Mr. Roger O. Anderson, Director
Nuclear Energy Engineering
Northern States Power Company
414 Nicollet Mall
Minneapolis, MN 55401

May 20, 1999

SUBJECT: PRAIRIE ISLAND NUCLEAR GENERATING PLANT: REQUEST FOR ADDITIONAL INFORMATION CONCERNING IPEEE PROGRAM (TAC NOS. M88663 AND M88664)

Dear Mr. Anderson:

Based on the staff's ongoing review of the Individual Plant Examination of External Events (IPEEE) submittals for the Prairie Island Nuclear Generating Plant (PINGP) dated December 1996, March 1998, and December 1998, we have determined that certain additional information is necessary to complete our review. The enclosed request for additional information (RAI) pertains to areas of seismic, fire, high winds, floods, and other external events. As agreed upon in a May 19, 1999, teleconference with Mr. Jack Leveille of your staff, your response is expected within 120 days of the date of this letter. If you have any questions regarding this matter, please contact me at (301) 415-1392.

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Sincerely,

Original signed by:
Tae Kim, Senior Project Manager, Section 1
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-282
and 50-306

Enclosure: As stated

cc w/encl: See next page

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| DATE | 5/20/99 | | 5/20/99 | | 5/11/99 | | 5/20/99 | |

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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Mr. Roger O. Anderson, Director
Northern States Power Company

Prairie Island Nuclear Generating
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## PRAIRIE ISLAND NUCLEAR GENERATING PLANT

### Request For Additional Information on IPEEE Submittal

**Seismic**

1. Although it is stated in the IPEEE submittal that the Prairie Island seismic margins assessment follows the guidance of EPRI NP-6041-SL, the procedures used in the success path selection of structures, systems, and components are not consistent with those described in EPRI NP-6041-SL. Success path logic diagrams (SPLDs) were not provided in the IPEEE submittal; although equipment for important safety functions were identified and discussed, specific success paths that could bring the plant to a safe shutdown condition were not identified. It is not clear whether the selected equipment can provide two success paths with sufficient redundancy and diversity.

   In addition, the six safety functions used in the Prairie Island IPEEE for system selection (discussed on page A-11) are not consistent with the four safety functions identified in EPRI NP-6041-SL: (1) reactivity control; (2) reactor coolant system pressure control; (3) reactor coolant system inventory control; and (4) decay heat removal.

   Please provide information on success path development and system selection consistent with that described in EPRI NP-6041-SL. Please include in the discussion the development and identification of the success paths, the systems and equipment included in the Safe Shutdown Equipment List (SSEL) and their safety functions, and the isolation of systems that are excluded from the SSEL (for example, successful isolation of the condensate storage tanks when the water source of the auxiliary feedwater (AFW) pumps is switched).

2. Prairie Island has been identified in NUREG-1407 as a plant belonging to the 0.3g focused-scope seismic margin assessment group; hence, the evaluation that was performed for the Prairie Island seismic IPEEE (using a reduced-scope at 0.12g pga) does not conform to the guidance in NUREG-1407 and Supplement 4 to Generic Letter (GL) 88-20.

   Please provide the following:

   a) a list of structures, systems, and components (including SSEL items and containment systems equipment) that did not screen at the 0.3g Review Level Earthquake (RLE).

   b) the basis for the disposition of each item that did not screen at the 0.3g RLE, including the results of new calculations for seismic capacities.

   c) an evaluation (at 0.3g RLE) of masonry/block walls that may influence the performance of success path components.

d) an evaluation (at 0.3g RLE) of flat-bottomed tanks, as requested in NUREG-1407 and GL 88-20 for focused-scope plants. Address both tank failures themselves as well as potential flooding concerns resulting from tank failures.

e) the comparisons of the design basis ground spectrum and in-structure response spectra (IRS) to the IPEEE 0.3g pga RLE ground spectrum and in-structure response spectra. If scaling is used, describe the scaling method. If new IRS are generated, describe the analyses performed to generate all significant RLE IRS.

f) the seismic evaluation for the refueling water storage tank (RWST).

3. Non-seismic failures and human actions are not specifically discussed in the IPEEE submittal. For non-seismic failures and human actions, NUREG-1407 states that "Success paths are chosen on a screening criterion applied to non-seismic failures and needed human actions. It is important that the failure modes and human actions are clearly identified and have low enough probabilities to not affect the seismic margins evaluation." Since specific success paths were not identified in the IPEEE (see Question 1) discussions of non-seismic failures and human actions, and their impact on the selection and reliability of the success paths, were not provided.

