NMC
Committed to Nuclear Excellence

Nuclear Management Company, LLC
Prairie Island Nuclear Generating Plant
1717 Wakonade Dr. East • Welch MN 55089

October 16, 2000

Generic Letter 88-20

U S Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket Nos. 50-282 License Nos. DPR-42
50-306 DPR-60

Response to Requests for Additional Information Regarding Report NSPLMI-96001, Individual Plant Examination of External Events (IPEEE), Related to Generic Letter 88-20 (TAC Nos. M88663 and M88664)

In December 1996 and October 1998, we submitted, respectively, report NSPLMI-96001, PINGP Individual Plant Examination for External Events (IPEEE) and Revision 1 to that report, in response to Generic Letter 88-20. The NRC issued a Request for Additional Information (RAI) May 20, 1999 and we responded with a letter dated September 17, 1999. One of the areas of concern of the May 1999 RAI was the IPEEE treatment of fires. Our response to the "fire" questions prompted further questions from the NRC, transmitted by email. This letter responds to those questions; the questions are repeated with our response.

In this letter we have made no new Nuclear Regulatory Commission commitments. Please contact Jack Leveille (651-388-1121, Ext. 4142) if you have any questions related to this letter.

Joel P. Sorensen
Site General Manager
Prairie Island Nuclear Generating Plant

c: (see next page)

A011

c: Regional Administrator - Region III, NRC
Senior Resident Inspector, NRC
NRR Project Manager, NRC
J E Silberg

Attachments:
1. Affidavit
2. Response to RAI Area of Concern on Fire, Supplemental RAI 1
3. Response to RAI Area of Concern on Fire, Supplemental RAI 2

UNITED STATES NUCLEAR REGULATORY COMMISSION

NUCLEAR MANAGEMENT COMPANY, LLC

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

DOCKET NO. 50-282
50-306

GENERIC LETTER 88-20, INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS FOR SEVERE ACCIDENT VULNERABILITIES - 10 CFR 50.54(f)

Nuclear Management Company, LLC, a Wisconsin corporation, with this letter is submitting information requested by requests for additional information related to NRC Generic Letter 88-20.

This letter contains no restricted or other defense information.

NUCLEAR MANAGEMENT COMPANY, LLC

By Joel P. Sorensen
Joel P. Sorensen
Site General Manager
Prairie Island Nuclear Generating Plant

State of Minnesota
County of Goodhue
On this 16th day of October 2000 before me a notary public in and for said County, personally appeared Joel P. Sorensen, Site General Manager, Prairie Island Nuclear Generating Plant, and being first duly sworn acknowledged that he is authorized to execute this document on behalf of Nuclear Management Company, LLC, that he knows the contents thereof, and that to the best of his knowledge, information, and belief the statements made in it are true.

Jack Leveille

JACK ALAN LEVEILLE
NOTARY PUBLIC – MINNESOTA
My Comm. Expires Jan. 31, 2005

ATTACHMENT 2

Response to RAI Area of Concern on Fire, Supplemental RAI 1

Response to RAI Area of Concern on Fire, Supplemental RAI 1

Note that quotes from NRC emails have dotted underlines.

Supplemental RAI 1:

The original IPEEE fire RAI #3 was related to assumptions in the Prairie Island IPEEE on the assessment of electrical panel fires. One aspect of the question was related to the assumed heat release rate (HRR) values. The response to the RAI stated that a 65 BTU/s HRR was used in the fire analysis on a limited basis to determine whether further evaluation of individual panels was warranted. Panels and cabinets that might cause damage assuming the 65 BTU/s HRR were further assessed assuming a deterministic failure of circuits in overhead cable trays. The potential effect of a higher HRR was not examined apparently because the licensee concluded that higher HRR values would not affect the screening. This conclusion appears to contradict the described panel assessment process given that panels apparently were screened based on the damage potential assuming a 65 BTU/s fire. If a higher HRR is assumed, then some of these panels may no longer screen and would require further evaluation.

Furthermore, the response to original RAI #3 did not identify the types of panels/cabinets for which the 65 Btu/s HRR was assumed, did not establish a basis for concluding that the 65 BTU/s value was applicable to these panels, and did not compare the screening criteria used to the criteria provided in the revised EPRI guidance for responding to *Fire PRA Implementation Guide* Generic RAI Question 12 (on the same topic).

Finally, the response to original RAI #3 also states that the only location in the plant where the use of the 65 Btu/s HRR materially affected the analysis was Fire Area 18 (Relay and Cable Spreading Room). This response raises additional questions that were not resolved by the previous RAI response. A number of cabinets in this fire area were apparently screened on the basis of construction ("sealed with limited openings and vents") and the presence of cables that "... are either IEEE 383 qualified or equivalent." These screening criteria are not consistent with accepted practice, the available panel fire test results, the original *FIVE* guidance, nor the revised EPRI *Fire PRA Implementation Guide* guidance (see Generic RAI #12). Furthermore, in reviewing the response to original RAI #3, it was noted that in the analysis of Fire Area 18 (see the original IPEEE submittal, pg. A-2, Attachment A, Appendix B, Attachment 3), the 65 Btu/s HRR was reduced by 25%, apparently because the licensee interprets the 65 BTU/s value as only being applicable to open panels and "because of the small percentage of the total surface area that is open." This, too, is inconsistent with the available IPEEE guidance documents (see, in particular, the EPRI response to *Fire PRA Implementation Guide* Generic RAI #11 for the most recent guidance). Given these observations, it would appear that both the screening criteria and the HRRs used in the analysis of Fire Area 18 were inconsistent with, and more optimistic than, the criteria provided in any of the currently available IPEEE guidance documents.

