Northern States Power Company

Prairie Island Nuclear Generating Plant

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10 CFR Part 50
Appendix R

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

Exemption Request
Use of Hot Shutdown Repair to Meet the Requirements of Appendix R

10CFR50, Appendix R, Section III.G.2 requires that "Except as provided for in paragraph G.3 of this section, where cables or equipment, including associated non-safety circuits that could prevent operation or cause maloperation due to hot shorts, open circuits, or shorts to ground, of redundant trains of systems necessary to achieve and maintain hot shutdown conditions are located within the same fire area outside of primary containment, one of the following means of ensuring that one of the redundant trains is free of fire damage shall be provided: . . ." We request exemption from this requirement for the circumstance discussed below.

A concern has been raised with respect to circuit failure modes that could affect the ability to maintain a hot shutdown status during a control room fire, when power operated relief valves (PORVs) may be inadvertently opened and rendered inoperable. This condition could occur if the PORV block valves were not shut and a hot short damaged the PORV control circuit, opening the PORV and maintaining it open.

As a provision to prevent the potential loss of Reactor Coolant System inventory during a Control Room fire scenario, the operators close the PORV block valves prior to Control Room evacuation. In addition, the PORV control circuit fuses are removed locally ensuring that neither a hot short nor a short to ground can cause a PORV to open or be held open. The necessity of removing the fuses does not specifically meet the Appendix R criteria for maintaining hot shutdown.

Satisfying Appendix R criteria would require plant hardware modifications; for example, installation of switches outside of the Control Room to de-energize the circuit in this scenario. As discussed below, we consider that the current operator actions provide an adequate substitute response, and that



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expending the resources to perform the hardware changes are not justified. Therefore, this letter requests exemption from the Appendix R criteria in order to allow removal of the fuses in the PORV control circuit as a means of ensuring that proper RCS inventory is maintained.

The following evaluation demonstrates that the combination of low probability of the PORV opening, remaining open, and resulting in core damage, and the straightforward action required to manually remove the fuses in the PORV control circuit is acceptable and does not adversely affect the health and safety of the public.

An analysis of the PORV control circuitry indicates that the following scenario must occur to cause an open PORV resulting in the loss of RCS inventory. (As noted below this requires three separate failures to cause this event.)

- The operator fails to shut the PORV Block valve and/or a material failure occurs (i.e., a short prevents the valve from closing or causes the valve to open).
- A "hot short" in the control circuitry causes the PORV to open.
- The PORV circuit failure is sustained long enough for the open PORV to jeopardize plant safety.

In order to assess the likelihood of this scenario causing core damage, a Probabilistic Risk Assessment was performed. The core damage sequences of concern involving fires in the control room in which the PORV and block valves are open have a combined core damage frequency of 1.5E-6 per year. In addition, the analysis contains sufficient conservatism to lead to the conclusion that the concern of a PORV hot short due to a control room fire should be dismissed due to its small contribution to overall risk. The reasons for its minimal contribution are as follows:

Procedural Direction

The operators are instructed to close the PORV block valves as part of the immediate response to a control room fire which requires evacuation (Step 3.3.1 of Procedure F5, Appendix B, "Control Room Evacuation (Fire)." Completion of this action prevents an inadvertently opened PORV from affecting the plant.

Compensatory Measures

The operators are also instructed to remove the fuses for the PORV control circuit as an immediate action in response to a control room fire and

subsequent evacuation. This action closes the PORVs if they are open and prevents them from reopening.

Training

Training is held for all plant operators to enhance the familiarity with and proper response to the scenario of control room fire and evacuation. In addition, as part of EOP training, the operators are also familiar with closure of PORV block valves independent of the control room fire scenario.

In addition to these items, the evaluation of the control room fire and evacuation scenario contains conservatisms which, if relaxed, could result in further reduction of the calculated probability of core damage sequences resulting from an open PORV. These include:

Sustained Hot Short

The scenario requires the assumption that the PORV cables are damaged in such a way to cause a hot short which is sustained, such that the PORV is held continuously open. The mechanism of a "hot short" is considered very unlikely. For a sustained "hot short" to occur and affect PORV position, the two wires of proper polarity must fuse together to essentially form a jumper. Other circuit failure modes; i.e., open circuit or short to ground will not affect PORV position, and are considered more probable than a "hot short." If the conductors of the wires of concern were to touch one another, the developed current would most likely tend to open the short. Therefore, the probability of such a short occurring is considered to be much lower than assumed in the analysis.

