12, EFP, S2, TW12, W3, W4	<1E-7/yr

The initiating event frequency for the above scenarios is 9E-4/yr which excludes pump motors and the elevator which are not near the cable trays. The initiating event is MSIV closure for the first 3 scenarios and loss of PB103 (A3X) for scenario 4. The fraction of fires that could cause the consequences of scenario 1 can be shown to be less than 0.2 based on a spatial reduction factor. Also, detection and suppression before this impact occurs has not been evaluated.

T2B - Turbine Building El 250 South

A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The location of fire sources is based on walkdowns. The following summarizes the walkdown and evaluation:

- There is fire detection and water sprinklers for the cable trays.
- Floor drain sump pump motors are not near cable trays (>6 feet). A vented transformer in one corner is about 6 feet from trays 11TA and TB. A compressor oil drain tank is somewhat removed from 11TA and TB (>6 feet). The elevator (hydraulic fluid) is about 6 feet from 11TA and TB.
- There are 6 cable trays that are grouped together (11TJ, 11TK, and 11TL are stacked on top of each other and right next to 11TF, 11TG, and 11TH also stacked on top of each other). Two other cable trays are grouped together (11TA and 11TB stacked on top of each other) and are approximately 10 feet from the group of 6 (about 6 feet apart in one location). Tray 11TE runs between these two groups in part of the fire zone.
- Generally, power cables (11TA and TB) come down to El 250 on the South wall and the "11" train cables are routed West and then North where as the "12" cables are routed East. Therefore, direct loss of balance of plant is not likely (normal power to PB11 and 12,

feedwater, and the main condenser). Both MSIV isolation train control cables are in the bank of six trays, thus MSIV isolation is likely in these areas. In certain specific locations, emergency power and normal offsite power are in close proximity. The focus of the analysis below is locations where both trains of Balance of Plant (BOP) equipment come in close proximity with emergency power and/or offsite power.

The fire impact assessment (Section 4.3) indicates a transient fire is unlikely to damage both sets of trays (e.g., the bank of six and the group of two discussed above). The following scenario locations were identified and evaluated below:

Scenario*	Raceway	Impacts on IPE
1 (28)	11TA, TB, TE	A2EDG, LA, B1, B2 and equipment supplied by B1 & B2
2 (29)	11TA, TB	B1 (11) train and FW13
3 (1,2,3,8)	11TA, TB	A2, B2 and equipment supplied by B2
4 (4)	11TF-TL	MSIV, KA, OG1, OG2, OG4, A2, A3 (PB17B is available), D1, RV11, and B1 supported equipment
5	11TF-TL	same as 4 except A3 is available
6 (6,7)	11TA, TB, TQ, TF-TL	Combination of scenario 2 and 4 except A3 is available.
7	11TF-TL	same as scenario 4 except no KA, OG and A3

*Fire impact assessment scenarios in Section 4.3 are shown in parenthesis.

Scenario 1 (North end, trays 11TA, TB and TE) impacts are similar to scenario 1 in T2A, but the initiating fire frequency is less (the only sources are 10% of power cables and <10% of transient area). Trays 11TJ and 11TK are on the other side of TE, but there is no major impact. This scenario screens at <1E-7/yr.

Scenario 2 (Northwest, West & Southwest ends, trays 11TA and TB) includes a compressor oil drain tank or power cable tray fire (50%) or transient (<10%) with minimal impact. This scenario screens at <1E-7/yr without credit from the fire impact assessment. The compressor drain tank may contain oil from the compressors but is enclosed and is not subject to spills since the liquid level is below the level of the floor. No fires were postulated or analyzed with regard to this tank. The tank is not directly below critical targets or intervening combustibles.

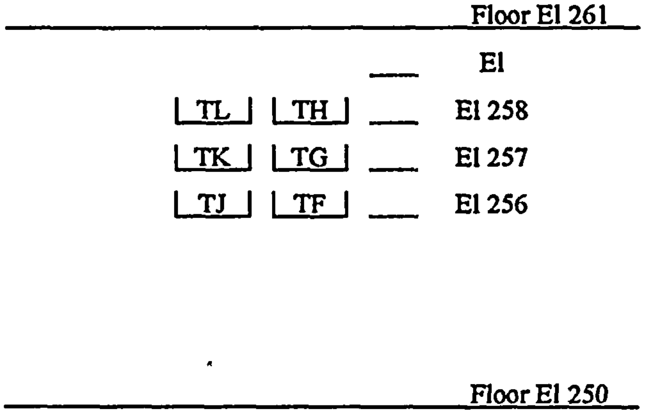
Scenario 3 (Southeast end, trays 11TA and TB) includes elevator hydraulics or a transformer or tray (40%) or transient (<10%) with minimal impact in comparison to scenario 4 below. This scenario screens at <1E-7/yr without crediting fire impact assessment. However, the following summarizes the fire impact assessment results from Section 4.3 since they provide insights into other related scenarios:

- The dry transformer in corner screens target-outside-of-plume scenario and radiant-exposure scenario.
- Floor based transient fails target-in-plume scenario with center location utilizing trash bag with 145 Btu/s heat release rate. Target is cable tray 11TA. Transient analysis performed utilizing center location of transient and results indicated time to damage is 159 seconds while time to actuate detection (suppression) is 50 seconds when the spray nozzle is "in-the-plume" which is estimated to occur 50% of the time due to the relatively close spacing of the nozzles.

The results also indicate that insufficient time is available to credit manual suppression activities.

- The effects of a self-initiated fire in the power cable tray 11TA were evaluated considering the impact on the target tray 11TB above it. The target-in-plume scenario analysis fails to screen and the transient analysis indicates time to damage is 2 seconds.
- A spill of the hydraulic fluid associated with the elevator was assessed. The targets are cable trays 11TA and 11TB which would be located in the plume above the "pool fire" created by the spilled oil. The target-in-plume scenario fails to screen utilizing a very low heat release rate of 125 Btu/s. The transient analysis was performed utilizing a range of heat release rates and indicates that over a wide range, the detector actuation (sprinkler system actuation) will occur before target damage occurs.

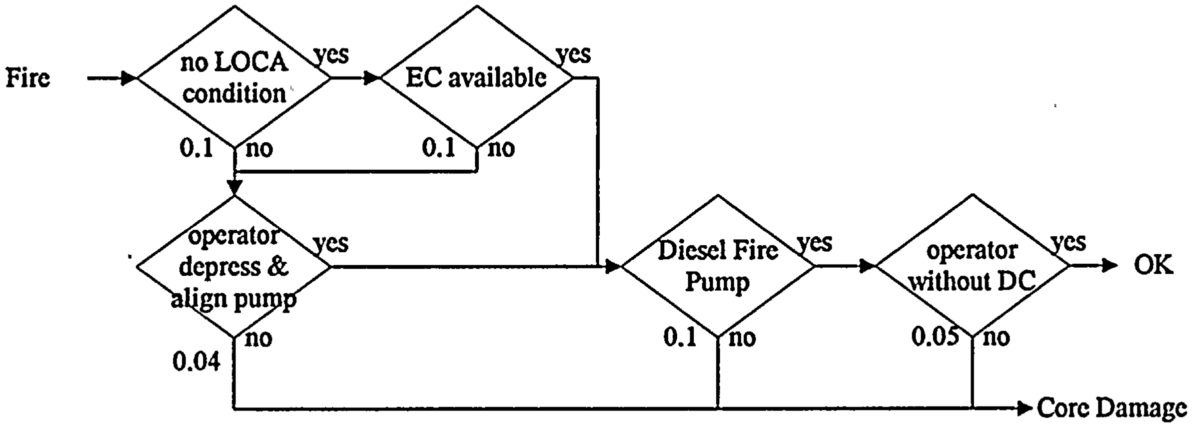
Scenario 4 (Southeast corner, trays 11TF-TL) includes transients (5% of 9.1E-5/yr) with a frequency of 4.6E-6/yr. The following sketch summarizes the arrangement.



The impacts are summarized below:

11TJ - MSIV11, FW11, RW11 & 13, R1, SD11 & 13, SA
11TF - FW11
11TK - D1, FW11, and RV11
11TG - KA, OG1, OG2, OG4, A2, A3 (PB17B is not impacted)
11TL - none
11TH - MSIV12

The fire impact assessment indicates that automatic suppression does not occur before damage to 11TG. However, power board 12 (KB, OG3, and B2) is not affected in this area. Also, feedwater 12 (FW12) and RBCLC 12 (RW12) are not affected, but power board 17B is unavailable (the crosstie of PB17A, from power board 12, to PB17B to recover RW12 and support FW12 can not be performed). Although MSIV closure (MSIV11 and 12) is possible, containment venting (CV) is not affected. Thus, it appears for this fire that all feedwater will be lost and as shown in the figure below the operators would have to depressurize and use the diesel fire water pump if emergency condensers are not successful (stuck open relief valve or reactor recirculation pump seal LOCA). Later into this event, batteries will run out; timing depends on how quickly load shedding occurs. Instrumentation in the control room is lost without DC power and the relief valves close. The operators have to use the Yarway level instruments (local gages) in the East or West instrument rooms. If a relief valve sticks open, makeup can continue with diesel fire water. If relief valves reclose, ECs can be used with a full vessel.



CDF can be estimated as the product of the initiator, 4.6E-6/yr, times the unavailability of the above success path, 0.2 is assumed, which is about 9.2E-7/yr. Early core damage is about 0.03 times 4.6E-6/yr which is 1.4E-7/yr.

The following summarizes the transient analysis in Section 4.3:

- Floor based transient fails target damage screen with center location utilizing trash bag with 145 Btu/s heat release rate. Target is cable tray 11TG (or 11TK). Transient analysis performed utilizing wall location of transient (x2) and results indicate time to damage is 28 seconds while time to actuate detection (suppression) is 56 seconds. These results indicate that suppression actuation is not likely to occur before critical target damage. The results also indicate that insufficient time is available to credit manual suppression activities.

Scenario 5 (Southwest end) includes transients (8% of 9.1E-5/yr) with a frequency of 7.3E-6/yr and impact is same as Scenario 4 except power board 103 (A3) is available. Based on the results of Scenario 5, CDF can be estimated as <1E-7/yr.

Scenario 6 (Southwest corner) postulates a fire where the power cable trays (TA & TB) cross the control cable trays (TF-TL) and offsite power comes into TG from TQ. Fire frequency includes transients (1/30 of 9.1E-5/yr) and power cables (1/30 of 1.3E-3/yr*0.33). Since power board 103 (A3) is available, CDF can be estimated as <1E-7/yr. The following summarizes the transient analysis in Section 4.3:

- A transient combustible fire was postulated at the floor in the aisle way between the two stacks of trays. The aisle way is 8.5 feet wide at this point. The scenario screened easily for the target-outside-plume and for the radiant exposure scenarios. However, a transient directly under the trays is not expected to screen similar to scenario 4 above.
- The effects of a self-initiated fire in the power cable tray 11TA and the impact on the target tray 11TG above was evaluated. At this location the trays cross over one another near column 2AA. The target-in-plume scenario analysis fails to screen and the transient analysis indicates time to damage is 2 seconds. No further effort was expended on this scenario at this time. Further consideration of the scenario is warranted.

Scenario 7 (West wall) includes transients (20% of 9.1E-5/yr) near trays 11TF-TL with a frequency of 1.8E-5/yr. CDF is <1E-7/yr based on less impact than scenario 5.

T2D - Turbine Building EL 250 East

The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The location of fire sources is based on walkdowns. The following summarizes the analysis findings:

- There is fire detection and water sprinklers for the cable trays.
- There are 6 cable trays that are grouped together (11TJ, 11TK, and 11TN are stacked on top of each other and right next to 11TF, 11TG, and 11TM also stacked on top of each other). Three other cable trays are grouped together (11TAR, 11TA and 11TB stacked on top of each other) and are approximately 7 feet from the group of 6.
- One floor drain sump motor was relatively close to the group of 6 cable trays (near cable spreading room), but there was a sprinkler over the sources. Other motors and a radiation monitoring cabinet (not identified in the fire frequency database) were at least 6 feet away from cable trays.

The fire impact assessment in Section 4.3 indicates a transient fire is unlikely to damage both sets of trays (e.g., the bank of six and the group of three discussed above). In fact, it may be unlikely that all cable trays within a group would be impacted before detection and suppression. However, this was assumed for the following location scenarios postulated and evaluated below.

Scenario	Raceway	Impacts on IPE	CDF
1	11TAR, TA, TB	A2, B1, B2, C1, C2, CW12, EFP, FW12, FW13, S2, TW12, W1, W2	4E-7/yr
2	11TJ, TK, TN, TF, TG, TM	A3, AS12, C1, C3, C4, CR2, CW11, CW12, D2, EFP, LC2, LT12, MSIV11, MSIV12, RV12, RW12, SB, SD, W3, W4	<1E-7/yr

A MSIV isolation was modeled as the initiating event at 1.2E-2/yr. This frequency excludes the contribution from motors since they are not near 11TA and TB. The fraction of fires that could cause the consequences of scenario 1 can be shown to be less than 0.25 based on a spatial reduction factor. Also, detection and suppression before this impact occurs has not been evaluated.

T3A - Turbine Building EL 261 North

The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The location of fire sources is based on walkdowns. The following summarizes the analysis findings:

- There are a number of fire sources including electrical panels. However, many of the trays are relatively high off the floor relative to fire sources on the floor.

- Potential scenarios at this location are judged to be enveloped by those postulated in T3B, C1, T4B, and T2B. Power board 102 can be impacted, but normal offsite power and power board 103 are not impacted. Feedwater can be impacted and at a specific location where both MSIV trains cross there is a potential for MSIV closure and loss of main condenser. At another location, shutdown cooling, parts of containment spray, and containment venting can be impacted, but there is no impact on emergency condensers and power supplies. The following potential worst case scenario was identified for evaluation:

Cable trays 12TE, TF, and TG cross the corridor between the auxiliary control room and diesel generator rooms (power board 102 and shutdown cooling impact). About six feet away, there is a vertical cable tray (VT11TM) which impacts power board 103 and the electric fire pump. The fire impact assessment in Section 4.3 evaluated a scenario (33) which involves a floor-based transient in a wall configuration which ignites and involves vertical cable tray 11TM in the corridor outside the diesel generators. The combined exposure was used to evaluate the impact on target cable trays 12TE, TF and TG. The targets failed the target-outside-plume screen and were subjected to a transient analysis which indicated that the time to damage was 181 seconds and the time to suppression actuation was 17 seconds. The time to suppression actuation was performed utilizing the target-outside-plume worksheet and thus the effectiveness can be taken to be 100%. The target trays were subjected to a radiation exposure screen and passed the screen. Also, even if this worst case scenario is assumed, the balance of plant (feedwater, main condenser and their support systems) is available. Therefore, this scenario is screened.

T3B - Turbine Building EL 261 South

The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The location of fire sources is based on walkdowns. The following summarizes the analysis findings:

- There are a number of fire sources including electrical panels and there are no cable tray water sprinklers in the vicinity of electrical panels.
- The Southeast corner of this elevation, near the auxiliary control room, is used for temporary storage of material for radwaste survey.
- Those areas with the greatest potential impact are identified below for further assessment.

The following location scenarios are postulated and evaluated.

Scenario*	Raceway	Impacts on IPE
1 (30,32)	12TB, TC, TD, CAU	KB, A1, A2, D2, A3EDG
2 (13-15)	13TAA, TAB, 12TN, TB, TC, TD, TK	A1, A2, D2, A3, TW, FW, SD, RW
3 (16,17)	12TB, TC, TD	A1, A2, A3, D2, SD

*Fire impact assessment scenarios in Section 4.3 are shown in parenthesis.

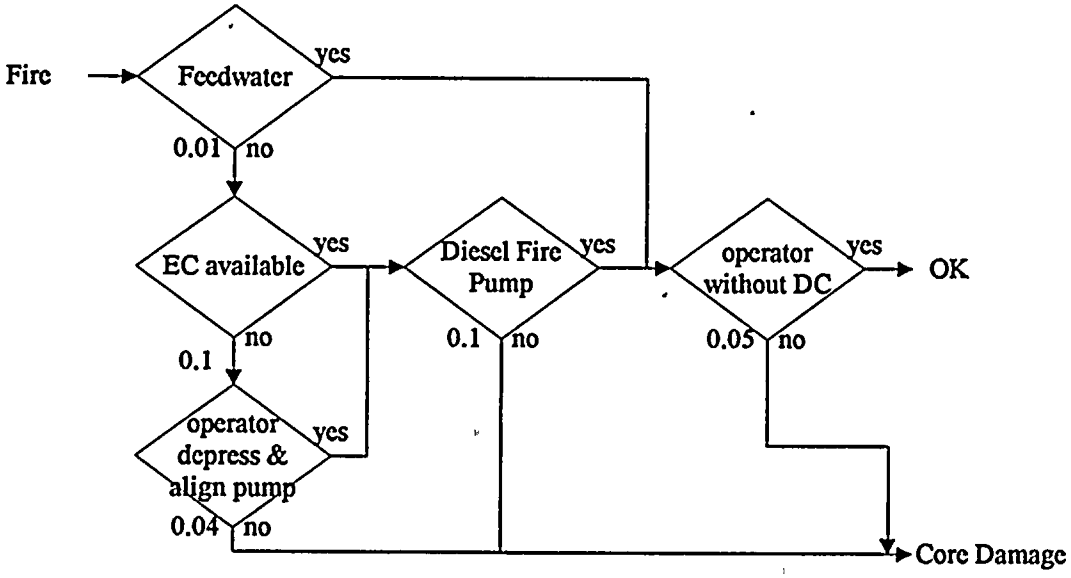
Scenario 1 is in the Southeast corner next to auxiliary control room (column 17AA). A transient next to vertical tray 12CAU or under trays 12TB, 12TC, and 12TD (about 20 feet) does not

screen in the fire impact assessment. Also, a dry transformer fire on the wall in this same location impacts trays 12TB, 12TC, and 12TD. The frequency of a transient from the front of 12CAU down about 20 feet can be estimated as 1.2E-4/yr*1/50(spatial fraction) which is about 2.4E-6/yr. The frequency of a dry transformer fire is 1.27E-3*1/9 which is about 1.4E-4/yr. Thus, the transformer fire dominates. A review of the impacts in this area indicate the following equipment is available:

KA, OG1, B1, FW11, RW11 (B1), CW11, TW11, AS11, S1, CV, D1, RV11, diesel fire pump, and ECs

Therefore, feedwater train 11 and the main condenser (circulating water 11 available) are expected to be available. Also, the emergency condensers are available unless there is a stuck open relief valve (does not appear likely at this location). Containment venting is available if the main condenser and emergency condensers are lost, but RPV makeup is needed from feedwater or the diesel fire pump. When BB11 (D1) runs out due to loss of charging (A2 failure), air operated MSIVs will close (loss of condenser), and instrumentation in the control room is lost. The operators have to use the Yarway level instruments (local gages) in the East or West instrument rooms. If a relief valve sticks open, makeup can continue with either feedwater or diesel fire water. If relief valves close, ECs can be used with a full vessel.

CDF can be estimated as the product of the initiator, 1.4E-4/yr, times the unavailability of the above success paths shown in the figure below, 0.05 is assumed, which is about 7E-6/yr. Early core damage is about 0.001 times 1.4E-4/yr which is 1.4E-7/yr.



The following summarizes the fire impact analysis from Section 4.3:

- The effect of a transient fire on vertical tray 12CAU and overhead trays 12TB, 12TC and 12TD was evaluated. This scenario is beyond the scope of the screening methodologies presented in FIVE and could not be subjected to the screening worksheets. The vertical tray

ignites due to the transient and fire propagation results which is beyond the capabilities of the FIVE methodologies.

- The impact of the small dry transformer mounted on the wall outside the auxiliary control room was evaluated. The radiant exposure on trays 12TB, 12TC and 12TD was evaluated using the radiant exposure worksheet and the screen failed because the trays run within six inches of the transformer.

Scenario 2 is in Southeast corner next to the auxiliary control room (column 15AA). Fire sources include dry transformer, transient, and cable tray fire (12TK). The fire impact assessment in Section 4.3 indicates that dry transformer and transient fires screen. The cable trays are fairly high off the floor and the vertical trays (13TAA and 13TAB) are even higher, near the ceiling. The self ignited tray fire in 12TK (top tray) impacts 12TD just below and 12TY (close by), but 12TB and 12TC screen. The frequency of cable tray fire in this specific location can be estimated as 6E-4*0.01(spatial fraction) or about 6E-6/yr. A review of the impacts in this area indicate the following equipment is available:

KA, KB, B1, B2, FW, RW11 (B1), AS11 & 12, CV, S1, S2, D1, RV11, diesel fire pump, and ECs

Similar to scenario 1 above, feedwater and ECs will provide early RPV makeup and control. The main condenser is lost and there is a higher likelihood of a stuck open relief valve. When BB11 (D1) runs out due to loss of charging (A2 failure), air operated MSIVs will close (loss of condenser), and instrumentation in the control room is lost. The operators have to use the Yarway level instruments (local gages) in the East or West instrument rooms. If a relief valve sticks open, makeup can continue with either feedwater or diesel fire water. If relief valves close, ECs can be used with a full vessel.

CDF can be estimated as the product of the initiator, 6E-6/yr, times the unavailability of the above success paths, 0.05 is assumed, which is about 3E-7/yr. Early core damage is about 0.001 times 6E-6/yr which is <1E-7/yr.

The following summarizes the fire impact analysis from Section 4.3:

- The affect of a fire involving a dry transformer was evaluated. A wall location fire was postulated and the radiation exposure on targets 13TAA, 13TAB, 12TB, 12TC, and 12TD. All of the trays are sufficiently distant from the transformer to pass the screening methodology.
- A floor based transient fire on the outside corner of the intersection of the corridors was assessed. A single trash bag fire was postulated and the effect on targets 13TAB and 12TB was evaluated. These targets bound the other cable trays in the area. The trays fail the target-in-plume screen and a transient analysis was performed. The transient analysis indicates that target damage occurs in approximately 75 seconds while the directional sprinkler nozzles actuate in approximately 42 seconds. This review assumes that the nozzles are "in-the-plume" and field walkdowns validate this is a valid assumption due to the number of spray nozzles in the area and their proximity.

- The impact of a self-initiated cable tray fire in power cables in tray 12TK on adjacent tray (below) 12TD was evaluated. The radiation exposure screening worksheet was utilized and the target (12TD) failed to screen indicating likely cable tray damage. A transient analysis worksheet was completed and indicates relatively short time-to-damage of 14 seconds. Time to suppression actuation was not calculated because the suppression system could not be effective for limiting damage for this type of exposure fire.

Scenario 3 is at East end of building at column 12A. Fire sources include small wall panels and transient. Cable tray 12TD screens in the fire impact assessment (Section 4.3) for transients. The small wall panel fire is suppressed 50% of the time before damage occurs to cable tray 12TB (if 12TB ignites, 12TD fails). The frequency of this panel fire without suppression is 1.7E-3 *(2/17)*0.5 which equals 1E-4/yr. A review of the impacts in this area indicate the following equipment is available:

KA, KB, B1, B2, FW, CN, RW11 (B1), AS11 & 12, S1, S2, CV, D1, RV11, diesel fire pump, and ECs

Scenario 3 is similar to scenario 1 above, except there are more feedwater and main condenser capabilities. Still, CDF is probably dominated by the operators maintaining control after DC power runs out. CDF can be estimated as the product of the initiator, 1E-4/yr, times the unavailability of the above success paths, 0.05 is assumed, which is about 5E-6/yr. Early core damage is about 0.001 times 1E-4/yr which is 1E-7/yr.

The following summarizes the fire impact analysis from Section 4.3:

- The impact of a fire in a panel in the corridor north of the battery board rooms was evaluated. The panel is relatively small and a heat release rate of 100 Btu/s was used for this screen due to the small size of the panel. A wall location was analyzed which increased the exposure to 200 Btu/s. The target selected for review was cable tray 12TB. The scenario failed the target-in-plume screen. The transient analysis results indicated time to damage is 36 seconds while time to actuate detection (suppression) is 26 seconds when the spray nozzle is "in-the-plume" which is estimated to occur 50% of the time due to the relatively close spacing of the nozzles.
- A floor based transient was utilized to determine the impact on cable trays 12TD and 12TM. The scenario passed the target-in-plume screen.

A subsequent walkdown identified the small panels as 2 DC switches (SBC171A & B) and a DC pull box (DCPB171) between the two switch panels. Only one of these switch panels is energized and all three panels are enclosed and sealed. The cable trays are about 5 feet above the three wall panels. It appears that there is inadequate combustibles (a switch and/or a few cables) in these enclosed panels to damage the cable trays.

T4A - Turbine Building EL 277 North

The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The location of fire sources is based on walkdowns. The following summarizes the analysis findings:

- Cable tray 13TBA contains 1 three phase power cable (PB103 normal power supply) and the tray is enclosed.
- Conduits for containment venting are far removed from other impacts, including MSIV closure.
- There are a number of fire sources including electrical panels. However, many of the trays are relatively high off the floor away from fire sources on the floor.
- Potential scenarios at this location are judged to be enveloped by those postulated in T4B, T3B, C1, and T2B. Power board 103 and depending on the specific location, additional impacts can include loss of feedwater and/or main condenser.

The following location scenarios were identified, but were not evaluated since other locations envelope risk.

Scenario	Raceway	Impacts on IPE
1	13TBA, TB, TA, VTTAF, VTTAG	FW, MSIV, A3, TW, D2AC
2	13TB, TBA	FW, MSIV11, A3, TW, D2AC
3	13TAC, TAD, TAE	A1, A3, FW, MSIV11, TW

Scenario 1 (column 15B) could postulate a transient and cable tray fire in 13TBA (this tray only contains one three phase power cable, which although normally energized, it is not an overloaded cable, there is no influence from other cables, and there is adequate ventilation).

Scenario 2 (North of column 15B) is bounded by Scenario 1, but there are electrical cabinets in the vicinity as potentially new sources.

Scenario 3 (Column 15BB) could postulate a transient fire.

These scenarios were not evaluated in detail since CDF is judged to be <1E-6/yr (based on scenarios in T4B and T3B enveloping impacts).

T4B - Turbine Building EL 277 South

The routing of cables was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The location of fire sources is based on walkdowns. The following summarizes the findings of the analysis:

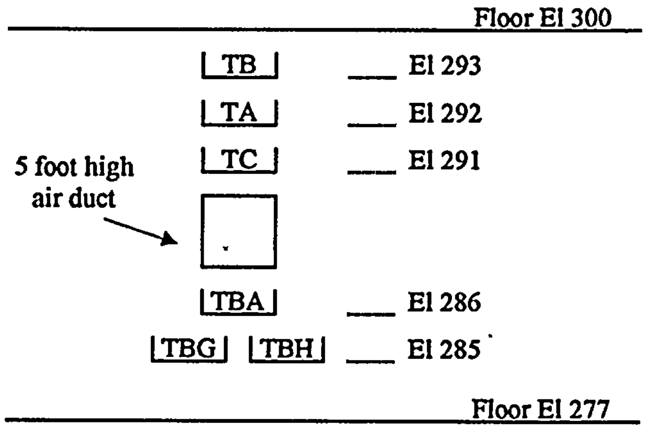
- There are a number of fire sources including electrical panels and a trash storage area in the Southwest corner of the building.

- Those areas with the greatest potential impact from fires are identified below for further assessment.

Scenario	Raceway	Impacts on IPE
1 (21-23)	13TBA, TC, TA, TB, TBG, TBH	A1, A2, A3, RW, FW, EFP, LC2, R2 R2 cabinets are one source
2 (31)	13TAA, TAB, TC, TBA, TBG, TBH	same as scenario 1
3 (24-26)	Duct, 13TBA, TC, Breaker R1012	KA, KB, A2 (breaker & 13TC), A3 (13TBA)
4 (27)	Duct, 13TC	KA, KB, RW, FW12
5	12TB, TC, TD, TJ, TK, TH 13TA, 13TC	FW, SD, D1, A2, RW, AS12, C2, LC2, R1AC, R2AC, MG167, W1A

Fire impact assessment scenarios in Section 4.3 are shown in parenthesis.

Scenario 1 - Looking East from the battery rooms, the following sketch shows the layout for the 13 trays; 13TBA contains 1 three phase power cable and UPS cabinets are beneath it.



Tray impacts are summarized below:

13TBG & TBH - RPS Bus 12
13TBA - Power board 103
13TC - Power board 101, 102, & 103, RBCLC, FW & electric fire pump, LC2
13TA - none
13TB - none

Scenario 1 applies from Southeast corner to PB102 feeder breaker cabinet. The fire sources include UPS cabinets (board over cabinets), power cable in tray 13TBA, and transients. The fire impact assessment from Section 4.3, summarized below, indicates no damage from transient, cable tray (13TBA), and UPS fires, thus, scenario 1 is assumed to screen at <1E-6/yr.

- A transient combustible in the corridor area was evaluated with the targets being cable trays 13TBA, 13TBG, and 13TC. The targets all passed the target-in-plume scenario considering a "center" location for the transient.

- A self-initiated cable fire in the tray due to non-qualified power cable in tray 13TBA was considered. The critical impact target is tray 13TC which is approximately five feet above 13TBA. This scenario was screened via the target-in-plume screening criteria with the additional notation that the tray is completely shielded from the plume by ventilation ductwork which is between the source and the target.

- The effects of a fire initiated in a panel was considered; the critical impact target was considered to be 13TC. Target 13TC was subjected to the target-outside-plume scenario because there is a large duct below the cable trays which effectively shields the trays from being in a fire plume exposure from the panel below. The target passed the target-outside-plume scenario due to the large volume of the Turbine Building available for dissipation of the plume energy and the relatively small energy available for the fire. Trays above 13TC are bounded by this analysis and would also avoid critical damage if subjected to the target-outside-plume scenario.

Scenario 2 is in the Southeast corner, in the hall next to the control room. The fire source is a transient and the target is cable tray 13TBA. A transient fire screens with suppression 50% of the time according to the fire impact assessment. Also, a fire in cable tray 13TBA was considered. Vertical trays VT13TAA and VT13TAB are in the vicinity, but have covers (about 6 feet up from the floor) and can be screened. Since the impact is limited to 13TBA and not the vertical trays, this scenario can be screened at <1E-6/yr. This area is inside the corridor that provides access to the control room. The following summarizes the transient analysis from Section 4.3:

- The source was a floor based transient and the target was cable tray 13TBA. This tray was chosen because an analysis of this tray will bound the other targets in the area. The tray failed the target-in-plume screen. The effect of the automatic water spray suppression system was evaluated utilizing the transient analysis worksheet which results in the conclusion that the suppression system will actuate prior to damage when the spray nozzle is "in-the-plume" which is estimated to occur 50% of the time due to the relatively close spacing of the nozzles.