   Please discuss these issues in accordance with Section 3.2.5.8 of NUREG-1407 and Section 3 of EPRI-NP-6041-SL.

4. The Cooling Water system is very important for Prairie Island. In addition to providing the cooling water source for both equipment cooling and heat removal (directly or indirectly through component cooling water (CCW) and Safeguards Chilled Water), it also provides an alternate water supply to the AFW system (but represents the only AFW source for the IPEEE). It consists of five pumps shared by the two units. Only three of the five pumps (two diesel-driven and one motor-driven) will be available following a loss of offsite power, and all of them were found in the IPEEE and the A-46 program to have anchorage and shaft stability problems. As a result of the A-46 program finding, the two diesel-driven pumps were classified by the Seismic Qualifications Utilities Group (SQUG) as outliers and the problem will be resolved with the closure of the A-46 program. On the other hand, no action is planned for the motor-driven pump. The motor-driven pump was subsequently removed from the equipment list for the IPEEE, because, according to the Updated Safety Analysis Report (USAR), the cooling needs for both units can be met by the operation of one diesel-driven pump. Consequently, all the cooling needs for both Prairie Units will be provided by the two diesel-driven Cooling Water pumps.

   According to the IPEEE submittal, the normal water supply for the Cooling Water system is from the circulating water pump bays in the screenhouse, and an emergency intake pipe is used if the normal path from the Mississippi River through the outer screenhouse is blocked or if Lock/Dam # 3 fails. Because of the limited capacity of the emergency intake pipe, operator actions to reduce the cooling water loads is required.

Please provide discussions of the following:

a) the seismic capacity of the diesel-driven Cooling Water pumps including the potential impact of losing both pumps in a seismic event.

b) the overall cooling loads of the Cooling Water system for the selected success paths and the ability of the Cooling Water system to meet these requirements (based on one pump for both units) including the effect of the loss of the normal water supply path.

c) system alignment and isolation in case of loss of the normal water supply path; operator actions required for system alignment and isolation, and coordination between the operators of the two units, if any; and whether seismic failure of components not included in the SSEL would have an adverse effect on the operators' ability to isolate non-essential cooling water loads.

5. Both diesel-driven Cooling Water pumps would be lost in Burn Sequence 69 as stated in the evaluation of seismic-induced fires (page B-77 of the submittal). It is argued in the submittal that this is not a problem because the remaining motor-driven pump can provide sufficient cooling water supply for both units. However, this is not consistent with the seismic assessment portion of the IPEEE in that the motor-driven pump is not included in the equipment list (or not available in a seismic margin earthquake) because of anchorage and shaft stability problem. Burn Sequence 69 will therefore result in the loss of all Cooling Water pumps, and consequently, the loss of nearly all the safety systems required to bring the plant to a safe shutdown condition.

Please resolve this apparent inconsistency.

**High Winds, Floods, and Other External Events**

1. The discussion in the submittal on local intense flooding resulting from the probable maximum precipitation (PMP) did not provide the basis to draw the conclusion that the new PMP criterion as given in Generic Letter (GL) 89-22 would be bounded by the previously calculated flood levels for the Prairie Island site as determined in the (USAR) Appendix F.

Please provide the basis for the conclusion that the PMP criterion used in the USAR calculation is the same as that of GL 89-22. If the PMP criterion specified in GL 89-22 was not used in USAR, perform an analysis that assesses the impact of local intense precipitation (i.e., PMP) on Prairie Island.

**Fire**

1. In Fire Areas 18 and 31, it appears that both severity factors and fire suppression were credited. The inclusion of explicit credit for suppression and fire severity factors could result in counting suppression efforts twice. In Fire Areas 58 and 41B, fire severity factors were used while the submittal states that no automatic fire suppression is present and, for unstated reasons, manual suppression is not credited. Fire severity factors and conditional probabilities of large fires based on NSAC-178L were used for the IPEEE fire analyses. As documented in the fire events database, the potential for a large fire is dependent upon fire suppression. Use of a severity factor in an area where little or no suppression capability exists would implicitly credit non-existent suppression systems.

   a) Please describe the fire scenarios in which fire severity factors or conditional probabilities of large fires were used in conjunction with explicit credit for suppression. For these cases (e.g., Fire Areas 18 and 31), explain why crediting both suppression and severity factors does not constitute double counting for suppression. Alternatively, provide an estimate of the change in the fire core damage frequency (CDF) if only one factor is included.

   b) In those areas (e.g., Fire Areas 58 and 41B) where automatic fire suppression systems and manual efforts are discounted, please discuss how the data and suppression systems present support the use of severity factors. Alternatively, provide an estimate of the change in the fire CDF if severity factors are dropped.