Suppression Probability

The fire suppression failure probability was assigned a probability consistent with NUREG-4550 and the NUMARC FIVE methodology for all control room fire scenarios. Due to the presence of operators in the control room, a fire will most likely be detected and suppressed in an expeditious manner; therefore, this failure probability is considered much lower than assumed in the analysis.

Block Valve Closure Probability

Block valve closure was assumed to be a "high" stress activity. However, the action to close the block valves is simple, is contained in the EOPs, is practiced by the operators, and is accomplished in a single step for each block valve; therefore, this could be considered a "moderate" stress activity. If this were the case, this one factor would reduce the overall

core damage probability to approximately 7E-7 per year.

Fuse Removal Probability

The simplicity of this operation and the aforementioned operator training increases the likelihood of operators completing this task in an expeditious manner. The completion of this action has been shown by walk-through to take less than 4 minutes.

In addition to the low probability of this event occurring, an evaluation has been performed to determine the impact of the worst case control room fire scenario on the RCS inventory. The analysis assumptions include:

- AC power is unavailable, preventing the closure of the PORV block valves,
- Pressurizer PORV is stuck open for the first six minutes of the scenario,
- Letdown flow continues at a flow-rate of 25 gpm for first 10 minutes,
- The Turbine Driven AFW pump starts delivering water to both Steam Generators 10 minutes into the event.

The dominant effect of the open PORV is to reduce system pressure, which tends to increase pressurizer level by increasing the coolant volume. At approximately three minutes the system pressure drops below the saturation pressure for the coolant temperature, and voids begin forming in the system. This causes a dramatic increase in coolant volume which overwhelms all other factors, causing a rapid rise in pressurizer level and the pressurizer goes solid at 4.2 minutes. After closure of the PORV, thermodynamic conditions in the pressurizer cause the reformation of the bubble at 15 minutes into the event and pressurizer level drops gradually afterwards. The void formation in the vessel is not sufficient to inhibit natural circulation cooling of the core. In addition, PINGP Procedure F5, Appendix B, "Control Room Evacuation (Fire)," contains necessary instructions for plant operators to vent the reactor vessel of any voids which could have formed. Therefore, even in a worst case scenario, core cooling is maintained and procedures are available for recovering from this scenario.

The proposed action of closure of the PORV block valves and removing the control circuit fuses a means of assuring that a control room fire will not result in a sustained loss of RCS inventory was previously reviewed by NRC Region III personnel and found to be acceptable at the time of Prairie Island's Appendix R inspection. The basis cited in Reports No. 50-282/88013(DRS) and 50-306/88013(DRS) is as follows:

"The licensee's plant specific configuration for pulling the pressurizer

PORV fuses was examined and found as follows:

- The fuse panels (4) are readily accessible,
- The fuses are clearly identified in the panels,
- The fuse panels have sufficient space to permit ready/easy access for pulling the fuses,
- Fuse pullers are installed in each panel, and
- The operators are trained and experienced in removing/pulling fuses.

Based on the above conditions, discussions with NRR representatives, and **the previous acceptance of removing/pulling fuses to achieve hot shutdown at other nuclear plants**, the control of the PORV interface was found to be satisfactory (emphasis added).

Therefore, the pressurizer PORV section of this open item is considered closed."

Based on the demonstration that the combination of low probability of the PORV opening, remaining open, and resulting in core damage, and the straightforward action required to manually remove the fuses in the PORV control circuit provides assurance of the maintenance of safe shutdown capability, it is requested that the exemption be granted.

In this letter we are making no new NRC commitments.

Please contact Jack Leveille (612-388-1121, Ext. 4662) if you have any questions related to this letter.

M D Wadley for Roger O Anderson

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Licensing and Management Issues

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