Please re-assess the panel fire screening and fire assessment criteria and assumptions applied in the Prairie Island IPEEE including consideration of both panel fire HRR and the potential for fire spread outside the panel. Compare the applied criteria to the revised EPRI panel and cabinet fire assessment guidance provided in the EPRI responses to Generic RAI Questions 11 and 12. If the applied criteria were not consistent with the revised EPRI guidance, identify and reevaluate any affected compartments using the revised EPRI guidance. Re-analyze those panels and cabinets affected and provide the results, including revised CDF estimates, for the applicable fire scenarios. Explicitly include in this assessment a re-evaluation and discussion of the results for Fire Area 18 providing consistent treatment of the panels in this fire area.

Prairie Island's Original Response, Transmitted to the NRC July 6, 2000:

Attachment 3 to the IPEEE Internal Fires Analysis (Reference 1) identified the cabinets in the Relay Room that were considered potential fire ignition sources. The enclosures for each of these were examined to determine whether the potential for fire propagation outside the cabinet exists. Each cabinet was categorized into one of five different categories of enclosures based on whether openings in the cabinets exist, and, if so, whether other mitigating features (spatial separation, intervening materials, etc.) exist that would limit the potential for fire spread outside the cabinet. The five categories, identified as notes to the table on page A-13 of Reference 1, were:

1. The cabinet/panel is a standalone unit with no unsealed openings that present a fire propagation path. Cable entries are via conduits only.
2. The cabinet/panel is generally sealed. Limited openings/vents do exist, but the nearest overhead raceway (combustible) is located more than 1 foot above which satisfies the acceptance criteria for required spacing to prevent fire propagation.
3. Raceways above the cabinet/panel are provided with fire wrapping material. This material is credited for precluding the propagation of a postulated fire beyond the boundaries of the cabinet/panel.
4. The cabinet/panel is generally sealed. Limited openings/vents do exist and the nearest overhead raceway (combustible) is located less than 1 foot above the panel. Potential fire propagation to the trays must be evaluated.
5. The cabinet/panel is generally sealed. Limited openings/vents do exist and the nearest overhead raceway (combustible) is located less than 1 foot above the panel. However, this panel contains only electrical wiring and terminations. Postulated credible fire events are not considered to be capable of propagation beyond the panel boundaries.

These categories identify how the assumed 65 Btu/s heat release rate (HRR) was intended to be used as a screening criteria for the next phase of the analysis, core damage frequency quantification. Only Category 1 panels would be independent of HRR considerations in the potential for fire propagation, since they are sealed with no openings that provide a path for fire spread. Categories 2, 3, and 5 have openings, but

other considerations were considered to effectively preclude the spread of fires initiating within the panels. Only Category 4 panels would have been assumed to have the potential to spread and damage equipment beyond the panel boundaries. Had a HRR higher than 65 Btu/s been used in the analysis, it is possible that any or all of the cabinets in categories 2, 3 and 5 would also have been assumed to result in propagation outside the initiating cabinet.

However, notwithstanding the analysis presented in Reference 1, the existing IPEEE Fire PRA core damage frequency quantification for FA 18 (Relay Room) already includes a more conservative treatment for the potential of fire spread outside the cabinets. In fact, except for the small subset of cabinets identified in the Reference 1 analysis as being completely sealed and for which no pathway for propagation exists (Category 1 panels), fires in every cabinet and panel in the Relay Room were quantified as if they had the potential to spread.

The physical arrangement of cable trays in the room is such that only train-related trays are routed above the initiating cabinets with fire propagation potential. The fire propagation analysis in Reference 1, pp. A-3 and A-4, describes how horizontal propagation across a "gap" of over six feet would be required before the opposite train of equipment would be challenged. Therefore, for fires that propagate outside the initiating cabinet or panel, damage to one train of equipment is assumed. Assuming successful suppression of the fire (through either automatic suppression system initiation, or through manual means via the fire brigade response), plant shutdown from the control room with only the remaining train of equipment would then be required to prevent core damage. Failures of equipment in the remaining train due to causes unrelated to the fire were included in the quantification of successful shutdown. If manual and automatic suppression has failed, then shutdown from outside the control room (at the hot shutdown panel) is required. This treatment results in an upper bound to the CDF for FA 18, independent of the choice of HRR values. In addition, the existing analysis is consistent with (and likely more conservative than) the guidance given in EPRI's response to Generic RAI Questions 11 and 12.

It is recognized that the current submittal is unclear as to the actual panel screening criteria followed in development of the CDF for FA 18. Therefore, NSP will revise and clarify the text in the applicable sections of the IPEEE Internal Fires Analysis to reflect the actual (and potentially conservative) application of the fire modeling results in the CDF quantification. This work will be included in the next update to the Fire PRA, which will be performed following the Level 1 internal events PRA revision that is currently scheduled for completion later this year.

Reference:

1. NSPLMI-96001, Rev. 1, PINGP Individual Plant Examination of External Events (IPEEE), Appendix B, Rev. 2, Internal Fires Analysis, Attachment 3, ERIN Engineering Calculation 130-98-01, Rev. 0, Fire Area Scenario for FA 18.

NRC Evaluation of Prairie Island's Response Above:

Part 1

The licensee has cited cabinet classification and screening criteria that are unique, are not consistent with the revised EPRI panel fire analysis guidance, and may be optimistic. In particular, the licensee criteria appear to screen panels that do have openings but where the nearest raceway is at least 1 foot above the panel. No basis (other than judgement of the analyst) is provided for this screening criteria. In general, accepted practice would consider the potential for fire damage and/or fire spread at more substantial distances above a burning panel (based on fire modeling).

In the specific case of FA18, the Cable Spreading and Relay Room (CSRR), the actual analysis has apparently mitigated most of the potential optimism associated with the categories used to screen electrical panels as fire sources. For FA18, all panels, with the exception of fully closed panels, in which fires originated were apparently assumed to lead to a propagating fire that damaged one train of equipment. This would generally be acceptable provided that the fire propagation analysis supports the contention that the second equipment train is adequately separated so as to prevent fire spread and/or damage, and that the analysis, including the potential for fire suppression, has adequately considered the possibility of CSRR fires requiring MCR abandonment. There is little detail available to support this contention in the previous licensee submittals, and no additional information is provided in the proposed draft RAI response.