2. The submittal does not describe the qualification specifications of the cables used for power, control, and instrumentation circuits. Damage worksheets show a damage temperature of 700° F indicating that IEEE 383 qualified cable was assumed, as opposed to coated non-qualified cable. The submittal states that cable is *assumed* to be qualified in several places. It should be noted that flame propagation tests employed to show fire propagation properties similar to those of qualified cables do not imply any increased resistance to thermal damage. That is, the 425° F damage temperatures typical of unqualified cable are more appropriate for coated, unqualified cable unless additional tests show such damage resistance. If both qualified and unqualified cable are in use, damage parameters should be those of the actual target.

   There was no description of cable tray fire modeling in the submittal. The only ignition temperature given was 932° F, which is appropriate for spontaneous ignition of qualified cable. For piloted ignition, 700° F is more appropriate. Again, damage temperatures may be lower for coated, unqualified cable than for qualified cable.

   Please provide the following:

   (a) a discussion of the qualification of the cables at Prairie Island, including ignition and damage temperatures for each type of cable. If damage, piloted ignition, and/or self-ignition temperatures are not indicated by testing (i. e. if the cable is not IEEE 383 qualified), please describe the modifications in IPEEE conclusions if damage and ignition parameters typical of cable actually in use are assumed.

(b) a description of the modeling of propagation of cable tray fires used in the IPEEE fire study.

3. The submittal does not provide a basis for the heat release rate of 65 Btu/sec assumed for electrical cabinet fires. Sandia's test results for the control cabinet heat release rates have frequently been misinterpreted and have been inappropriately extrapolated, resulting in low estimated heat release rates. In contrast, experimental work has shown heat release rates ranging from 23 to 1171 Btu/sec.

   Considering the range of heat release rates that could be applicable to different electrical cabinet fires, and to ensure that cabinet fire areas are not prematurely screened out of the analysis, a heat release rate in the mid-range of the currently available experimental data (e.g., 550 Btu/sec) should be used for the screening analysis. New EPRI guidance is forthcoming and may be helpful in formulating a new response for particular types of cabinets. It is anticipated that the recommended heat release rate will be higher than the 65 Btu/s assumed in the Prairie Island submittal.

   Discuss the heat release rates used in the assessment of control cabinet fires. Please provide a discussion of changes in the IPEEE fire assessment results if it is assumed that the heat release from a cabinet fire is increased to that recommended by the new EPRI guidance.

4. The Prairie Island IPEEE submittal utilizes an approach to the analysis of electrical cabinet fires that is similar to the approach recommended by the *EPRI Fire PRA Implementation Guide* (i.e., enclosed ignition sources cannot lead to fire propagation or other damage outside the enclosure). Oil-filled transformers and high-voltage components (> 480 V) in cabinets, for example, are susceptible to energetic faults leading to cabinet breach. Switchgear fires at Oconee Unit 1 in 1989 and Yankee-Rowe in 1984 both resulted in fire damage outside the cubicles. Cabinets are also susceptible to warping under intense heat loads, which may invalidate any assumption of limited combustion air. It is critical that such assumptions in the submittal be validated, especially in such typically important areas as the relay room and cable spreading room. New EPRI guidance is forthcoming and may be helpful in formulating a new response to this question.

   Please provide the basis for the assumptions and a discussion on how the specific enclosures were analyzed to ascertain that the assumptions are applicable to them. Please provide a revised estimate of the fire CDF for those compartments where re-examination and/or consideration of the new EPRI guidance indicates that different assumptions should be applied.