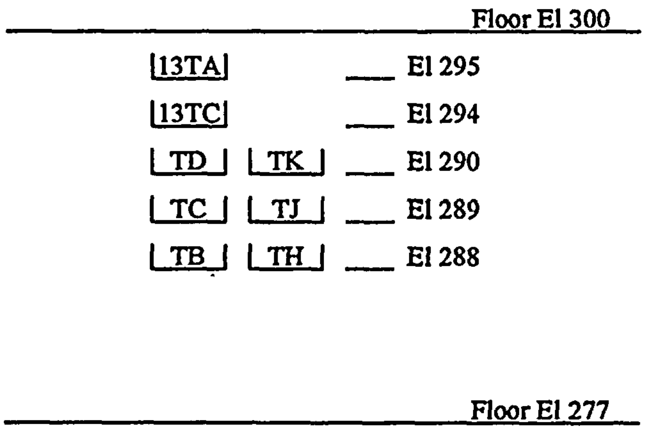
Scenario 3 is at the PB102 breaker cabinet where offsite power (KA and KB) ducts come into PB101 and the breaker cabinet. Tray 13TBA and 13TC are also important targets. Fire sources include the breaker cabinet, transients, UPS 11 cabinets along the wall, and a cable tray fire in 13TBA. There is a mineral board fire protection below 13TBA and Flamemastic in 13TBA and 13TC. The fire impact analysis indicates that a fire in one cabinet will not impact other cabinets or trays and a single transient fire is also unlikely to impact more than one target at a time. The trays and ducts are quite high in this area. Based on these results, Scenario 3 is screened at <1E-6/yr. The following summarizes the transient fire analysis from Section 4.3:

- The effects of a fire in the panel west of the battery rooms on the trays above and the adjacent panel was considered. The critical impact targets were considered to be 13TBA and the adjacent panel. Tray 13TBA was evaluated utilizing the target-outside-plume screening worksheet and screened successfully. The adjacent panel was evaluated utilizing the radiant-exposure worksheet screen and screened successfully.
- The effect of a floor-based transient on the equipment in the open area west of the battery rooms was considered. The critical impact targets were tray 13TBA, the duct banks, and the panels. The tray and the duct banks pass the target-in-plume screen analysis and require no further consideration. The effects of a transient fire on the panel were not evaluated, this is not judged to be significant.
- The effects of a fire within one of the miscellaneous panels behind the MCC area west of the battery rooms was evaluated. The critical impact targets were taken to be 13TBA, the MCC panels, and the duct banks above. The duct banks were considered to be in-the-plume and passed the target-in-plume screen. Tray 13TBA was subjected to the target-outside-plume

analysis and passed the screen. The MCC panels were considered to be exposed to the radiation from the miscellaneous panels and were subjected to and passed the radiant exposure screen.

Scenario 4 is in the Southwest corner of the building where offsite power duct banks enter the building. Although the impact is less in this particular area, this scenario was included because it is a storage area with combustibles. The fire impact assessment in Section 4.3 considered four trash bags as the transient fire source and concluded no damage. Again, the ducts are very high in a large building, away from transients on the floor. The area in the southeast corner was evaluated considering the exposure due to four trash bags of transients in the area. This exposure was chosen due to the amount of combustibles that were observed in the area during plant walkdown. The duct banks were analyzed utilizing the target-in-plume exposure and passed the screen successfully.

Scenario 5 is on the West end of the building between columns C-4 and BE-2. Tray 12TK contains power cables.



Impacts:
12TB - C2, D1AC, SD, LC2
12TH - FW, R1AC
12TC - MSIV12, R2AC
12TJ - FW12, FW13
12TD - A2, W1A, SD, MSIV12
12TK - D1AC, MG167, FW11, R1AC
13TC - RW, FW12
13TA - none

The impact of this scenario is bounded by others analyzed and there are no equipment sources in this limited area, thus this scenario is assumed to screen at <1E-6/yr.

4.6.2.3 Control Complex

Practically every plant system can be impacted by a fire in the cable spreading room (C1) or auxiliary control room (C2) or main control room (C3), if everything is assumed to fail. Recognizing that a more detailed evaluation is required in these areas, the initial screening analysis assumed the total fire frequency went directly to core damage. Each of these areas is evaluated in this section.

As shown in Table 4.0-2, core damage frequency is estimated to be greater than 1E-6/yr. The most important scenarios identified are station blackout events in all three areas. The following summarizes the success potential for these scenarios:

- Emergency condensers are available, unless a stuck open relief valve or seal LOCA occurs.

- The diesel fire pump is available.

- At least one battery and associated relief valves are available, but DC power will only last 2 to 8 hours depending on how quickly load shedding is performed.

- Because it is difficult to recover failures due to a fire (i.e., cables burned), it is possible DC power will run out before the emergency power boards are recovered. This would result in loss of instruments in the control room and the relief valves will close if they were open. Since this is likely to occur more than 2 hours after the initial fire, credit was given for the operators utilizing the East and West instrument rooms (N1-SOP-14) to monitor instrument gages. Also, it is recognized at this point in time that if there is a stuck open relief valve, fire water or feedwater could continue makeup with containment venting. If the relief valves are closed, the ECs are capable of providing level control and heat removal with a reactor vessel that is at normal level and reduced decay heat (i.e., shrinkage not a concern relative to reaching top of active fuel).

The probability of success is developed in the evaluations and depends on the availability of equipment and the likelihood of relief valves being challenged and sticking open.

The following summarizes insights for each location:

- Elevation 250 (C1): the fire frequency is low and includes power cables and transients. Transient fires may be reduced to a reasonably low frequency through programmatic controls of combustibles. The location where unqualified power cables in 11TA, TB and TAP can initiate fires could be checked periodically (i.e., with Thermography) to assure that cables are not heating up to an unacceptable level. Also, the analysis did not include a detailed fire analysis to determine whether suppression could possibly prevent the damage assumed in this study (based on the simplistic FIVE rules, suppression is not successful).

- Elevation 261 (C2): fires here are dominated by electrical cabinets (one event has occurred in the NMP1 auxiliary control room, but it was suppressed and did not propagate and cause significant damage). It may be appropriate to consider Thermography periodically to assess aged equipment in critical cabinets (i.e., see plant specific event discussion below). The risk is also dominated by uncertainties in human performance during these events (i.e., evacuation, ability to open ERVs outside control room, and utilizing the East and West instrument rooms). It may be appropriate to include these insights in training on these risk significant events and procedures. The analysis did not include a detailed fire analysis to determine whether suppression could possibly prevent propagation from the electrical cabinet to the first cable tray and then to higher trays above the first tray (based on the simplistic FIVE rules, suppression is not successful). However, the probability of propagation beyond the first cable tray was assumed to be 0.1. Based on detection capabilities, the close proximity of the control room, common knowledge that this is a critical location, and the judgment that fire

development and propagation would take time from the initial smoke detection, this was considered a reasonable compromise to performing more complicated detailed analyses.

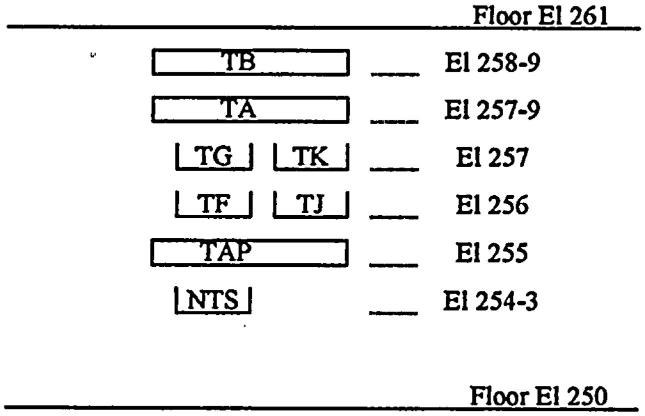
- Elevation 277 (C3): fires here are dominated by electrical cabinets. The risk is also dominated by uncertainties in human performance during these events (i.e., evacuation, ability to open ERVs outside control room, and utilizing the East and West instrument rooms). It may be appropriate to include these insights in training on these risk significant events and procedures. The analysis did not include a detailed fire analysis of fire development and propagation. A fire was assumed to impact two panel sections (i.e., at the interface or propagate) and the worst location was evaluated. Based on detection capabilities, close proximity of operators, and the judgment that fire development and propagation would take time from the initial smoke detection, this was considered a reasonable compromise to performing more complicated detailed analyses.

C1 - Cable Spreading Area

The routing of cables in the cable spreading room was evaluated using the cable database, electrical drawings, and walkdowns. A table (similar to Table 4.6-4) was developed to summarize cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The following summarizes the findings of the analysis:

- There is automatic detection (Ionization) and suppression (Cardox and preaction water) in the cable spreading room.
- There are no electrical cabinets or equipment in the room to start fires; the frequency of a fire in this room is relatively low (i.e., <1E-3/yr) and is based on non qualified cables and transients.
- Although both trains of most systems enter the cable spreading room, generally they do not come together (i.e., within 5 to 10 feet). For example, 11 train cables come in through the West wall (i.e., cable tray 11TJ) and the cables go up into auxiliary control room before the tray reaches the 12 train cables which enter the North wall (i.e., 11TJ) and go up into the auxiliary control room before the tray reaches 11 train. The most important location was determined to be where both emergency power trains and normal power cables cross. This scenario is discussed and evaluated further below.

In order to estimate core damage frequency, the most critical location, where the potential for station blackout exists, was analyzed.



This sketch helps to explain the configuration being analyzed. Two types of fire sources apply to this location: (1) transient fire on the floor and (2) a non qualified power cable fire in the trays. Cable trays 11TA, 11TB and 11TAP contain power cables. The critical cable trays with regard to causing a station blackout are 11TB and 11TG.

The key impacts in each tray are summarized below:

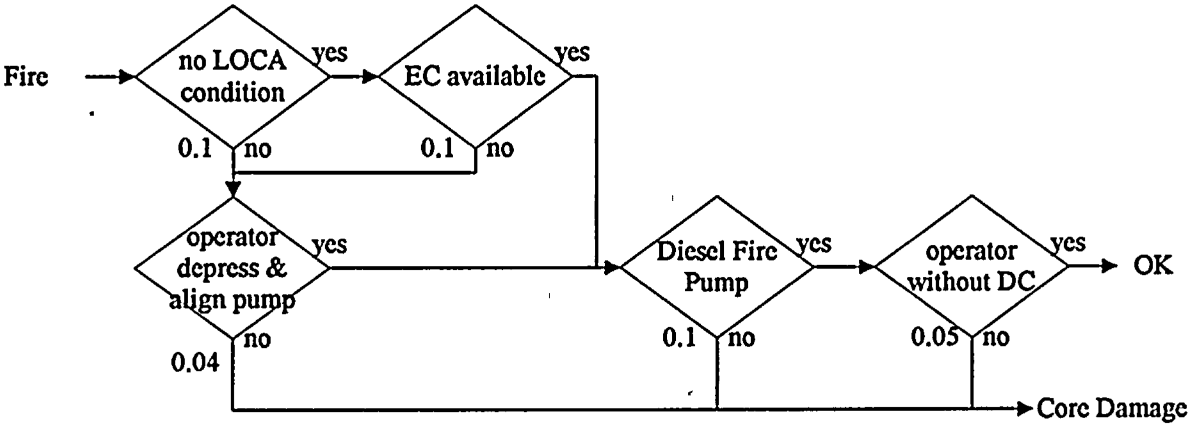
11TB - power board 102, power board 12 and systems supported
11TA - power board 12 and systems supported, feedwater 13
11TG - power board 103 and systems supported, normal power to PB102 and 11, MSIV12
11TK - none
11TF - containment spray raw water 121 & 122, containment spray 121, core spray pumps supplied by PB103
11TJ - containment spray 111
11TAP - none
11NTS - EDG 103

There are two fire sources that apply in this area; (1) transient and (2) unqualified cable in the cable trays. The fire impact assessment (fire impact scenarios 11 and 12 in Section 4.3) indicates that both transient and cable tray fires result in damage before suppression. Since an irrecoverable station blackout occurs in this location, CDF equals 1.0, given this initiating event in the IPE. The frequency of each initiator is estimated below:

TRAN = transient fire frequency in cable room*fraction of area that causes impact
TRAN = 9.1E-5/yr * 0.05 (spatial factor) = 4.6E-6/yr
TRAY = tray fire frequency in cable room*fraction of area/total power tray area
TRAY = 3.2E-4/yr * (1/3) * 0.05 (spatial factor) = 5.3E-6/yr

Total CDF is the sum of the above sequences; which is approximately 1E-5/yr. In the IPE, if AC power is not recovered within 8 to 10 hours, core damage is assumed even if the emergency condensers and the diesel fire water pump are available and working. It is assumed that DC power runs out, the relief valves reclose, and there is no instrumentation; this is conservatively binned to core damage.

The following simplified model is used to estimate a more realistic core damage frequency for this fire.

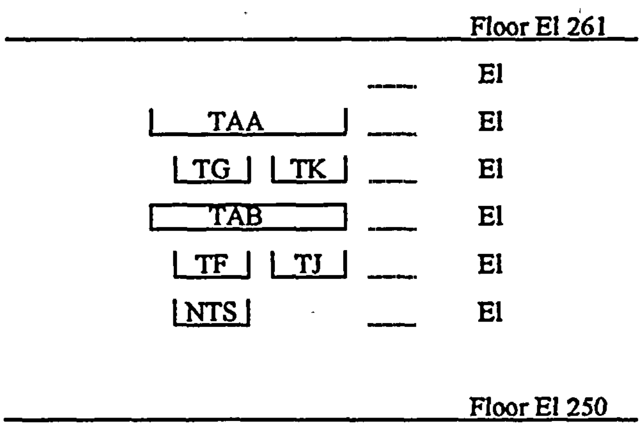


This 1E-5/yr scenario does not affect emergency condensers, the diesel fire water pump, relief valves, and DC power. Therefore, the opportunity for protecting the reactor is good at least until DC runs out. But, at this point in time (i.e., 2 to 8 hours depending on DC load shedding), the RPV could have been depressurized with emergency condensers and/or relief valves and filled with the diesel fire water pump connection. The operators could utilize visual instruments in the East and West instrument rooms (N1-SOP-14 "Loss of Instrumentation"), and the emergency condensers could provide RPV control almost indefinitely as long as there is no LOCA. If there is a LOCA, it is assumed the diesel fire water pump could continue to provide RPV makeup. CDF can be estimated as the product of the initiator, 1E-5/yr, times the unavailability of the above success path, 0.2 is assumed, which is about 2E-6/yr. Early core damage is about 0.03 times 1E-5/yr which is 3E-7/yr. It should be noted that this analysis has not penalized the human error probabilities in the IPE as a result of the fire. For fires in the control room, human error probabilities were increased, but for fires outside the control room it is assumed that the operator distraction is less likely to impact human performance and the practice at NMP1 is for the fire brigade to respond to these events.

The following summarizes the fire impact assessment from Section 4.3:

- A floor based transient combustible was used in a center location for this scenario. The target-in-plume screen failed for both targets (11TB and 11TG) and indicates ignition of cables in tray 11NTS. A transient analysis was performed and it indicated time to damage (ignition) of tray 11NTS was 21 seconds and exceeds time to suppression actuation by a wide margin (21 vs. 88). Further analysis would be required to support any credit for suppression.
- The fire impact analysis only modeled preaction water. A more detailed fire progression modeling analysis is required to assess CO_2 actuation and suppression timing. Also, the fire transient frequency may not credit any plant programs and inspection programs that may reduce TRAN. Detailed analysis of tray fires may show suppression before damage to other trays other than the one directly above the source (i.e., smoldering and ionization detection before a large fire gets started would be more realistic). 11TA has 9 three phase cables, 11TB has 8 power cables, and 11TAP has 1 three phase cable. The other control cable trays are 90 to 100% full.

This sketch shows the arrangement of another location near column 16AA that was identified for analysis. There are no power cables at this location, but there is a wall which increases the transient heat release rate.



The fire impact assessment indicates that both 11NTS and 11TG are damaged. Thus, a transient fire here could cause loss of offsite power and loss of EDG 103. Still, EDG 102 should be available. Core damage frequency due to a transient fire here can be estimated as the TRAN frequency above times the probability that EDG102 is unavailable.

TRAN*0.05 = 2E-7/yr

A floor based transient combustible fire against the wall was evaluated. The target-in-plume screening analysis fails to screen and indicates that the bottom tray, 11NTS, ignites. Time to suppression actuation exceeds time to damage (ignition) by a wide margin.

C2 - Auxiliary Control Room

To more realistically evaluate this room, the following evaluations are performed:

1. A more realistic fire frequency that causes major damage (i.e., an initiating event and failure of plant mitigating equipment) and/or control room evacuation is developed below.

2. The impact of a fire in each panel is evaluated and the results are summarized in Table 4.6-1. Fires are postulated in those panels with the greatest impact on mitigating systems (i.e., those panels judged to envelope risk are chosen for evaluation). With the operators present just up stairs in the control room, fire detectors in each panel, and relatively low combustibles to start the event, it is assumed a fire is very unlikely to consume more than 1 panel.

3. The impact of failing each cable tray is evaluated and a combination of panel impacts (item 2 above) and cable tray impacts above the panel are evaluated to determine which combinations envelope risk due to impact (i.e., those panels judged to envelope risk are chosen for further evaluation). Table 4.6-2 summarizes the results for this evaluation and the enveloping scenarios (i.e., most severe impact on mitigating systems and operator response) are discussed below.

4. A simplified event tree model is developed to evaluate core damage frequency for the enveloping panel/cable tray combinations in item 3 and with a more realistic fire frequency from item 1. This evaluation includes an assessment of procedures relative to operator response both inside and outside the control room. The model is discussed further below and Figure 4.6-2 summarizes the model and results.

Fire Frequency

The auxiliary control room fire frequency is based on the following contributors:

Electrical cabinets	3.0E-3
Transient	9.1E-5
Transformer (1 transformer)	1.4E-4

Non-qualified cables (power), junction boxes, and welding are assumed to be unimportant in this room for the reasons discussed previously. The transient frequency is more than an order of magnitude less likely than electrical cabinets and spatially it appears that the areas of concern would be next to the electrical panels of concern. Considering transient combustible controls, detection & suppression (operators are just up stairs all the time), and a spatial knock down factor for those transient fires that could have major impact, it is judged that analysis of electrical cabinet fires envelope risk.

A more realistic frequency of auxiliary control room fires that cause major damage to mitigating systems and/or potential control room evacuation is developed here. The frequency of fires in the main control room is addressed in the next section; it was determined that the events in the database were relatively minor. However, the auxiliary control room was considered more like a switchgear room than a control room, although something in between may be more appropriate. The frequency of an auxiliary control room fire in the initial screening analysis is based on 19 fires in 1264 reactor years. These 19 events were all assigned to the "Electrical Cabinet" category and "Switchgear Room" location. The following summarizes the events and their potential applicability to NMP1 auxiliary control room (ACR):

1. Bus fault in main auxiliary transformer - does not apply, no high power transformer
2. 4KV switchgear (relays burned) - could apply (i.e., relays), but short duration
3. 480V switchgear (rodent bridged phases) - does not apply, no 480V power
4. 480V switchgear (self-extinguished) - does not apply, no 480V power
5. Supply bus in switchgear room - does not apply, no supply bus
6. Breaker in switchgear room (out of adjustment contacts) - does not apply, this type of breaker not located in ACR
7. Construction electrician shorted out bus - probably does not apply, but cold shutdown event and associated with construction with personnel present.
8. Stuck relay - appears to apply, but occurred during refueling and suppression time was short
9. Core boring by EMD resulted in water dripping into RCL #13 - could apply if performing core boring during operation, but suppression time was very short with personnel present
10. Local supply breaker - could apply, but these are enclosed small panels
11. Large overcurrent 4KV transformer (small electrical fire) - 4KV does not apply
12. Transformer (breaker) - does not apply, no high power transformer breakers
13. 6.9KV RCP breaker fire/explosion - does not apply, no high power breakers
14. Trip coil solenoid on condensate in breaker cubicle - does not apply, no high power breakers
15. MCC (1% power, incorrect field wiring installation) - does not apply and short duration
16. 4KV ESF switchgear (electrician fatality) - does not apply, no high power buses

17. Electrical bus - does not apply, no high power buses
18. MCC transformer - does not apply, no MCC type of transformer
19. Switchgear breaker -does not apply, no high voltage switchgear

With the exception of events 2 and 8 which could have occurred in a relay type panel, and event 10 which could occur in an enclosed small wall panel, the others seem to be associated with higher power MCCs and switchgear not found in the ACR. In addition, many of the events were relatively small electrical fires and/or were extinguished quickly. Based on this review, it would appear that 3 events could apply, however, none of the events are judged severe enough to destroy a cabinet and propagate beyond the cabinet. Also, it can be assumed that control room evacuation did not occur. If it had, it would be known to the industry. It was also concluded from the review that possibly control room events are more applicable to the auxiliary control room rather than switchgear room events. As a result, the control room events in the next section were reviewed relative to the ACR. As many as 8 or 9 of the 12 control room events could apply, however, similar conclusions can be reached as with the control room. The events resulted in relatively minor impact and it can be concluded that control room evacuation did not occur.

A review of plant specific events, identified a fire in the ACR at NMP1 (DER No. 1-93-2062). The fire occurred in a cabinet, detectors in the cabinet annunciated in the control room, the fire was put out in 5 minutes without a reactor shutdown (plant was in operating condition 1 and continued operation safely). N1-SOP-9 was entered and exited. A relay caused the fire due to service conditions and aging. Subsequent physical inspection and thermography assessments did not find and similar problems in other relays. Subsequent physical inspections and Thermography of similar relays found no severe aging and periodic inspections are being conducted to identify these potential aging problems before overheating occurs. This event was a small localized fire similar to the applicable industry events in the switchgear and control rooms. Based on this plant specific event and actions being taken to prevent a repeated similar event, a cabinet fire frequency of 1 event in 25 years of operation (i.e., 0.04 events/yr) is assumed as an upper bound relative to failing every thing in the cabinet. However, the cabinet FMEA in Table 4.6-1 suggests only a subset of the auxiliary control room cabinets could potentially have a major impact and there is always backup equipment available even for those with the worst impact. In addition, continued routine thermography has not found any electrical degradation that could cause a fire. A fire would have to be larger and/or propagate to the cable trays above the cabinets to significantly impact the availability of safe shutdown equipment. With regard to a fire that propagates to the cable trays and/or leads to evacuation, it can still be concluded no such event has occurred.

In conclusion, the frequency of a fire in the auxiliary control room that causes significant damage (propagates beyond the cabinet and potentially damages cable tray above) is taken to be the same as the frequency developed for the control room. Although it is judged that a significant fire may be more likely in the auxiliary control room than the main control room (i.e., a precursor has occurred at NMP1 ACR), in the analysts opinion the control room fire could be considered to be conservatively estimated rather than the auxiliary control room underestimated. In fact, they both could be conservative with respect to the assumed impacts and modeling discussed below. The likelihood that a fire goes undetected (each cabinet has a fire detector) and is not extinguished (the ACR is just down stairs from the control room and is considered part of the control room

boundary) before propagation and damage to cable trays is judged to be less likely than the initiating fire frequency developed for the control room. This is evaluated further below.

Combination of Electrical Cabinet & Cable Tray Impact
Table 4.6-2 summarizes the impact of cable trays and cabinet combinations assessed to have the greatest impact. The following summarizes the most significant impacts in Table 4.6-2 by ID number:

1. A fire at cabinet 1C6, El 271 (trays CAC and CI intersect), results in loss of offsite power and power board 102. Available equipment includes power board 103 and its diesel, the 12 portion of both core spray loops, containment spray 222, CRD pump and emergency condensers (given no LOCA condition), and both 125V DC boards. If the fire propagates up to El 272 trays (CAB and CAK), a station blackout occurs with loss of 125V DC board 11. Recovery from this scenario is possible and it is evaluated in detail later as a bounding scenario; panel 1C6 is the fire source (El 272 SBO without D1).
2. The impact of a fire at cabinet 1S28 is less significant than item 1 above. The fire must propagate to cable tray CAA at El 273 to cause a station blackout and loss of DC battery board 12. Recovery from this scenario is possible and it is evaluated in detail later as a bounding scenario; panel 1S28 is the fire source (El 272 SBO without D2).
3. This section of trays does not run over an electrical cabinet and is therefore neglected. The impacts here are less than item 1 above; the fire must propagate to tray CAA at El 273 to cause a station blackout.
4. A fire at cabinet 1S44 would have less impact than item 1 above and this cabinet is a future cabinet with no energized equipment (i.e., not considered a likely source). The fire must propagate to tray CAA at El 273 to cause a station blackout.
5. A fire at cabinets 1U14 through 19 must propagate to tray CAA at El 273 to cause a station blackout and fail DC battery board 12. Recovery from this scenario is possible and it is evaluated in detail later as a bounding scenario; panels 1U14-19 are the fire sources (El 273 SBO without D2).
6. A fire at cabinet 1U13 must propagate to tray CAA at El 273 to cause a station blackout and fail DC battery board 12. Recovery from this scenario is possible and it is evaluated in detail later as a bounding scenario; panel 1U13 is the fire source (El 273 SBO without D2).
7. A fire at panels 1C2 through 5 must propagate to El 272 (CAK) to cause a total loss of feedwater and failure of DC board 11 and both diesels. The worst impact is at panel 1C2 where power board 103 is also lost. However, normal AC power to power boards 11 and 12 is available as well as equipment normally running from these buses. In addition, MSIVs are expected to be open and the main condenser would be available (i.e., less chance of relief valve challenges and LOCA conditions). Containment spray raw water is also available through the core spray crosstie. Thus, this scenario is judged to be enveloped by others described above.
8. A fire at panels 1C0 through 2 has similar impacts as item 7 above.
9. A fire at panels 1S12 through 14 has similar impacts as item 7 except there is no total loss of feedwater.

10. A fire at panels 1S10 and 11 has less impact than 7 through 9. If a fire was postulated at vertical tray VT12CBD (i.e., transient), additional impacts would occur. However, the frequency of this scenario is judged to be enveloped by electrical cabinet fires.
11. A fire at panels 1S25 through 28 must propagate to EL 272 (CAM and CAS) to cause loss of balance of plant (power boards 11 and 12) and power board 103. Availability of power board 102 and its normal AC power provides sufficient safe shutdown capability.
12. The worst case for this section is a fire at panel 1S17 where tray CJ intersects with tray CR at EL 271; impact includes loss of feedwater and containment venting. This scenario is bounded by others.
13. A fire at panels 1S17 through 21 has less impact than item 12 above.
14. A fire at panels 1S40 through 44 can fail half of core spray and containment spray and all of shutdown cooling. If the fire propagates to El 273 (CAR), loss of balance of plant (power boards 11 and 12) will occur. This scenario is still bounded by others.
15. A fire at panels 1S36 and 37 could fail power board 102 portion of containment spray and core spray systems, as well as feedwater and shutdown cooling systems (tray CL and CR at El 270). Propagation to El 272 (tray CAM) could lead to additional losses of both CRD pumps and relief valves dependent on battery board 12. This scenario is still bounded by others.
16. A fire at panels 1S33 and 36 could result in loss of feedwater (panels and tray CE at El 270). Propagation to El 271 (tray CF and CR) could lead to additional losses of shutdown cooling and power board 102 portion of containment spray and core spray systems. Propagation to El 272 (CR) could fail both CRD pumps and power board 102 EDG. However, normal AC power is available and this scenario is still bounded by others.
17. A fire at panels 1S70 through 72 could result in loss of feedwater (1S70) or main condenser (1S71) or shutdown cooling (1S72); these systems are also affected by propagation to the cable trays and propagation to EL 272 at the intersection of tray CAF results in loss of power board 103 portion of core spray. However, normal AC power is available and this scenario is still bounded by others.
18. A fire at panels 1S72 through 75 could result in loss of feedwater, shutdown cooling, and power board 103 portion of containment spray and core spray systems. Propagation must reach El 273 (CAT) to cause a loss of the main condenser and this scenario is still bounded by others.
19. A fire at panels 1S76 and 77 could fail balance of plant (power boards 11 and 12), feedwater, and shutdown cooling systems, but this event is bounded by other scenarios.
20. A fire under this section of trays (no electrical cabinets here) could lead to loss of feedwater, shutdown cooling, and both CRD pumps if the fire propagates to El 273 (CAN). At the intersection of CAF (El 272), additional losses of containment spray and most of service water can occur. This event is enveloped by other scenario impacts and the likelihood of transient initiator is less than for electrical panels.
21. A fire under this section of trays (no electrical cabinets here) is even more significant than item 20 above. Still, AC power is not affected, as well as CRD pumps, emergency condensers, and DC power. This event is enveloped by other scenario impacts and the likelihood of transient initiator is less than for electrical panels.
22. A fire under this section of trays (no electrical cabinets here) is similar, but less significant than items 20 and 21 above.

23. The worst impact at panels 1S12 and 19 is loss of power board 103 and battery board 11 if the fire propagates to El 272 (CAK). Loss of containment venting and both CRD pumps is also possible. However, one train of feedwater is available and loss of condenser is not expected. Other scenarios envelope this impact.
24. The worst impact at panels 1S19 and 33 is loss of feedwater, power board 103 portion of containment spray and core spray, and loss of both CRD pumps and containment venting. Additional failure of emergency AC to power board 102 (EDG 102) occurs if the fire propagates to EL 272 (CAH). Other scenarios envelope this impact.
25. Loss of feedwater and containment venting occurs at EL 270 (CO). Propagation to EL 272 (CP and CAF) can fail balance of plant (RBCLC and TBCLC), most of service water, and the power board 102 portion of containment and core spray systems. Also, half of the relief valves could become unavailable depending on the panel impacted. Power board 103 portion of containment spray and core spray are available, as well as emergency condensers, CRD pumps and a portion of the relief valves. Other scenarios envelope this impact.
26. MSIV closure can occur if a fire propagates to El 272 (intersection of CO and CAL). Other impacts include loss of containment venting and partial loss of core spray and containment spray. Other scenarios envelope this impact.
27. The worst impact here is loss of balance of plant (power boards 11 and 12 at El 272, CAD), battery board 11 (CAD), containment venting (CO, 1S66), and partial loss of service water and other systems. Other scenarios envelope this impact.

Based on the above assessment, 10 cabinets (see items 1, 2 , 5, and 6 above) are identified as potentially causing a station blackout. These scenarios are evaluated further below.

Procedure Review.
The main control room evaluation discussed below summarizes the review of N1-SOP-9 and 9.1, as well as discussions with operations. The same conclusions apply to the auxiliary control room.

With regard to evacuation due to habitability, the physical location of the auxiliary control room is separate from the control room. The ventilation system recirculates air between the two locations, however, the operators can align smoke removal ventilation to either area and utilize emergency breathing apparatus.

Simplified Event Tree Evaluation (See Figure 4.6-2)
Based on the above assessment of a more realistic fire frequency, fire impacts to cabinets and cable trays, and procedures, the simplified model in Figure 4.6-2 is developed to evaluate the two types of fires as summarized below:

1. A fire in cabinets 1C6 or 1S28 or 1U13 through 19 which propagates past the first cable tray (i.e., ignites and propagates to the second and/or third tray). It was determined that a single cabinet and damage to the immediate tray above the cabinet was not a limiting event with regard to impacts on systems. These propagation scenarios lead to a station blackout with loss of one DC battery board and are judged to envelope impact on mitigating systems and operator response. This portion of the event tree includes sequences 9 through 31 where top event "No Prop" has failed. The probability of failure, 0.008, is based on 10 cabinets out of a

total of 132 cabinets in the auxiliary control room (10/132) causing station blackout and a 0.1 conditional probability that the fire propagates sufficiently to damage the second and/or third tray above the cabinet. This event limits the availability of mitigating systems and significantly challenges the operators.

