Omaha Public Power District

444 South 16th Street Mall
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June 11, 2004
LIC-04-0072

U. S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, D.C. 20555

References:
1. Docket No. 50-285
2. NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," dated June 9, 2003 (NRC-03-0114)
3. Letter from OPPD (Richard P. Clemens) to NRC (Document Control Desk) dated August 8, 2003, Fort Calhoun Station Unit No. 1, 60 Day Response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors (LIC-03-0105)
4. Letter from OPPD (Ralph L. Phelps) to NRC (Document Control Desk) dated May 21, 2004, Fort Calhoun Station Unit No. 1 License Amendment Request, "Incorporation of Allowance to Secure Containment Spray Pumps During a Loss-of-Coolant-Accident to Minimize the Potential for Containment Sump Clogging" (LIC-04-0050)
5. Letter from NRC (Alan B. Wang) to OPPD (R. T. Ridenoure) dated May 24, 2004, Request for Additional Information Regarding Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors" (NRC-04-0067)

SUBJECT: Response to Requests for Additional Information on the Fort Calhoun Station Unit No. 1 Response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors"

In support of the Omaha Public Power District (OPPD) response to Bulletin 2003-01 (Reference 3), OPPD provides the attached response to the Nuclear Regulatory Commission's (NRC's) Request for Additional Information of Reference 5.

No commitments are made to the NRC in this letter. If you have any questions or require additional information, please contact T. R. Byrne of the Fort Calhoun Station Unit No. 1 Licensing staff at (402) 533-7368.

Sincerely,

Ralph L. Phelps
Division Manager
Nuclear Engineering

RLP/TRB/trb

Attachment: Response to Requests for Additional Information on the Fort Calhoun Station Unit No. 1 Response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors"

c: B. S. Mallett, Regional Administrator, NRC Region IV
A. B. Wang, NRC Project Manager
J. G. Kramer, NRC Senior Resident Inspector

ATTACHMENT

RESPONSE TO NRC REQUESTS FOR ADDITIONAL INFORMATION ON THE FORT CALHOUN STATION UNIT NO. 1 RESPONSE TO NRC BULLETIN 2003-01, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY SUMP RECIRCULATION AT PRESSURIZED-WATER REACTORS"

Question 1

On page 2 of Attachment 1 of your Bulletin 2003-01 response, in Section 1.b., [Omaha Public Power District] OPPD listed five "primary actions" which were being considered as procedural changes. However, the response does not completely discuss the operator training to be implemented. Please provide a detailed discussion of the operating procedures to be implemented, the indications of sump clogging that the plant operators are instructed to monitor, and the response actions the operators are instructed to take in the event of sump clogging and loss of [Emergency Core Cooling System] ECCS recirculation capability.

OPPD Response:

Operator Training:

Operating crews and key Emergency Response Organization (ERO) personnel were trained on the plant referenced simulator for identification of the symptoms indicative of a degraded sump. This training was completed in accordance with Commitment 1.a of our Bulletin response.

Additional operator training for the procedural changes associated with Commitment 1.b of OPPD's response will be conducted. This training will include Emergency Operating Procedure (EOP) and Abnormal Operating Procedure (AOP) changes drafted to implement the compensatory actions and an overview of the GSI-191 concerns. This training will be completed prior to implementation of final EOP and AOP changes currently scheduled for September 30, 2004.

Procedure Changes:

Changes to EOP's and AOP's have been drafted, based on Fort Calhoun Station (FCS) plant specific review and Westinghouse Owners Group (WOG) recommendations, to provide preemptive and responsive compensatory measures.

Preemptive compensatory measures are those actions designed to delay or minimize the onset of sump screen blockage. Changes to EOP-03, Loss of Coolant Accident, EOP-20, Functional Recovery Procedure, and AOP-22, Reactor Coolant Leak include the following preemptive compensatory actions:

1) New procedure steps to secure High Pressure Safety Injection (HPSI) pump 2C (SI-2C) prior to, or shortly following the Recirculation Actuation Signal (RAS) if all three HPSI pumps are in operation, Safety Injection (SI) flowrate is within the delivery curve contained in EOP

Attachment 3, Safety Injection Flow vs. Pressurizer Pressure, and reactor water level indication is above the top of active fuel and NOT lowering. New step added to restore SI-2C if the above conditions cannot be met.