The fact that fully closed panels in FA18 were screened is not consistent with the revised EPRI guidance for Generic RAI Question 11 if the cabinets are rated for voltages at or above 480V. However, it is not likely that many such cabinets are present in the CSRR and even if such cabinets were included in the analysis, the effect on the fire risk would probably not be significant.

Overall the treatment of FA18 is acceptable, but contains weaknesses in the methods used, quantification, and treatment of fire spread.

Part 2

For plant areas other than FA18, the licensee has provided no additional information as to how the panel screening criteria used might have impacted the analysis. This was an important aspect of the supplemental RAI that is not addressed in the draft response. This point was emphasized during a conference call with the licensee. The licensee should be asked to focus additional attention on this aspect of the question. In particular, per the SRAI, the fire screening and fire assessment criteria that were used should be described and compared to the revised EPRI guidance for Generic Questions 11 and 12. In those cases where this comparison reveals inconsistencies, the affected cabinets will need to be re-analyzed and the results provided in the

response. Without this information, the potential impact on fire risk due to cabinet fires in areas other than FA 18 can not be assessed.

Prairie Island's Response to NRC Evaluation (immediately above):

The evaluation comments on our draft response for the first supplemental RAI question conclude, in part, that the treatment of the Relay Room (FA 18) in the IPEEE (Reference 1) is acceptable, but contains weaknesses in the methods used, quantification, and treatment of fire spread. We believe that several statements made in the evaluation (Part 1) apparently leading to this conclusion are incorrect based on information provided in previous submittals, and our basis is provided below. Our response to the request for additional information regarding the treatment of fires in plant areas other than FA 18 (Part 2) is also provided.

Part 1

- Our response repeated the Relay Room (FA 18) panel screening criteria from the IPEEE submittal, and provided an explanation of how that screening criteria was superceded by the probabilistic analysis that used a more conservative implementation of those criteria. However, the evaluation of our draft response asserts that no basis, except for the judgement of the analyst, was provided for the screening criteria applied to cabinets that are not fully closed but where the nearest raceway is at least 1 foot above the panel. That basis was provided in the original IPEEE submittal, and no discussion of the development of the original screening criteria was given because it was not believed to be necessary for responding to the RAI question. In response to the assertion, the reviewers are directed to the IPEEE submittal (Reference 1), Attachment 3, pp. A-2 to A-3 for a detailed description of the basis for the specified screening criteria. The following is an excerpt from this section of the IPEEE:

  > The FIVE Inside Plume worksheet predicts a critical target spacing of slightly over 2 feet while the Radiant Exposure worksheet predicts a critical target spacing of 10 inches. Since the virtual fire was located in the interior of the panel 2 feet from the top, the inside plume worksheet predicts a damage distance only slightly above the panel top. These results indicate that a postulated credible panel fire does not represent a significant threat to circuits in overhead raceways. This conclusion is consistent with the guidance in IEEE 384-1992 which suggests that wiring and component failures within enclosures have a very limited potential for propagation. Based on this information, the analysis was based on a criteria that a vertical spacing of 1 foot above the panel top was necessary in order to prevent propagation of a postulated electrical panel fire.

- After stating that the actual analysis had mitigated most of the "optimism" associated with the original screening criteria, the evaluation states that the treatment of FA 18 would be acceptable provided that the fire propagation analysis supports the contention that the second equipment train is adequately separated so as to prevent fire spread and/or damage, and that the analysis, including the potential for fire

suppression, has adequately considered the possibility of Relay Room fires requiring Main Control Room abandonment. The evaluation goes on to say that none of the submittals to the NRC provide the details to support this contention. However, the original submittal does indeed provide the detail desired by the reviewers (see Reference 1, Attachment 3, pp. A-3 and A-4). The following is an excerpt from the original submittal:

> A walkdown of the cable spreading room and review of electrical raceway drawings were performed to gain insights to the potential consequences. The drawing review determined that the arrangement of panels and raceways in the cable spreading room maintained train separation. This was confirmed by the walkdown. The panels and raceways in the room are arranged in two circular paths. The outer circle follows the room outer walls and consists of train B raceways and related panels. An inner circle contains the train A raceways and related panels. In addition, the network of safety related trays is designed such that they are over 2 feet above the panels. However, in many cases, this 2 foot space contains an intervening non-safety related tray. In some cases, there are two layers of non-safety related trays between the panel top and the safety related tray. Given this arrangement a postulated propagation of a panel fire beyond the panel boundaries would require the ignition of the intervening non-safety related trays before the safety related circuits are challenged. In addition, a horizontal propagation across a 'gap' of over 6 feet would be required before the 'opposite' train of safety related trays would be challenged.

This detail supports the fact that propagation to the opposite train of equipment is unlikely. However, the probabilistic analysis still conservatively includes the potential for propagation given unsuccessful suppression. In addition, only very limited credit (50%) for successful manual suppression of the fire was used in the analysis, which was intended to address complicating issues including control room abandonment.

- No panels within FA 18 were found to be rated and operated at voltages at or above 480 V. Therefore, the fact that fully closed panels in FA 18 were screened is consistent with the revised EPRI guidance for Generic RAI Question 11.