2. A fire anywhere in the auxiliary control room that may force evacuation, but has less impact on mitigating systems is represented by sequences 1 through 8. This probability is 0.992 (1-0.008), but the availability of mitigating systems is high from the control room and more limiting if control room evacuation occurs.

The remaining model top events and sequences are essentially the same as describe for the main control room in the next section. The results and sensitivities are shown in Figure 4.6-2.

C3 - Main Control Room

Practically every plant system can be impacted by control room fires if we assume that everything in the room fails. Recognizing that a detailed evaluation was going to be required, the initial screening analysis assumed that the total fire frequency went directly to core damage. To more realistically evaluate this room, the following evaluations are performed:

1. A more realistic fire frequency that causes major damage (i.e., an initiating event and failure of plant mitigating equipment) and/or control room evacuation is developed below.

2. The impact of a fire in each control panel section is evaluated and the results are summarized in Table 4.6-3. Fires are postulated in those panel sections with the greatest impact on mitigating systems (i.e., those panel sections judged to envelope risk are chosen for evaluation). With the operators present, fire detectors in each panel, and relatively low combustibles to start the event, it is assumed a fire is very unlikely to consume more than 1 or 2 panel sections. The panel evaluation and determination of the enveloping panels (i.e., most severe impact on mitigating systems and operator response) is discussed below.

3. A simplified event tree model is developed to evaluate core damage frequency for the enveloping panel sections in item 2 and with a more realistic frequency from item 1. This evaluation includes an assessment of procedures relative to operator response both inside and outside the control room. The model is discussed further below and Figure 4.6-1 summarizes the model and results.

Fire Frequency

The control room fire frequency is based on the following contributors:

Electrical cabinets	9.5E-3
Transient	9.1E-5
Fire panel (1 panel)	1.4E-4

Non-qualified cables (power), junction boxes, and welding are assumed to be unimportant in this room for the reasons discussed previously. The transient frequency is 2 orders of magnitude less

likely than electrical cabinets and spatially it appears that the areas of concern would be inside the electrical panels. Considering transient combustible controls, detection & suppression (operators are there all the time), and a spatial knock down factor for those transient fires that could have major impact, it is judged that analysis of electrical cabinet fires envelope risk.

A more realistic frequency of control room fires that cause major damage to mitigating systems and/or potential control room evacuation is developed here. The frequency of control room fires in the initial screening analysis is based on 12 fires in 1264 reactor years. These 12 events were all assigned to the "Electrical Cabinet" category. The following summarizes the events and their potential applicability to NMP1:

- One event was associated with an oven. There is a stainless steel coffee pot at one end of the control room, but this electrical device is kept a safe distance from the control panels.

- One event was associated with an electrical fault in a circuit card. This could apply to the annunciator panel portion of control room panels or within recorders and controllers. NMP1 does not have open nested circuit cards except in the G and J panels which contain radiation monitoring and neutron monitoring electronics. The annunciator panels contain circuit cards, however, they are in the upper portion of the panels and are self contained enclosed boxes such that fires could not propagate easily out of the box. Also, this area of the panel is some what removed from areas that contain cables. Recorders and controllers are also contained in metal boxes. A fire in the G and J panels does not have a significant impact.

- One event was associated with a shorted wire which was pinched with a cabinet door. This would be difficult based on the cabinet design at NMP1. The main control panels at NMP1 are the walk through type with a door on each end and the cables are routed through wire ways inside the panels. Although there is some probability that the outer panel covers or electronic drawers could pinch a loose wire, it appears unlikely and the consequences of pinching a low voltage wire would be localized and of limited impact.

- One event was associated with CRD cabinets at a PWR. The sequence of events appears to be unlikely for the panels being evaluated here. At NMP1, CRDs utilize hydraulic/low power versus high power. Also, there is no high power paralleling associated with control room panels.

- One event has no description available except that it occurred during an outage. Our judgment is that this could not have been a significant event, because if it was, it would be known in the industry.

- Seven events were associated with relays (5) and resistors (2). All of these events are applicable to NMP1. Resistors and relays are located in the center of the panel section and cables associated with adjacent panel sections are routed in enclosed wire ways between the sections. Given the amount of combustibles associated with relays and resistors and their location within the panels, it would appear that these events could not easily impact multiple panel sections by propagating between sections.

Based on the above review, some events may not apply to NMP1 and the others resulted in relatively minor impacts or are judged to be minor events if they occurred at NMP1. It can be concluded that no event resulted in control room evacuation. If either of these consequences had occurred, it would be well known to the industry. In addition, plant specific fires were reviewed to confirm that no significant events have occurred in the NMP1 control room.

The frequency of a fire in the control room that causes significant damage and/or potential recovery from outside the control room is less than 1 event in 1264 reactor years (<1/1264=7.9E-4/yr). To estimate this frequency, a prior distribution is developed assuming a lognormal distribution with a 95th percentile of 1E-2/yr (i.e., 12 events/1264 years) and a lower bound 5th percentile of 1E-5/yr. The resulting mean of this distribution is 2.9E-3. A bayesian update is performed utilizing 0 events in 1264 years as the appropriate evidence for fires in the control room that cause significant damage and/or possibly cause evacuation of the control room. This resulted in a mean frequency of 2.3E-4/yr.

In conclusion, the frequency of a fire that causes major damage and potential control room evacuation is taken to be 2.3E-4/yr. When evaluating the risk of a fire in a particular panel section due to major equipment impacts (i.e., those sections are judged to dominate or envelope risk), this frequency is divided by the total number panel sections (50) in the control room. The console panel (E) and main fire panel (FP2) are counted as one section each.

Electrical Cabinet Fire Impact

Table 4.6-3 summarizes the impact on IPE top events for each main control room panel. As shown in the table, each "section" of these electrical cabinets (panels) was evaluated. Based on the size of these cabinets, their design, fire detection within the cabinets, and operators present at all times, it is assumed that a fire would not impact more than 1 or 2 sections. The most significant impacts identified in the Table 4.6-3 evaluation are discussed below:

- Panel A, sections 4 and 5 (4A and 5A in Table 4.6-3), could cause a station blackout if the impact associated with both sections is combined. Loss of offsite power and faulted power boards 102 and 103 is assumed to be the initiator for fires in these two panel sections. Available mitigating systems include emergency condensers and the diesel fire water pump (with relief valves for reactor makeup).
- Panel F, section 1 (1F), could cause MSIV closure, loss of feedwater, and failure of the main steam relief valve controls. The worst case initiator in this panel would be MSIV closure that challenges relief valves. Available mitigating systems include CRD and emergency condensers (as long as there is no stuck open relief valve), containment spray, and containment venting. Failure of relief valves prevents reactor depressurization if low pressure makeup is required (i.e., core spray, raw water, and fire water). The reliability of emergency condensers and CRD is relatively high so long as there is no stuck open relief valve. In the IPE, a stuck open relief valve in combination with an emergency condenser sufficiently depressurized the reactor for low pressure injection. Therefore, it was decided that the Panel A fire envelopes impact on systems and operator response.

- Panel H, section 1 (1H), could cause loss of most cooling water systems (service water, emergency service water, RBCLC, and TBCLC) which would lead to loss of main condenser, feedwater, and other systems. The worst case initiator in this panel would be a loss of condenser that challenges relief valves. Available mitigating systems include CRD and emergency condensers, if there is no stuck open relief valve, core spray and containment spray, fire water, and containment venting. The panel A fire envelopes impact on systems and operator response.
- Panel K has three sections and contains controls for feedwater, core spray, containment spray, emergency condensers, liquid poison, and shutdown cooling. Emergency condenser actuation is not prevented and it will automatically actuate. Loss of liquid poison is not a concern because the probability of a fire and reactor protection system failure is very low. No plant trip initiators were identified in this panel except potentially loss of feedwater (feedwater control valves can fail-as-is with a loss of signal or may fail open or closed with a false signal) if a false control signal closes valves. A plant scram by the operators or a partial loss of feedwater is assumed to be the initiator in this panel (i.e., relief valve challenges are judged unlikely). Available mitigating systems include CRD, emergency condensers, fire water, main condenser, and containment venting. The panel A fire envelopes impact on systems and operator response.

Based on the above, a fire in panel A (A4 and 5) is judged to envelope the impact on mitigating systems and is therefore evaluated below.

Procedure Review

N1-SOP-9 (Rev 5) "Fire in the Plant" and N1-SOP-9.1(Rev 4) "Control Room Evacuation" were reviewed relative to plant response to fires and to support the fire evaluation below. Overall, these procedures are well developed and take advantage of local control capabilities outside the control room whether control room evacuation occurs or not. If the control room is evacuated, it was concluded that the main condenser would likely be unavailable by procedure (MSIVs are closed) and the ability to open a relief valve would not likely be available unless the operators re-entered the control room. The following summarizes the major conclusions from this review.

- Decision "Is Control Room Evacuation Required?" - based on discussions with operations, only a severe environmental habitability (e.g., personnel danger) condition would force full evacuation. The emergency breathing apparatus would be used and local recovery is proceduralized without requiring evacuation of the control room. It is judged unlikely that evacuation would occur at NMP1 unless absolutely necessary.
- If operators decide to evacuate control room in N1-SOP-9, they are instructed to verify that the MSIVs are closed. Thus, when evacuation occurs, the main condenser is assumed to be unavailable.
- If control room is evacuated, there is no procedure directed capability to depressurize the reactor with ERVs (i.e., to utilize core spray or the diesel fire pump). N1-SOP-9.1 refers to Attachment 5 relative to providing fire water makeup to RPV. This attachment refers to the control room in two places, yet we have evacuated the control room; operations staff believe that eventually the fire would be extinguished in time to allow a return to the control room, if necessary. Also, the operators indicated that an ERV could be opened from the East or West

instrument rooms using portable test equipment. In addition, it appears that there may be more capability than assumed in the IPE to depressurize with an EC without an ERV (i.e., EC capacity is greater than specified in previous analyses).

- The procedures focus on diesel recovery versus offsite power recovery which may be more recoverable. However, if a station blackout fire scenario occurs, the operators would also be in N1-SOP-18 "Station Blackout" which increases the priority of offsite power recovery.
- The fire IPEEE model does not allow diesel recovery with damage repair procedures within the first 8 hours after the fire. If ECs and/or the diesel fire pump are successful, diesel recovery is not needed for 8 hours, but DC power will likely run out in a station blackout scenario. Given success for 8 hours, the reactor can continue to be protected with loss of DC if the operators utilize the East and West instrument rooms (i.e., N1-SOP-14 "Loss of Instrumentation"). Recovering a diesel or offsite power without DC power is questionable even if the damage repair procedure is successful. The operators could possibly utilize portable generators and battery chargers, but this is not proceduralized.
- There was a question of whether N1-SOP-14 would be entered and used (i.e., East and West instrument room instruments) when DC power runs out and no RPS bus is available. However, the operators were quick to point out that they would use the instrumentation in these rooms. Also, they indicated that portable test equipment could be used in these rooms to ascertain reactor pressure, temperature, and level.

Simplified Event Tree Evaluation (See Figure 4.6-1)

The simplified model in Figure 4.6-1 evaluates two types of fires as summarized below:

1. A fire in panel A causing station blackout because this is judged to envelope impact on mitigating systems and operator response. This portion of the event tree includes sequences 9 through 31 where top event "Not Panel A" has failed. The probability of failure, 0.02, is based on 1 panel section out of 50 (1/50) causing station blackout. This event limits the availability of mitigating systems and significantly challenges the operators.

2. A fire anywhere in the control room that may force evacuation, but does not have major impact on mitigating systems is represented by sequences 1 through 8. This probability is 0.98 (1-0.02), but the availability of mitigating systems is high from the control room and more limiting if control room evacuation occurs.

The remaining model top events and sequences are described below:

- "No Evac" models the probability that operators evacuate the control room (down branch of top event "No Evac" in Figure 4.6-1). Since the frequency of fire is based on zero events in the industry that resulted in major damage and/or resulted in control room evacuation, it is difficult to assign a low conditional probability for this event. A value of 0.1 was assumed to compare the results with and without evacuation (see sensitivities in Figure 4.6-1). Since no credit is given to the operators returning to the control room to depressurize RPV with ERV to utilize the diesel fire pump, this conditional probability is judged to be reasonable. Also, the capability may exist to depressurize enough with an EC and a stuck open ERV with an EC will also depressurize the RPV; both of which are not credited in this evaluation.

- "No LOCA" models the probability of LOCA conditions from the IPE. This includes both a stuck open relief valve (0.046) and a reactor recirculation pump seal LOCA (0.05). A value of 0.1 is used for station blackout which includes both contributors. For the non blackout sequences 7 and 8, the probability of a stuck open relief valve is used; this assumes relief valves are challenged (i.e., scram on reactor side does not occur first). The probability of seal LOCA is much less and is neglected.
- "EC Avail" models the probability that at least one EC is not available to maintain RPV inventory and heat removal control. This unavailability is less than 0.01 unless all MSIVs close potentially causing an overfill condition. The 0.01 value is judged to reasonably represent the likelihood of this event and failure of the operators to recover the emergency condensers after isolation.
- "Shed DC" models the probability operators fail to shed DC loads within 15 to 30 minutes after station blackout. A 0.04 value was used in the IPE, but this was increased to 0.1 for a fire scenario. If the operators fail to perform this function, the batteries will discharge faster (i.e., in 2 hours versus 8 hours if loads are shed within 15 minutes) causing loss of control room and remote shutdown panel instrumentation. This top event is not likely to be needed for the non blackout portion of the model ("Not Panel A" success) and is not questioned.
- "DFP Makeup" models the unavailability of the diesel fire pump (0.11) and the probability that operators fail to depressurize reactor and align the pump for reactor makeup (0.04 in the IPE and increased to 0.1 for fires). Aligning the diesel fire pump is only questioned for the blackout portion of the model when the operators do not evacuate the control room. This top event is not likely to be needed for the non blackout portion of the model ("Not Panel A" success) and is not questioned. Relief valves can not be opened and controlled from outside the control room, thus the diesel fire pump is assumed to be unavailable and is not questioned when evacuation occurs.
- "OP" models operator recovery from the fire and its impacts. Each of the operator actions are discussed by sequence below:
  - Sequence 2: this sequence represents the expected case; a fire with much less impact on mitigating systems than assumed for sequences 9 through 31 (station blackout). The operators do not evacuate the control room. This is considered the best situation for the operators with adequate equipment; core damage frequency is judged to be dominated by human response or its uncertainty.
  - Sequence 4: operators evacuate the control room, but there is no LOCA condition (stuck open relief valve) and emergency condensers are available and operating. There is some probability that a feedwater train or CRD pump is available and even if not available this represents the best conditions with significant time for the operators which are within their procedures (N1-SOP-9 and 9.1).
  - Sequences 6 and 8: operators evacuate the control room and there is a LOCA condition (stuck open relief valve or ECs unavailable). Since relief valves can not be opened from outside the control room, low pressure makeup systems are assumed unavailable. LOCA conditions disable ECs and CRD as possible success paths and the availability of a feedwater train becomes important. This operator action failure is based on the probability that feedwater is unavailable (8 of 48 panel sections contain FW impacts, 0.167) and the operators fail to follow N1-SOP-9.1 (0.1).

- Sequence 10: a station blackout occurs due to a fire in Panel A, but the operators do not evacuate control room, there is no LOCA condition, ECs are available, operators shed DC loads which means there is significant time (4 to 8 hours) before DC power runs out, and the diesel fire pump has been used to ensure adequate inventory even if DC runs out before AC power recovery. There is a significant opportunity for recovery; the probability of failure, 0.01, is the lowest value used for a fire in Panel A. Note that the operators could utilize N1-SOP-14 to monitor reactor pressure and level if DC power runs out causing loss of control room instrumentation.
- Sequence 12: similar to sequence 10 except the diesel fire pump was not used to refill RPV before DC power potentially runs out. This reduces the time and opportunity for operator recovery (i.e., at 6 to 8 hours, RPV level could be at top of active fuel due to minor leakage and shrinkage). The probability of operator failure was increased an order of magnitude.
- Sequence 14: similar to sequence 10 except the operators did not shed DC loads within 15 to 30 minutes. This reduces the time and opportunity for operator recovery (i.e., DC runs out at 2 to 4 hours requiring N1-SOP-14 to be utilized to monitor level and pressure). Because of the reduced time, human action dependency, and uncertainty about utilizing N1-SOP-14, very little credit is given to operator recovery.
- Sequences 17 and 21: similar to sequence 10 except there is a LOCA condition (stuck open relief valve, seal LOCA, or ECs unavailable). The reactor has been depressurized, the diesel fire pump is maintaining inventory control, and DC loads have been shed. Because of LOCA conditions, operator failure probability was increased an order of magnitude.
- Sequence 25: a station blackout occurs due to a fire in Panel A, operators evacuate the control room, there is no LOCA condition, ECs are available, and operators shed DC loads which means there is significant time (4 to 8 hours) before DC power runs out. The diesel fire pump is not available because relief valves can not be opened from outside control room. The operators must recover AC power within 4 to 8 hours. Failure to recover in this time frame may require the operators to utilize N1-SOP-14 to monitor level and pressure and continue recovery. Eventually the operators could be assumed to align the diesel fire pump and return to control room to open relief valves. The probability of human failure is increased an order of magnitude for sequence 10.
- Sequence 27: similar to sequence 25 except DC loads were not shed within 15 to 30 minutes. This reduces the time available for recovery and entry into N1-SOP-14.
- Sequences 29 and 31: similar to sequence 25 except LOCA conditions or unavailability of ECs is assumed to lead to core damage. Relief valves can not be opened from outside the control room to allow the diesel fire pump to provide makeup and the timing for recovery is much shorter with LOCA conditions.

4.6.2.4 Screenhouse (S1)

The routing of cables and the layout of equipment was evaluated in the screenhouse using the cable database, electrical drawings, and walkdowns. A matrix table was developed to summarize

cable tray and conduit impacts on IPE top events, and drawings were marked up to show the routing and layout of cable trays. The following summarizes the findings of the analysis:

- All raw water pumps (4 containment spray and 2 EDG), service water pumps (2 normal and 2 emergency), electric fire water pump, and 2 circulating water pumps are located in the screenhouse. All pumps are located at elevation 256; conduits are routed under or embedded in the elevation 256 floor slab. A single fire is unlikely to impact all pumps because of cable routing (discussed below) and separation between pumps.
- The following summarizes pump cable routing:
  - Cable tray 11TM and conduits for emergency service water 12, and both EDG raw water pumps are routed through the cable tray room.
  - Conduits for circulating water 11, normal service water 11, and containment spray raw water 111 and 112 are routed in the same vicinity but are not exposed to the 256 elevation.
  - Conduits for circulating water 12 and containment spray raw water 121 and 122 are routed in the same vicinity but are not exposed to the 256 elevation.
  - Conduits for normal service water 12 and the electric fire water pump are routed in the same vicinity but are not exposed to the 256 elevation.
  - Conduits for emergency service water 11 and 12 are routed in the same vicinity but are not exposed to the 256 elevation.
- Equipment layout, separate cable routing, and the routing of conduits in the floor make it difficult for a single fire to impact more than 2 pumps. Because of the distance between the circulating water pumps, it is also difficult for a single fire to impact both of these pumps. The more likely combinations of two pump impacts (closest together) are as follows:
  - Two containment spray raw water pumps. Because conduits cross in the routing to pumps 111 and 122, there is a slight chance of losing three of four of these pumps.
  - One containment spray raw water pump 121 and emergency service water pump 11.
  - Both emergency service water pumps.
  - Both EDG raw water pumps.

The above combinations of pump failures can be screened by inspection (impact is not significant and the frequency of a localized fire is less). Also, the grouping of conduits can be screened by inspection for similar reasons and the conduits are not exposed. The most significant impact would be a fire in the cable room which contains cable tray 11TM and conduits for emergency service water 12, EDG 102 raw water pump, and EDG 103 raw water pump. A fire was postulated in this location with these impacts to evaluate core damage frequency with the IPE. The initiating event is loss of condenser vacuum, due to loss of circulating water pumps, with a frequency of 1.3E-4/yr (excludes contribution from pump motors, cabinets, and fire pump which are not located in this room). CDF was less than 1E-7/yr, thus, the screenhouse screens out.

4.6.2.5 DG102 Room (D2B)

The initiating fire frequency is relatively high (3.2E-2/yr) for a diesel generator room. Even so, core damage frequency from the initial screening (1.4E-6/yr) was close to the screening cutoff of

<1E-6/yr. The location of impacts and fire sources was reviewed using the cable database, drawings, and walkdowns. The following summarizes the findings:

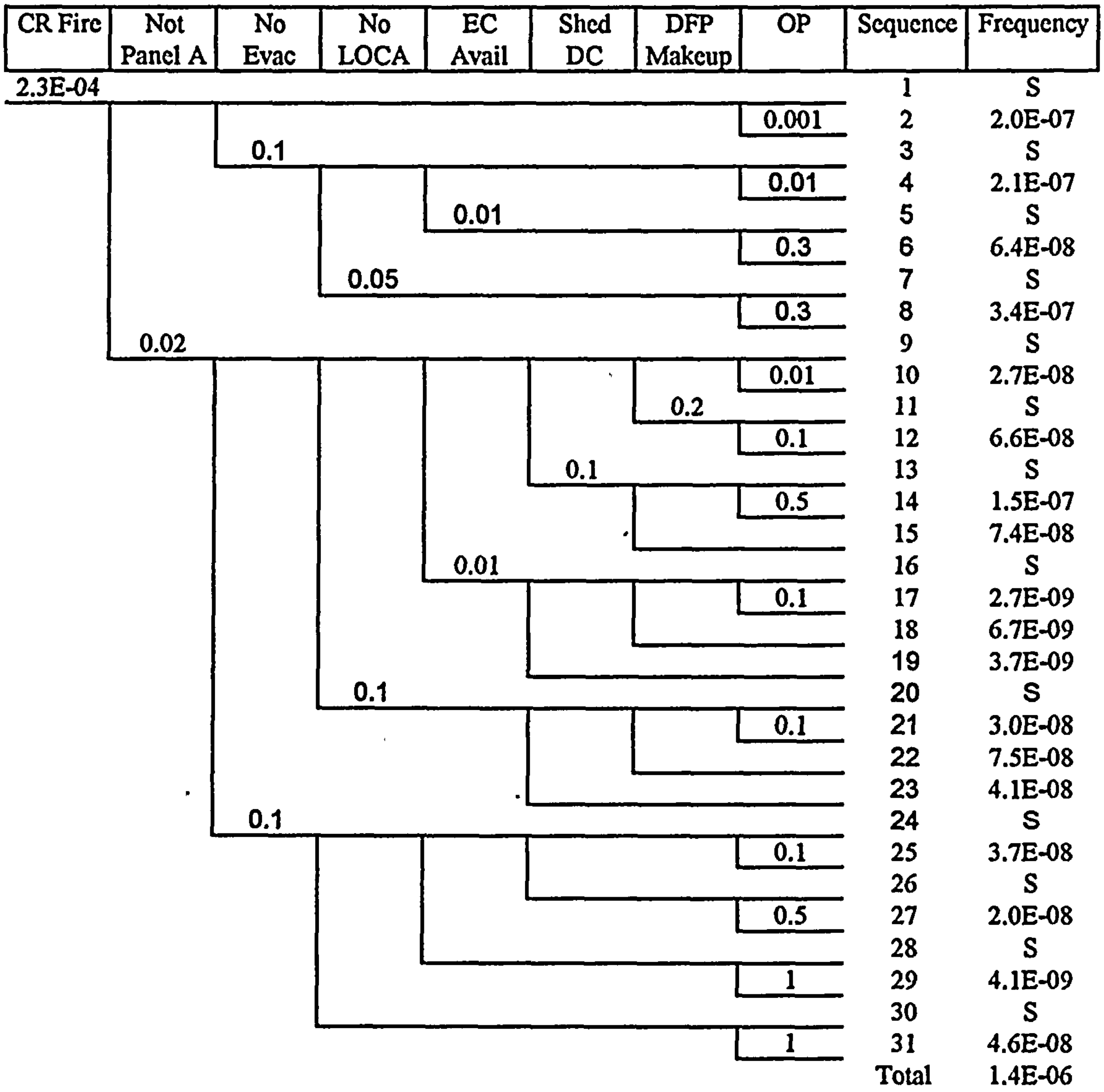
- With the exception of DG102, other impacts are contained on one wall in cable trays 12TE, 12TF, and 12TG. These trays are stacked about 10 feet off the floor and there is another approximate 30 feet from top of trays to the ceiling. Also, the trays contain Flamemastic.
- Major cabinets, a fire source, are on the other side of the room away from the cable trays. Small wall panels, pull boxes, and enclosures are 6 feet from the trays and are not vented.
- Ventilation fans, a fire source, are in the roof and are not over the trays.
- The rollup door motor, a fire source, is on the opposite side of the room from the trays.
- There is a clean rags metal container with attached metal cover about 10 vertical feet under the trays; not considered a fire source.
- The two air compressors, a fire source, are directly under the trays; about 10 vertical feet from the compressors to the trays.
- The diesel generator, about 10 horizontal feet from the trays, is the other fire source.

A fire that impacts only the diesel generator is not risk significant. It does not cause an initiating event and even if a plant scram is assumed, core damage frequency is less than 1E-7/yr. The fire must impact cable trays 12TE, TF, and TG to have major impact. The following summarizes the fire frequency contributors for the diesel room, their potential for impacting the cable trays, and screening insights:

Fire Source	Annual Frequency	Impact on Trays & Screening
Diesel generator	2.6E-2	10 feet horizontal, evaluate
Electrical cabinets	2.4E-3	not a source; can be screened
Air compressors	9.4E-4	10 feet vertical, frequency low enough to screen
Ventilation fans	8.6E-4	not a source, can be screened
Motor	1.3E-3	not a source, can be screened
Other sources	1E-4	potential sources, spatially, but frequency low

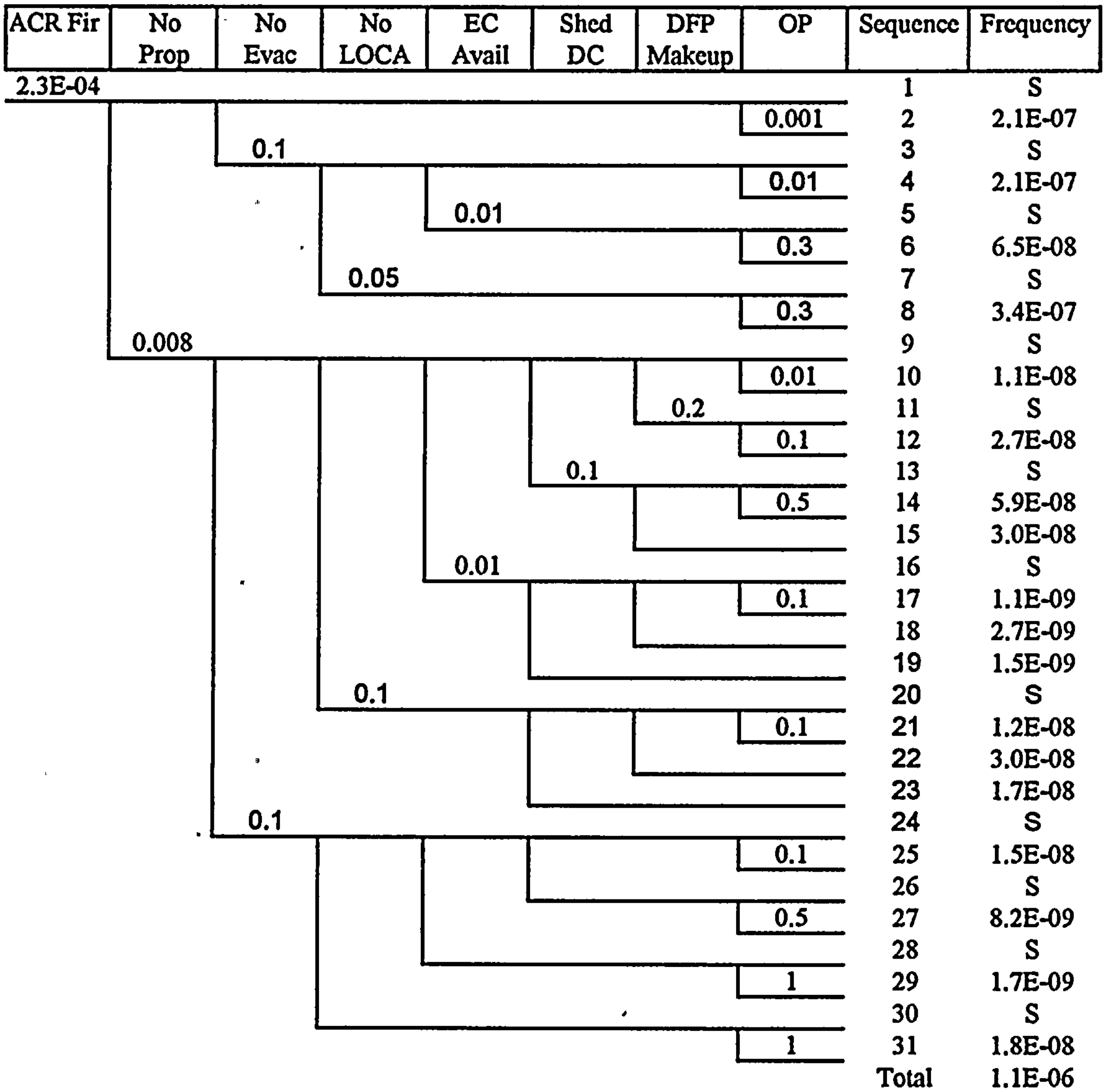
Based on the above, diesel generator fires dominate and have to be considered in greater detail. Since the diesel is at least 10 feet away from the trays, the fire has to be severe and/or the fire must go undetected and not be suppressed in order to impact the trays. There are 65 fires associated with the diesels in the EPRI database[25]. A number of these events were small fires and/or occurred during maintenance and testing. Although information is limited for some events, it was not clear whether any of the events were severe enough to have impacted the cable trays at NMP1. This in combination with automatic detection and suppression was used to screen this room.