5. The approach to modeling fire propagation was not described in the submittal. The submittal states only that "a postulated fire can be assumed to remain confined within Fire Area boundaries" (e.g., in the discussion of Fire Area 58). Fire Area 58 is of particular interest. It appears in figures to be open to a similar Unit 2 area, Fire

Area 73. Both areas contain large pumps associated with their respective units and, according to the submittal, no automatic or credible manual fire suppression is available. The areas also contain both A and B shutdown train cabling. The submittal notes the presence of other cabling in these areas, failure of which "results in additional plant system impacts." The combination of multiple ignition and combustible materials sources, multiple shutdown system cabling, multi-unit consequences, and no credible fire suppression merits some discussion of the basis for precluding fire propagation.

Please provide a general discussion of the basis for precluding fire propagation scenarios for the six areas modeled in the Prairie Island IPEEE. Describe the features of Fire Areas 58 and 73 that support this conclusion. The discussion should include descriptions of the distance between postulated fire sources and targets, as compared to damage radius, the treatment of smoke and heat products, and modeling applied to intervening paths of combustible materials such as cable trays.

6. NUREG-1407, Section 4.2 and Appendix C, and GL 88-20, Supplement 4, request that documentation be submitted with the IPEEE submittal with regard to the Fire Risk Scoping Study (FRSS) issues, including the basis and assumptions used to address these issues, and a discussion of the findings and conclusions. NUREG-1407 also requests that evaluation results and potential improvements be specifically highlighted. Control system interactions involving a combination of fire-induced failures and high probability random equipment failures were identified in the FRSS as potential contributors to fire risk.

The issue of control systems interactions is associated primarily with the potential that a fire in the plant (e.g., the control room) might lead to potential control systems vulnerabilities. Given a fire in the plant, the likely sources of control systems interactions could occur between the control room, the remote shutdown panel, and shutdown systems. Specific areas that have been identified as requiring attention in the resolution of this issue include:

(a) Electrical independence of the remote shutdown control systems: The primary concern of control systems interactions occurs at plants that do not provide independent remote shutdown control systems. The electrical independence of the remote shutdown panel and the evaluation of the level of indication and control of remote shutdown control and monitoring circuits need to be assessed.

(b) Loss of control equipment or power before transfer: The potential for loss of control power for certain control circuits as a result of hot shorts and/or blown fuses before transferring control from the MCR to remote shutdown locations needs to be assessed.

(c) Spurious actuation of components leading to component damage, loss-of-coolant accident (LOCA), or interfacing systems LOCA: The spurious actuation of one or more safety-related to safe-shutdown-related components as a result of fire-induced cable faults, hot shorts, or component failures leading to component damage, LOCA, or interfacing systems LOCA, prior to taking control from the remote shutdown panel, needs to be assessed. This assessment also needs to include the spurious starting and running of pumps as well as the spurious repositioning of valves.

(d) Total loss of system function: The potential for total loss of system function as a result of fire-induced redundant component failures or electrical distribution system (power source) failure needs to be addressed.

Please describe how your procedures provide for transfer of control to the remote station(s). Provide an evaluation of whether loss of control power due to hot shorts and/or blown fuses could occur prior to transferring control to the remote shutdown location and identify the risk contribution of these types of failures (if these failures are screened, please provide the basis for the screening). Finally, provide an evaluation of whether spurious actuation of components as a result of fire-induced cable faults, hot shorts, or component failures could lead to component damage, a LOCA, or an interfacing systems LOCA prior to taking control from the remote shutdown panel (considering both spurious starting and running of pumps as well as the spurious repositioning of valves).

7. The analysis of the relay room/cable spreading room, Fire Area 18, credits manual fire suppression with preserving elements of a single shutdown train. This assumption is made without providing a supporting basis in terms of manual fire fighting effectiveness in the room. Such a basis would include a description of the layout of the room and address separation and other geometric factors relevant to estimating fire damage from specific sources, and with emphasis on the features that enhance survival of a single train. (In making this determination, responses to questions above on heat release rates and credit for cabinet enclosures should be included.) Also, those factors affecting fire brigade performance in the scenarios developed should be addressed, including the effects of heat, smoke, and loss of lighting.

Please provide a supporting basis for the assumed fire brigade credit for preserving one shutdown train following postulated fires in the cable spreading room and relay room.

8. In the Conclusions and Recommendations section of the submittal, Section B.2.15.2, nine modifications and enhancements, and one verification were noted.

Please provide an indication of the status of each of these with regard to implementation and/or completion. Also, please indicate which were assumed and credited in the IPEEE study.