Part 2

The Prairie Island IPEEE submittal does contain the 65 Btu/s HRR assumption in the analysis of fires in areas other than FA 18. The assumption was used in the analysis of fires initiating in 480 V Motor Control Centers (MCCs) in the Unit 1 and Unit 2 Auxiliary Feedwater (AFW) Pump Rooms (FAs 31 and 32) and in the 695' elevation of the Auxiliary Building (FAs 58 and 73). The use of this assumption for MCCs was consistent with the revised EPRI guidance. Also, 65 Btu/s HRR was referred to in the discussion of the methodology used for the analysis of fires initiating in the main control board in the Control Room (FA 13). However, the analysis methodology used actually bounds fires with higher heat release rates. The following discusses the basis for these conclusions:

Motor Control Centers (MCCs): 480 V MCCs were evaluated as exposed ignition sources using the 65 Btu/s HRR, i.e., no credit was given for the potential for some MCCs to be classified as unvented with adequate breaker protection. Note that it is likely that most would screen from the analysis based on these considerations (adequate breaker protection exists for all MCCs, and all of the MCCs are essentially sealed). Also, all fires initiating within the MCC were assumed to result in failure of all equipment supplied by that MCC. Therefore, propagation beyond the single bundle of cables was conservatively assumed in all cases. In addition, all unprotected equipment (not enclosed within a 1 hour fire wrap) located within a height of 3.8 feet above the switchgear was assumed to be damaged. (Targets located above but laterally away from the MCC are outside the plume and damage was not assumed.) Based on this conservative treatment, no reevaluation of the MCCs using a higher HRR assumption is necessary.

Main Control Room: In the main control room, panels other than the main control board panels were found to be discrete structures with solid, non-combustible boundaries. Fires initiated in these panels were assumed to result in failure of all equipment within those panels but propagation to adjacent panels was not assumed. The main control board panels were evaluated as exposed ignition sources. The extent and consequence of panel internal wiring damage was conservatively evaluated using an overlapping zone approach. This approach basically assumes that any realistic panel fire could only affect a finite length of the panel given the available time for suppression. The use of overlapping zones allowed treatment of all credible scenarios. The linear length of each 'zone' was taken to be 10 feet. Fires initiating within the 25 overlapping control board zones identified were assumed to result in failure of all equipment controlled from that zone. Therefore, the analysis results depend on the choice of the length of each zone. A nominal control board panel fire HRR of 65 Btu/s was considered in the evaluation of the zone length. However, the final chosen zone length of 10 feet was considered conservative with respect to all credible internally-generated panel fires based on the combustible content of the panels, nuclear power plant operational experience with control board fires, and the high likelihood of detection and suppression by the control room operators prior to fire spread outside the zone. As such, assumption of a higher credible HRR (such as the 190 Btu/s value recommended in the revised EPRI guidance -- Reference 2, Section 4.12), would not have resulted in a larger assumed zone length. In addition, the overlap regions in all cases are greater than the 1.5 feet separation criterion in the revised EPRI guidance, with an average overlap of over 4 feet. Consequently, there are no issues with propagation of fires that initiate at or near the zone-to-zone interfaces. Therefore, no reevaluation of the control room panels using a higher HRR assumption is necessary.

References:

1. NSPLMI-96001, Rev. 1, PINGP Individual Plant Examination of External Events (IPEEE), Appendix B, Rev. 2, Internal Fires Analysis.

2. Electric Power Research Institute, Guidance for Development of Response to Generic Request for Additional Information on Fire Individual Plant Examination for External Events (IPEEE), Final Report. B. Najafi, et. al., May, 1999.

ATTACHMENT 3

Response to RAI Area of Concern on Fire, Supplemental RAI 2

Response to RAI Area of Concern on Fire, Supplemental RAI 2

Note that quotes from NRC emails have dotted underlines.

Supplemental RAI 2:

Original RAI #6 requested that the control system interactions issues associated with the Fire Risk Scoping Study (FRSS) and GSI-147 be addressed. The RAI response cited section B.2.13.5 of the IPEEE submittal which includes a discussion of the plant remote shutdown panel features and the capability to isolate necessary control functions and associated circuits from the control room via isolation switches. Spurious actuation of some valves was mentioned, but potential fire-induced LOCAs resulting from circuit faults and spurious actuations were not discussed. The issues of loss of control equipment or power before transfer and total loss of system function were also not discussed in the response.

Availability of a remote shutdown capability, by itself, is not considered adequate to address the control system interactions issues. In order to meet the objectives of the IPEEE process, the IPEEE fire assessment should include an explicit assessment of the remote shutdown capability including a human factors assessment of the likelihood that remote shutdown operations will be successful. It should also be noted that the *FIVE* methodology was approved by the USNRC for use in the IPEEE process subject to enhanced treatment of the Fire Risk Scoping Study issues. As a result, a response developed only on the basis of the *FIVE* guidance may be incomplete.

> ***Please re-assess the impact of the control system interactions issues that were not addressed in the response to original RAI #6 as identified above. In formulating a response, please consult sections 3.7 and 4.7 of the EPRI Fire PRA Implementation Guide revised guidance for responding to Generic RAI Question 7. The response should be formulated consistent with that revised guidance. In particular, the response should explicitly include an assessment of the reliability of remote shutdown operations and the impact on fire CDF of failure to control the plant from the remote shutdown station(s).***

Prairie Island's Response:

The EPRI revised guidance (Reference 2), Section 3.7, gives supplemental guidance regarding the steps outlined in the Fire PRA Implementation Guide (Reference 3), Appendix M for analysis of control systems interactions for control room fires. Analysis guidance regarding availability of the remote shutdown function following control room evacuation are also given. Section 4.7 provides guidance to follow in putting together the plant-specific response to the generic question. The following response was developed according to the Section 4.7 guidance (which is listed in italics):

"Review the Safe Shutdown Analysis and fire procedures to obtain and discuss the following attributes of the plant's safe shutdown methodology:

a) *Provide a discussion of the actions described in the MCR evacuation procedure, pre- and post-evacuation,"* *

Reference 5 provides the procedural steps necessary to achieve and maintain hot shutdown, and to cool down to cold shutdown in the event of a catastrophic fire that results in the functional loss and/or evacuation of the Control Room and Relay Room. The following is a summary of the actions performed by on-shift operations personnel pre- and post-evacuation, organized by position, to place both units in a stable hot shutdown condition:

Unit 1 Shift Supervisor: Upon making the decision to evacuate the Control Room, the Unit 1 Shift Supervisor will announce the evacuation, assure appropriate notifications are made and then proceed to the Hot Shutdown Panels in the Auxiliary Feedwater Pump Rooms. Using (Reference 5) Attachment A as a guide, he will then align equipment for operation from the Hot Shutdown Panels and locally from the AFW Pump Room. In radio communication with the various operators performing activities throughout the plant, he will direct additional activities as necessary.