Figure 4.6-1 Control Room Fire



Sensitivity Cases	Sequence Totals			Total
	1 to 8	9 to 23	24 to 31	
Base Case Above	8.2E-07	4.7E-07	1.1E-07	1.4E-06
Evacuation = 0.01	2.8E-07	5.2E-07	1.1E-08	8.2E-07
Evacuation = 1.0	6.1E-06	0.0E+00	1.1E-06	7.2E-06

Figure 4.6-2 Auxiliary Control Room Fire



Sequence	Frequency
1	S
2	2.1E-07
3	S
4	2.1E-07
5	S
6	6.5E-08
7	S
8	3.4E-07
9	S
10	1.1E-08
11	S
12	2.7E-08
13	S
14	5.9E-08
15	3.0E-08
16	S
17	1.1E-09
18	2.7E-09
19	1.5E-09
20	S
21	1.2E-08
22	3.0E-08
23	1.7E-08
24	S
25	1.5E-08
26	S
27	8.2E-09
28	S
29	1.7E-09
30	S
31	1.8E-08
Total	1.1E-06

Sensitivity Cases	Sequence Totals			Total
	1 to 8	9 to 23	24 to 31	
Base Case Above	8.3E-07	1.9E-07	4.3E-08	1.1E-06
Evacuation = 0.01	2.9E-07	2.1E-07	4.3E-09	5.0E-07
Evacuation = 1.0	6.2E-06	0.0E+00	4.3E-07	6.6E-06

Table 4.6-1 Auxiliary Control Room (C2) Panel FMEA

Panel	Functional Description & Impacts	IPE Impacts
1C0	345KVA relays	Turbine Trip
1C1	345KVA relays	Turbine Trip
1C2	345KVA relays	Turbine Trip
1C3	345KVA relays	Turbine Trip
1C4	345KVA relays	Turbine Trip
1C5	345KVA relays	Turbine Trip
1C6	345KVA relays	Turbine Trip
1C7	345KVA relays	Turbine Trip
1D1	115KV relays	OG1,OG4 (nonrecoverable due to air operated breakers)
1D2	115KV relays	OG1,OG2,OG3,OG4 (nonrecoverable due to air operated breakers)
1D3	115KV relays	OG2,OG3 nonrecoverable due to air operated breakers)
1S1	Future	N/A
1S2	Future	N/A
1S3	diesel relay panel 1T	A2EDG (potentially nonrecoverable due to over excitation of generator)
1S4	diesel relay panel 2T	A3EDG (potentially nonrecoverable due to over excitation of generator)
1S5	Turbine supervisory instrument	Turbine Trip assumed
1S6	345KV Nine Mile: Clay No. 8	Turbine Trip
1S7	Transfer trip carrier Nine Mile-Volney line No. 9	Turbine Trip
1S8	Communications	None
1S9	Communications	None
1S10	Reactor level & torus temperature monitoring channel 12	ADS12 (1/2 auto initiation signal)
1S11	ATWS channel 12	None (no FW12LC impact as in 1S48)
1S12	CRD & off gas system	CR1,CR2,EOP,FW12LC

Table 4.6-1 Auxiliary Control Room (C2) Panel FMEA

Panel	Functional Description & Impacts	IPE Impacts
1S13	CRD manual control	None
1S14	CRD manual control	None
1S15	CRD manual control	None
1S16	Drywell Ambient Temperature Monitoring Channel 11	None
1S17	Drywell Ambient Temperature Monitoring Channel 12	None
1S19	Rod position information system	None
1S20	Rod position information system	None
1S21	Rod position information system	None
1S22	Turbine auxiliaries	Turbine Trip assumed
1S23	Turning gear auxiliaries	None
1S24	Generator auxiliaries	Turbine Trip assumed
1S25	115KV & 345KV line transducers	None
1S26	Precision W-H meter system	None
1S27	Generator transducers	Turbine Trip assumed
1S28	Generator MW telemetering	None
1S29	345KV line tone equipment	None
1S30	345KV line tone equipment	None
1S31	Reactor Building Temperature Monitoring Cabinet	None
1S32	Reactor Feedwater	FW11SF (locks up)
1S33	Feedwater (both channels)	FW11,FW12,FW11LC,FW11SF,FW12LC, FW12SF
1S34	Feedwater	EOP,FW11LC,FW11SF,FW12LC,FW12SF
1S35	Feedwater GE Mac	FW11LC,FW12LC,FW12SF
1S36	Reactor recirculation control GE/MAC	Scram
1S37	Electrical pressure regulator	Turbine Trip
1S38	Recirculation #11	None
1S39	Recirculation #12	None
1S40	Recirculation #13	None
1S41	Recirculation #14	None

Table 4.6-1 Auxiliary Control Room (C2) Panel FMEA

Panel	Functional Description & Impacts	IPE Impacts
1S42	Recirculation #15	None
1S43	Future	N/A
1S44	Future	N/A
1S45	Future	N/A
1S47	Future	N/A
1S48	ATWS channel 11	FW11LC
1S49	Pressure safety and relief valve position indication	None
1S50	Containment atmospheric dilution 11	IAA2C,IBA2C
1S51	Reactor protection system	CV1,EOP,FW11,FW12,EC1(1/2 actuation of EC),EC2(1/2 actuation of EC)
1S52	Reactor protection system	EOP,EC1(1/2 actuation of EC),EC2(1/2 actuation of EC)
1S53	Reactor protection system bus 11 reactor trip 131	R1 (Locks up FW 11&13)
1S54	Instrument and control bus 130 & 130X	SD11,SD12,SD13,TW (Locks up shaft driven FW pump clutch)
1S55	Reactor protection system bus 12 reactor trip 141	EOP,R2,SD11,SD12,SD13 (Locks up FW 12)
1S56	Reactor protection system	MSIV11A,MSIV11C,MSIV12B,MSIV12D EC1(1/2 actuation of EC),EC2(1/2 actuation of EC), EOP,P2B,IAC,IBC
1S57	Reactor protection system	CV2,EC1(1/2 actuation of EC),EC2 (1/2 actuation of EC),EOP,FW11,FW12
1S58	Containment atmospheric dilution 12	IAA3C,IBA3C
1S59	Main steam channel 11	RVA,RVB,RVE,1/2MSIV,LBA3
1S60	Main steam channel 12	RVC,RVD,RVF,1/2MSIV,LBA2
1S61	Service and cooling water	RW,RW11,RW12,RW13,SA,SB,S1,S2,TW TW11,TW12
1S62	Clean-up	None
1S63	Core spray	IAC,LAA2,LBA2

Table 4.6-1 Auxiliary Control Room (C2) Panel FMEA

Panel	Functional Description & Impacts	IPE Impacts
1S64	Containment spray	C1,C2,W1,W2,EOP
1S65	Liquid poison & emergency cooling	EC1(1/2 isolation of EC),EC2(1/2 isolation of EC),LC1(valve fails open but is recoverable at RSP or locally at valve)
1S66	Ventilation (Primary Containment Vent and Purge)	CV1,CV2,EOP
1S67	Service & instrument air, drywell & torus leak rate & analyzer	AS11,AS12,AS13,AS
1S68	Reheater Instrumentation, access alarms, drywell/torus differential pressure	EOP
1S69	Reactor level & torus temperature monitoring channel 11	ADS11(1)
1S70	Condensate & feedwater	FW11,FW12,FW13,LT12
1S71	Off gas & condenser system	CW11,CW12,CN
1S72	Shutdown cooling system	SD,SD11,SD12,SD13
1S73	Core spray	IBC,LAA3,LBA3
1S74	Containment spray	C3,C4,W3,W4,EOP
1S75	Emergency cooling	EC1(1/2 isolation of EC),EC2(1/2 isolation of EC),LC2(valve fails open but is recoverable at RSP or locally at valve),EOP
1S76	Ventilation (Primary Containment Vent and Purge)	CV1,CV2
1S77	Ventilation, drywell instrumentation, drywell/torus differential pressure	None
1S78	Alarm relay 74A	A2EDG,A3EDG
1S79	Alarm relay 74A	None
1S80	Alarm relay 74A	A2EDG,A3EDG,D1AC,D2AC,EC1(1/2 actuation of EC),EC2(1/2 actuation of EC), MG167
1S81	Alarm relay 74A	A2/16B,A2N,A3/17B,A3N
1S82	Alarm relay 74A	None
1S83	Annunciator	A2/16B,A2N,A3/17B,A3N
1S84	Annunciator	None
1S85	Annunciator	EOP
1S86	Alarm relay 74A	None

Table 4.6-1 Auxiliary Control Room (C2) Panel FMEA		
Panel	Functional Description & Impacts	IPE Impacts
1S87	Alarm relay 74A, test panel-feedwater heater extraction, drain trap level alarms	A3EDG
1S88	Alarm relay 74A	A2EDG
2S1	Alarm relay 74A, fire protection	None
2S2	Alarm relay 74A, fire protection, sequential event recorder	None
2S16	115KV Oswego-NMP line No. 1	OG1,OG4
2S17	115KV NMP-Fitz line No. 4	OG2,OG3
2S18	Transfer trip tone equipment Nine Mile-Volney No. 9	None
2S31	Future	N/A
2S32	Future	N/A
2S33	Future	N/A
2S34	Future	N/A
2S35	Future	N/A
RTU		None
ILRT	Integrated leak rate test cabinet	None
LPRM	Low power range monitor isolation	None
AMP.	Amplifier rack	None
1U1-1U30	Approximately 22 miscellaneous computer cabinets	None

NOTES:

(1) 1/2 Auto Initiation Signal
(2) 1/2 Actuation of EC
(3) 1/2 Isolation of EC
(4) Fails Open but Recoverable at RSP or at Valve

Table 4.6-2 Cable Tray, Panel, and Combination Impacts

ID	Cable Trays				Panel Impact	Intersection Impact
	Tray	EL	Section	Impact		
1	CAA	273	END-CI/CAK	A2/16B, A2N, A2EDG, CV1, CV2, FW, FW11, FW12, MSIV11, W1B,	1C6-TT 1S7-TT	CI(271-6)-CV1, CV2, OG1, OG2, OG3, OG4, FW12LC, IAC CAK(272-6)-A3EDG, D1, MSIV11, FW11, FW12
	CAB	272	END-CI/CAK	A2/16B, A2N, A2EDG, CV, CV1, CV2, FW12LC, IAC, IAA3C, IBA3C	Same as above	Same as above
	CAC	271	END-CI/CAK	A2, A2EDG, A2N, C1, C2, C3, CR1, FW12LC, IBC, LAA2, LBA2, MSIV11, SD, SD12, W1, W2	Same as above	Same as above
2	CAA	273	CI/CAK-CAN/CAM/CK/CJ	A2/16B, A2N, A2EDG, CV1, CV2, D2, D2AC, A3EDG	1S28-None	CAN(273)-A1N, A1S, B1, B2, CV1, CV2, OG1, OG2, OG3, W1B CAM(272)-A2EDG, B1, B2, OG2, OG3, OG4, SD12 CK(271)-OG1, OG2, OG3, OG4 CJ(270)-CV, IAA3C, IBA3C, MSIV11
	CAB	272	CI/CAK-CAN/CAM/CK/CJ	A2, A2EDG, A2N, A2/16B, CV, IAA3C, IBA3C, MSIV11, OG1, OG2, OG3, OG4	Same as above	Same as above
	CAC	271	CI/CAK-CAN/CAM/CK/CJ	A2, A2N, C1, C2 IBC, LAA2, LBA2, SD, SD12, W1, W2	Same as above	Same as above

Table 4.6-2 Cable Tray, Panel, and Combination Impacts

ID	Cable Trays				Panel Impact	Intersection Impact
	Tray	EL	Section	Impact		
3	CAA	273	CAN/CAM/ CK/CJ- CL/CE	A1N, A1S, A2, A2N, A2EDG, A2/16B, A3EDG, D2, D2AC, KA, OG1, OG2, OG4	None	CL(270-6)-C1, C2, IAC, LAA2, LBA2, SD, W1, W2 CE(270)-None
	CAB	272	CAN/CAM/ CK/CJ- CL/CE	A2EDG, A2N, A2/16B, KB, OG2, OG3, OG4	None	Same as above
	CAC	271	CAN/CAM/ CK/CJ- CL/CE	A2, A2N, IBC, LAA2, LBA2, SD	None	Same as above
4	CAA	273	CL/CE-CW	A1N, A1S, A2, A2EDG, A2N, A2/16B, A3EDG, D2, D2AC, KA, OG1, OG2, OG3	1S44 (future - no energized equipment)	CW(272-6)-A2EDG, A2N, A2/16B, D1AC, D2AC
	CAB	272	CL/CE-CW	A2EDG, A2N, A2/16B, KB, OG2, OG3, OG4	Same as above	Same as above
	CAC	271	CL/CE-CW	A2, A2N	Same as above	Same as above
5	CAA	273	CW-CZ	A1N, A1S, A2, A2N, A2/16B, A3EDG, D1AC, D2, D2AC, KA, OG1, OG2, OG4	1U14-1U19-None	CZ(272-6)-OG1, OG2, OG4
	CAB	272	CW-CZ	A2N, KB, OG2, OG3, OG4	Same as above	Same as above
	CAC	271	CW-CZ	A2, A2N	Same as above	Same as above
6	CAA	273	CZ-END	A1N, A1S, A2, A2N, A2/16B, A3EDG, D1AC,D2, D2AC, KA	1U13-None	None

Table 4.6-2 Cable Tray, Panel, and Combination Impacts

ID	Cable Trays				Panel Impact	Intersection Impact
	Tray	EL	Section	Impact		
	CAB	272	CZ-END	KB, OG2, OG3, OG4	Same as above	None
	CAC	271	CZ-END	A2, A2N	Same as above	None
7	CAK	272-6	CAA/CAB/CAC-CAR/CAS	A2EDG, A3EDG, C3, D1, IA, FW11, FW 12, FW12LC, MSIV11	1C2-TT 1C3-TT 1C4-TT 1C5-TT	CAS(272)-A2EDG, A3, A3EDG, A3N, A3/17B, EFP
	CI	271-6	CAA/CAB/CAC-CAR/CAS	A2EDG, CV1, CV2, C3, FW12LC, IAC	Same as above	Same as above
8	CAK	272-6	CAR/CAS-CR	A1S, A1N, A3, A3N, A2EDG, D1, EFP, FW11, FW12, FW12LC, MSIV11	1C0-TT 1C1-TT 1C2-TT 1S15-None	CR(271-6)-no additional impacts
	CI	271-6	CAR/CAS-CR	C3, CV1, CV2, FW12LC, IAC	Same as above	Same as above
9	CAK	272-6	CR-CP	A1N, A1S, A3, A3N, A2EDG, D1, EFP, FW12LC, IAC, MSIV11	1S12-CR1, CR2, EOP, FW12LC 1S13-None 1S14-None	CP(271-6)-CR1, CR2, CV1, CV2, EC2, FW12LC, IAC, MSIV11
	CB	271	CR-CP	CR1, CV1, CV2, FW12LC, IAC	Same as above	Same as above
10	CAK	272-6	CP-END	A1N, A1S, A3, A2EDG, A3N, D1, EFP	1S10-ADS12 1S11-None	VT12CBD-D2, RV12, TW11, TW12
	CB	271	CP-END	None	Same as above	Same as above
11	CAN	273-6	CAA/CAB/CAC-CAR/CAS	B1, B2, CV1, CV2, W1B	1S25-None 1S26-None 1S27-TT 1S28-None	CAR(273)-B1, B2, A1S CAS(272)-A3, A3EDG, A3N, A3/17B
	CAM	272-6	CAA/CAB/CAC-CAR/CAS	A3, A3EDG, A3N, A3/17B, B1, B2, SD12	Same as above	Same as above
	CK	271-6	CAA/CAB/CAC-CAR/CAS	None	Same as above	Same as above

Table 4.6-2 Cable Tray, Panel, and Combination Impacts

ID	Cable Trays				Panel Impact	Intersection Impact
	Tray	EL	Section	Impact		
	CJ	270-6	CAA/CAB/CAC-CAR/CAS	CV1, IAA3C, IBA3C, MSIV11	Same as above	Same as above
12	CAN	273-6	CAR/CAS-END OF PNL 1S22	D1AC, W1B	1S22-TT 1S23-None 1S24-TT	None
	CAM	272-6	CAR/CAS-END OF PNL 1S22	SD12	Same as above	None
	CJ	270-6	CAR/CAS-CR/CQ	CV, CV1, CV2, IAA3C, IBA3C, MSIV11	1S17-None 1S22-TT 1S23-None 1S24-TT	CR(271-6)-C3, FW11, FW12 CQ(270)-None
13	CD	270-6	CR/CQ-CO/CP	CV, CV1, CV2, IAA3C, IBA3C, MSIV11	1S17-None 1S19-None 1S20-None 1S21-None	CP(271-6)-CR1, CR2, CV, CV1, CV2, FW12LC, IAC, IAA3C, IBA3C, MSIV11
14	CL	270-6	CAA/CAB/CAC-CAR/CAS	C1, C2, IBC, LAA2, LBA2, SD, W1, W2	1S40-None 1S41-None 1S42-None 1S43-None 1S44-None	CAR(273)-A1S, B1, B2
	CE	270	CAA/CAB/CAC-CAR/CAS	None	Same as above	Same as above
15	CL	270-6	CAR/CAS-CR/CQ	C1, C2, IBC, LAA2, LBA2, SD, W1, W2	1S36-SCRAM 1S37-TT	CAN(273)-CR1, D1AC, FW11, W1B CAM(272)-CR1, CR2, FW11, FW12, FW11LC, FW12LC, FW11SF, FW12SF, RV12, SD12 CR(271-6)-C3, FW11, FW12, IBC, MS1V11, SD

Table 4.6-2 Cable Tray, Panel, and Combination Impacts

ID	Cable Trays				Panel Impact	Intersection Impact
	Tray	EL	Section	Impact		
16	CAI	273	CR/CQ-CP	FW11LC, FW12LC	1S33-FW11, FW12, FW11LC, FW12LC, FW11SF, FW12SF 1S34-EOP, FW11LC, FW12LC, FW11SF, FW12SF 1S35-EOP, FW11LC, FW12LC, FW12SF 1S36-SCRAM	CR(271-6)-C3, FW11, FW12, IBC, MSIV12, SD CQ(270)-None CP(271-6)-
	CAH	272	CR/CQ-CP	A2EDG, CR1, CR2, FW11, FW12, FW11LC, FW11SF, FW12LC,FW12SF	Same as above	Same as above
	CF	271	CR/CQ-CP	C1, C2, FW11, FW12, FW11LC, FW11SF, FW12LC, FW12SF, LAA2, LBA2, W1, W2	Same as above	Same as above
	CE	270	CR/CQ-CP	FW11, FW12, FW11LC	Same as above	Same as above
17	CR	271-6	CAI/CAH/CF/CE-CAG/CAF	C3, FW11, FW12, FW13, FW11LC, FW12LC, IBC, LT12, MSIV12, SD	1S70-FW11, FW12, FW13, LT12 1S71-CN, CW11, CW12 1S72-SD, SD11 SD12, SD13	CAG(273)-None CAF(272)-C3, C4, FW11, FW12, FW13, LAA3, LBA3, LT12, SD, SD11, SD12, SD12

Table 4.6-2 Cable Tray, Panel, and Combination Impacts

ID	Cable Trays				Panel Impact	Intersection Impact
	Tray	EL	Section	Impact		
	CQ	270-6	CAI/CAH/CF/CE-CAG/CAF	FW11, FW12, FW13	Same as above	Same as above
18	CR	271-6	CAG/CAF-CBN/CAT/CAL	C3, C4, FW12, FW11LC, FW12LC, IBC, LAA3, LBA3, LC2, MSIV12, SD, SD11, SD12, SD13, W3, W4	1S72-SD, SD11, SD12, SD13 1S73-IBC, LAA3, LBA3 1S74-C3, C4, W3, W4, EOP 1S75-EOP, LC2	CBN(274)-None CAT(273)-MSIV11, SD13 CAL(272)-C3, C4, IAA3C, IBA3C, LC2, MSIV12, RV12, SD11, SD12, SD13, TC, W3, W4
	CQ	270-6	CAG/CAF-CBN/CAT/CAL	LBA3	Same as above	Same as above
19	CR	271-6	CBN/CAT/CAL-CAE/CAD	FW12, FW11LC, FW12LC, MSIV12, SD, SD11, SD13	1S76-CV1, CV2 1S77-None	CAE(273)-MSIV12 CAD(272)-B1, B2, FW12
	CQ	270-6	CBN/CAT/CAL-CAE/CAD	None	Same as above	Same as above
20	CAN	273	CF/CE-CAG/CAF	CR1, D1AC, W1B	None	CAG(273)-AS13, RV12, W3, W4 CAF(272)-C1, C2, C3, C4, D1AC, FW11, FW12, FW13, RW, RW11, RW13, S1, S2, SA, SD, SD11, SD12, SD13
	CAM	272	CF/CE-CAG/CAF	CR2, FW11, FW12, FW13, FW11LC, LT2, RV12, SD, SD12	None	Same as above

Table 4.6-2 Cable Tray, Panel, and Combination Impacts

ID	Cable Trays				Panel Impact	Intersection Impact
	Tray	EL	Section	Impact		
21	CAN	273	CAG/CAF-CBN/CAT/CAL	LAA3, LBA3, RV11, RW12, SB, SD13, TC	None	**CBN(274)**-CV1, RV11 **CAT(273)**-MSIV11, SD11, SD13, W1, W2 **CAL(272)**-AS12, C1, C2, C3, C4, IAA3C, IBA3C, LAA2, LBA2, LAA3, MSIV12, RV12, SD11, SD12, SD13, W1, W2, **VT12CBD**-D2, RV12, TW11, W3, W4, W1A, TC
	CAM	272	CAG/CAF-CBN/CAT/CAL	AS13, A3EDG, C1, C2, FW11LC, FW12LC, LAA3 LBA3, RW, RW11, RW13, RV12, S1, S2, SA, SD, SD11, SD12, SD13, TC, TW, TW11, TW12, W1A	None	Same as above
22	CAN	273	CBN/CAT/CAL-CAE/CAD	AS12, CV1, TC	None	**CAE(273)**-MSIV12 **CAD(272)**-AS11, B1, B2, CV1, CV2, D1, FW12, RW12, SB, TC
	CAM	272	CBN/CAT/CAL-CAE/CAD	A3EDG, AS11, AS13, C1, C2, C3, C4, CV2, LAA2, LBA3, LAA3, LC1, MSIV12, RW12, SB, SD, SD11, SD12, SD13, TC, W1, W2, W3, W4	None	Same as above

Table 4.6-2 Cable Tray, Panel, and Combination Impacts

ID	Cable Trays				Panel Impact	Intersection Impact
	Tray	EL	Section	Impact		
23	CP	271-6	CAK/CB/CA-CD/CC	CR1, CR2, CV1, CV2, FW12LC, IAC, MSIV11	1S12-CR1, CR2 EOP, FW12LC 1S19-None	CAK(272)-A1N, A1S, A2EDG, A3, A3N, D1, EFP, FW12LC, MSIV11 CB(271)-CR1, CV1, CV2 FW12LC, IAC CA(270)-None CD(271)-CV, CV1, CV2, IAA3C, IBA3C, MSIV11 CC(270)-None
24	CP	271-6	CD/CC-CAI/CAH/CF/CE	CR1, CR2, CV, CV1, CV2, FW12LC, IAA3C, IBA3C, MSIV11	1S19-None 1S33-FW11, FW12, FW11LC, FW12LC, FW11SF, FW12SF	CAI(273)-None CAH(272)-A2EDG, CR1, CR2, FW11, FW12, FW11LC, FW12LC, FW11SF, FW12SF CF(271)-C1, C2, FW11, FW12, FW11LC, FW12LC, FW11SF, FW12SF, LAA2, LBA2, W1, W2 CE(270)-FW11 FW12, FW11, LC

Table 4.6-2 Cable Tray, Panel, and Combination Impacts

ID	Cable Trays				Panel Impact	Intersection Impact
	Tray	EL	Section	Impact		
25	CP	271-6	CAI/CAH/ CF/CE-CAG/CAF	C1, C2, CV1, CV2, FW11, FW11LC, IAC, LAA2, LBA2, RW, TW, W1, W2	1S33-FW11, FW12, FW11LC, FW12LC, FW11SF, FW12SF 1S59-LBA3, MSIV11, RVA RVB, RVE 1S60-LBA2, MSIV12, RVC RVD, RVF 1S61-RW, RW11, RW12, RW13, SA, SB, S1, S2, TW, TW11, TW12 1S62-None 1S63-IAC, LAA2, LBA2	CAG(273)-AS13, MSIV12, RV12, W3, W4 CAF(272)-MSIV11, RW, RW11, RW12, RW13, S1, S2, SA, SD12, SD13, TW, TW11
	CO	270-6	CAI/CAH/ CF/CE-CAG/CAF	CV, CV1, CV2, FW11, FW12, FW11LC, IAA3C, IBA3C, MSIV11, RW12, SB	Same as above	Same as above
26	CP	271-6	CAG/CAF-CBN/CAT/ CAL	C1, C2, CV1, CV2, IAC, LAA2, LBA2, W1, W2	1S62-None 1S63-IAC, LAA2, LBA2 1S64-C1, C2 EOP, W1, W2 1S65-LC1	CBN(274)-CV1, RV11 CAT(273)-MSIV11, SD11, SD13, W1, W2 CAL(272)-AS12, C1, C2, LAA2, LBA2, LC1, MSIV12, W1A, W1, W2
	CO	270-6	CAG/CAF-CBN/CAT/ CAL	CV, CV1, CV2, D1AC, FW11, IAA3C, IBA3C, MSIV11, RW12, SB	Same as above	Same as above

Table 4.6-2 Cable Tray, Panel, and Combination Impacts

ID	Cable Trays				Panel Impact	Intersection Impact
	Tray	EL	Section	Impact		
27	CP	271-6	CBN/CAT/CAL-CAE/CAD	FW12, IAA2C, BA2C, W1A	1S65-LC1 1S66-CV1, CV2, EOP 1S67-AS, AS11, AS12, AS13 1S68-EOP 1S69-ADS11	CAE(273)-D1AC CAD(272)-AS12, B1, B2, D1, FW12, MSIV12, RW12, SB, TC
	CO	270-6	CBN/CAT/CAL-CAE/CAD	AS11, AS12, CV, CV1, CV2, D1AC, RW12, SB	Same as above	Same as above

Table 4.6-3 Main Control Room (C3) Panel FMEA

Panel	Functional Description, Panel Contents & Impacts	IPE Impacts
1A	Turbine generator controls & indications: can cause turbine trip and loss of bypass valves (same as MSIV closure)	MSIV, TT, CN
2A	Turbine generator controls & indications: can cause turbine trip and loss of main condenser	CN, TT, MSIV
3A	Controls for AC supplies from PB16B & 17B to battery chargers 161 and 171. UPS 162 & 172 may be lost and DC power will be from batteries only	D1AC, D2AC, R1AC, R2AC
4A	4KV power distribution: breaker controls associated with PB11, 102, & 16A . PB 101 will still be available to feed these PB's via local operation of the feeder breakers , but the feasibility of this has not yet been determined	B1, A2, A4
5A	4KV power distribution: breaker controls associated with PB12, 103, & 17A. PB 101 will still be available to feed these PB's via local operation of the feeder breakers, but the feasibility of this has not yet been determined	B2, A3, A5
6A	Offsite feed from Clay-8 & feed from Main generator	NONE Loss of indication
7A	Offsite power and main generator controls: main generator output & exciter, turbine trip	TT
8A	Offsite power control: 115KV feeders to transformer 101N and 101S	LOSP (KA, KB)
1B	Turbine valve controls & trip logic relays: MSIV closure is possible as well as turbine trip	MSIV, TT, CN
2B	Turbine monitoring & controls: loss of main condenser & Turbine Trip	CN, TT, MSIV
3B	Turbine monitoring & controls: turbine trip	TT
4B	Electric power distribution & main generator monitoring & monitoring for PB11, PB101, EDG102, EDG103, 115KV	TT Loss of EPDS monitoring
5B	Electric power distribution indication & controls: PB 11, 12,	KA, KB, B1, B2
6B	Electric power distribution relays: Main output transformer	TT
7B	Electric power distribution relays: Main output transformer	TT
8B	Electric power distribution relays: loss of 115KV	LOSP (KA, KB)
1L	Turbine Bldg H&V, Offgas Bldg H&V, Reactor Bldg H&V	none
2L	CAM 11 & 12 (H2O2), N2 and drywell and torus vent & purge, vacuum breakers, drywell floor & equipment drain sumps	none
3L	Emergency vent system & post LOCA vent, instrument & service air	AS, CV

Table 4.6-3 Main Control Room (C3) Panel FMEA

Panel	Functional Description, Panel Contents & Impacts	IPE Impacts
1K	Containment spray 111 & 112, emergency condenser 11 & 12 (auto initiation is not lost and level control is still available), Liquid Poison	C1, C2, W1, W2, SL (3), EC1, EC2
2K	Containment spray 121 & 122, core spray 111, 112, 121 & 122	C3, C4, W3, W4 (3), LA, LB
3K	Shutdown cooling 11, 12, & 13, reactor water cleanup 11 & 12, HPCI 11 & 12 level controls	SD, FW(5)
1N	Main turbine North side reheater & turbine drain	TT
2N	Main turbine South side reheater & turbine drain	TT
3N	Control room normal & emergency ventilation	none
1M	RPS 12 sub 2, ECCS & ESF relay logic	1/2 Scram (2)
2M	RPS 12 sub 1, ECCS & ESF relay logic	1/2 Scram (2)
3M	CRD scram time testing jacks	none
4M	RPS 11 sub 2, ECCS & ESF relay logic	1/2 Scram (2)
5M	RPS 11 sub 1, ECCS & ESF relay logic	1/2 Scram (2)
1H	RBCLC, service water, emergency service water, shutdown cooling bypass, TBCLC, offgas	CN, SD, RW, TW, S1, S2, SA, SB
2H	Circulating water 11 & 12, fish screen 11 & 12, cond water box vent & blocking valves	CN
3H	Cond transfer pump 11 & 12, cond pump 11, 12 & 13, feedwater booster 11, 12 & 13	FW
1J	Area rad monitors, process rad monitors	none
2J	Area rad monitors, process rad monitors	none
3J	Area rad monitors, process rad monitors	none
4J	Seismic monitoring	none
5J	Tip System controls	none
6J	Tip System controls	none
1F	Feedwater 11, 12 & 13, ERV111,112,113,121,122,123, MSIV111,112,121,122, ADS inhibit	MSIV, FW (5), RV (1)
2F	Recirc loop 11, 12 & 13, ATWS channel 11, RPI & LPRM, channel 11 scram valve indication	Scram
3F	Recirc loop 14 & 15, ATWS channel 12, RPI & LPRM, channel 12 scram valve indication	Scram
4F	Demin water to CRD, CRD 11 & 12, RPV head cooling, SDV drain, Primary Cont isol status	CR1, CR2
1G	IRM 17 & 18, SRM 13 & 14, APRM 15 & 18	Scram

Table 4.6-3 Main Control Room (C3) Panel FMEA

Panel	Functional Description, Panel Contents & Impacts	IPE Impacts
2G	Recirc flow for APRM, MSL Rad mon 112 & 122, IRM 15 & 16, APRM 16 & 17	Scram
3G	IRM 13 & 14, SRM 11 & 12, APRM 11 & 14	Scram
4G	Recirc flow for APRM, MSL Rad mon 111 & 121, IRM 11 & 12, APRM 12 & 13	Scram
5G	Met tower instruments & circ water recorders	none
1E	Operators Control Console Feedwater flow controllers, and push buttons that cause Turbine Trip, Scram, Primary Containment Isolation, and RPV Isolation.	TT, Scram, FW (5), MSIV (due to the RPV isolation)
FP2	Main Fire Panel 2 Remote controls for fire pumps & valves.	FP (4)

(1) ERV's will function in the mechanical pressure relief mode

(2) ECCS is fail safe deenergize to actuate and two sub divisions must trip to cause a full Scram

(3) Emergency Condensers will actuate on loss of power and EC level can be maintained using controls at the RSP or manually at the valves.

(4) Local controls of fire pumps and valves will still be available.

(5) Feedwater Flow Control Valves will fail as is with a loss of control signal or may fail open or closed with a false control signal.

NOTE: If specific controls are lost to a fire operators may be able to take local control if the circuits are clear.

