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Mr. James L. Caldwell
Regional Administrator
United States Nuclear Regulatory Commission
Region III
801 Warrenville Road
Lisle, Illinois 60532-4351

Subject: Response to the Preliminary Significance Determination for a Greater Than Green Finding on the High Pressure Injection Pump Design Issue at the Davis-Besse Nuclar Power Station

Dear Mr. Caldwell:

On October 8, 2003, the Nuclear Regulatory Commission (NRC) issued Integrated Inspection Report 2003-021 – "Preliminary Significance Determination for a Greater Than Green Finding – Davis-Besse High Pressure Injection Pump Design Issue," regarding a performance deficiency involving the high pressure injection (HPI) pumps for accident mitigation during the recirculation mode of emergency core cooling. The Inspection Report documented that the preliminary safety significance of the inspection finding based on the change in core damage frequency (CDF) due to internal, external and large early release frequency (LERF) considerations was "Greater than Green" and that preliminary significance varied greatly depending on assumptions regarding the impact of sump debris on the reliability of the HPI pumps. The NRC requested additional information from the FirstEnergy Nuclear Operating Company (FENOC) to facilitate a more refined risk analysis and FENOC committed to providing the NRC with validated information to credit utilization of more appropriate assumptions (reference Serial 1-1332 dated November 7, 2003).

On May 5, 2003, the FENOC submitted to the NRC License Event Report 2003-002, "Potential Degradation of High Pressure Injection Pumps Due to Debris in Emergency Sump Fluid Post Accident," which discussed the concerns for potential debris from the Containment Emergency Sump impacting the HPI pumps following a design-basis accident. FENOC determined that the pump internals may be damaged to the extent that they would not be able to complete their

intended safety function. Attached are the results of the Davis-Besse Risk Evaluation of the HPI Recirculation and Debris in Emergency Sump issue.

Discussions have been conducted with Ms. Sonia Burgess, NRC Region III – Senior Risk Analyst, (both on site and per telephone) to provide informational updates on our preliminary risk evaluation and to obtain clarification regarding FENOC's overall approach to support the NRC's request throughout the risk analysis preparation period.

FENOC agrees with the NRC's preliminary evaluation that established the "Greater than Green" finding as an important to safety issue and, as requested, is providing the attached risk assessment for the NRC to review and utilize to facilitate a more refined risk analysis. The containment debris transport study, combined with an evaluation of the HPI pump response to this limited debris, determined that the High Pressure Recirculation (HPR) is viable to support plant cool-down during a reactor coolant pump seal loss-of-coolant accident and MakeUp/HPI cooling for a limited period of time. Additionally the lack of activation of containment spray for these types of events also provides a significant amount of time for MakeUp/HPI cooling before depleting the Borated Water Storage Tank and reduction in the decay heat source such that the mission time of HPI recirculation can be limited to 24 hours or less. After 24 hours low pressure recirculation is able to be placed in operation and provide adequate core cooling. The incremental core damage probability due to the potential for HPR failure was determined to be approximately 4.69×10^{-5}.

Please contact Mr. Kevin L. Ostrowski, Manager – Regulatory Affairs at (419) 321-8450, should you have any questions or require additional information.

Very truly yours,

AWB/s

Attachment

cc: DB-1 NRC/NRR Senior Project Manager
DB-1 Senior NRC Resident Inspector
USNRC Document Control Desk
Utility Radiological Safety Board

COMMITMENT LIST

The following list identifies those actions committed to by the Davis-Besse Nuclear Power Station in this document. Any other actions discussed in the submittal represent intended or planned actions by Davis-Besse. They are described only as information and are not regulatory commitments. Please notify the Manager – Regulatory Affairs (419-321-8450) at Davis-Besse of any questions regarding this document or associated regulatory commitments.

COMMITMENTS	DUE DATE
None	N/A

Risk Evaluation of High Pressure Recirculation and Debris in Emergency Sump

License Event Report (LER) 2003-002, "Potential Degradation of High Pressure Injection Pumps Due to Debris in Emergency Sump Fluid Post Accident," reported the performance deficiency involving the High Pressure Injection (HPI) pumps during the recirculation mode of emergency core cooling. In response to a request from the Nuclear Regulatory Commission (NRC) in NRC Integrated Inspection Report 2003-021 – "Preliminary Significance Determination for a Greater Than Green Finding – Davis-Besse High Pressure Injection Pump Design Issue," dated October 8, 2003, FENOC has completed a more refined risk analysis of this issue. This more refined analysis has addressed additional information specifically requested by the NRC including: (1) failure probability of the HPI pump when operating in the high pressure recirculation mode, including the impact of the as-found containment conditions; and (2) contribution of risk due to fires.

The risk evaluation considered internal events, boron precipitation control, flooding, fire and seismic events. Generally, conservative assumptions were made regarding HPI pump capability when operating in the high pressure recirculation (HPR) mode. However, a more detailed analysis of HPI pump capability was completed for HPR following a loss-of-feedwater accident and a reactor coolant pump seal loss-of-coolant accident (LOCA). These events were selected for more detailed analysis based on their contribution to core damage frequency and the more limited debris generation and transport that was expected.