2) New procedure step to secure one Containment Spray (CS) pump prior to, or shortly following RAS if all CS pumps are running, containment pressure is less than 60 psig, all available containment vent fans are in operation, and SI flowrate is within the delivery curve contained in EOP Attachment 3, Safety Injection Flow vs. Pressurizer Pressure. New step to restore the secured CS pump if the above conditions cannot be met.

3) New procedure step to direct refill of the Safety Injection and Refueling Water Storage Tank (SIRWT) following RAS.

4) New Attachment 25, Methods for Refilling the SIRWT Post-RAS, which provides guidance and various methods for refilling the SIRWT.

Responsive compensatory measures are actions designed to identify sump screen blockage and direct actions for continued core cooling. The goal of these actions is monitoring of key parameters associated with sump screen blockage, identifying symptoms of reduced CS and SI pump performance, providing a strategy to minimize the risk of a loss of core cooling, and providing actions for restoration of core cooling. Changes to EOP-03, Loss of Coolant Accident, EOP-20, Functional Recovery Procedure, and AOP-22, Reactor Coolant Leak include the following responsive compensatory actions:

1) New steps to monitor for indications of sump screen blockage and provide operator guidance for symptoms of sump screen blockage.

2) New steps to provide immediate actions in the event that sump screen blockage indication are observed. These immediate actions include:

   a. Direction to secure operating CS pumps to prevent or minimize CS and HPSI pump damage due to operation under inadequate net positive suction head (NPSH) conditions;

   b. Direction to verify that HPSI pump performance improves;

   c. Direction of actions to protect the affected HPSI pumps; and

   d. Direction of action to establish minimum SI flowrate to the core.

3) Once immediate actions are taken in response to sump screen blockage, the new procedure steps direct operators to long-term actions in EOP-20, Functional Recovery Procedure, IC-2 Continuing Actions. EOP-20 IC-2 provides the following continuing actions:

   a. Injection to the Reactor Coolant System (RCS) using borated water from a refilled SIRWT

   b. Injection to RCS using borated water from any available Boric Acid Storage Tank (BAST)

c. Injection to RCS using water from undischarged Safety Injection Tanks (SIT)

d. Maximizing RCS cooldown

e. Actions to depressurize the RCS if high pressurizer pressure is preventing adequate SI flow

f. Ensuring that all available containment vent fans are operating with maximum capacity to ensure adequate containment cooling capability

g. Establishing shutdown cooling (SDC) if entry conditions can be met.

h. Criteria for reestablishing flow from the containment sump after a specified settling period.

Sump Screen Blockage Indications:

Guidance will be added to EOP-03, Loss of Coolant Accident, EOP-20, Functional Recovery Procedure, and AOP-22, Reactor Coolant Leak to provide operators with indications to monitor for symptoms of sump screen blockage. Operators are provided with the following new direction to assist in diagnosis of sump screen blockage following RAS:

> **ANY** of the following conditions existing on two or more operating, or previously operating pumps:
>
> - Erratic indication or inability to maintain desired CS or HPSI flow
> - Erratic or sudden decrease in HPSI Header Pressure
> - Erratic or sudden decrease in HPSI or CS Pump Motor Amps
> - CS or HPSI Pump Trip Annunciator
> - Increased HPSI or CS Pump noise.

The criteria requires that indications be observed on two or more pumps to ensure that individual pump degradation, or a failure in a single component, will not be interpreted as a failure of the sump screens.

The criteria rely on indications available to the operator in the Control Room, with the exception of audible indications of pump cavitation. Audible indication can be used as input to the diagnosis in the event that personnel are in the SI Pump room and observe the indication; however, it is not necessary to confirm an inoperable sump.

Containment level indication is not included in the criteria because it is not a conclusive indication of sump screen blockage. Water level should remain relatively constant after the RAS occurs due to no injection of additional water sources. Unexpected changes in level may indicate in-leakage from other water sources, leakage outside containment, or pooling inside containment due to blocked choke points along the return path to the sump.