Table 4.6-4 Fire Zone R1A Impact Table (Typical For Zones Requiring Detailed Analysis)

IPE Impact	Conduit	Cable Raceways							
		Q11	L12	M12	11RF	11RG	11RAB	11RAC	11RJ
1/2ADS				D					
ADS	X			X		X			
A3/17B		X							
A3N		X							
AS12		X							
C2/MOV	161-30,31	1							
C2/P	X102-9A,B								
C3/MOV			X						
C4/MOV	171-30,31,32		X	1	1	1			
C4/P	103-9B								
CR1	X			X					
CR2		X							
CV1	1L-20		X						
RV12	X			X		X			
FW12	1S-679			X					
IAA3			X	C					X
LAA3	PB19717-S		X						
IBA2			C					END-END	C
IBA3			C	X		X			C
LBA2			X						X
LBA3			X						X
LT12			X						
MSIV11		X					X		
MSIV12				X					
RW12		X							
SB		X							
SD				X					
SD12		X							

4.7 Analysis of Containment Performance

Fires are very unlikely to have impact on passive structural components of the primary containment. The most likely ways identified for fires to impact containment performance are as follows:

- Core damage with containment isolation failure or bypass
- Core damage event causes containment failure (containment response)

Containment Isolation

The containment penetration screening analysis in the IPE[1] was reviewed. The containment isolation system is normally energized and the loss of electrical support results in a containment isolation. In addition, many normally open isolation valves fail closed on loss of their actuator support (i.e., instrument air). Other normally open paths are associated with closed systems or emergency core cooling and containment systems. In the IPE[1], normally open fail-as-is MOVs have a fail closed AOV in series with them. Thus, the containment isolation function was found to be very reliable even for station blackouts. The contribution of containment isolation failure to early large release in the IPE[1] is less than 1%. Based on the fire analysis in Section 4.6.2 and the discussion below, this contribution is judged to be similar for fires.

Containment Bypass

Containment bypass due to a fire induced LOCA outside containment is considered to be an insignificant contributor to risk for the following reasons:

- The shutdown cooling system is normally isolated by double isolation valves and the system piping is designed for 1200 psig, therefore, the potential for a LOCA outside containment through this system is judged unlikely even if hot shorts were assumed to open the valves (the likelihood of two closed valves opening during a fire event is small).
- The core spray injection paths are also unlikely to lead to a LOCA outside containment because there is a normally closed MOV and a check valve in each potential path. Even if a hot short opened a MOV, check valve failure is unlikely.
- Other paths contain fail closed valve(s) and/or a check valve and/or are connected to high pressure designed piping.

An interfacing LOCA is unlikely based on the above. Even the possibility of a fire induced hot short spuriously causing the permissive required for core spray is an unlikely scenario since a check valve disc would also have to fail. In addition, the core spray piping was assessed to have high pressure capacities in the IPE. Thus, the frequency of a fire caused hot short and check valve failure and pipe failure outside containment that leads to core damage is unlikely.

Early Large Release in IPE

In order to have an early large release (assumed to dominate public risk), core damage must occur early (i.e., within 4 hours after accident initiation) and the containment must fail either due to core damage (i.e., core & containment phenomena) or containment isolation failure. Based on the NMP1 IPE, the most likely causes of an early large release include LOCA, ATWS, and station blackout scenarios. Given one of these scenario types, containment failure is most likely due to containment response (i.e., phenomenological impacts) and is less likely to be due to containment isolation failure (i.e., highly reliable as discussed above). The following summarizes how this impacts the risk from fire initiating events:

- LOCA initiators (i.e. pipe breaks) are not likely to be caused by fires. Spurious ADS (i.e., large steam LOCA) was found to be possible in the reactor building, was evaluated, and screened below 1E-7/yr. LOCA conditions are more likely to be caused by a stuck open relief valve as described below for station blackout.

- ATWS is also unlikely to be caused by fires; actually fires are expected to cause a reactor scram not prevent this fail-safe function.

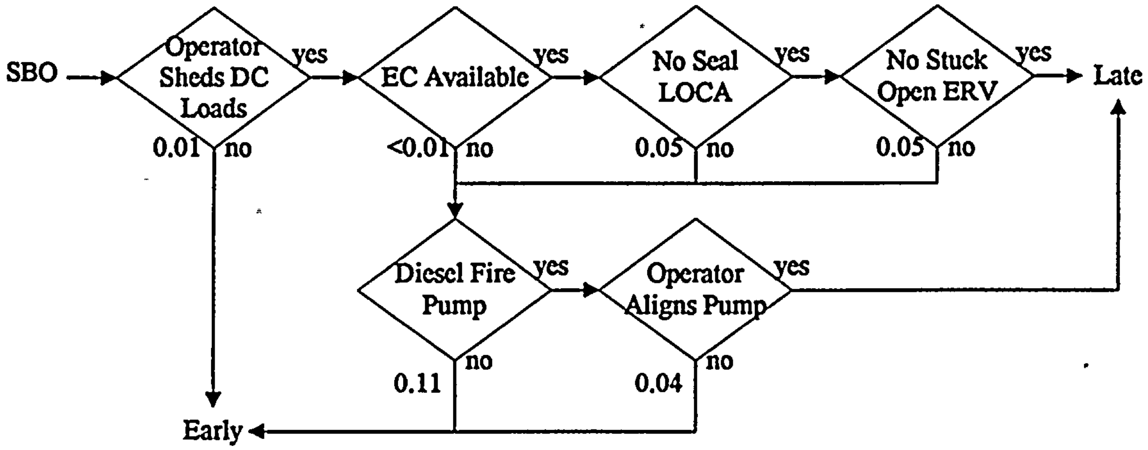
- Station blackout and other transients can only lead to early core damage when LOCA conditions exist (i.e., stuck open relief valve) and/or the emergency condensers fail to actuate. Failure of emergency condensers (highly reliable and fail-safe with regard to loss of support systems) is unlikely. The more likely scenario is a stuck open relief valve or reactor recirculation pump seal LOCA during station blackout. LOCA conditions make the emergency condensers ineffective in delaying loss of RPV level. Station blackout is the most likely way to disable all injection systems except the diesel driven fire water pump.

It can be concluded that the most likely cause of early core damage would be a LOCA condition (stuck open relief valve or seal LOCA that makes the emergency condensers ineffective in delaying loss of inventory) and loss of all injection (station blackout scenario is most likely in the IPE).

Given early core damage, the conditional probability of containment failure (due to phenomenological impacts) is relatively high and is conservatively neglected in this analysis. For this same reason, containment isolation can be shown to be unimportant. Most normally open containment penetrations have a fail closed AOV and/or the system outside is a high pressure design and/or there is a check valve. Thus, the conditional probability of containment isolation failure is low (<1E-2).

It can be concluded that an estimate of early core damage provides a reasonable, but conservative estimate of an early large release for NMP1. If required, this can be assessed in greater detail with the IPE.

The portion of core damage frequency that is early can be estimated directly from the IPE for any given fire scenario. The figure below explains how the conditional probability of early core damage, given station blackout, is estimated to be 0.03 from the IPE:



In some cases, this study estimated early core damage frequency utilizing insights from the IPE. For example, the frequency of a station blackout was estimated when it is judged to dominate the result; recovery of station blackout was not considered when caused by fire. Then, the conditional probability of early core damage, given station blackout, as estimated above (i.e., 0.03) is used. It should be noted that this analysis has not penalized the human error probabilities in the IPE as a result of the fire. For fires in the control room, human error probabilities were increased, but for fires outside the control room it is assumed that operator distraction is less likely to impact human performance and the practice at NMP1 is for the fire brigade to respond to these events.

As shown in the figure, this value of 0.03 is derived from the probability that DC loads are not shed within 30 minutes (0.012) or emergency condensers lose effectiveness times the probability the diesel fire water pump is not successful for 4 hours. Contributors to loss of emergency condenser effectiveness include emergency condenser reliability (<0.01), stuck open relief valve (0.046 assuming they are challenged), and seal LOCA (0.05). The probability of not having successful diesel fire water for at least 4 hours includes the pump (0.11) and operator actions associated with aligning pump (0.036) and depressurizing RPV (3E-3). The IPE included scenarios where an abrupt MSIV closure led to RPV overfilling and EC isolation, then allowed the operators to recover the ECs (the IPE only allowed a 90% chance of successfully recovering the ECs). If this 0.1 probability was conservatively assumed to occur all the time in the above figure instead of <0.01 for the ECs, the conditional value of early core damage would be 0.04. This is considered an upper bound and was not used.

Based on the above, it can be concluded that a 1E-6/yr core damage frequency screening can be associated with 1E-7/yr or less early large release. Section 4.6.2 discusses the likelihood of early large release for those areas that did not screen out and Table 4.0-2 summarizes the results.

4.8 Treatment of Fire Risk Scoping Issues

4.8.1 Seismic/Fire Interaction

4.8.1.1 Seismically Induced Fires

Based on the results of the seismic margins assessment (SMA), seismic walkdowns, and fire protection walkdowns, and the design review activities described below, it is concluded that the fire protection program adequately minimizes risk.

The concern of seismically induced fires focuses on the potential for seismic events to cause a release of flammable or combustible liquids or gases. Hydrogen piping within the plant was not a relevant hazard since this piping is not normally pressurized. Hydrogen is dispensed from outside storage tanks on an as-needed batch basis and the supply valves are closed unless dispensing is being performed. This operation is performed on a daily basis. In addition, an excess flow valve is installed to limit hydrogen flow in the event of piping rupture and the generator is equipped with emergency hydrogen dump capability. The hydrogen piping system is confined to the west end of the turbine building where limited safety related equipment is located. Hydrogen detectors are installed in areas of likely leaks. This hydrogen arrangement is an acceptable alternative to resolve Generic Safety Issue 106, "Piping and the Use of Highly Combustible Gases in Vital Areas" as discussed in NRC Generic Letter 93-06. The probability of seismically induced fires from this source causing core damage is very small.

During the plant walkdowns for the fire protection portion of IPEEE, combustible liquid tanks and/or piping were observed in the areas listed below:

Fire Area	Fire Zone	Description
FA5	T3A	Oil Storage
FA5	T1	Turbine Generator Oil Reservoir
FA5	T4A	Flammable Liquid Storage
FA5	T4C	Oil, H_2 Seal Oil Room
FA5	T6A	Turbine Generator Lube Oil Storage Tanks
FA19	D2A	EDG-103 Day Tank, Fuel Oil
FA22	D2B	EDG-102 Day Tank, Fuel Oil
FA13	S1	Flammable Liquid Storage
FA15	WD3	Waste Building Baler Room
FA15	RS2A	RSSB Truck Loading Area
FA14	S2	Diesel Fire Pump, Diesel Fuel Day Tank

While a seismic event could cause a release of flammable or combustible liquid from the tanks or piping within the areas listed, the impact would be minimized by several design features, including the following:

- Tank storage areas are diked to contain any spill within the area of origin.

- Areas with flammable/combustible liquid piping have floor drains to prevent spills from migrating into other fire areas.

- Fire detection is provided in areas with flammable or combustible liquid tanks or piping so that a fire would be promptly detected.

- Automatic fire suppression systems are installed in areas containing flammable or combustible liquid tanks or piping.

In addition to the design considerations, fire brigade training includes strategy and tactics exercises for fighting flammable and combustible liquid fires.

Fire areas 5, 19, 22 and 13 contain safety related equipment required to function in response to design basis accidents. Diesel fuel oil supplies (FA19 and 22) and related equipment are seismically designed to preclude failure and were evaluated as part of the SMA scope. If an event beyond the design causes a fuel oil leak, the applicable EDG is rendered inoperable, regardless of any ensuing fire. As described above, propagation between fire areas is difficult. Also, the seismic margins assessment indicates that the capacity of this equipment is well above the design basis earthquake.

The fire sources in FA5 and FA13 were considered during the SMA walkdowns as described in Section 3. Section 3.1.2.3.2 describes seismic-fire interaction evaluations further.

Fire areas 14 and 15 are non-safety related areas and no equipment in these areas is included in the seismic margin success path. Thus, these fire sources were not evaluated in the SMA. Also, propagation from these areas to other important areas is judged unlikely. Thus, the risk significance of fires in these areas is low.

4.8.1.2 Seismic Actuation of Fire Suppression Systems

The fire detection panels at NMP1 use mercury switches which may be susceptible to inadvertent activation during a seismic event. Inadvertent actuation of Halon and Carbon Dioxide due to detection system actuation would result in the release of extinguishing agent. Inadvertent operation of a Halon or Carbon Dioxide system would not result in any equipment operability concern, although in the case of a Carbon Dioxide actuation, persons entering the area of the discharge would require the use of self contained breathing apparatus until the area was purged and sufficient oxygen was present. These mercury switches were identified as a potential seismic systems interaction (refer to Section 3) in the relay chatter evaluation because they could isolate diesel generator room cooling.

Section 3.1.2.3.1 describes seismic-flood interaction evaluations further. This section describes the four types of water-based fire suppression systems installed at NMP1 and the basis for concluding that these systems are adequately designed.

4.8.1.3 Seismic Degradation of Fire Suppression Systems

Generally non-seismic equipment, such as fire protection piping, is installed in such a way that it can not fall onto, or otherwise cause failure of equipment which is required to mitigate a seismic event. The industry criteria for assuring that fire suppression systems meet this requirement is to assure that the fire suppression system has been installed in accordance with National Fire Protection Association (NFPA) codes and standards. NMP1 fire suppression systems have all been installed in accordance with the appropriate standard for the system type, including the requirements for supports and hangers. This conformance gives adequate assurance that the fire suppression systems will not fall on required safe shutdown components during a seismic event.

Further, the fire suppression systems are installed to minimize the affect of a seismic event through the use of cross zone actuation and/or use of preaction sprinklers. The installation of the fire suppression systems was reviewed during fire protection walkdowns to assure installation in accordance with NFPA codes and standards. No deviations from the installation standards which might adversely impact safe shutdown were noted during either walkdown. Also, the seismic analysis considered these type of interactions.

4.8.2 Fire Barrier Qualification/Effectiveness

Based on this review of fire barrier design, installation and surveillance requirements, the fire barriers credited within the analysis are considered to be adequate and effective at minimizing plant risk.

Fire Barrier Materials
The fire barrier program at NMP1 consists of design, installation, surveillance and maintenance criteria which assure effective fire barrier performance in the event of fire. Specifically, all primary fire barrier components are included in the program: the barrier itself (wall or floor), fire doors, penetration seal assemblies, fire dampers, fire wraps, and fire enclosures.

The fire barriers are derived from National Fire Protection Association (NFPA) material and thickness requirements and/or specific tested configurations such as those listed by Underwriters' Laboratories, Inc. An ongoing program of periodic inspection is in place to assure that fire barriers are maintained in accordance with original design. Identified deficiencies are promptly corrected in accordance with plant procedures.

Fire Doors
All fire doors in rated fire barriers are included in a comprehensive inspection and maintenance program. All Appendix R fire doors are inspected on a daily basis to assure that they are maintained in their correct position. Deviations from the normal position are allowed in accordance with plant procedures, with appropriate compensatory measures in place to mitigate the deviation. Required maintenance for fire doors is identified through the periodic operation of

each fire door or identification of necessary maintenance through the deviation reporting procedure utilized by all personnel on site.

Penetration Seal Assemblies
As a result of NMPC filing a Licensee Event Report (LER 88-09) with the NRC, NMP1 performed a baseline 100% penetration seal inspection on all Appendix R required barrier penetrations in 1989-90. In addition, the penetration seal inspection procedure, seal drawings, and database were revised and updated. These actions were reviewed and approved by the NRC.

Penetration seal assemblies are inspected on a periodic basis in accordance with plant procedures. These inspections are tailored to assure continued functionality of the penetration seal as originally designed. The program is based on a sampling technique which is an industry standard (10% of each design type with additional samples inspected if inoperable seals are identified). Deficiencies discovered by site personnel outside the scope of the surveillance procedure are identified via plant procedures for identification of plant deficiencies.

Fire Dampers
Fire dampers are inspected on a periodic basis to assure operability in the event of a fire. Information Notice 89-52 addressed concerns of potential operational problems. Fire dampers have been tested to assure closure in their as-installed position under airflow conditions. In addition, plant procedures currently test the operation of the fire dampers with the ventilation system in the normal airflow condition. This approach satisfies the concerns about the operability of installed fire dampers at NMP1 .

4.8.3 Manual Firefighting Effectiveness

Based on the evaluation of the established program for reporting fires, staffing and training of the fire brigade, periodic conduct of drills with critiques, and the maintenance of adequate training records, the NMP1 program for manual fire fighting adequately minimizes plant risk. The basis for this conclusion is described below.

Reporting Fires
General Employee Training (GET) provides the initial and retraining efforts for all employees within the Protected Area to receive instruction on the procedure to report plant fires. This includes instructions to notify the Control Room via the telephone or the Gai-Tronics system in the event of a fire discovered at the site.

Portable fire extinguishers are located throughout the plant in accordance with National Fire Protection Association (NFPA) Standard 10, which specifies the minimum number of extinguishers and the maximum travel distance allowed to access an extinguisher. Plant personnel expected to utilize the portable extinguishers have received appropriate training in their use in accordance with NMPC Corporate Policy for Employee Fire Training. These personnel include the fire brigade and all personnel qualified to serve as fire watches for hot work activities.

Fire Brigade Staffing and Equipment

A minimum of five qualified fire brigade members is on shift at all times. Each fire brigade member receives an annual physical examination to assure the capability to perform strenuous fire fighting activities. Personal protective equipment is available for each fire brigade member, which includes turnout gear, boots, gloves, hard hats and self-contained breathing apparatus. In addition, portable radios, portable lights, portable ventilation equipment and fire extinguishers are available for fire brigade use. Fire brigade equipment is included in the Emergency Preparedness equipment list which is subject to periodic surveillance per plant procedures. This provides assurance that all fire brigade equipment is maintained in operable condition and ready for use in a fire event.

Fire Brigade Training

There is a comprehensive fire brigade training program required by plant procedures. This training program includes initial and retraining requirements which are repeated at least once every two years. The following topics are presented to every fire brigade member prior to assignment to the fire brigade and at least once every two years thereafter:

- Indoctrination of the plant fire fighting plan with specific identification of each individual's responsibilities
- Identification of the type and location of fire hazards and associated types of fires that could occur in the plant
- The toxic and corrosive characteristics of expected products of combustion
- Identification of the location of fire fighting equipment for each fire area and familiarization with the layout of the plant, including access and egress routes to each area
- The proper use of available fire fighting equipment and the correct method of fighting each type of fire
- The proper use of communication, lighting, ventilation, and emergency breathing equipment
- The proper method for fighting fires inside buildings and confined spaces

In addition to the topics above, the following topics are presented to the fire brigade leader and at least two fire fighters assigned to each shift prior to assignment to the fire brigade and at least once every two years thereafter:

- Training to understand the effects of fire and fire suppressants on safe shutdown capability
- Detailed review of fire fighting strategies and procedures as contained in the fire preplans
- Review of the latest plant modifications and corresponding changes in fire fighting plans

The fire brigade leader for each shift is trained in the following prior to assignment as the fire brigade leader:

- Electrical distribution and ECCS topics in order to assess the potential safety consequences of a fire and advise Control Room personnel
- Incident command training to be knowledgeable in the direction and coordination of fire fighting activities

Fire Brigade Practice
All fire brigade members attend training sessions at the Niagara Mohawk Fire School at least once per year. This training provides experience in actual fire extinguishment and the use of emergency breathing apparatus through the use of hands-on structural fire fighting. This training exposes fire brigade members to the variety of fires which are anticipated within the environment of a nuclear power generating station. Specifically, props including the following fire scenarios are utilized during the live fire training evolutions: Class A combustibles (interior and exterior applications), energized electrical equipment, search and rescue of victims combined with fire suppression, oil-filled electrical equipment, flammable/combustible liquid spills, natural gas or propane, vehicles, fuel storage, chemicals, elevated or sub-surface incidents. All live fire training is performed with full personal protective equipment and self-contained breathing apparatus in use.

Fire Brigade Drills
Fire brigade drills are conducted in the plant on a quarterly basis so that each fire brigade shift can practice as a team. Plant procedures require each fire brigade member to participate in at least two drills per year to maintain their qualification on the fire brigade. As required by plant procedures, at least one unannounced fire drill for each shift fire brigade is performed per year. One drill per year is conducted on the backshift for each shift fire brigade. All drills are pre-planned to establish training objectives and are critiqued per plant procedure to determine the adequacy of the drill response. Unsatisfactory drill performance results in an additional drill within 30 days to determine whether corrective actions were appropriate. As part of the required triennial QA audit of the fire protection program, an unannounced drill is performed and critiqued by the independent fire protection consultant.

Fire Fighting Strategies
Pre-fire plans have been prepared for all plant fire areas. These plans contain information to assist the fire brigade and Control Room personnel in determining strategy alternatives, suppression equipment available, safe shutdown equipment which may be affected during a fire, smoke removal options, and access and egress paths available. These pre-fire plans are updated on a periodic basis as required by plant procedures and are used extensively as part of the fire brigade training program.

Fire Brigade Records
The Training Department maintains individual training records for each fire brigade member. These records are reviewed periodically to assure the Fire Protection Supervisor that all fire

brigade members are receiving the appropriate level of training to allow continued assignment to the fire brigade. The minimum training that is required to be a member of the fire brigade is specified within plant procedures. Members who fail to meet the level of training required are removed from the fire brigade roster until their training is brought up-to-date.

4.8.4 Total Environmental Equipment Survival

Based on the review of available technical information relating to smoke damage, there does not appear to be a concern for operability of safe shutdown equipment outside the area of fire origin. Spurious or inadvertent operation of fire protection systems has been evaluated for its impact on safe shutdown equipment and operators have been trained and equipped to deal with safe shutdown actions. Therefore, the issue of total environmental equipment survival is considered to represent a small risk.

Potential Adverse Effects on Plant Equipment by Combustion Products
This section addresses the Sandia Risk Scoping issue of smoke damage to electronic equipment outside the area of fire origin (i.e., equipment that is not already considered as damaged under the worst case assumptions of the Safe Shutdown Analysis). Only the short term effects of smoke damage are addressed here, that is, can the operators expect to be able to shut down the plant without experiencing additional equipment losses due to smoke damage. The need to clean equipment to ensure its long term operability would still need to be addressed in the event of a significant fire.

The first step in addressing this issue was to perform a literature search at the National Institute for Standards and Technology's (NIST, formerly the National Bureau of Standards) Center for Fire Research library. This library features an electronic database permitting keyword searches of the fire protection research papers which have been collected for more than 20 years at the government's premier fire protection research facility.

The first thing evident from this literature survey was the scarcity of research dealing with the effects of smoke on electronic equipment. While there were more than 1000 articles on smoke, combining this keyword with electronics resulted in only four items dealing with both and none of these was germane to the practical resolution of the issue raised by Sandia. A more "relaxed" search for articles containing the keywords smoke and damage resulted in more than 70 potential research articles, however, a review of the title narrowed this list to less than 10, only three of which were actually related to the issue at hand.

As indicated below, none of the research looked at the short term operability of electronic equipment, instead it was focused on the long term operability and post-fire cleaning requirements. Another factor to keep in mind is that the research in this area is being driven (sponsored) by the telecommunications industry and not by insurance industry concerns over smoke-induced corrosion damage to other types of equipment. The circuitry in telecommunications facilities is much less robust than that in a power generation plant as

witnessed by the clean room technology which is required in many of these facilities to keep out dirt and moisture.

One of the issues raised by Sandia with respect to smoke damage is that the halogen content of cable jacketing materials (whether or not they are fire retardant) is a significant concern. Research reported by O'Neill[35] indicates that all smoke is corrosive and that simple measurements of pH, or other acid measurements, will not provide a true picture of corrosion potential. He also emphasizes that tests should be run with the material exposed to fire temperatures to ensure that the species evolved reflect fire conditions and that the test object be remote from the burning material to ensure that the capability of the smoke to transport the corrosives to a remote point (i.e., away from the room of fire origin) be incorporated in the test. As with all of the other research, the authors do not identify a concern with immediate inoperability of electronic equipment but with the long term effects, i.e., corrosion which occurs long after the fire (if the electronic components are not cleaned in the first day or two).

Reagor[36] indicates that contamination levels below 200 micrograms per square inch do not represent a significant long term corrosion threat and they are easily (economically) cleaned to prevent this long term corrosion. Contamination levels between 200 and 600 micrograms per square inch represent a significant long term corrosion threat and although they are capable of being cleaned to prevent this long term corrosion, the economics decrease as the level of contamination increases or the time before cleanup increases. Above 600 micrograms per square inch, the contamination probably makes replacement more economical than cleaning.

The lack of a perceived short term inoperability threat from exposure of sensitive electronic equipment to smoke can be seen by examining one of the most recent proposals for a standard fire test (to determine the corrosivity of the smoke from prospective building materials). In May, 1992, Tewarson[37] proposed that threshold concentrations (to cause corrosion damage) be assessed by an exposure lasting 22 hours and storage of the exposed sample for up to another 40 weeks before determination of the amount of metal lost to corrosion.

Based on the literature review, and the articles cited above, it is clear that the smoke damage issue for telecommunications companies is long term operability, on the order of several days to weeks or more, rather than the short term period required to bring a nuclear power plant to a controlled shutdown. Furthermore, it must be stressed that the electronic equipment of concern in the telecommunications is much more susceptible to smoke corrosion damage than the motors, breakers and switches of concern in shutting down a power plant.

The potential threat for smoke damage causing inoperability of equipment remote from the fire area at NMP1 is further reduced by several plant design features (many of which are common to most nuclear power plants). These features include:

- Most of the more sensitive electronic equipment is in the Control Room which has a separate ventilation system which can maintain the Control Room under positive pressure relative to the rest of the plant. In the event of a Control Room fire which is of sufficient magnitude to

cause evacuation, the plant can be shutdown by a remote shutdown panel which is electrically independent of the Control Room.

- The entire Control Complex, and many other plant areas, are provided with dedicated smoke removal paths which ensure that the products of combustion will not traverse other plant areas to reach the exterior of the building. NMP1 pre-fire plans enable this equipment to be quickly identified and activated in the event of a significant fire.
- While there is no dedicated smoke removal system in the Reactor Building, the large volume of air in the structure ensures that smoke from a fire would be rapidly diluted. This dilution would serve to decrease the level of corrosives in the smoke and minimize any potential smoke damage to electronic equipment.
- In other plant areas without a dedicated smoke removal system, the smoke venting instructions in the pre-fire plans generally direct the fire brigade to use stairwells as the path to take smoke to the exterior. This would serve to minimize the potential for smoke damage in areas away from the area of fire origin.
- In addition, the actual pumps, motors, etc. required for achieving and maintaining shutdown have local controls which can be utilized if smoke exposure to control boards should eventually cause damage to some of the remote control circuitry.

Spurious or Inadvertent Fire Suppression Activation
The issue of spurious or inadvertent fire suppression causing inoperability of safe shutdown equipment was discussed within the NMP1 analysis of NRC Information Notice 83-41. The events reported in IN 83-41 are numerous but focus on the interaction between fire suppression systems and safety related equipment, particularly that equipment relied on to achieve and maintain safe shutdown. Some events are caused by inadequate design considerations, others by inadequate maintenance or testing procedures. The consequences of fire suppression system actuations have resulted in unit shutdowns. Of concern within this evaluation is the concurrent loss of a safe shutdown component and its redundant counterpart due to suppression system actuation.

Design considerations for fire protection systems at NMP1 include the interaction between the fire protection system and other systems or components within the subject areas. Examples are carbon dioxide systems in dense electrical cabling areas and halon systems in normally inhabited areas. Cable raceways in the vicinity of powerboards and other safety related equipment are protected primarily by fire retardant materials or automatic closed-head (wet pipe or preaction) water sprinkler systems rather than by open-head (deluge) water sprinkler systems. Other design features include floor drains and sumps, curbs, and pedestals to elevate equipment above the floor to prevent water intrusion from flooding. Water shields and baffles are installed in areas where the potential exists for water discharge to enter electrical equipment from above. Additionally, fire barrier penetration sleeves are installed in floors and extend above floor level to prevent leakage through the penetration in the event of water accumulations during fire suppression activities.

Operator Action Effectiveness

Emergency operating procedures and special operating procedures N1-SOP-9 and 9.1 are in place which identify the steps necessary to achieve safe shutdown in the event of a fire. Operators have access to self contained breathing apparatus for use in the event of a need to access or pass through an area which may contain products of combustion.

In the event of a need to evacuate the control room, N1-SOP-9.1 delineates the actions necessary to achieve and maintain safe shutdown utilizing the remote shutdown system. Training on this procedure has taken place with operators required to accomplish safe shutdown.

4.8.5 Control Systems Interactions

The safe shutdown scenario for a fire in the main control room or auxiliary control room is discussed in UFSAR Section X (Appendix 10B) and concludes that the concern presented by the Sandia Fire Risk Scoping Study pertaining to control systems interaction has been addressed.

As part of the Appendix R safe shutdown analysis, critical control systems interactions were identified and modifications made to reduce their likelihood. The core spray MOV circuitry was modified such that it takes two shorts, each in different fire areas, to cause flow diversion and the shutdown supervisory control system in the reactor building provides redundant initiation of core spray and emergency condensers (ECs). ERV control circuitry was modified to prevent spurious ADS operation due to fire in the control room. Spurious ADS can occur in the reactor building and was included in the fire analysis. Spurious EC isolation is unlikely due to a modification and they fail-safe into operation. Also, there are transfer switches located at the remote shutdown panels for EC control. The remote shutdown panels have analog indications independent of the control room. Procedures are in place which outline the shutdown procedure utilizing the remote shutdown panels, local controls, and actions to be taken prior to evacuating the control room in the event of a fire. These procedures and the control room evacuation scenario are discussed in Section 4.6.

The fire analysis did not identify any new control systems interactions. Based on these analyses and procedures, the issue of control system interactions has been addressed to satisfy the Sandia concern.

4.9 USI A-45 and Other Safety Issues

IPE[1] Section 3.4.3 discusses and defines the systems/functions that support long term decay heat removal and their importance. This section supplements the IPE relative to the importance of fire hazards impact on this function. The contribution to IPE core damage frequency due to loss of decay heat removal is approximately 3.5E-7/yr. The results of this analysis indicate that the contribution from fires is higher, on the order of 1E-6 to 1E-5/yr. The following summarizes how the decay heat removal function is evaluated in the IPEEE:

All fire zones screened out in the initial screening analysis are screened utilizing the IPE which models the decay heat removal function. Thus, the decay heat removal contribution is less than 1E-6/yr for these zones and is more likely less than 1E-7/yr (see Table 4.0-1).

Detailed analysis of the reactor building, screenhouse, and turbine generator bay (see Table 4.0-2) indicates that core damage frequency, including the contribution from decay heat removal is less than 1E-7/yr for each fire zone.

Detailed analysis of the remainder of the turbine building fire zones (see Table 4.0-2) indicates that total core damage frequency is on the order of 1E-6/yr or less except for fire zone T3B. In the case of fire zone T3B, the focus of the analysis was on early core damage and providing reactor makeup, thus, the contribution from decay heat removal is not explicitly assessed. Similar to the IPE, station blackout type of scenarios focus on maintaining reactor inventory and buying time to recover AC power and other equipment (long term decay heat removal is neglected). However, availability of an emergency condenser (which provides decay heat removal as well as controls reactor pressure and maintains inventory) is very important in determining core damage frequency. As with the IPE, failure to maintain reactor inventory, although it causes loss of heat removal from the core, is not included in the loss of decay heat removal function definition.