The results of the risk analysis indicated that the incremental core damage frequency (ICDF) for this performance deficiency as reported in LER 2003-002 is 3×10^{-6} / year. This increase in core damage frequency is dominated by the contribution from fire sequences. The condition has existed since initial plant startup; consequently the incremental core damage probability (ICDP) corresponds to less than 5×10^{-5}.

Assessment Method Summary

The following general steps were taken during analysis preparation:

(1) Core-damage sequences considered in the Probabilistic Safety Assessment (PSA) for the Davis-Besse Nuclear Power Station (DBNPS) that are affected by the potential unavailability of HPR were identified.

(2) Each of the HPR-relevant sequences was evaluated to identify those for which the HPI pumps are expected to be affected by debris transported to the containment emergency sump.

(3) The baseline Core Damage Frequency (CDF) associated with each of the remaining HPR-relevant sequences was established.

(4) For each of the sensitive sequences the increase in CDF associated with postulated unavailability of HPR was calculated.

(5) The impact of internal fires was evaluated for HPR failure impact. The internal fires risk contribution was due to initiation of loss of feedwater and failing open of one of the pressurizer safety valves (PSV).

(6) The impact of seismic events with HPR was also evaluated. This was based upon an assessment of seismic risk for the DBNPS for ground acceleration up to 1.0g using data from the "Revised Livermore Seismic Hazards Estimate for 69 Nuclear Power Plant Sites East of the Rocky Mountains," NUREG 1488.

(7) The increase in CDF, combined with the relevant period of operation when the function of HPR was in question, was used to calculate a conditional Core-Damage Probability (CDP).

Summary of Risk Assessment

The potential accident sequences where HPR is required to support the success criteria in the Davis-Besse PSA were identified and evaluated. Three general types of core damage sequences were identified:

- A small break LOCA, with failure to cool the Reactor Coolant System (RCS) down to allow long term cooling via Low Pressure Recirculation (LPR). This would include transient events that cause a loss of reactor coolant pumps seal integrity.
- A loss of feedwater where Makeup (MU)/HPI cooling is required beyond the time the inventory in the Borated Water Storage Tank (BWST) is depleted.
- Following some LOCAs , HPR may be called upon as a means to control boron precipitation in the long term. Although this scenario is not directly considered in the Davis-Besse PSA, it has been addressed and is included in this risk evaluation.

HPI Pump Failure Probability during High Pressure Recirculation

The analysis of the HPI pump capability following a reactor coolant pump (RCP) seal LOCA or MU/HPI cooling did not provide a failure probability. Therefore, the sensitivity to this failure mode was analyzed by varying the probability for the basic common-cause failure of HPI pump failure. Sensitivity cases were evaluated with the probability for HPR failure set to 10 times and 1000 times the baseline common-cause probability.

Availability of HPI Pumps for Containment Sump Recirculation

An existing calculation of the containment response for a loss-of-feedwater with MU/HPI cooling event and the containment response using the COPATTA computer code determined containment pressure does not reach the set point for activation of Containment Spray System. A new calculation was completed using the most recent COPATTA inputs and the existing MU/HPI blowdown data. This calculation confirmed that containment spray would not be initiated even with maximum observed (i.e. 85 degrees F) service water temperature and one only containment air cooler in operation.

A containment debris transport study was completed for the MU/HPI Cooling sequences. These events were evaluated because containment spray is not expected to be actuated and the amount of debris generated would be limited by the location of the reactor coolant discharge into containment. Subsequently, an evaluation of the HPI pump response to this limited debris loading was performed, which concluded that HPR is viable to support plant cool-down during a RCP seal LOCA or MU/HPI cooling for a limited period of time. Additionally, the lack of activation of containment spray also provides a significant amount of time for MU/HPI cooling before depleting the BWST and reduces the decay heat source such that the mission time of HPI recirculation could be limited to 24 hours or less for these sequences. After 24 hours LPR can be placed in operation to provide adequate core cooling.

For events other than MU/HPI cooling or RCP seal LOCAs the debris generated was not quantified; consequently, it was assumed that HPR would fail when demanded.

Transient Sequences

The results of the impact assessment for sequences initiated by transients was approximately an 8.5×10^{-8} / year increase in CDF. This result was small due to the credit that was taken for the capability of HPI pumps following a RCP seal LOCA or MU/HPI cooling.

Small LOCA Sequences

The results of the impact assessment for sequences initiated by small LOCAs was approximately 4.6×10^{-7} / year increase in CDF. This is based on a CDF with HPR assumed to be failed directly for small LOCAs.