Unit 2 Shift Supervisor: The Unit 2 Shift Supervisor proceeds to the Battery Rooms to deenergize selected DC circuits. The purpose of this activity is to prevent spurious operations in systems that could affect RCS inventory. The systems of concern are (1) Instrument Air supply to Containment (for CVCS control valves); (2) Pressurizer PORVs; (3) RCS Head Vent System. DC Control Power to 4KV safeguards Bus 15 is also deenergized at this time to prevent spurious breaker operation while the Unit 1 lead plant equipment operator is aligning power to Bus 15.

Unit 1 Reactor Operator (RO): The Unit 1 RO will trip the reactor, ensure turbine trip, close MSIVs and PORV block valves before leaving the Control Room. He then ensures both turbines are tripped at their respective pedestals. He then proceeds to the Screenhouse to verify the Cooling Water Headers and Fire Protection Header are pressurized. If he finds that the local cooling water header pressure indicator is reading low, he locally starts the diesel cooling water pumps by disabling control power to the pumps and manually overriding the starting air solenoid valves. Once these actions are completed, the Unit 1 RO is available to the Shift

* Electric Power Research Institute, Guidance for Development of Response to Generic Request for Additional Information on Fire Individual Plant Examination for External Events (IPEEE), Final Report. B. Najafi, et. al., May, 1999.

Supervisor in the AFW Pump Room for additional assignments as necessary.

Unit 2 Reactor Operator (RO): The Unit 2 RO will trip the reactor, ensure turbine trip, close MSIVs and PORV block valves before leaving the Control Room. He then proceeds to the Auxiliary Building to (1) shift Train A CC Pumps to "LOCAL"; (2) disable Unit 2 MSIVs to prevent spurious opening; (3) disable U2 steam supply MOVs to 22 Turbine-Driven AFW pump to prevent spurious closure; and (4) align and start 22 Charging Pump for RCS inventory control; (5) place the motor-control center breakers for the Unit 2 RHR suction MOVs from the containment sump in the "off" position and verify that the valves are closed to prevent spurious opening, and (6) close the VCT outlet manual valve to prevent gas intrusion into the charging pump suction. The Unit 2 RO is then available for further assignments as directed by the Shift Supervisor in the AFW Pump Room.

Auxiliary Building Auxiliary Plant Equipment Operator (APEO): The Auxiliary Building APEO will (1) remove fuses to disable pressurizer PORVs for both units to prevent spurious opening; (2) disable Unit 1 MSIVs to prevent spurious opening; (3) disable Unit 1 steam supply MOVs to 11 Turbine-Driven AFW pump to prevent spurious closure; (4) align and start 12 Charging Pump for RCS inventory control; (5) place the motor-control center breakers for the Unit 1 RHR suction MOVs from the containment sump in the "off" position and verify that the valves are closed to prevent spurious opening; and (6) close the VCT outlet manual valve to prevent gas intrusion into the charging pump suction. The Auxiliary Building APEO is then available for further assignments as directed by the Shift Supervisor in the AFW Pump Room.

Unit 1 Lead Plant Equipment and Reactor Operator: The Unit 1 LPE&RO will perform necessary actions to assure 4KV safeguards Bus 15 and its associated 480V buses are energized to provide power for necessary safe shutdown equipment.

Unit 2 Lead Plant Equipment and Reactor Operator: The Unit 2 LPE&RO will perform necessary actions to assure 4KV safeguards Bus 25 and its associated 480V buses are energized to provide power for necessary safe shutdown equipment.

Shift Manager: The Shift Manager proceeds to the Technical Support Center and functions as Emergency Director. The Shift Manager will provide technical assistance to the Shift Supervisors in the AFW Pump Room. If the Emergency Response Computer System (ERCS) is available, the Shift Manager will monitor plant parameters and provide information to the Shift Supervisors as needed.

Once the necessary actions have been completed to place the units in Hot Shutdown, a status evaluation will be performed by the Shift Manager, Shift Supervisors and Technical Support Center personnel. A controlled cooldown to cold shutdown is described in Reference 5, Section 4.0 as a guideline for cooldown activities. Depending on actual conditions, alternative strategies may be employed as directed by plant management.

"b) *Explain features and/or actions taken to ensure electrical isolation of the remote shutdown capability,"* *

Reference 4, Appendix C provides the Appendix R Safe Shutdown Analysis for Fire Areas 13 and 18, the Control Room and Relay Room. It states that, in general, control circuitry for Train A equipment is designed with appropriate local/remote isolation, which allows out-plant (local) operation, or local manual operation to be credited.

Instrument loops for a Control Room/Relay Room fire are isolated from the Hot Shutdown Panel circuitry for channels which have indication at the Hot Shutdown Panel. Both trains of Event Monitoring instrumentation are available at the Hot Shutdown panels; however, Train A is the Appendix R-required set of instrumentation. For flux monitoring and wide range pressurizer level, only the Train A loops have local (outside the Control Room) indication available and is, therefore, the credited set. Other available indications in the AFW pump room/Hot Shutdown panel area include AFW pump flow, pressurizer level, RCS pressure and RCS temperature. Since RCS loop B temperature may not be available, decay heat removal is aligned to the Train A (11 and 21) steam generators. Steam generator pressure indication is also available at the Hot Shutdown Panel, however, it may be affected by the fire in the Control Room or Relay Room. The control room evacuation procedure (Reference 5) provides alternate indication locations in the Auxiliary Building for verification of this parameter. The Emergency Response Computer System (ERCS) may also be available to provide indications of system parameters. This information would be relayed by the Shift Manager in the Technical Support Center.