The cable spreading room, auxiliary control room, and main control room were evaluated similar to turbine building fire zone T3B above. Table 4.0-2 summarizes the results.

Based on the results of the fire analysis, loss of decay heat removal function in the IPE is potentially an order of magnitude less likely than assessed for fires. The upper bound for fires is judged to be less than 1E-5/yr, the frequency of core damage in fire zone T3B. The lower bound is judged to be on the order of 1E-6/yr or less, recognizing the value of emergency condensers and that reactor inventory control must be successful for several hours before decay heat removal can be considered a significant concern. In addition, the analysis does not credit locally aligning air operated valves (i.e., loss of air) for torus cooling and containment venting in the long term. Although there are no hand wheels on the necessary air operated valves, it is possible to operate these valves with air bottles, etc. This is acknowledged as a potential improvement in Section 7.

Other safety issues relative to fires are discussed in Section 4.8.

5.0 High Winds, Floods, Transportation, and Nearby Facility Accidents

For the high winds, floods, transportation, and nearby facility accidents, hereafter referred to as "other hazards", portion of the NMP1 IPEEE, the methodology outlined in NUREG-1407[3] was used. This methodology is best described as a progressive screening approach. In this approach, each issue is evaluated in greater detail for each subsequent step of the analysis until it can be shown to be either a low risk or vulnerability. For each type of potential hazard, the evaluation requires, at a minimum, a review of the plant relative to the hazard, a review of changes since the issuance of the plant's operating license (OL), and a review of the plant against the 1975 Standard Review Plan (SRP)[7]. Per NUREG-1407, the scope of the analysis includes high winds, external flooding, and transportation and nearby facility accidents. These events are discussed in the following sections. In addition, other external events are considered, in less detail, in Section 5.4.

Overall, the analysis breaks down into eight tasks, the first three of which were summarized in the above paragraph. Task 1 requires the analyst to review available information regarding the plant design and licensing basis relative to the hazard under evaluation. Task 2 requires the analyst to extend the set of information above by considering changes since the issuance of the plant's OL. Specifically, the review should evaluate changes with respect to military and industrial facilities within 5 miles (~8 km) of the plant, onsite storage, or other activities involving hazardous materials, transportation, and development that could affect the original design conditions. In addition, a plant walkdown is performed to identify any additional relevant information. In task 3, the analyst reviews the information obtained above relative to 1975 SRP criteria. If the plant conforms to the 1975 SRP criteria and no potential vulnerabilities are identified in task 2, the hazard is screened and is considered to pose a negligible risk.

If the hazard is not screened based on SRP criteria, then three types of detailed analysis are considered. If the hazard can be screened by any of the three detailed analysis approaches, then it is considered a negligible risk.

The three detailed analyses are: task 4 - hazard frequency analysis, task 5 - bounding analysis, and task 6 - probabilistic risk assessment (PRA). In the hazard frequency analysis (Task 4), the analysis considers the probability of the hazard occurring. If the event frequency can be shown to be less than 1E-5 per year with conditional core damage probability of 1E-1 per event, then the hazard can be screened. This amounts to showing that the hazard related core damage frequency is less than 1E-6 per year. If the hazard under review does not screen, then one of the other two detailed analysis approaches is used.

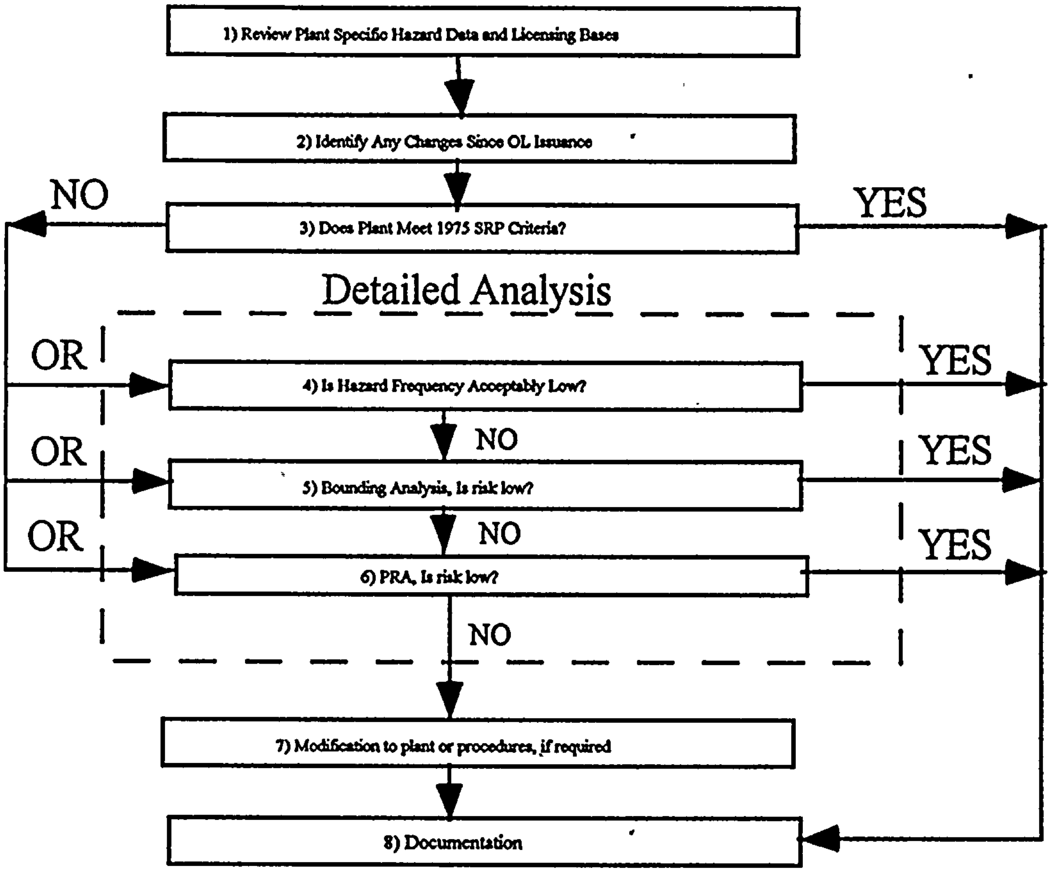
The second type of detailed analysis is called bounding analysis (Task 5) and it considers the consequence of the hazard. If it can be shown that the hazard could not result in core damage, then it can be screened as a negligible risk. If it cannot be screened, then PRA is considered.

In the PRA (Task 6), detailed fault trees and/or event trees are developed to model the frequency of the event and the probability that the plant equipment and operators respond to mitigate the event prior to core damage. The approach to this type analysis of is described briefly in Sections 2 and 3 of this report and in additional detail in both the NMP1 IPE[1] and NUREG/CR-2300[4].

Figure 5.0-1 shows a simplified representation of the approach for the others analysis. This figure was taken from NUREG-1407 and modified slightly. As shown in the figure, tasks 4 through 6 are optional tasks. One of the optional tasks, at a minimum, is used, at the discretion of the analyst, for any hazard that does not screen based on the SRP review. Two or three of the optional tasks may be used if the hazard is not screened. If the hazard can not be screened by the SRP review or any of the detailed analyses, then modification to the plant and/or procedures is considered in task 7.

The final task (Task 8) is documentation of the analysis. The remainder of this section describes the analysis and provides summary documentation of the analysis and results.

Figure 5.0-1 NMP1 Approach for Other External Hazards Evaluation



5.1 High Winds

The high winds portion of the analysis considers the potential for tornadoes and other high wind phenomena to affect the plant. The effect could be in terms of direct interaction with structures or indirect interaction via wind generated missiles. The approach outlined above was used in the IPEEE evaluation of high winds.

5.1.1 Plant Specific Hazard Data and Licensing Basis

Per the NMP1 UFSAR, major NMP1 structures are designed to withstand an external loading of 40 PSF. This corresponds to a wind velocity of approximately 125 mph at a height of 30 feet. UFSAR Table XVI-31 indicates that NMP1 has capacity beyond this design criteria. It indicates that the superstructure of key buildings is unlikely to fail below a wind speed of 190 mph. Key internal substructures such as the control room, EDG rooms, and battery rooms are not expected to fail below a wind speed of 230 mph. The screenhouse has a capability of 150 mph for elevation 261' (and above) and 300 mph below elevation 261'. The main stack has a capability of 175 mph.

Tornadoes and high winds are discussed in more detail in the NMP2 USAR. Since much of this information is directly applicable to NMP1 as well, it is useful to summarize here. The local prevailing wind speed averages 10 miles per hour (MPH) in the westerly direction. The fastest-mile wind recorded at Hancock International Airport in Syracuse is 63 miles per hour at a height of 72 feet in October 1954. Speeds up to 73 miles per hour have been recorded in the vicinity of the more distant Rochester airport. Per input from the New York Power Authority[58] (NYPA), wind speeds of 73 mph have been recorded at the Fitzpatrick site. Fitzpatrick is located immediately to the east of NMP2/NMP1. During the period between 1951 to 1980, 14 tornadoes were reported in the 14,000 square miles surrounding NMP2/NMP1. The two closest tornadoes were within 5.6 miles of the plants. Based on statistical analysis of these events, the NMP2 USAR reports a 3.57E-5 per year probability of a tornado striking NMP2.

As a precaution against tornado events, NMP1 has a Special Operating Procedure with regards to high winds. The procedure, N1-SOP-10 directs operators to take a number of actions following a tornado warning or alert. These actions include starting both EDGs in preparation for possibly losing offsite power.

5.1.2 Walkdown and Evaluation of Significant Changes Since OL Issuance

While new information has become available regarding high wind issues, the fundamental design of NMP1 against high wind related risk has not changed. New tornado frequency and severity data and studies have become available and lessons have been learned from events at other plants. Much of this new information is useful for quantitative risk assessment. In addition, the plant was walked down relative to high wind capabilities to identify any areas for further consideration. The following table describes the insights gleaned from the walkdown.

Table 5.1-1 OTHERS WALKDOWN - WIND RELATED OBSERVATIONS

Observation	Significance/Resolution
NMP1 Stack could damage risk significant equipment should it fall	Risk significance of this failure was determined to be minimal by the probabilistic study discussed below.
NMP1 appears "protected" by NMP2 against tornadoes from the east and south-east	Qualitative insight not implicitly credited in this analysis.
It was not apparent that EDG ventilation and exhaust was as rugged as the general building against tornadoes	Design Criteria Document DCD-120[66] indicates that the EDG room roof area is capable up to 144 PSF. The roof was walked down and it was determined that failures of the exhaust muffler and HVAC dampers were unlikely to impact the EDG [82].
Hydrogen is stored approximately 5 feet from NMP1 on the west for NMP1 and on the east for NMP2	Risk significance was determined to be minimal as discussed below in Section 5.3.4.
Potential missiles were noted west and north of the plant	Risk significance was determined to be minimal as discussed below.

5.1.3 SRP Criteria Review

Meeting SRP criteria for high winds requires that the design meets General Design Criteria (GDC) 2[43] and GDC 4[47]. Sections 2.3.1, 3.3.1, 3.3.2, 3.5.1.4, 3.5.1.5, 3.5.2, and 3.5.3 of the SRP provide the guidelines to meet GDC 2 and GDC 4 for high winds and tornadoes. It is not readily apparent that NMP1 meets the intent of the SRP with regards to high winds. It is assumed, for the purposes of the IPEEE, that NMP1 does not meet the intent of the SRP relative to the screening approach described above, thus requiring that a detailed analysis be performed.

5.1.4 Detailed Analysis

As discussed above, the NMP2 USAR reports a 3.57E-5 per year probability of a tornado strike. This represents the probability of a tornado of sufficient magnitude to cause damage at NMP2. In order to study high wind risk at NMP1, wind magnitude must be considered. Figure 5.1-1 shows a probability distribution for various wind speeds. Based on NMP1 design and Figure 5.1-1 it is judged that straight winds do not pose a significant risk at NMP1. Hurricanes are considered unlikely at NMP1 due to the geographic location, i.e., upstate New York. Therefore, tornadoes are considered to be the dominant contributor to NMP1 high wind risk.

Rutch[44] provides an approach for estimating the probability of tornadoes of various magnitudes at different locations throughout the United States. The Fujita scale (F-Scale) is used to classify the intensity of tornadoes. Table 5.1-2 shows this classification scheme.

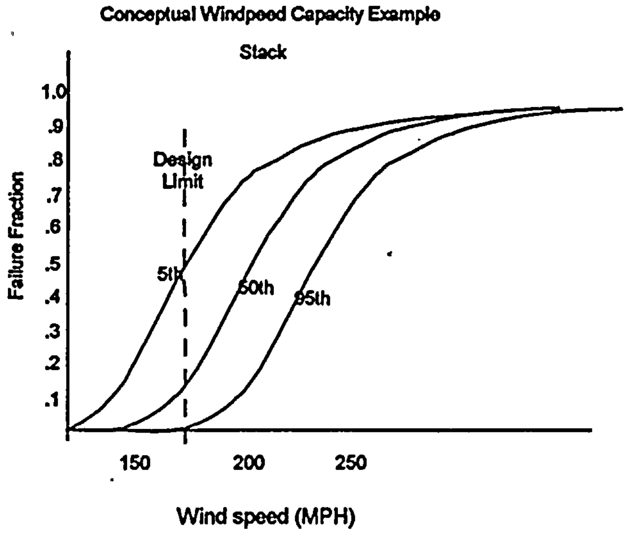
Table 5.1-2 Tornado Classification (F-Scale)

F-Scale	Wind Speed (MPH)	Damage
F0	40-72	Light
F1	73-112	Moderate
F2	113-157	Considerable
F3	158-206	Severe
F4	207-260	Devastating
F5	261-318	Incredible

Per Rutch, the 1° x 1° area in which NMP1 is located has a 1E-3 per year probability of a tornado. This is the probability of any magnitude tornado. The tornado magnitudes that are of concern for NMP1 can be taken from the above-mentioned plant design information. Since the upper portion of the screenhouse may fail in winds above 150 mph, this magnitude tornado is a potential contributor to risk. Since it has been determined that the stack is likely to fail in winds greater than 175 mph, the probability of these level winds is an important consideration. Since the superstructure of key buildings is likely to be damaged in winds of greater than 190 mph, the probability of winds greater than 190 mph is also an important figure to consider. Since widespread damage to building structures would be expected at wind speeds greater than 230 mph, this probability should be considered as well. The conditional probabilities of these wind

speeds can be extrapolated from data in the Rutch document. Table 5.1-3 shows the NMP1 specific figures of merit regarding tornadoes.

It should be pointed out that the high wind capacities of the structures mentioned above is generated using deterministic analysis. In this regard, the failure probabilities at these wind speeds represent a HCLPF type value since safety factors are present in design capability assessments. The following figure represents an example to demonstrate this concept.



In the analysis described here, structures were assumed to fail if the wind speed exceeded their design value (i.e. a step change in probability at the design value). In actuality, wind speeds corresponding to mean failure probabilities would be larger such that there is conservatism in the probability calculations discussed below. Determining the wind speeds corresponding to mean failure probabilities represents a level of effort not deemed necessary at this point due to the low calculated risks using the above-mentioned assumptions. This effort would entail the calculation of the capacity curves for each structure such that a figure similar to that shown above is generated.

Table 5.1-3 Relevant NMP1 Conditional Tornado Probabilities

Wind speed (MPH)	Probability - exceedance
150	2.0E-2
175	6.6E-3
190	3.0E-3
230	4.0E-4

Tornadoes with wind speeds less than 150 mph could cause a loss of offsite power (LOSP) event. These events are included in the overall LOSP initiating event frequency in the IPE. Since these events are unlikely to significantly damage the plant, it is assumed that risk is dominated by LOSP. Since events, that cause LOSP, were quantified in the IPE, they need not be considered here. In addition, tornadoes could lead to SCRAMs, manual or automatic, when offsite power remains

available. These SCRAMs could be precautionary in nature or due to failure of other equipment. These are assumed to be included in the SCRAM initiating event frequency modeled in the IPE and do not need to be considered here.

Based on the information above, a tornado event tree can be developed. Figure 5.1-3 shows this event tree. The initiating event is considered to be a tornado that occurs with a frequency of 1E-3 per year. It is assumed that the tornado causes a LOSP with load rejection event. As discussed above, sequences are assumed to be success in this particular model unless failures occur in addition to the LOSP. Top event T1 questions whether the tornado initiator exceeds 150 mph. The down branch represents a tornado with wind speed greater than 150 mph. From the above table this conditional probability is 2.0E-2 per tornado at NMP1. Should this magnitude tornado occur, it is assumed that the upper portion of the screenhouse will fail. Although critical equipment is located below the elevation that will fail, and is "shielded" from the brunt of the storm, debris may impact critical equipment located in the lower portions of the screenhouse. The reliability of plant mitigation given this magnitude tornado is addressed in top event REC below.

Top event T2 questions whether the tornado initiator exceeds 175 mph. The down branch represents a tornado with wind speed greater than 175 mph. From the above table this conditional probability is 6.6E-3 per tornado at NMP1. Should this magnitude tornado occur, it is assumed that the stack will fall in addition to the assumed LOSP. Stack failure is a primary concern only when it falls in such a way as to damage the EDGs/switchgear (south) or the EDG cooling water pumps (north-west) in the screenhouse building.

Based on Figure 5.1-2, a stack failure is only a concern if it falls south or north-west. These directions lead to EDG failure. Other failure directions are of less concern either because NMP1 is not struck or impact is limited such that a relatively high plant mitigation probability exists. The critical targets occupy approximately 50° of the 360° surrounding the stack. If we conservatively assume that a tornado is equally likely to come from any direction, the conditional probability that the stack falls on critical equipment is 50/360 = 0.14 per 175 MPH, or greater, tornado event. Top event STK is used to represent this failure. A success at STK indicates that the stack did not fall in a direction that would fail the EDGs. Note that, per the UFSAR, the stack can not reach the control room or other areas which would fail a significant amount of equipment capable of mitigating the event.

Based on windroses developed for general wind direction at NMP1, wind is more likely to come from directions that would not cause the EDG related failures of concern noted above. These windroses are discussed in the NMP1 UFSAR but are not specifically developed for tornado events. As such, directional probability of tornadoes is not credited here but a detailed study is likely to shown that tornadoes are more likely to come from the southerly direction. This generally would lead to the protection of the stack and screenhouse by NMP2 or other portions of NMP1. Such "protection" of critical NMP1 features would reduce NMP1 wind risk. While not credited here, the idea of tornado direction serves to demonstrate conservatism in this evaluation.

Top event T3 questions whether the tornado exceeds 190 mph. The downbranch at T3 represents a tornado with wind speeds greater than 190 mph. At these wind speeds structural failure of key

buildings can not be ruled out. Wind speeds of this magnitude could damage the reactor and turbine building superstructure such that significant plant damage could occur. Systems such as instrument air and RBCLC are assumed to be failed in addition to those that are explicitly failed by the LOSP-load rejection event (i.e., condensate, feedwater, and circulating water). In addition, operator actions are likely to be less straightforward than those modeled for the "conventional" SBO in the IPE. Further, the emergency condensers may be damaged since they are located in the top elevation of the reactor building. Thus, such a tornado represents an event with a greater plant impact than that modeled in the IPE. Available mitigative equipment is discussed and credited in top event REC, below.

Top event T4 questions whether the tornado exceeds 230 mph. The downbranch at T4 represents a tornado with wind speeds greater than 230 mph. This event would likely cause severe plant damage. EDGs, batteries, and the control room enclosures would all have a high conditional failure probability. As such, they are all conservatively assumed to fail under this scenario.

Top event REC questions whether the event can be mitigated with equipment that remains available. It also represents the likelihood that recovery actions fail and the probability that equipment inside a given building survives even though the building has failed. Although not explicitly included, the concept of building HCLPF discussed above was qualitatively considered when assigning unavailable values to top event REC split fractions. A recovery factor is applied to each tornado class modeled for NMP1. The downbranch at REC indicates that available equipment, if any, failed and operators were unable to recover critical equipment. Split fraction REC5 represents the probability that the plant does not mitigate a 150 MPH tornado. Failure is judged to be dominated by the probability that debris causes failure of the EDG cooling pumps and the diesel fire pump. These failures would fail success paths such as that credited in the seismic analysis (i.e. EDG, core spray, containment spray) as well as the emergency condenser with diesel fire pump makeup success path. Since the EDG cooling pumps are relatively isolated along a partial height wall and the diesel fire pump is located in a separate room a 1E-2 per demand screening value is assigned.

Split fraction REC4 represents the probability that the operators fail to recover during the sequence where a 175 mph tornado causes a stack failure that fails the EDGs. The only success path considered viable in this scenario is based on the ability of the operators to use the emergency condensers with make-up from the diesel fire pump (DFP). Under this recovery the operators would need to use the east and west instrument room to control the RPV since these instruments do not require AC or DC power. Should the stack fall to the north-west the EDG cooling pumps <u>and</u> the diesel fire pump could be failed. This is assumed to result in core damage. A screening value of 0.5 has been applied to this split fraction based on the potential of the stack to fall to the north-west as well as the relative difficulty in using the east-west instrument room success path.

Split fraction REC3 represents the probability that the stack failure does not impact success paths directly. However, the 175 MPH wind would likely fail the upper portion of the screenhouse and cause a scenario similar to that discussed in relation to split fraction REC5 above. A 5E-2 per demand screening value is applied to this split fraction.

Split fraction REC2 represents the probability that surviving equipment fails to respond to the 190 mph tornado event. While the 190 mph tornado may likely fail important components and systems, systems such as EDGs, DC power, core spray, and containment spray are all located in areas of the plant expected to survive a 190 mph tornado event. As such the mitigation failure probability for this events was set to 5E-2 per demand and represents the probability that the "safe shutdown" equipment fails to mitigate the event. The value was extrapolated from equipment unavailability data in Section 4 applied to the seismic success path (i.e. EDGs, core spray, containment spray) delineated in Section 3. This is conservative since the Section 3 success path assumes a small LOCA must be mitigated whereas a 190 mph tornado would not cause a small LOCA. Probability values in Section 4 represent the probability that critical equipment fails to function on demand. This equipment includes the RPS/SCRAM, EDG, DC power, core spray, and containment spray. Cables associated with this success path run in the area considered failed by the tornado event. These cables are of limited exposure (i.e. length) in affected areas and are generally located in lower elevations which would have more limited tornado damage potential. In this regard the 0.1 per event value is assumed to bound the survivability and recoverability of these cables given the event.

Split fraction REC1 represents the conditional probability that the 230 mph tornado is not mitigated. While a 230 mph tornado is expected to cause extensive damage, equipment may survive inside or be capable of being recovered. Since it is time consuming to generalize for all potential tornado directions, interaction, and equipment separation a screening value of 0.9 is applied to this split fraction. It is judged that more detailed study of tornado effects on the plant would produce a lower value. REC1 is also used to represent the probability that mitigation fails under the scenario where the 190 mph tornado causes stack failure that results in EDG failure.

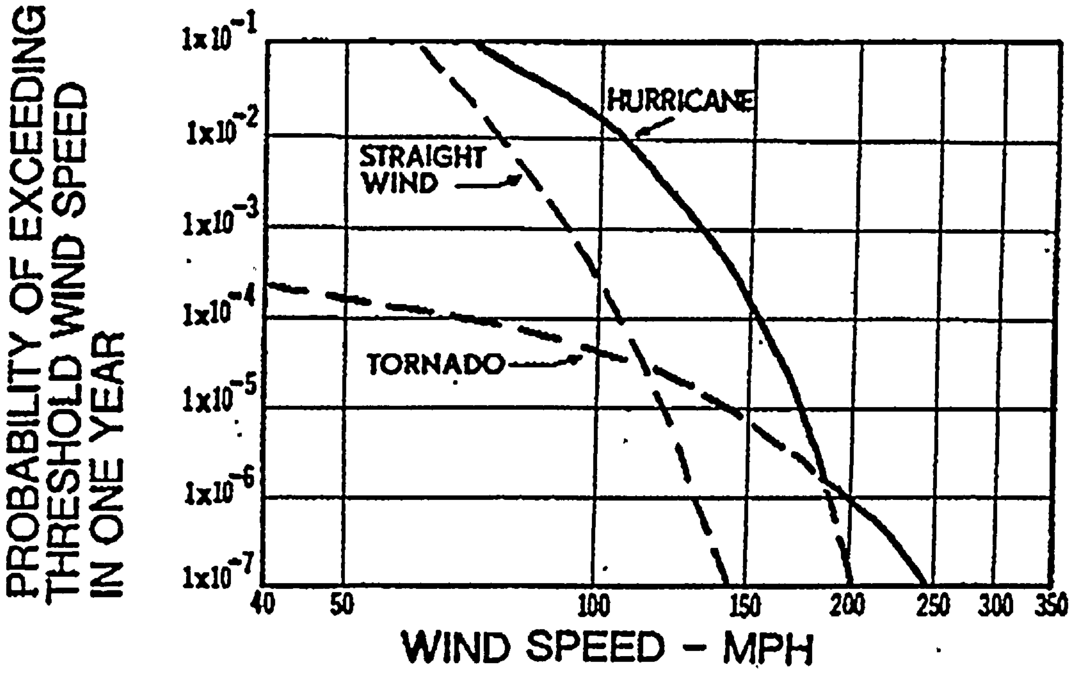
Table 5.1-4 Plant Tornado Mitigation Split Fraction Summary

Split Fraction	Sequence Description	Value
REC1	230 mph tornado causes massive failure of structures and failure of critical equipment housed within. Also, represent scenario where 190 mph tornado causes stack failure which in turn causes EDG failure. Success path would involve significant "damage repair" activities.	0.9
REC2	190 mph tornado fails turbine building and reactor building superstructure failure. BOP equipment failed and safety related cables potentially failed. Success path would be the EDG, core spray, containment spray type path described in Section 3.0.	0.1
REC3	175 mph tornado causes stack failure that does not affect EDGs but coincidentally causes failure of the screenhouse. Success paths include that for REC3 above should debris not fail EDGs and emergency condenser/fire pump make-up success path.	0.05
REC4	175 mph tornado causes stack failure and stack falls on EDGs or EDG cooling pumps. Success path is use of emergency condensers along with diesel fire pump.	0.5
REC5	150 mph tornado fails screenhouse. Success path includes survival of EDG cooling pumps or diesel fire pumps combined with corresponding success of core/cmt spray or emergency condensers	0.01

Using these values, the NMP1 tornado event tree was quantified and resulted in a core damage frequency value of 1.6E-6 per year. Core damage endstates that were judged to result in a large-early release were summed which resulted in a tornado related LERF of 7.6E-7 per year. Without the use of N1-SOP-14, including regular operator training (see Section 7 improvement initiatives), split fraction REC4 would be 1.0 which would correspond to a CDF of 2.1E-6 per year and a LERF of 1.0E-6 per year.

Tornado generated missiles are likely across the wide spectrum of tornado events classified in Table 5.1-2. During the walkdown a number of potential missiles were observed. The supplier of the siding used at NMP1 has tested the siding's ability to withstand missiles. These studies have shown that the siding is capable of protecting internal equipment against a 4" x 12" cross-sectional area test specimen weighting 105 lbs traveling at 300 mph. Doors have a lower missile resistance but represent limited cross-sectional area such that they are considered to be of minimal risk significance. Thus, missiles are judged to be a minor contributor when compared to the risk quantified above (i.e., events up to 230 mph).

Table 5.1-5 shows, for comparison, results of high wind risk assessments for other plants. Based on the considerations above, no wind related vulnerabilities have been identified and no modifications to the plant were determined to be necessary. It is recommended that some minor adjustments be made to procedure N1-SOP-14, "Loss of Instrumentation." This SOP addresses use of the East/West instrument rooms as discussed above. This recommendation is discussed in more detail in Section 7.0

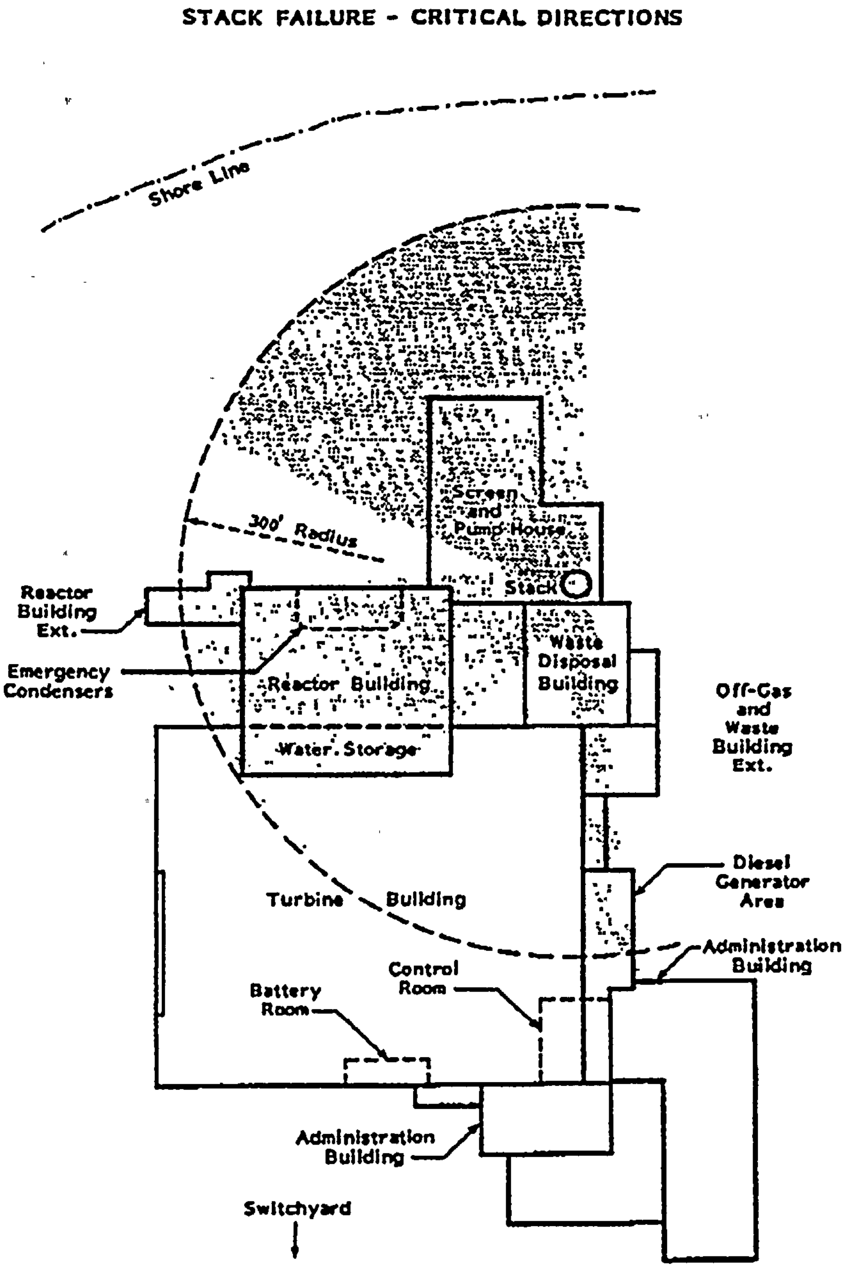


Typical Tornado, Hurricane and
Straight Wind Hazard Probability Models

Note: Relative positions of straight wind and hurricane probability models could be interchanged depending on site.