Internal Fire

The impact for internal fires was evaluated for those sequences involving a loss of feedwater or a transient-induced LOCA. This included the following fire areas as described in the Davis-Besse IPEEE:

- Clean Waste Receiver Tank Rooms; the Detergent Waste Drain Tank Room; and the Miscellaneous Waste Drain Tank Room in the Auxiliary Building;
- The Number 4 Mechanical Penetration Room in the Auxiliary Building;
- The Main Control Room;
- Several smaller rooms and passageways in the Auxiliary Building;
- Most of the Turbine Building;
- Adjacent areas outside the main plant buildings that house various large transformers;
- The High Voltage Switchgear Room B;
- The High Voltage Switchgear Room A;
- The room housing the spent fuel pool cooling pumps; and
- The Number 1 Low Voltage Switchgear Room.

The risk increase due to internal fires is a significant contributor to the overall HPR risk. This risk contribution was dominated by transient-induced LOCAs caused by the failure of Pressurizer Safety Valves (PSVs) to reseat. The PSVs play a more significant role in the fire sequences because some fire areas are assumed to disable the Pilot Operated Relief Valve. The High Voltage Switchgear Rooms are the dominant risk fire locations. The increase in CDF due to internal fires is approximately 2.2×10^{-6}/yr.

Impact of HPR Unreliability on Seismic Event Consequences

Davis-Besse has recently completed an assessment of the frequency of core damage due to seismic events. This seismic model was used to evaluate the impact of HPR unavailability on both transient sequences and small LOCAs. The conclusion of this assessment was that the seismic contribution to core damage frequency was negligible.

Impact of HPR Unreliability on Control of Boron Precipitation

During the period from May 18, 2000 to February 15, 2002, a plant modification was implemented to use a HPI pump as the primary means for controlling boron precipitation following those LOCAs where boron precipitation control is required. To perform this function, the HPI pump would take suction from the discharge of a DHR pump and provide boron dilution flow through the pressurizer auxiliary spray line. By the time operators establish this alignment following the LOCA, the DHR pumps would be taking suction from the containment emergency sump in the low pressure recirculation mode.

An alternate method that did not employ the HPI pumps was also available to the operators.

The risk contribution due to boron precipitation control was evaluated in detail during the development of the modification that installed the HPI method. This analysis was conservative because it did not provide any credit for passive methods. However, this evaluation was used to evaluate the significance of the potential unreliability of the HPI pumps to perform boron dilution. The result yielded a frequency for core damage due to failure of long term boron control of less than 4.3×10^{-7}/yr. Because this modification was only in service for one cycle the contribution to overall core damage probability was small.

Overall Increase in Frequency of Core Damage

Comparison of Frequencies for HPR Sensitive Sequences				
Initiator Category	Reference Frequency	Conditional Frequency[1]	Sensitivity Cases[2]	
			(1) HPR x 10	(2) HPR x 1000
Transients	3.60×10^{-7}	4.45×10^{-7}	4.47×10^{-7}	6.59×10^{-7}
Small LOCAs	1.55×10^{-9}	4.56×10^{-7}	4.56×10^{-7}	4.56×10^{-7}
Internal Fires	1.24×10^{-6}	3.46×10^{-6}	3.46×10^{-6}	3.56×10^{-6}
Seismic Events	Negligible	Negligible	Negligible	Negligible
Total CDF	1.60×10^{-6}	4.36×10^{-6}	4.36×10^{-6}	4.68×10^{-6}
LOCA (requiring boron precipitation control[3])	1.12×10^{-7}	4.29×10^{-7}	No Change	No Change

Table Notes:

1. Conditional frequency refers to the case with HPR assumed to be unavailable; it does not include scenarios involving a small LOCA caused by RCP seal failures or discharge through the pressurizer PORV.
2. The sensitivity cases add to the conditional frequency the impact of an increased unreliability for HPR assuming potential damage following a RCP seal LOCA or discharge from the PORV. This increased unreliability is applied for the two sensitivity cases by increasing the common-cause failure probability for the HPI pumps by a factor of 10 and 1000, respectively.
3. The LOCA sequence refers to failure to control boron precipitation. This sequence is not part of the PSA itself. Furthermore, the frequencies for the first five-initiator categories apply for the full operating period of the plant. The last event applies only during Cycle 13, which was the only time in which the procedures called upon use of the HPI pumps for control of boron precipitation.

Total Core Damage Probability due to Potential for Failure of HPR

The total ICDP associated with this potential was calculated to be approximately 4.69 x 10^{-5}. Although this represents a potentially risk-significant situation, it does not constitute a significant enough condition that the core damage probability approaches 1 x 10^{-4}.

The uncertainty associated with possible increases in HPR unreliability for scenarios in which failure of HPR would not necessarily be predicted was also investigated. Even for a relatively large increase in unreliability (a factor of 1000 times the common-cause failure probability to run of the HPI pumps), the increase relative to the effects for the sequences in which HPR is unavailable is very small.

The effects of this condition with respect to an increase in the frequency of a large early release (LERF) were not quantified in this calculation. The nature of the sequences of interest for this calculation, however, would not be important with respect to early releases. All of the sequences involve long-term core-damage sequences, and none presents a unique challenge to containment. Therefore, the increase in LERF and the corresponding conditional probability of a large early release would both clearly be proportionately smaller than the increases in CDF and conditional core damage probability. Since LERF is already quite small for Davis-Besse, further evaluation for this condition is not warranted.