Sump Screen Blockage Response Actions:

Once the onset of sump screen blockage is recognized, the EOP's direct actions to immediately reduce the recirculation flowrate, protect the operating CS and HPSI pumps, and provide transition to contingency actions designed to minimize the risk of a loss of core cooling, and provide actions for restoration of core cooling. Revisions to procedures EOP-03, Loss of Coolant Accident, EOP-20, Functional Recovery Procedure, and AOP-22, Reactor Coolant Leak, direct the following immediate actions:

1) Stop all operating CS pumps. Securing CS pumps will significantly reduce recirculation flowrate. Taking actions to reduce flow through the sump screens may allow the HPSI pump, which has lower flow and NPSH requirements than the CS pumps, to operate for a longer period to time on the degraded sump to continue to cool the core;

2) Monitor HPSI pump performance. If HPSI performance does not improve, the operators are directed to throttle SI flow to 50 gpm per pump. If HPSI performance improves, then the EOP directs that flow be increased to the minimum flow required to provide adequate decay heat removal. A curve showing minimum required HPSI flow vs. time after start of a LOCA has been developed and will be a Plant Technical Data Book (TDB) figure referenced by the EOP;

3) Take actions to protect HPSI pumps if performance does not improve; and

4) Go to new steps in the EOP-20, Functional Recovery Procedure, IC-2 Continuing Actions.

Once the immediate actions have been taken, the EOP's direct the transition to EOP-20, Functional Recovery Procedure, to provide for continuing actions to restore adequate core cooling. The following response actions have been added to EOP-20, IC-2 continuing actions:

1) Injection to the RCS using borated water from a refilled SIRWT;

2) Injection to the RCS using borated water from any available Boric Acid Storage Tank (BAST);

3) Injection to the RCS using borated water from undischarged Safety Injection Tank(s) (SIT);

4) Maximize RCS cooldown;

5) Depressurize the RCS if high pressurizer pressure is preventing adequate SI flow;

6) Ensure that all available containment vent fans are operating with maximum capacity to ensure adequate containment cooling capability;

7) Establish shutdown cooling (SDC) if the SDC entry conditions can be met; and

8) Reestablish flow from the containment sump after a specified settling period.

Question 2

On page 2 of Attachment 1 of your Bulletin 2003-01 response, in Section 1.b., OPPD stated that the following action was being considered: "Establishing the limiting injection water volume." Please elaborate as to the specific core-cooling mode (e.g. suction from safety injection and refueling water tank, or containment sump recirculation) that would be applicable during this potential procedural action.

OPPD Response:

The primary source of injection water would be borated water from a refilled SIRWT.

One HPSI pump would be aligned with its suction from the refilled SIRWT and injection would be via the normal HPSI injection path. SIRWT inventory may be limited; therefore, EOP-20 directs throttling of HPSI flow to the minimum required by the TDB Figure and maintenance of Reactor Vessel Level Measurement System (RVLMS) indication greater than or equal to the bottom of the RCS hot leg. While attempting to restore RCS inventory control, heat removal is maintained by maximizing RCS cooldown and ensuring maximum containment heat removal equipment is in service.

Other injection sources could be added at this time depending on their availability. If the entire BAST volume has not been injected, the procedures direct injection of this source. If RCS depressurization has not occurred, and SIT volume is available, the procedure will direct injection of available SIT volume(s).

Injection of these additional water sources may submerge critical recovery equipment and indications. The effect of rising containment level has been evaluated and a list of affected equipment, by containment elevation, will be provided in the Plant TDB for reference. EOP-20 contains steps to attempt to reestablish containment sump recirculation after a specified settling time. If the suction source can successfully be reestablished from the containment sump, then containment flooding can be minimized or delayed.

Question 3

On page 3 of Attachment 1 to your Bulletin 2003-01 response, at the end of Section 1, OPPD stated that "some or all of the actions will be implemented as deemed appropriate." The committed to completion date (March 26, 2004) for these potential procedural changes has passed. Please specify which procedural changes discussed in Section 1 of Attachment 1 of your Bulletin 2003-01 have been implemented, which procedural changes were deemed inappropriate for implementation, and the bases for deeming certain of the listed procedural changes to be inappropriate for implementation, if any.

OPPD Response:

The actions stated in Attachment 1, page 3, of our response were evaluated and the appropriate changes to procedures EOP-03, Loss of Coolant Accident, EOP-20, Functional Recovery Procedure, and AOP-22, Reactor Coolant Leak, were drafted based on draft WOG guidance prior to March 26, 2004. Implementation of procedure changes was coordinated to allow OPPD review of the final WOG approved submittal of WCAP-16204, "Evaluation of Potential ERG and EPG Changes to Address NRC Bulletin 2003-01 Recommendations." This delay was necessary to preclude making additional FCS-specific EOP changes if further changes were made to the final WOG recommendations as a result of verification and validation activities. OPPD has completed review of the final WOG report and will implement the procedure changes addressed in Attachment 1, page 3, in upcoming revisions to EOPs and AOPs prior to September 30, 2004. This date is required to support plant specific verification and validation and operator training activities.