Reference 5 identifies the primary means through which electrical isolation of the remote shutdown capability is ensured. The Unit 1 Shift Supervisor provides a large portion of the isolation function through his actions to place the Local/Remote control switches for the required circuits in the AFW pump room to "LOCAL". This provides local isolation for the following equipment:

- Group A and B pressurizer heaters

---

* Electric Power Research Institute, Guidance for Development of Response to Generic Request for Additional Information on Fire Individual Plant Examination for External Events (IPEEE), Final Report. B. Najafi, et. al., May, 1999.

- Train A and B AFW pumps
- Train A and B AFW pump suction MOVs from cooling water system
- Train A and B AFW pump suction MOVs from condensate system
- Train A and B AFW pump discharge throttle MOVs to both SGs
- CVCS letdown orifice isolation valves
- Train A boric acid transfer pump
- Train B charging pumps
- Steam generator PORVs

The Unit 1 Shift Supervisor then aligns the AFW system for operation from the AFW pump room. The motor control center breakers for the suction isolation valves from the CSTs are opened to prevent potential spurious operation, and the valves are verified open. He then verifies system operation by checking that the pumps are running, starting them locally if necessary, and verifying system flow and steam generator pressure. Alternate local indication of steam generator pressure is also specified in the procedure should the indication on the hot shutdown panel be affected by the fire. Motor control center breakers for the AFW pump discharge to steam generator throttle valves (and, if necessary, for the alternate suction supply motor-operated valves from the cooling water system) are opened to prevent spurious operation, and the valves are manually operated to maintain adequate flow to at least one steam generator per unit.

If Train A safeguards 4kV and 480 V buses are available, the shift supervisor then shifts control for the 121 and 123 instrument air compressors to LOCAL and starts them from the local ON/OFF switches in the AFW pump room. The shift supervisor then controls RCS temperature with the Train A SG PORVs, and maintains pressurizer level and RCS pressure within a set range using charging pumps and pressurizer heaters. When hot shutdown conditions can be maintained, at least one safeguards bus per unit is available and the fire has been extinguished, then cooldown to cold shutdown is performed.

The Unit 2 RO and the Auxiliary Building APEO also have duties upon control room evacuation that assist in isolation of the remote shutdown capability. The Unit 2 RO proceeds to Auxiliary Building to shift the Train A CC pumps to "LOCAL" and locally aligns and starts the 22 Charging Pump for Unit 2 RCS inventory control. The Auxiliary Building APEO locally aligns and starts the 12 Charging Pump for Unit 1 RCS inventory control. Prior to starting the pumps, suction for both charging pumps is locally shifted to the Refueling Water Storage Tank (RWST).

The Unit 1 and Unit 2 LPE&ROs also both assist in isolation of the remote shutdown capability by locally establishing power supplies to the Train A 4kV electrical buses that are not affected by the fire. At each of the Train A 4kV buses (Buses 15 and 25), the LPE&RO determines the status of the feeder breakers to the bus. For Unit 1 Bus 15, he shifts LOCAL/REMOTE switches for

the 480 V transformer load breakers to the "LOCAL" position. Since the protection circuitry for the breaker providing the normal offsite power source to Bus 15 is potentially damaged by the fire, (if found to be closed) this breaker is locally tripped and voltage restoration is allowed to repower the bus from the alternate offsite source or emergency diesel generator (this step is not necessary for Unit 2 Bus 25, since the normal offsite source breaker circuitry is not affected by the fire). For both buses, verification of the source providing power to the bus is accomplished locally by observing relay target flags inside the respective safeguards bus sequencer.

If an offsite source is powering the bus, then at the diesel generator local panels, remote metering is established, and the diesel generator and output breaker isolation switches are placed in "LOCAL". If an offsite source is not available and cannot be established, then the associated diesel generator is verified to be running. If necessary, the diesel generator is locally started. At the diesel generator local panels, remote metering is established, the diesel generator and output breaker isolation switches are placed in "LOCAL", and local engine control is established.

After verifying successful repowering of the bus through either offsite power or the onsite diesel generator source, alignment of the 480 V safeguards supply breakers is verified, and DC control power is reestablished to the bus. The Unit 1 Shift Supervisor at the Hot Shutdown Panel is then notified of the availability of the bus for local starting of the Train A CC pump. While DC control power is unavailable to the 4kV buses, if any breakers are found to be not in the correct shutdown alignment, local manual breaker operations to restore the system are performed using protective equipment pre-staged in areas adjacent to the 4kV buses.

Once conditions have been stabilized at Hot Shutdown, then with concurrence of the Shift Manager and the Operations Committee, cooldown and depressurization to Cold Shutdown may commence according to the procedure in Reference 5. If the Control Room remains unavailable for this evolution, then it is performed locally using Train A equipment. In this process, breakers for all equipment required to operate are opened (or in the case of MCC breakers, placed in OFF) and all pump breaker operations and valve operations are performed manually. All tools and other materials required for these operations are located in dedicated storage containers near the work locations.

"c) *Explain features and/or actions taken for preventing spurious actuations that could potentially impact component availability at the remote shutdown locations:"* *

* Electric Power Research Institute, Guidance for Development of Response to Generic Request for Additional Information on Fire Individual Plant Examination for External Events (IPEEE), Final Report. B. Najafi, et. al., May, 1999.