Taken from Figure 4.1 NUREG/CR-5042

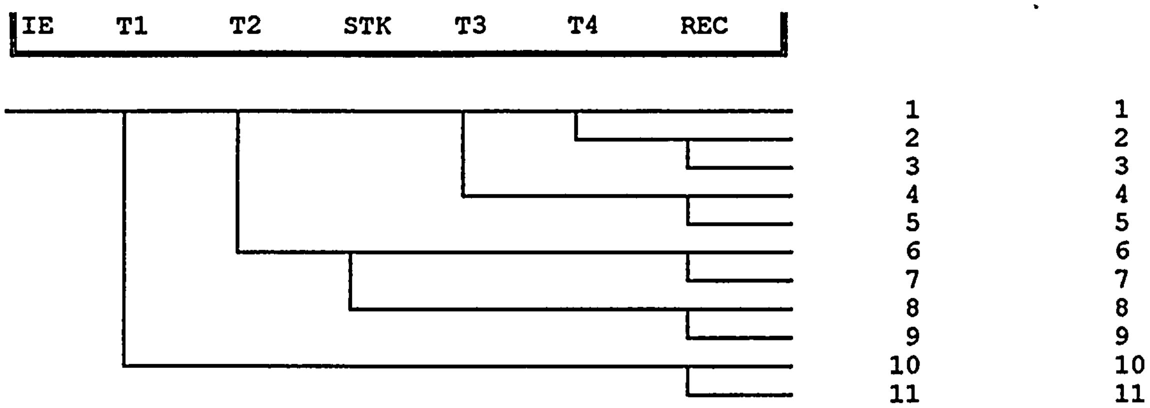
Figure 5.1-1



Taken from Figure III-23 NMP1 USAR

Figure 5.1-2

Figure 5.1-3 Tornado Event Tree



Top Event Designator.....	Top Event Description............................
IE	Initiating Event
T1	≥150 MPH TORNADO
T2	≥175 MPH TORNADO
STK	STACK FAILURE
T3	≥190 MPH TORNADO
T4	≥230 MPH TORNADO
REC	PLANT MITIGATION FAILURE

Table 5.1-5
High Wind/Tornado Plant-Specific PRA Frequencies

Plant Name	Tornado Strike Frequency (Any Size) (/yr.)	High Wind Core Damage Frequency (/yr.)	Tornado Core Damage Frequency (/yr.)	Noteworthy Structures
Indian Point 2	1.00E-04	3.60E-05	<E-7	Unit 1 Superheater Stack Unit 2 DG Building Unit 2 Control Building
Indian Point 3	1.00E-04	1.30E-06	<E-7	
Limerick 1 and 2	2.30E-04	9.00E-09	<E-8	None
Millstone 3	1.87E-04	Low	<E-7	
Oconee 3		Low	<E-9	None
Seabrook 1 and 2	7.77E-05	<3.89 E-8	2.06E-09	None
Zion 1 and 2	1.00E-03	N.A	<E-8	
Arkansas Nuclear One-1	1.53E-03	1.16E-07	5.19E-06	DG Exhaust Stack Fails both DGs
Point Beach 1 and 2	5.38E-04	6.60E-07	3.30E-06	DG Exhaust Stack Fails both DGs
Quad Cities 1 and 2	1.04E-03	<<E-8	1.35E-07	310' Concrete Stack 4 kV, 480 V Switchgear Area Unit 2 Battery Room
St. Lucie 1	1.70E-04	<<E-8	<E-09	None
Turkey Point 3	1.70E-04	2.25E-05	1.73E-06	Unit 2 400' Concrete Stack DG Building DG Fuel Oil Transfer Pumps Switchgear Building Unit 3 RWST DG Fuel Oil Storage Tank CST Intake Pumps

5.2 Floods

The flooding portion of the evaluation deals with the potential for lake flooding, overland flooding, and/or heavy precipitation to damage critical plant equipment and structures. These effects could be in terms of water entering buildings from outside or in terms of heavy roof loads. Flooding due to plant internal sources, such as tank ruptures, was previously evaluated in the internal floods portion of the IPE. The screening approach outlined above was used in this external flooding risk assessment.

5.2.1 Plant Specific Hazard Data and Licensing Bases

The NMP1 UFSAR indicates that the plant has been designed to withstand flooding events. Specifically, Section I states:

> *Principal structures and equipment which may serve either to prevent accidents or to mitigate their consequences are designed, fabricated and erected in accordance with applicable codes to withstand the most severe earthquake, flooding condition, windstorm, ice condition, temperature and other deleterious natural phenomena which can be expected to occur at the site.*

Relative to flooding, design calculations [67] indicate that the maximum expected monthly mean lake level at NMP1 is 249', based on the Army Corps of Engineers lake level regulation plan. The floor grade elevation of the plant is 261'. Also noted is the 1000' rock dike constructed along the lake shoreline which is designed to protect the plant from wave action, ice accumulation, and soil erosion. NMP2 has additional information regarding flood issues that are applicable to the site as a whole.

The principle body of water relating to NMP1 and NMP2 is Lake Ontario. There are no major streams or rivers within the drainage area that contains the site. Lake Ontario is approximately 193 miles long and 53 miles wide and has an area of approximately 7,340 square miles. It has a maximum depth of 802 feet and an average depth of 283 feet. The lake is fed by runoff from an approximately 27,300 square mile watershed. This provides approximately 36,000 cubic feet per second (CFS) supply to the lake. In addition, the lake is fed by the Niagara, Genesee, Oswego, Black, and Trent Rivers. Waters flow from the lake via the St. Lawrence River. During the winter the lake is seldom more than 25 percent ice covered.

Dams on the St. Lawrence River, controlled by the US Army Corps of Engineers, are used to control lake level at 248 maximum monthly mean lake level. The NMP2 USAR reports a historical monthly average maximum lake level of 249.29 feet and an instantaneous maximum lake level of 250.19. The maximum lake level since the current regulation plan was implemented is 249.58 (October 1963 to December 1978). The monthly average minimum lake level is 242.68 feet and the average lake level is 246 feet.

Maximum hourly precipitation recorded at the site is 2 inches. The maximum 24 hour amount is 6.34 inches. The maximum recorded 24 hour snowfall is 24.5 inches.

5.2.2 Walkdown and Significant Changes Since OL Issuance

Relative to flooding, the issuance of US Army Corps of Engineers revised precipitation estimates is the most significant change since issuance of the NMP1 operating license. HMR-51[50] and HMR-52[51] were issued which indicated that higher precipitation than that previously considered was possible. These documents indicated that a rainfall at the rate of 29.8 in/hr for 20 minutes, while unlikely, could not be ruled out. This level of precipitation is greater than anything considered at NMP1 relative to roof loading and external flooding. Additional probable maximum flood analysis for NMP2 showed that the latest precipitation estimates lead to a site flood level of 262.85 feet. The 262.85 foot value is based on superimposing the maximum regulated lake level, the maximum probable precipitation, and the maximum probable wave action due to windstorm. The effect on roof loading and potential plant flooding is discussed below.

In addition, the plant was walked down relative to flooding to identify any areas for further consideration. The following table describes the insights gleaned from the walkdown.

Table 5.2-1 Others Walkdown - External Flooding Related Observations

Observation	Significance/Resolution
Screenhouse - lake level greater than 256' will enter via the intake gates	Per below, not a likely event (Lake control plan in place, large floodplain, intake damping of storm surge)
Screenhouse - any water entering over 261' (due to rainfall buildup) will return to the lake through open steel grating	Considered a design attribute of minor safety significance, see discussion below
Turbine building - water entering over 261' will drain to elevation 250'. Remote shutdown panel is on 250' and could be damaged once approximately 12" of water builds up. No other critical equipment (i.e. cables) on 250' appeared vulnerable to flooding	Considered a design attribute of minor safety significance, see discussion below
Turbine Building - Switchgear and panels are located on 261' but vital components are sealed to approximately 5" above the floor	Considered a design attribute of safety significance, see discussion below
Turbine Building - EDGs are located on 261' but damage was judged unlikely up to approximately 5" above the floor	Considered a design attribute of safety significance, see discussion below

5.2.3 SRP Criteria Review

Meeting SRP criteria for flood protection requires that design meet GDC 2[43] and 10CFR100, Appendix A[52]. Sections 2.4.1, 2.4.10, 2.4.13, 3.4.1, and 3.4.2 of the SRP provide the guidelines for flood protection. There is no indication that NMP1 meets these criteria and it is

conservatively assumed, for the purpose of this analysis, that NMP1 does not meet the screening criteria so that the issues are considered using the detailed analysis process.

5.2.4 Detailed Analysis

Analysis of flood risk entails the review against a number of potential scenarios. These include:

- Probable maximum precipitation coincident with historic maximum lake level
- Probable maximum "stillwater" lake level coincident with historic maximum precipitation
- Maximum controlled lake level coincident with probable maximum surge, seiche, and wave action due to the probable maximum wind storm
- Roof collapse due to local intense precipitation

Each of these postulated scenarios can be considered in more detail.

<u>Probable maximum precipitation (PMP) coincident with historic maximum lake level:</u>
The consequence of this event, in terms of flooding, was determined for NMP2 using calculations WH-B-061, 062, 063, and 076. This analysis showed that the scenario would result in a flood depth of 262.85 feet. This flood depth is driven by the short duration where the intense precipitation causes water to buildup around the buildings since it can not flow away as fast as it precipitates. Based on the walkdown this event would have minimal impact since NMP1 has a limited amount of openings (i.e., doors) and water would generally flow to lower elevations where there is less critical equipment. In addition, the evaluation has a number of conservative assumptions that, when considered, effectively reduce any potential concerns relative to this potential scenario.

Specifically, the following assumptions are viewed as conservative:

- Postulated event: The PMP is defined as the theoretically greatest depth of precipitation for a given duration that is meteorologically possible over the applicable drainage area that would produce flows which there is virtually no risk of being exceeded. Combining this event with a coincident maximum lake level produces a scenario which is exceedingly rare.
- Storm drainage: Storm drainage was assumed failed during the event. Under more likely boundary conditions storm drains would effectively reduce the overall flood depth.
- Wave runup - a ten foot runup was assumed which did not take credit for the rock dike located along the shoreline (2.3 feet was added to the 10 foot assumption for additional conservatism).
- Culvert Blockage - 50% blockage was assumed. A sensitivity case where 25% blockage was used resulted in a flood level only 3" above 261'.

Probable maximum "stillwater" lake level coincident with historic maximum precipitation:
The maximum "stillwater" lake level was established as 251' in correspondence with the NRC[70]. The stillwater lake level includes the probable maximum wind storm surge of approximately 2 feet. The NMP2 USAR indicates that this combination of events would result in a flood level of 260.4'. This is less than the 261' floor elevation of the plant and water would not be expected to enter the plant in significant amounts.

Maximum controlled lake level coincident with probable maximum surge, seiche, and wave action due to the probable maximum wind storm:
The maximum lake level since the Army Corps of Engineers began their current lake level management plan is 249.6' and a maximum surge, seiche, wave action induced runup is expected to total 10'. This results in an effective flood elevation of 259.6'. This is below the ground elevation of NMP1 and water would not be expected to enter the plant in significant amounts. However, under this scenario water may potentially enter the screenhouse at elevation 256' and fail significant safe shutdown equipment. However, intakes are located well below the lake surface such that wave runup is not expected to be translated within the intake bay to the same degree that could occur on the open lake. This damping of the storm surge prior to the intake bay is expected to protect the critical equipment in the screenhouse during this postulated event.

Roof collapse due to local intense precipitation:
The roofs of critical buildings at NMP1 are designed to withstand 40 PSF. Roof drainage was designed to handle flows such that water buildup will not effect roof integrity. Because of the issuance of new precipitation estimates (i.e., HMR-51,52) it is now considered possible to accumulate precipitation on the roofs. However, NMP1 drawings [69] indicate that NMP1 has capabilities beyond the 40 PSF design specification. These drawings indicate that the roofs are capable of supporting 100 PSF. Subtracting 25 PSF to account for roof building materials the 75 PSF margin would support approximately 14.4 inches of water which gives adequate margin to support any backlog of water that temporarily occurs due to precipitation beyond the roof drain capability.

NMP1 Design calculation S0.0-DCD120-UPGRAD01 describes snow load cases. The 100 year return period snowpack is equivalent to 40 PSF. The probable maximum winter precipitation (PMWP) from Hydrometerological Report 53 is equivalent to 56 PSF. Thus, the total snow load for NMP1 is equivalent to 96 PSF. This exceeds the 75 PSF capability noted above. However, the 96 PSF estimate is conservative for a number of reasons. The 96 PSF case only occurs when the maximum possible snowfall occurs while the 100 year return period snowpack exists. The combination of these events is expected to be exceedingly rare. In addition, the 96 PSF value corresponds to approximately 12 feet of fresh snow. Given the approximately 3 foot roof wall height and normal winds off Lake Ontario is is judged unlikely that this level of snow could accumulate on roofs; the 96 PSF value is much more applicable for the ground. Further, critical NMP1 roofs are uninsulated such that snowmelt and removal via the roof drains is expected.

NMP1 IPEEE team members report that warm air eminated from roof drains during cold weather roof walkdowns.

With all this in mind, the core damage frequency resulting from external flooding is considered negligible. As an additional point of reference, the core damage frequency for Zion 1 and 2 can be considered [42]. These plants, although different design, are located on Lake Michigan, another "Great Lake", and are thus a viable comparison for NMP1. The CDF was determined to be 2E-8 per year. Contributors to this value included the emergency switchgear, an additional similarity with NMP1.

5.3 Transportation and Nearby Facility Accidents

This portion of the analysis considers the potential for transportation and nearby facility accidents to affect the plant. The effect could be in terms of direct interaction with structures or by causing operators to be incapacitated due to vapors or fumes. The approach outlined above was used in the IPEEE evaluation of Transportation and Nearby Facility Accidents.

5.3.1 Plant Specific Hazard Data and Licensing Bases

The NMP1 UFSAR makes mention of a number of industrial facilities that could impact NMP1. These are also outlined in the NMP2 USAR. Only one manufacturing or industrial plant, Alcan Aluminum Corporation's Alcan Sheet and Plate Division is located within 8 km. of Unit 1. There are also two electrical power generation facilities, the J.A. Fitzpatrick Nuclear Power Plant operated by NYPA (New York Power Authority) and Nine Mile Point Unit 2 operated by Niagara Mohawk Power Corporation, located within 8 km. of Unit 1. Sithe Energies, USA has recently completed construction of the Independence electrical generating station approximately 2 miles from the Nine Mile Point site. The Independence station is a natural gas fuel electrical generating plant. The implications of this construction on NMP1 are discussed in the detailed analysis section below.

The principle products of the Alcan Aluminum Corporation plant are aluminum sheet and plate. There are no chemical plants, refineries, military bases, or underground gas storage facilities within 8 km. of the plant. In addition, no pipeline (except the Independence plant supply, discussed below) or fuel storage facilities lie within the 8 km. radius except those storage facilities associated with the Alcan plant, the FitzPatrick plant, and Nine Mile Point Units 1 and 2. The Pollution Abatement Services (PAS) hazardous waste site is located approximately 8 km west of NMP1. Nearly across the street from the PAS site is the NMPC Fire School. Neither of these sites is considered a threat to NMP1 due to the limited amount of materials present and the relatively large distance between them and NMP1.

The principle roadway within proximity of Unit 1 is Route 104, which passes 6.2 km. south of the plant and connects the City of Oswego and the Village of Mexico. Highway access to the Site is

via two county routes, Route 1A to the southwest and Route 29 to the east. A private east-west road crosses the site and connects these two county routes.

One railroad company, Consolidated Rail Corporation (Conrail), transports freight in the vicinity of the plant. The closest rail line to Unit 1 is the Oswego-Mexico branch of Conrail located approximately 2.5 km from the Nine Mile Point Site. This branch line has daily service on demand and averages one train daily, five days a week. A rail spur was constructed to serve Unit 2 during construction of the plant.

The Oswego River passes within 11 km of Unit 1 at its nearest point and serves as a major route for waterborne commerce on Lake Ontario. Freight traffic statistics are maintained by the US Army Corps of Engineers. Totals for the river section from New York State Barge Canal Lock No. 8 to the port of the City of Oswego are the only statistics applicable for the nearest reach of river to the station. The port of Oswego, the easternmost port on Lake Ontario, is located approximately 11 km southwest of Unit 1 and provides a link with all ports on the Great Lakes and St. Lawrence River. Ships in normal commercial lanes bound to and from the Port of Oswego pass no closer than 11.3 km to the intake structures of NMP1.

Regular commercial air service is provided at the Clarence E. Hancock Airport, located 49.8 km southeast of Unit 1 near Syracuse, New York. The nearest flight corridor associated with this airport is 22.2 km from the Nine Mile Point Station. Light plane traffic is handled at the Oswego County Airport in the Town of Volney, approximately 19.3 km south of the Nine Mile Point Site. Lakeside Airstrip, a private facility which operates primarily as a maintenance facility with very little air traffic, is located along Route 176 approximately 10 km south of the Nine Mile Point Site. In addition, helicopter service is provided for local transportation to the site. The helipad is located approximately 1000 to 2000 feet east and south of the plant.

5.3.2 Walkdown and Significant Changes Since OL Issuance

Much of the information above came about as part of changes in the vicinity of the plant since it was granted an operating license. This type of information is kept up to date as part of normal updates to the UFSAR. In addition, a great deal of applicable information and analysis has been developed as part of the more recent licensing of NMP2. With this in mind, reviewing the timeline of changes since NMP1's operating license was considered impractical. Rather, the current set of information from NMP1 and NMP2 was used to consider NMP1 external events risk. A walkdown of local transportation activities and nearby facilities was also considered impractical due to the nature of the potential risk. Surveying the Alcan plant, barge traffic, etc., was not considered necessary for this scope of work.

5.3.3 SRP Criteria Review

There is no indication that NMP1 meets SRP criteria with regards to transportation and nearby facility events and it is conservatively assumed, for the purpose of this analysis, that NMP1 does

not meet the screening criteria so that the issues are considered using the detailed analysis process.

5.3.4 Detailed Analysis

Description of Products and Materials

To identify hazardous materials regularly stored or used within 8 km of the site, surveys were conducted of industrial firms, pipeline companies, and distributors that might be expected to handle toxic chemicals or explosives. Hazardous materials used by industries or distributors in the vicinity of the station are summarized in Table 5.3-1. The chemical storage at the Independence station was not explicitly polled for this evaluation. It is assumed similar, other than natural gas noted elsewhere, to NMP1, NMP2, and Fitzpatrick. Given the additional distance to the Independence station, risk from chemical storage and use is considered negligible.

In 1978, waterborne commerce accounted for approximately 1.2 million tons of cargo transported on Lake Ontario. The nearest passage of commercial vessels to Unit 1 occurs when navigating to and from the City of Oswego harbor. The Port of Oswego Authority indicated that none of the hazardous materials listed in Table 5.3-1 have been transported on Lake Ontario, either originating at or destined to the Port of Oswego. Instead, all industries reported receiving hazardous material shipments via U.S. Highway 104 and County Route 1 by truck.

Explosions

Based on a comprehensive survey of industries within a 8 km radius of Unit 1, performed for input to the Unit 2 USAR, the nearest highway on which explosive materials can be transported is Route 104, which is a distance of about 6.2 km from safety-related structures. This separation distance is sufficient to effectively protect NMP1.

In discussions with Conrail, it was determined that no explosive or flammable materials are transported to the Oswego terminal on the rail line between Oswego and Mexico, New York. In any event, the distance from this rail line to Unit 1 is sufficient to effectively protect NMP1.

Since the nearest commercial shipping lanes on Lake Ontario are more than 10 km from Unit 1, potential explosions on a ship or barge are not considered a design basis event. This distance is sufficient to effectively protect NMP1.

Approximately 3,785 liters (1,000 gallons) of propane and 308,000 ft^3 of hydrogen are stored at the James A. FitzPatrick plant about 700 meters from the NMP site. NMP1 is sufficiently distant and effectively "protected" from Fitzpatrick by NMP2 such that these potential explosions are assumed to be of minimal risk significance. Alcan Rolled products and the Sithe Independence Power Station are located approximately 2 miles from the plant. While they use potentially explosive materials, the separation is judged adequate to make risk significance minimal. The Sithe plant includes a natural gas pipeline within approximately 2 miles of NMP1. The explosion

hazard created by this gas pipeline can be evaluated using bounding analysis as discussed in Section 5.0 and in NUREG-1407.

NMPC calculation 94-071[55] evaluated the consequences of a postulated break in the Sithe natural gas pipeline. The calculation assumed a complete severance of the pipeline with a ground level release at sonic velocity at the point closest to NMP1. The maximum resulting pressure effect on NMP1 due to the explosion is less than 100 PSF. This may damage some NMP1 structures but critical equipment (i.e., EDGs and ECCS) would be expected to survive.

The above-mentioned postulated break, and lower magnitude explosions, would likely lead to a loss of offsite power (LOSP) event with degraded potential for offsite power recovery. However, since the pipeline is located in a remote area, explosion probability is considered to be a negligible contributor to LOSP frequency.

Onsite storage of Hydrogen is also a potential explosion hazard. The related risk significance can be considered using Branch Technical Position APCSB 9.5-1 "Guidelines for Fire Protection for Nuclear Power Plants" [59] and NFPA 50A "Standard for Gaseous Hydrogen Systems at Consumer Sites." [60] APCSB 9.5-1 indicates that plants should comply with NFPA 50A in order to protect safety related equipment from events related to gaseous hydrogen storage. NFPA 50A indicates that adequate protection exists if there is 5 feet of separation, building walls are fire resistant, and sprinklers are used. Since NMP1 meets this level of protection, the explosion hazard related to the bulk hydrogen storage is minimal. As such, risk is considered negligible. Onsite storage of welding gas cylinders and other types of internal hazards are discussed in Section 4.0 of this document.

Flammable Vapor Clouds (Delayed Ignition)

Propane stored at the James A. FitzPatrick plant is the only potential source of a flammable vapor cloud that might affect the Unit 1 plant. Approximately 3,785 liters (1,000 gallons) of propane, and 24 tons of carbon dioxide are stored at the James A. FitzPatrick plant about 700 meters from the NMP site. NMP1 is sufficiently distant and effectively “protected” from Fitzpatrick by NMP2 such that these potential vapor clouds are assumed to be of minimal risk significance. Alcan Rolled products and the Sithe Independence Power Station are located approximately 2 miles from the plant. While they use potentially flammable materials, the separation is judged adequate to make risk significance minimal.

Potential Sources of Toxic Chemicals

For the Nine Mile Point Site, sources of potential toxic chemical hazards include chemicals stored on site, as well as four stationary and two transportation sources within 8 km of the site. Table 5.3-1 lists the chemicals associated with each source along with their quantities and approximate distances from the Unit 1 Control Room air intake. The three stationary sources include the James A. FitzPatrick plant, the Alcan Rolled Products Division, Oswego Wire Incorporated, and Unit 2. One transportation source of possible hazardous materials is truck traffic along Route 104, which passes within 6.2 km of the Site. The second transportation source is the railroad line

between Oswego and Mexico, New York. Discussions with Conrail indicate that on an average, only one hazardous chemical shipment during an 18-month period passes throughout the Oswego terminal. Traffic on a spur to the Site is not frequent enough (<30 per year) to warrant consideration.

The effect of an accidental release of each of the chemicals on Control Room habitability was evaluated, for the NMP2 USAR, by calculating vapor concentrations inside the Control Room as a function of time following the accident. This calculation is performed using the conservative methodology outlined in NUREG-0570 and utilizing the assumptions described in Regulatory Guide 1.78. The results of the analysis indicates that none of the toxic chemicals evaluated have the potential to incapacitate the Control Room operators. These results are considered applicable to NMP1 as well. In addition, control room operators are capable of using portable air packs to maintain their capabilities in a hazardous environment.

Fires

The production of high heat fluxes and smoke from fires at industrial or storage facilities, oil and gas pipelines, transportation routes, or homes in the Site vicinity does not present a hazard to the safe operation of the plant due to the distance of these potential fires from the site. The nearest truck route (Route 104) passes the site at a distance of about 6.2 km from the plant. There are no known regular shipments of flammable materials on Route 104 with the exception of possible local gasoline deliveries. The nearest residence is approximately 1.6 km from the site.

The site is sufficiently cleared in areas adjacent to the plant such that forest or brush fires pose no safety hazards. On site fuel storage fires do not jeopardize plant safety since these facilities are designed in accordance with applicable fire codes.

Collisions with Intake and Discharge Structures

Oswego Harbor is located approximately 12 km southwest of the intake structures. The intake structures are located in a water depth of at least 10 feet at the minimum controlled lake level.

If a barge should drift or break loose in the shipping lane, the distance of structures from that lane should provide sufficient maneuvering area for retrieval. In the case where a ship or barge should break up, any non-floating load would sink before reaching the intake or discharge structures. The location of these structures, approximately 6 miles to the nearest commercial shipping lane, minimizes the potential for being struck by passing commercial traffic and their depths minimize the potential for damage by any pleasure craft that may frequent the area.

In the unlikely event that a ship or barge were to collide with and completely incapacitate the intake or discharge structures, station safety would not be jeopardized because there are gates which can be realigned to provide adequate cooling to critical equipment (i.e., EDG cooling water pumps). The "E-Gate" cross-tie could be used to assure that cooling water would be available to the critical pumps even though circulating water, and possibly service water, would be inoperable. High lake temperatures (i.e. >81^{0}F) may preclude removing heat commensurate with equipment

design but the simultaneous occurrence of these events is considered to be negligible probability.

Liquid Spills

No oil and liquids that may be corrosive, cryogenic, or coagulant are stored at, delivered to, or transported through the area of the intake structure in Lake Ontario. All oil and liquids used at Unit 2 and the James A. FitzPatrick plant are transported by truck or rail. All oil and liquids that may be corrosive, cryogenic, or colagulable, which are transported within the 8 km radius, are moved on land. There is at most an extremely remote possibility of occurrence of liquid spills in the area of the intake structures, originating from land-based storage or transport. Service water is drawn in at low velocities through the sides of the intake structures. These provisions prevent the formation of vortices. Therefore, surface spills of liquids with sufficient density to reach the intakes must pass the region of induced turbulence and would be subject to dilution effects.

Any accidental liquid spills to Lake Ontario would be further diluted because of the distance between the origin of spills from either commercial shipping or land-based transport, and the intake structures. Liquids from land-based spills would have to travel a relatively great distance to reach the intake structures and would be subject to dilution during transport. Any liquid spills originating during common commercial ship transport would have to travel approximately 10 km to reach the intake location. Due to the combined effects of the submerged intake structure design and the distance between intake structure location and origin of the potential liquid spill, the risk of entrainment of any significant quantities of oil, or corrosive, cryogenic, or coagulable liquids by the intake structures is negligible.

Airplane Crashes

The nearest air corridor is approximately 22.5 km east of the site. There are only two airfields between the 8 km and 24 km radii of the site; the Lakeside Airport and Oswego County Airport are about 12 km and 19 km south of the Site, respectively. The aircraft approaches to these airports are not near the plant site. The general aviation movements at these airports total approximately 1,460 per year and 19,900 year, respectively. The annual movements are below the critical number at which a probability analysis for aircraft accidents would be required according to Regulatory Guide 1.70. Therefore, the probability of aircraft crashing into the site is considered to be remote, and airplane crashes need not be considered design basis events.

Similarly, for helicopter operations to and from the site, the probability of a helicopter crash resulting in radiological releases in excess of 10CFR100 guidelines has been conservatively estimated[61] to be approximately 1×10^{-6}, using the methodology of NRC Standard Review Plan 3.5.1.6. In accordance with Standard Review Plan 2.2.3, additional qualitative arguments could be made which would lower this probability to less than about 10^{-7} per year. This satisfies the guidelines of Regulatory Guide 1.70 such that helicopter crashes need not be considered as design basis events.

5.4 Other External Hazards

The risk significance of other external events is discussed in Table 5.4-1. Note that sabotage is considered outside the scope of this analysis. In addition, there have been no other plant unique hazards identified which are considered to represent a significant threat to NMP1.

Table 5.3.1

Sources of Toxic Chemicals Within 8 KM of Unit 1 Site+*

Chemical Location	Chemical	Amount (gal)	Distance to NMP2 Intakes (m)
James A. Fitzpatrick Plant	N_2	0.305×10^8	620
	$H_2 SO_4$	0.346×10^8	620
	CO_2	1.18×10^7	620
	Propane	0.221×10^7	620
	Halon 1301	0.260×10^7	620
Alcan	$C1_2$	0.181×10^7	4,990
	Propane	0.363×10^8	4,990
	N_2	0.227×10^8	4,990
	HCL	0.226×10^7	4,990
	CO_2	0.535×10^8	4,990
Route 104	HC1	0.542×10^7	5,470
	N_2	0.183×10^8	5,470
	CO_2	0.272×10^7	5,470
Nine Mile Point Unit 1	N_2	0.443×10^8	290
	CO_2	0.907×10^7	265
	$H_2 SO_4$	0.114×10^7	290
	HCL	0.454×10^5	290
	Halon 1301	0.227×10^6	290
Nine Mile Point Unit 2	CO_2	0.118×10^7	33
	Halon 1301	0.113×10^6	45
	N_2	0.671×10^8	46
	$H_2 SO_4$	0.159×10^9	146
Oswego Wire Incorporated	Isopropyl Alcohol	0.330×10^5	7,080
	N_2	0.525×10^5	7,080
	Propane	0.947×10^5	7,080
	$H_2 SO_4$	0.750×10^5	7,080
	HCL	0.182×10^4	7,080

+ The new Independence Station is discussed above

* Table based on information in NMP2 USAR. Considered applicable to NMP1 although distance to intake is referenced to NMP2 intake structures.

TABLE 5.4-1 SUMMARY OF RESOLUTION OF OTHER EXTERNAL EVENTS		
Description of External Event	**Summary of NRC Resolution (From NUREG-1407)**	**Conclusion for NMP1**
Lightning	The NRC has concluded that the probability of a severe accident caused by lightning (other than one due to loss of offsite power) is relatively low and further consideration of lightning effects should be performed only for plant sites where lightning strikes are likely to cause more than just loss of offsite power or a scram (e.g., degradation of instrumentation and control systems).	NMP1 lightning protection features ensure that the site strike consequences are relatively low. Initiating events modeled in the IPE such as loss of offsite power and loss of a divisional AC power division are believed to envelope the frequency and consequences of potential lightning impacts on the plant.
Severe Temperature Transients (Extreme Heat, Extreme Cold)	The NRC has concluded that severe temperature transient events do not have to be considered in the IPEEE because the most significant effects (i.e., slow degradation of the ultimate heat sink and loss of offsite power), are generally unimportant from a risk perspective or are already treated in the IPE.	The NMP1 IPE considered the impact on plant risk from a loss of offsite power initiating event, regardless of its cause. NMPC agrees that the capacity reduction in the ultimate heat sink and other impacts would tend to be a slow process allowing time for proper actions. Temperature transient initiating events need not be addressed in the NMP1 IPEEE, as concluded by the NRC.