The actions described in section b) above to isolate the remote shutdown capability also prevent spurious actuations of equipment. In addition, the following are actions taken during the preparation for shutdown from outside the control room for the purpose of preventing spurious equipment actuations:

1. In the AFW pump room, the Unit 1 Shift Supervisor performs the following actions to prevent spurious equipment operation:
   - places the motor control center breakers for the suction isolation valves from the condensate storage tanks (CSTs) in OFF to prevent potential spurious operation, and the valves are verified open, and
   - places the motor control center breakers for the AFW pump discharge to steam generator throttle valves (and, if necessary, for the alternate suction supply motor-operated valves from the cooling water system) in OFF to prevent spurious operation, and the valves are manually operated thereafter.
2. The Unit 2 Shift Supervisor locally deenergizes circuits supplying DC control power to Unit 1 Train A 4kV Bus 15, in order to prevent spurious breaker operation while the Unit 1 lead plant equipment operator is aligning power to that bus.
3. In the Auxiliary Building, the Unit 2 RO performs the following actions to prevent spurious operation of equipment:
   - disables the Unit 2 main steam isolation valves (MSIVs) to prevent spurious opening (MSIV accumulators are isolated and bled down to ensure that the valves close and steam flow is secured), and
   - places the motor control center breakers for the U2 steam supply motor-operated valves to 22 Turbine-Driven AFW pump in OFF to prevent spurious closure.
4. The Auxiliary Building Auxiliary Plant Equipment Operator (APEO) performs the following actions to prevent spurious operation of equipment:
   - removes fuses to disable pressurizer power-operated relief valves (PORVs) for both units to prevent spurious opening,
   - disables the Unit 1 main steam isolation valves (MSIVs) to prevent spurious opening (MSIV accumulators are isolated and bled down to ensure that the valves close and steam flow is secured), and
   - places the motor control center breakers for the U1 steam supply motor-operated valves to 11 Turbine-Driven AFW pump in OFF to prevent spurious closure.
5. During the cooldown and depressurization to Cold Shutdown, and the establishment of long term cooling from the RHR system, breakers for all equipment required to operate are opened (or in the case of MCC breakers, placed in OFF) to prevent spurious operation and all pump and valve operations are performed manually.

"d) *Explain features and/or actions taken for preventing spurious actuations that could cause LOCA or interfacing systems LOCA."* *

The following are features of the plant design or configuration during normal operation that prevent spurious actuations from resulting in a LOCA or an interfacing systems LOCA (ISLOCA):

1. The parallel RHR suction lines from the loop RCS hot legs are isolated by redundant, closed motor-operated valves. Also, the motor-control center breakers for the inside containment isolation valves are maintained in the "OFF" position.
2. The RHR shutdown cooling return line to the RCS loop B cold leg is isolated by a closed motor-operated valve with the motor-control center breaker maintained in the "OFF" position.
3. Each of the RHR and SI injection lines are isolated from RCS pressure by two check valves in series (or in the case of the ¾" diameter SI injection and accumulator injection test lines, one check valve and one normally closed, fail closed air-operated valve in series), rather than reliance only on closed motor-operated valves that could be susceptible to spurious actuation.

The following operator actions are taken following Control Room evacuation to prevent these types of spurious equipment actuations:

1. The Unit 2 Shift Supervisor deenergizes circuits in the Battery Rooms that prevent spurious actuation of the following equipment that could cause a loss of RCS inventory or small LOCA:
   - Instrument air supply to containment (CVCS letdown, excess letdown isolation valves),
   - Pressurizer power-operated relief valves (PORVs), and the
   - RCS Head Vent System.
2. The Auxiliary Building Auxiliary Plant Equipment Operator (APEO) removes fuses to disable pressurizer PORVs for both units to prevent spurious opening (provides a redundant isolation function to the Unit 2 SS actions described above to ensure PORV closure),
3. The following actions are taken to prevent spurious equipment operation that could result in an intersystem LOCA:
   - In the Auxiliary Building, the Unit 2 RO places the motor-control center breakers for the Unit 2 RHR suction motor-operated valves from the containment sump in the "OFF" position and verifies that the valves are closed to prevent spurious opening.
   - The Auxiliary Building Auxiliary Plant Equipment Operator (APEO) places the motor-control center breakers for the Unit 1 RHR suction motor-

* Electric Power Research Institute, Guidance for Development of Response to Generic Request for Additional Information on Fire Individual Plant Examination for External Events (IPEEE), Final Report. B. Najafi, et. al., May, 1999.

operated valves from the containment sump in the "OFF" position and verifies that the valves are closed to prevent spurious opening.

4. During the cooldown to cold shutdown following control room evacuation, the motor-control center breakers for all motor-operated valves in the RHR and SI systems that interface with the RCS and that require operation are placed in the "OFF" position and the valves are operated manually.

"Discuss where and how the fire IPEEE models:

a) The extent (e.g., all circuits in the panel fail in the undesired mode) and timing (e.g., before or after the transfer) of the fire induced failures in the MCR including hot shorts," *

In the IPEEE Control Room fire analysis, the main control board was considered to consist of a series (25 in all) of overlapping control board zones. In addition, 62 other panels were identified within the Control Room that were assumed to be potential fire sources. A fire initiating in any main control board zone or other control room panel was assumed to result in the failure of all equipment controlled within that zone or panel to the most undesirable state. If spurious actuation of the affected equipment produced the most undesirable state in the recovery from the fire, then that failure mode was assumed. All fire-related equipment failures and spurious actuation events were assumed to occur immediately upon the initiation of the fire, and their probability of occurrence was assumed to be unity (1.0).

Examples of treatment of fire-induced failures from the Fire IPEEE Control Room fire analysis (Reference 6) include:

- A fire initiating in main control board Zone 6 (initiating event I-F13-ZONE6) was assumed to immediately result in a transient similar to an unisolable Main Steamline Break (MSLB), since the controls for both SG PORVs exist in this panel and are assumed to spuriously open due to the fire. In addition, the fire was assumed to cause the immediate loss of the Main Feedwater (MFW) and the Auxiliary Feedwater (AFW) systems.
- A fire initiating in main control board Zone 8 (initiating event I-F13-ZONE8) was assumed to immediately result in a small LOCA, since the controls for both pressurizer PORVs exist in this panel and are assumed to spuriously open due to the fire. Controls for the PORV block valves are also located in this panel, and were assumed to be unavailable for isolation of LOCA from the outset of the event. In addition, the fire was assumed to cause the immediate loss of the CVCS charging pumps.

* Electric Power Research Institute, Guidance for Development of Response to Generic Request for Additional Information on Fire Individual Plant Examination for External Events (IPEEE), Final Report. B. Najafi, et. al., May, 1999.

- A fire initiating in control board Zone 7 (I-F13-ZONE7), which was assumed to overlap equipment controls in both Zones 6 and 8, could affect both the SG PORVs, and the pressurizer PORVs. Therefore, this fire was assumed to result in the immediate initiation of both a small LOCA and a MSLB-transient on both SGs. Potential core damage sequences due to both initiating events were conservatively quantified.

Fire-related failures and spurious actuation of equipment from Relay Room fires were treated in a manner similar to that used in the analysis of Control Room fires. Examples of treatment of fire-induced failures from the Fire IPEEE Relay Room fire analysis (Reference 1) include:

- A fire initiating in Panel TB1202 (initiating event I-F18-TB1202) was assumed to immediately result in a transient similar to loss of Main Feedwater (LOFW), due to the assumed immediate loss of the Main Feedwater (MFW) and the Auxiliary Feedwater (AFW) systems.
- A fire initiating in Panel TB1211 (initiating event I-F18-TB1211) was assumed to result in failure of the 12 AFW pump, and a number of MFW and AFW system motor-operated valves. Some of these valves have more than one failure mode modeled in the Fire PRA . For example, failure of the AFW discharge throttle valves to the SGs to remain open (to provide flow) and to close (to provide isolation of the AFW system from a faulted SG) were both modeled. In these cases, all failure modes for the components were conservatively assumed to have occurred due to the fire.
- A fire initiating in Panel TB1218 (initiating event I-F18-TB1218) was assumed to result in failure of the Train A (12) Charging pump and MSIV. Also, the Train A pressurizer PORV and MSIV, and the Train A RCS and pressurizer vent solenoid-operated valves are affected. Spurious opening of these valves is assumed to result in a small LOCA.

"b) The ability to recover from fire-induced LOCA and interfacing systems LOCA." *

In the Fire IPEEE analysis, once a fire-induced LOCA was assumed to have occurred, no credit was given for the potential to isolate the LOCA and terminate the event. It was assumed that systems that remained free from fire damage were required to be used in conjunction with plant procedures for safe shutdown of the unit. A review for operator actions that could not be credited in the response to each of these fires (due to equipment damage or other fire-related limitations, including access to equipment) was also included in the analysis.

No significant additional risk for fire-induced interfacing systems LOCA was identified in the Fire IPEEE. As described in the response to Generic RAI

* Electric Power Research Institute, Guidance for Development of Response to Generic Request for Additional Information on Fire Individual Plant Examination for External Events (IPEEE), Final Report. B. Najafi, et. al., May, 1999.

Question d) above, the plant design, together with the required at-power systems alignment and procedures available for safe shutdown in response to fires was found to effectively limit the risk of fire-induced interfacing systems LOCA.

The likelihood of unsuccessful shutdown from outside the control room is dominated by fire-affected equipment failures and by operator action failures. Treatment of fire related equipment failures and spurious actuation is discussed above. In addition, many local operator actions are required and familiarity with the specific actions is not as high as with more routine evolutions. However, regular training of licensed operators on the actions is performed. The Fire IPEEE assumed a failure probability of 6.4E-2 for shutdown from outside the control room. The overall contribution to core damage frequency from fires involving failure of shutdown from outside the control room was 5.3E-6/rx-yr (10.9% of the total CDF) . If the remote shutdown function was assumed to have a failure probability of 1.0, then the CDF from fires would rise by less than a factor of 3 (Risk Achievement Worth of 2.94). Due to its importance to the overall risk due to fires, the IPEEE submittal included a recommendation that the risk significance of this activity be stressed in operator training (this recommendation has since been implemented – see Reference 7, response to previous RAI Question #8).

References:

1. NSPLMI-96001, Rev. 1, PINGP Individual Plant Examination of External Events (IPEEE), Appendix B, Rev. 2, Internal Fires Analysis, Attachment 3, ERIN Engineering Calculation 130-98-01, Rev. 0, Fire Area Scenario for FA 18.
2. Electric Power Research Institute, Guidance for Development of Response to Generic Request for Additional Information on Fire Individual Plant Examination for External Events (IPEEE), Final Report. B. Najafi, et. al., May, 1999.
3. Electric Power Research Institute Report TR-105928, Fire PRA Implementation Guide, Final Report. W. J. Parkinson, et. al., December, 1995.
4. PINGP Calculation GEN-PI-026, Safe Shutdown Analysis for Compliance with 10CFR50, Appendix R, Section III.G, Rev. 2, Northern States Power Company, June 1998.
5. PINGP procedure F5, Appendix B, "Control Room Evacuation", Rev. 20.
6. NSPLMI-96001, Rev. 1, PINGP Individual Plant Examination of External Events (IPEEE), Appendix B, Rev. 2, Internal Fires Analysis, Attachment 2, ERIN Engineering Calculation 130-98-01, Rev. 0, Fire Area Scenario for FA 13.
7. Letter dated September 17, 1999, J. Sorensen (NSP) to USNRC, "Response to Request for Additional Information Regarding Report NSPLMI-96001, Individual Plant Examination of External Events (IPEEE), Related to Generic Letter 88-20".