TABLE 5.4-1 SUMMARY OF RESOLUTION OF OTHER EXTERNAL EVENTS		
Description of External Event	**Summary of NRC Resolution (From NUREG-1407)**	**Conclusion for NMP1**
Severe Weather Storms	The NRC has concluded that the most significant effect of severe weather storms is the potential for causing a loss of offsite power event. However, this event is considered in the IPE; therefore, the NRC has stated that severe weather events do not have to be evaluated in the IPEEE.	The NMP1 IPE has evaluated the risk associated with loss of offsite power events; therefore, the potential risk associated with severe weather storms need not be evaluated in the IPEEE.
External Fires (Forest Fires, Grass Fires)	The NRC has concluded that the effects of fires occurring outside the plant site boundary (i.e., causing a loss of offsite power and isolation of ventilation), have been evaluated during operating license review against sufficiently conservative criteria. Therefore, the NRC has stated that these events do not need to be reassessed in the IPEEE.	The effect of a forest fire on the offsite electrical power system was not identified as a significant contributor to the frequency of Loss Of Offsite Power in the NMP1 IPE. Additionally, other effects of fires occurring outside the plant site boundary (i.e., isolation of ventilation and control room evacuation), have been evaluated during operating license review. Therefore, it is judged that this event poses no significant risk to the safe operation of NMP1.

TABLE 5.4-1 SUMMARY OF RESOLUTION OF OTHER EXTERNAL EVENTS		
Description of External Event	**Summary of NRC Resolution (From NUREG-1407)**	**Conclusion for NMP1**
Extraterrestrial Activity (Meteorite Strikes, Satellite Falls)	The NRC has concluded that the probability of a meteorite strike or a satellite fall is very small (<1.0E-9 reactor per year). Additionally, the NRC has stated that this event can be dismissed on the basis of its low initiating event frequency.	Based on the NRC's direction in NUREG-1407, the NMP1 IPEEE does not consider the effect of extraterrestrial activity to be risk significant.
Volcanic Activity	The NRC has concluded that those sites that are located in the vicinity of active volcanoes should assess the impact on plant risk posed by volcanic activity.	NMP1 is not located near a volcano; therefore, it is judged that risk posed to safe plant operation from a volcanic initiating event is negligible.

6.0 Licensee Participation and Internal Review Team

As with the IPE, NMPC believes that the maximum benefit from the IPEEE is derived when a significant investment of in-house resources is applied. NMPC has been involved in all aspects of IPEEE preparation and review. Section 6.1 shows the organization of the IPEEE development team and Section 6.2 shows the organization of the IPEEE review team. Sections 6.3 and 6.4 summarize the review process.

6.1 IPEEE Program Organization

The NMP1 IPEEE team was comprised of NMPC staff and contractors. The following table summarizes the IPEEE team and shows the areas of involvement for each team member.

NMP1 IPEEE Team

Team Member	Organization	Area of Responsibility
NMPC Staff		
Peter E. Francisco	Analysis	Project Manager, Fire & Seismic Analysis, Others Review
Robert F. Kirchner	Analysis	Project Management, PRA Support, Fire & Seismic Review, Others Analysis
L. D. Kassakatis	Analysis	PRA Support, Fire & Seismic Analysis, Others Review
Steven D. Einbinder	Analysis	Fire Analysis
Carmine V. Grippo	Mechanical Design	Fire Analysis
Carmen R. Agosta	Structural Design	Seismic Analysis
Ghassan B. Attiyeh	Analysis	Others (High Winds and Floods) Analysis
Consultants		
James H. Moody	J. H. Moody Consulting, Inc.	Lead Consultant, PRA Support, Fire Analysis, Seismic Analysis, Others Review
Thomas J. Casey	J. H. Moody Consulting, Inc.	PRA Support, Fire Analysis, Seismic Analysis
Walter Djordjevic	Stevenson and Assoc.	Seismic Analysis
Tsi-ming Tseng	Stevenson and Assoc.	Seismic Analysis
Tom Baileys	IBEX Eng Serv, Inc.	Fire Analysis

The following table shows the nature of the review provided within the IPEEE Team. The IPEEE team review was viewed as important for a number of reasons:

- IPEEE Team review reduces the reliance on the Independent Review Team.
- Because of the limited specialties involved in IPEEE, in many cases the IPEEE team relied on all cognizant NMPC staff; thus limiting the pool of available Independent In-house Reviewers.
- Provided more timely feedback on the analysis.
- Provided more opportunity to understand the inter-relationship between various IPEEE analysis tasks.
- Provided for review of associated Tier II documents upon which the Tier I is based.

IPEEE TEAM PREPARERS/REVIEWERS

Report Section	Preparer(s)	Reviewer(s)
3.1 Seismic Margins Method 3.1.1 Review of Plant Information, Screening, and Walkdown	See description in Section 3.1.1	NA
3.1.2 Systems Analysis	P. E. Francisco L. D. Kassakatis T. J. Casey J. H. Moody	R. F. Kirchner C. R. Agosta
3.1.3 Analysis of Structure Response	C. R. Agosta W. Djordjevic Tsi-ming Tseng	R. F. Kirchner J. H. Moody P. E. Francisco
3.1.4 Evaluation of Seismic Capabilities	C. R. Agosta W. Djordjevic Tsi-ming Tseng	R. F. Kirchner J. H. Moody P. E. Francisco
3.1.5 Analysis of Containment Response	T. J. Casey J. H. Moody	R. F. Kirchner L. D. Kassakatis P. E. Francisco
3.2 USI A-45, GI-131, and Other Seismic Safety Issues	T. J. Casey J. H. Moody	R. F. Kirchner L. D. Kassakatis P. E. Francisco
4.1 Fire Hazard Analysis	C. V. Grippo	S. D. Einbinder R. F. Kirchner J. H. Moody
4.2 Review of Plant Information & Walkdown	C. V. Grippo J. H. Moody	S. D. Einbinder R. F. Kirchner P. E. Francisco
4.3 Fire Growth & Propagation	T. Baileys	S. D. Einbinder R. F. Kirchner J. H. Moody
4.4 Evaluation of Component Fragility's & Failure Modes	J. H. Moody	S. D. Einbinder R. F. Kirchner
4.5 Fire Detection & Suppression	C. V. Grippo	S. D. Einbinder R. F. Kirchner J. H. Moody

IPEEE TEAM PREPARERS/REVIEWERS

Report Section	Preparer(s)	Reviewer(s)
4.6 Analysis of Plant Systems, Sequences & Response	T. J. Casey P. E. Francisco L. D. Kassakatis J. H. Moody	S. D. Einbinder R. F. Kirchner
4.7 Analysis of Containment Performance	T. J. Casey J. H. Moody	P. E. Francisco R. F. Kirchner L. D. Kassakatis
4.8 Treatment of Fire Risk Scoping Issues	C. V. Grippo J. H. Moody	S. D. Einbinder P. E. Francisco R. F. Kirchner
4.9 USI-45 and Other Safety Issues	T. J. Casey J. H. Moody	S. D. Einbinder R. F. Kirchner L. D. Kassakatis
5 High Winds, Floods, and Others	R. F. Kirchner	J. H. Moody G. B. Attiyeh L. D. Kassakatis P. E. Francisco

6.2 Composition of Independent In-house Review Team

The following individuals comprised the internal review team.

NMP1 IPEEE Independent In-house Review Team

Team Member	Organization
Julie Fischer	Technical Support - Generation
John Brady	Electrical Design - Engineering
Mohammad Alvi	Structural Design - Engineering
Mike Annett	Mechanical Design - Engineering (*Contractor)
Joe Thuotte	Licensing
Ted Kulczycky	Fuels and Analysis - Engineering

In addition, the in-house review team was supplemented by an external consultant. Robert Kennedy, Structural Mechanics Consulting, Inc., was contracted as an independent peer reviewer of the seismic portion of the IPEEE and A-46 programs. He was not involved in the preparation of the analysis and reviewed the program when the technical analysis was complete.

6.3 Areas of Review and Major Comments

Each portion of the analysis was reviewed by at least one IPEEE team reviewer and an independent reviewer. The IPEEE team review was handled informally and comments were generally incorporated directly within the development effort. The independent review comments were handled more formally. The independent review team was asked to comment on the Draft Tier I submittal. There were no "major" comments; where a major comment would be defined as one that led to a noteworthy change in IPEEE results.

6.4 Resolution of Comments

All review comments were either encorporated in the final draft or reviewed with the commenter.

7.0 Plant Improvements and Unique Safety Features

Performing the IPEEE (an external events risk assessment) leads to a unique perspective on the plant under study. Section 7.1 discusses NMP1 features that were noted to be of particular interest during the study. Improvements identified during the study that resulted in specific improvement initiatives are discussed in Section 7.2. In addition to these initiatives, the study developed some insights that are discussed in Section 7.3. For a number of reasons, these insights did not result in immediate action, but should continue to be studied by NMPC. As more research is performed and information becomes available, specific actions may be initiated.

7.1 Unique Safety Features

Some interesting NMP1 features were identified during the IPEEE and are summarized below:

Favorable Seismic Hazard

The seismic hazards developed for the NMP site area[17 and 18] are very favorable; based on these hazards, the seismic risk as described in Section 1 is relatively minor for NMP1.

Spatial Considerations

The observation from the IPE that spatial arrangement and separation of equipment is very good cannot be as strongly endorsed for internal fires. The weaknesses identified are associated with the location of electrical cables; a level of detail not considered in the IPE. Still the overall risk of fires is relatively low for a plant designed while the general design criteria were evolving.

Seismic Design

The seismic capacity of NMP1 structures, systems, and components was found to be relatively good. However, this conclusion is based on the assumption that identified modifications will be made. Seismic interactions due to seismically induced flooding and fires were found to be unlikely. Potentially significant fire hazards in the turbine building (hydrogen piping, and large oil tanks) and flooding hazards (fire water) are adequately designed to limit the effects of a seismic event.

Emergency Condensers

Availability of the emergency condenser shells (ECs) is not affected by fires and as long as a LOCA does not occur, the ECs extend the time to recover from severe fires, including station blackout. The ECs are important to reducing the likelihood of core damage, as well as the likelihood of early core damage which affects the likelihood of an early radiation release due to primary containment failure.

East & West Instrument Rooms and N1-SOP-14

These rooms contain local instruments (i.e., reactor level) that do not depend on AC or DC power. In the IPE, no credit was taken for the operators using these rooms after DC power is

exhausted during a station blackout (conservatively neglected, but the frequency is relatively low). However, in the IPEEE fire analysis, the use of these rooms is credited and is important; as a combination of ECs and/or the diesel fire pump (RPV makeup), and the capability to utilize the instrumentation in the east and west instrument rooms, including SOP-14 "Loss of Instrumentation", provides a potential success path. In addition, the analysis of high winds and tornadoes identified potential station blackout scenarios where the plant stack fails and falls on the emergency diesel generator rooms (offsite power is assumed lost due to the high winds or a tornado). Although the frequency of these events is relatively low, SOP-14 is credited recognizing that the East and West instrument rooms are not affected.

N1-SOP-9 "Fire in the Plant" and N1-SOP-9-1 "Control Room Evacuation"
These procedures were found to be well developed and thought out by station staff (the impact of fires by plant location is included within the procedure). The fact that these procedures address plant control from a combination of locations both locally and at the remote shutdown panels or control room in some detail is considered a plus.

Diesel Fire Water Pump
For fires and other external hazards, station blackout scenarios are important. The diesel fire pump is mostly independent of the spatial events that cause station blackout and it is important in reducing core damage frequency.

7.2 Plant Improvements

A number of benefits were derived from the IPEEE. An appreciation of the range of severe accidents that could occur at NMP1 now includes external hazards as well as the internal events evaluated in the IPE. The more likely sequences that contribute to risk, the importance of equipment, systems, and human actions that determine the risk are an immediate value. In addition, cost beneficial improvements are usually identified during these studies. Table 7-1 summarizes improvements or initiatives identified during the IPEEE; key improvements are summarized below:

Fire Analysis - The Fire portion of the IPEEE credits operator action in SBO scenarios where DC power fails. Under these scenarios all instrumentation is lost except devices in the east and west instrument rooms. These devices do not require DC power to provide RPV level, RPV pressure, and drywell pressure and represent a relatively unique NMP1 capability. A procedure, N1-SOP-14 "Alternate Instrumentation", is available which directs operators to use the east and west instrument room devices. However, a step in the procedure directs operators to "Verify RPS buses available." The IPEEE team was concerned that this step would cause problems in the SBO with DC power unavailable scenario since the RPS buses would not be available. As such DER 1-96-1736 was written. In the disposition of this DER Operations indicated that this step would not effect operators during the scenario of concern in the IPEEE. In further review of this issue the IPEEE team determined that operator training does not currently include review of these

type of SBO scenarios. As such, a Training Review Request (TRR) was written to request that operator training include a review of these types of scenarios and the associated use of the east and west instrument rooms.

Seismic Analysis - a number of modifications were identified in order to satisfy the 0.3g HCLPF (high confidence low probability of failure) screening value; the seismic analysis results are based on these modifications. These modifications are summarized in Section 3.0 and Table 7-1. Some house keeping improvements (i.e., routinely verifying that panel doors are closed and latched properly) were also identified during the walkdowns.

Other Hazards Analysis - the same improvement identified relative to SOP-14 in the fire analysis above applies to high winds and tornadoes. The likelihood of station blackout, although relatively low, can be cost effectively reduced by this improvement.

7.3 IPEEE Insights

There were additional insights identified during the IPEEE that may be considered in the future. These insights were identified similar to those in the section above, but have not been defined in a manner that supports closure. None of the insights are particularly risk significant, but in the future proposed improvements may prove cost-beneficial. These insights are included in Table 7-1 and some of the key insights are summarized below:

Fire Risk Insights - for the critical locations identified in this analysis, it is possible that programmatic controls of transient combustibles, use of thermography, even moving a small transformer could reduce the risk of fires. None of these potential improvements have been fully evaluated, but may be considered in the future. Similar to the IPE, station blackout was found to be relatively important; thus, insights from the IPE with regard to potential benefits of being able to recover offsite power with other DC boards (only battery board 11 can be used presently) and having a portable battery charger could be considered.

Both torus cooling and containment venting are rendered inoperable when instrument air is lost. Given the significant time available to locally operate these air operated valves, reliability of the decay heat removal function could be improved if there were procedures and a demonstrated capability (the valves do not have hand wheels, but could be repositioned with a nitrogen bottle or hand wheel addition could be evaluated). This was also identified in the IPE, but is potentially more important in the IPEEE.

The reliability of ERVs to reclose (failure to reclose prevents ECs from significantly delaying loss of RPV level), reactor recirculation pump seals (seal LOCA also reduces reliability of ECs), and the diesel fire water pump are important to the analysis results. These were also identified as important in the IPE and considered risk significant in the IPE. Thus, no changes in the

maintenance rule implementation, regarding the identification of risk significant systems, were found.

Seismic Risk Insights - The seismic analysis provides appropriate risk insights by considering a simple PRA model as described in Section 1. The non-seismic unavailability of front line systems at NMP1, such as ERVs, core spray (4 trains), and containment spray (4 trains), is relatively low. Thus, the most likely way to fail these systems is a seismic loss of offsite power (a known low capacity) and non-seismic failure of the emergency diesels (2 diesels are much less reliable than 4 trains of pumps and valves). Consistent with NMP2 and most seismic PRAs, station blackout is judged to be important. In addition, if the seismic capacity of ECs is relatively high (excluded from analysis scope) and the likelihood of LOCA conditions is relatively low (small LOCA was assumed in the analysis), station blackout could be coped with for some time over a range of earthquake levels approaching the 0.3g HCLPF screening value.

Similar to the fire analysis, proceduralizing the ability to locally operate air operated valves in the containment spray (torus cooling) and containment venting systems could be a potential cost beneficial improvement to the decay heat removal function.

As discussed above, emergency diesel reliability is judged to be most important for seismic events. Similar to the fire analysis, given station blackout, the reliability of ERVs to reclose (failure to reclose prevents ECs from significantly delaying loss of RPV level), reactor recirculation pump seals (seal LOCA also reduces reliability of ECs), and the ECs are important relative to delaying core damage. These were also identified as important in the IPE and considered risk significant in the IPE. Thus, no changes in the maintenance rule implementation, regarding the identification of risk significant systems, were found.

Other Hazards Insights - similar to the above, station blackout is judged to be the key scenario, thus the analysis of others is supportive of the above conclusions. Since the main stack can fall on the diesels, power boards, and support equipment, it is a noteworthy contributor to risk. Improved training in procedure N1-SOP-14 has been recommended to assure that this risk is controlled.

Table 7-1 NMP1 IPEEE Improvement Initiatives

Action ID	IPEEE Section	Improvement	Benefit	Significance	Status
1	Seismic	Control room panels F through N require top cross-ties	Control room panels have weak lateral support and could twist and separate in an earthquake. This would render a significant portion of the control room inoperable and would likely force evacuation and thereby significantly affect success path capabilities.	High, control room response following an earthquake is critical and should be reliable.	DER 1-95-3212 due RFO15, targeted for RFO14.
2	Seismic	Power boards 16A/B and 17A/B require base plug welding	These power boards are weakly anchored and could topple in an earthquake. This would fail a significant amount of equipment, combined with the likely coincident LOSP, would fail the success path.	High, failure of these power boards, combined with LOSP, would fail the success path.	DER 1-95-3140 due RFO15, targeted for RFO14
3	Seismic	Power boards 102/103 require rear base plug welding	These power boards are weakly anchored and could topple in an earthquake. This would fail a significant amount of equipment, combined with the likely coincident LOSP, would fail the success path.	High, failure of these power boards, combined with LOSP, would fail the success path.	DER 1-95-3090, 3091 due RFO15, targeted for RFO14.
4	Seismic	Aux Control room cabinets 1S34, 35, 36, 51, 52, 53, 54, 55, 56, 57, 59, 60, 62, 63, 64, 65, 69, 70, 73, 74, 75 require base fillet weld	1S34 through 36 have little impact, but could topple over on other critical cabinets with success path components. Cabinets 59, 60, 63, 64, 73 and 74 are also important based on containing success path components. The remaining cabinets are not important except to the extent they can impact other important cabinets.	High, failure of these cabinets can fail most if not all of the success path.	DER 1-95-3147, 3148, 3149, 3151, 3152, Targeted for RFO14.
5	Seismic	Aux Control room cabinets 1S37 through 42 require positive anchorage	These cabinets can topple on cabinets 1S80, 82, 84, 85, 86, 87, 88 failing all emergency AC power, Panels 1S37 and 1S38 dominate risk considerations.	High, failure of emergency AC, combined with LOSP, would fail the success path.	DER 1-95-3147, 3148, 3149, 3151, 3152 due RFO15, Targeted for RFO14.
6	Seismic	Aux Feed breakers require additional anchorage	Should these circuit breakers fail to transfer on demand they could align the EDG to offsite power and effectively fail the EDGs.	High, failure of these circuit breakers, combined with LOSP, would fail the success path.	DER 1-95-3141 due RFO15, Targeted for RFO14.

Table 7-1 NMP1 IPEEE Improvement Initiatives					
Action ID	IPEEE Section	Improvement	Benefit	Significance	Status
8	Seismic	Cable tray in turbine building El261 requires rod replacement	Failure of these cable trays could cause station blackout.	High, station blackout would fail the success path.	DCD 1S-00006 issued due RFO15, Targeted for RFO14.
9	Fire, Others	Enhance operator training on procedure N1-SOP-14 to include station blackout (SBO) mitigation without DC power	Long term unrecoverable SBO was a somewhat minor contributor in the IPE. However, IPEEE scenarios where AC power can not be recovered are more prevalent. Fire and high winds can lead to SBO scenarios where recovery is not likely for much longer than the 8 hours currently considered for SBO mitigation. It is proposed to have operator training review the procedure N1-SOP-14 "Alternate Instrumentation" in the context of a SBO with DC power unavailable. This would better enable NMP1 to cope with a long term SBO and would give NMP1 a capability unique within the nuclear industry.	High, this action item is considered to be significant such that IPEEE results will be adversely affected should it not be implemented	Training Review Request (TRR) written
10	Fire	Storage of combustibles in fire area T3B should be curtailed or more tightly controlled	Cables associated with both divisions of emergency AC, DC, and various front-line systems (i.e. feedwater) are located in the south-east corner of the turbine building (el 261') near the old personnel access point. During recent IPEEE team walkdowns a number of combustibles were noted in this immediate vicinity. These combustibles included: five drums filled with oily rags, paint cans, bags of trash, electronic equipment, and aerosol spray cans. All of these sources lead to a relatively high transient fire event probability in this area. Curtailing storage would reduce a significant fire related safety issue.	High, a relatively minor fire could result in severe plant impacts	DER 1-96-1737
11	Seismic	Cast iron inserts require tightness check and possible replacement	Cast iron inserts are used widely to attach cable trays to ceilings. Failure could result in widespread cable tray failure and failure of associated cables and equipment. Reliability of these components is crucial to maintaining the capability of the success path.	High, widespread failure of these anchors could fail the success path.	A-46 open item due RFO15

Table 7-1 NMP1 IPEEE Improvement Initiatives					
Action ID	IPEEE Section	Improvement	Benefit	Significance	Status
12	Seismic	Lead cinch anchors require tightness check and possible replacement	Lead cinch anchors are used for anchorage of various success path components. Their reliability is important to earthquake mitigation.	High, widespread failure of these anchors could fail the success path.	DCR N1-95-001LG545 issued due RFO15
13	Seismic	Secure control room ceiling panel diffusers to T-bars in ceiling	Ceiling panels could fall during a seismic event and impact operators. Modification would improve operator safety and effectiveness.	Moderate, would not necessarily effect success path capability; would affect operator reliability.	PID 11209 issued, due RFO15, targeted for RFO14
14	Fire	The following are potential improvements in critical areas requiring analysis: 1. additional control of combustibles (C1, T2B) 2. Thermography or a barrier (C1, T3B) 3. Move a small transformer or use of thermography (T3B)	These areas (cable spreading room, turbine building - southeast and turbine building north wall next to elevator) and scenarios contribute to the fire analysis results. Thus any inexpensive change to the plant can have a relatively large benefit.	Moderate	These areas have been added to the thermography program.
15a	Seismic	Relay 31D-X requires replacement or procedure change	This normally deenergized relay enables EDG field flashing. If normally open (NO) relay contact chatters EDG breaker will close and trip EDG. If NC contact chatters the field flash contactor 31D will chatter while passing field current and would likely result in catastrophic failure of the contact thus preventing EDG restart.	High, failure of this relay, combined with LOSP, would fail the success path.	Temporary procedure in place, long term fix via DER 1-94-1077 due RFO14
15b	Seismic	Relay 67NI requires testing, replacement, or procedure change.	This relay can momentarily actuate causing 86DG-3 relay to trip the EDG and the associated circuit breaker.	Moderate, results in EDG trip but failure is recoverable; EDG will restart on undervoltage after seismic motion subsides and breaker recloses automatically.	Temporary procedure in place, long term fix via DER 1-94-1077 due RFO15

Table 7-1 NMP1 IPEEE Improvement Initiatives					
Action ID	IPEEE Section	Improvement	Benefit	Significance	Status
15c	Seismic	Relay 87DG-2 requires testing, replacement, or procedure change.	This relay can momentarily actuate trip of the EDG and closure of associated circuit breaker.	Moderate, results in EDG trip but failure is recoverable; EDG will restart on undervoltage after seismic motion subsides and breaker recloses automatically.	Temporary procedure in place, long term fix via DER 1-94-1077 due RFO15
15c	Seismic	Relay 51G requires testing, replacement, or procedure change.	This relay can energize a trip of offsite power and prevent EDG breaker closure until relay is reset.	Moderate, results in EDG breaker trip but failure is recoverable; EDG will restart on undervoltage after seismic motion subsides and breaker recloses automatically.	Temporary procedure in place, long term fix via DER 1-94-1077 due RFO15
15d	Seismic	Relay 50/51 requires testing, replacement, or procedure change.	This relay can energize a trip of offsite power and prevent EDG breaker closure until relay is reset.	Moderate, results in EDG breaker trip but failure is recoverable; EDG will restart on undervoltage after seismic motion subsides and breaker recloses automatically.	Temporary procedure in place, long term fix via DER 1-94-1077 due RFO15
15e	Seismic	Relay 1H-9 requires replacement or procedure change.	This relay in the fire actuation system could actuate in a relatively minor seismic event. This would cause isolation of the EDG room HVAC system and actuation of Cardox fire suppression in several areas. Improvement of these relays would enhance the probability that important equipment is available to mitigate the impact of earthquakes.	Moderate, these relays could trip EDG ventilation which could only affect the EDG after some duration judged to be at least 30 minutes. Cardox initiation could affect operator actions outside the control room but this is not expected to be significant, actions can still be accomplished.	DER 1-95-2987 due RFO15

Table 7-1 NMP1 IPEEE Improvement Initiatives					
Action ID	IPEEE Section	Improvement	Benefit	Significance	Status
15f	Seismic	Relay 1H-10 requires replacement or procedure change	This relay in the fire actuation system could actuate in a relatively minor seismic event. This would cause isolation of the EDG room HVAC system and actuation of Cardox fire suppression in several areas. Improvement of these relays would enhance the probability that important equipment is available to mitigate the impact of earthquakes.	Moderate, these relays could trip EDG ventilation which could only affect the EDG after some duration judged to be at least 30 minutes. Cardox initiation could affect operator actions outside the control room but this is not expected to be significant, actions can still be accomplished.	DER 1-95-2987 due RFO15
15g	Seismic	Relay 74A-9 requires replacement or procedure change	This relay in the fire actuation system could actuate in a relatively minor seismic event. This would cause isolation of the EDG room HVAC system and actuation of Cardox fire suppression in several areas. Improvement of these relays would enhance the probability that important equipment is available to mitigate the impact of earthquakes.	Moderate, these relays could trip EDG ventilation which could only affect the EDG after some duration judged to be at least 30 minutes. Cardox initiation could affect operator actions outside the control room but this is not expected to be significant, actions can still be accomplished.	DER 1-95-2987 due RFO15
15h	Seismic	Relay 74A-10 requires replacement or procedure change	This relay in the fire actuation system could actuate in a relatively minor seismic event. This would cause isolation of the EDG room HVAC system and actuation of Cardox fire suppression in several areas. Improvement of these relays would enhance the probability that important equipment is available to mitigate the impact of earthquakes.	Moderate, these relays could trip EDG ventilation which could only affect the EDG after some duration judged to be at least 30 minutes. Cardox initiation could affect operator actions outside of the control room but this is not expected to be significant, actions can still be accomplished.	DER 1-95-2987 due RFO15

Table 7-1 NMP1 IPEEE Improvement Initiatives

Action ID	IPEEE Section	Improvement	Benefit	Significance	Status
15i	Seismic	Relay 45X-9 requires test, replacement, or procedure change	This relay in the fire detection circuitry could cause actuation of the 1H-9 relay with impact discussed above.	Moderate, see 1H-9	DER 1-96-1678 due RFO15
15j	Seismic	Relay 45X-10 requires test, replacement, or procedure change	This relay in the fire detection circuitry could cause actuation of the 1H-10 relay with impact discussed above.	Moderate, see 1H-10	DER 1-96-1678 due RFO15
15k	Seismic	Series 2 timer requires replacement or procedure change	This timer in the fire actuation system could actuate in a relatively minor seismic event. This would cause isolation of the EDG room HVAC system and actuation of Cardox fire suppression in several areas. Improvement of these relays would enhance the probability that important equipment is available to mitigate the impact of earthquakes.	Moderate, this timer could trip EDG ventilation which could only affect the EDG after some duration judged to be at least 30 minutes. Cardox initiation could affect ex-control room operator actions but this is not expected to be significant, actions can still be accomplished.	DER 1-95-2987 due RFO15

Table 7-1 NMP1 IPEEE Improvement Initiatives

Action ID	IPEEE Section	Improvement	Benefit	Significance	Status
16	Fire	Storage of combustibles in fire area A1 should be curtailed and smoking area designation removed	Cables associated with offsite power are located east of the chemistry offices on elevation 250' of the administrative building (G Building). The cables of concern are located in cable trays behind the locked gates in this area. Storage of records, computer equipment, and other combustible material was observed immediately under these cable trays. In addition, the area just outside the gate appears to be used as a break area. It was posted as a "Designated Smoking Area" and two ashtrays with cigarette butts were present. In addition, this area is also used for storage of files and other materials. Given the importance of offsite power, we recommend that, as a minimum, the material underneath the cable trays be moved and that smoking be prohibited in this area. Measures to remove all unnecessary storage in this area may also be prudent.	Moderate, a relatively minor fire could result in significant plant impacts	DER 1-96-1737
17	Seismic	Electrical cabinet doors should be checked periodically	Several electrical cabinet doors were found loose on a random sample basis during the walkdowns. In a seismic event they could rattle and lead to failure of sensitive equipment in the cabinet. This preventative maintenance activity would help to ensure operability of safety related equipment	Moderate, considered an enhancement to current preventative maintenance.	DER 1-95-3090, 3091 due RFO15, targeted for RFO14. Subsequent walkdown found doors tight but DER will still be pursued.

Table 7-1 NMP1 IPEEE Improvement Initiatives

Action ID	IPEEE Section	Improvement	Benefit	Significance	Status
18	Seismic	Lube oil reservoir sight glasses of pumps should be checked periodically	Several lube oil reservoir sight glasses were found loose on a random sample basis during the walkdowns. In a seismic event they could leak and lead to seizing the pump. This preventative maintenance activity would help to ensure operability of safety related equipment.	Low, considered an enhancement to current preventative maintenance. Based on additional walkdown, only pumps on success path with these type of reservoirs are core spray topping pumps (They were confirmed loose). With seismic/SLOCA scenario, pumps are of minimal importance since core spray pumps provide adequate flow.	DER/PID issuance pending
19	Fire, Seismic	Remove containment vent and torus cooling dependency on instrument air	Currently instrument air is required to align containment vent and containment spray in the torus cooling mode. Containment vent valves could be opened with handwheels. Containment spray valves 80-15, 16, 35, 36 currently fail as is (open) on loss of instrument air and have no handwheels for manual operation. It is proposed to have manual handwheels added to these valves so that operators could align torus cooling without instrument air. This would increase the reliability of torus cooling.	Low, this action item is considered to be a benefit but IPEEE results would not be adversely affected without implementation.	This action is considered cost-beneficial only if implemented along with other work that may arise in the future (i.e. perform this mod if valves are modified for any other reason). On hold for future consideration.

8.0 Summary and Conclusions

The NMP1 IPEEE set out with a number of goals and objectives. These were met by forming a capable in-house team and performing a state-of-the-art PRA analysis of external hazards impacts on the plant.

Quantitative results show that NMP1 poses no undue risk to the health and safety of the public. As a snapshot, the IPEEE and the IPE combined give confidence in the ability of NMP1 to safely produce electricity. Also, the study suggests that future cost effective improvements may be difficult to justify relative to external hazard risks. Clearly, the IPEEE with the IPE, as a living program, will continue to benefit the plant until decommissioning.

During the IPEEE, a number of unresolved issues were studied. Based on the IPEEE, these issues can be resolved. These issues are described in Sections 3.2 and 4.9.

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Drawing No. F-45030-C, Rev 1, Sheets 2 of 3
Drawing No. F-45030-C, Rev 3, Sheets 3 of 3
Drawing No. C-35970-C, Rev 5, Sheets 1 of 1
Drawing No. C-35971-C, Rev 8, Sheets 1 of 1
Drawing No. C-35972-C, Rev 4, Sheets 1 of 1
Drawing No. C-35973-C, Rev 3, Sheets 1 of 1
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