The following actions have been evaluated per Attachment 1, Section 1, of the OPPD response:

- Securing pumps not required for core coverage

  Secure one CS Pump Prior to RAS

  It was determined that securing one CS pump prior to RAS provides a positive risk benefit and is an acceptable compensatory action to address sump screen blockage concerns.

  This change will be implemented into the upcoming revision to EOP-03, Loss of Coolant Accident, EOP-20, Functional Recovery Procedure, and AOP-22, Reactor Coolant Leak.

  Secure two CS Pumps Prior to RAS (Commitment 2b)

  It was determined that securing two CS pumps (i.e., reducing to one operating CS pump and header) will provide a positive risk benefit as a compensatory action to address sump screen blockage concerns.

  This action is not incorporated into the current EOP/AOP changes. The action requires an amendment to the FCS Operating License prior to implementation for substitution of manual actions for automatic actions. The License Amendment Request, LIC-04-0050, was submitted for NRC review and approval on May 21, 2004.

  Securing all CS Pumps Prior to RAS

  This action was deemed inappropriate for FCS because at least one CS pump is required to operate for a period of five hours following a LOCA to satisfy source term reduction requirements per the LOCA Radiological Consequence Analysis.

  Securing HPSI Pump SI-2C Prior to RAS (Commitment 2a)

  It was determined that securing SI-2C prior to RAS provides a positive risk benefit

and is an acceptable compensatory action to address sump screen blockage concerns.

This change was implemented in a March 2004 revision to EOP-03, Loss of Coolant Accident, EOP-20, Functional Recovery Procedure, and AOP-22, Reactor Coolant Leak.

Securing two HPSI Pumps

It was determined that securing two HPSI pumps (i.e., reducing to one operating HPSI pump) was inappropriate for FCS because:

1) This action provides limited benefit in reducing the rate of sump plugging due to its low flow rate compared to an operating CS pump. Actions such as securing a CS pump as discussed above provide a significantly greater risk benefit with regard to sump screen blockage.

2) Action to secure one HPSI pump (SI-2C), as discussed above, will provide the benefit of preserving an operable HPSI pump for use in later mitigation strategies.

3) Current LOCA analyses do not account for a total interruption of flow to the core due to loss of a HPSI pump. Additional plant specific analysis would be required to demonstrate that a loss of HPSI flow following the action to reduce to one HPSI pump operation would not result in core uncovery and fuel damage.

- Monitoring pumps for indications of cavitation

  This change will be implemented into the upcoming revision to EOP-03, Loss of Coolant Accident, EOP-20, Functional Recovery Procedure, and AOP-22, Reactor Coolant Leak.

- Establishing the minimum required HPSI flow from the SIRWT

  This change will be implemented into the upcoming revision to EOP-03, Loss of Coolant Accident, EOP-20, Functional Recovery Procedure, and AOP-22, Reactor Coolant Leak. A graph showing minimum required HPSI flow vs. time has been developed and will be incorporated in the Plant TDB.

- Establishing the limiting injection water volume

  This change will be implemented in the upcoming revision to EOP-20, Functional Recovery Procedure. The EOP change allows water to be injected from a refilled SIRWT. The intent is to fill the containment to at least the top of the hot legs to allow for long-term cooling via: 1) countercurrent flow through the break with fan coolers providing the ultimate decay heat removal, or 2) initiation of shutdown cooling for decay heat removal once adequate level is established in the RCS.

The effect of adding water from a refilled SIRWT was evaluated for impact on containment design parameters and submergence of critical recovery equipment and instrumentation. A list of affected equipment, by containment elevation, will be provided in the Plant TDB for reference.

- Switching back and forth between the containment sump and the SIRWT to allow time for debris settling while minimizing the addition of water to maintain core water level during long term core cooling.

  This change will be implemented into the upcoming revision to EOP-20, Functional Recovery Procedure, IC-2 Continuing Actions.

Question 4

The Westinghouse Owner's Group (WOG) has developed operational guidance in response to Bulletin 2003-01 for Westinghouse- and CE-type pressurized water reactors (PWRs). Please provide a discussion of OPPD's plans to consider implementing this new WOG guidance. Include a discussion of the WOG recommended compensatory measures that have been or will be implemented for FCS, and the evaluations or analyses performed to determine which of the WOG recommended changes are acceptable for FCS. Provide technical justification for those WOG recommended compensatory measures not being implemented by OPPD. Also include a detailed discussion of the procedures being modified, the operator training being implemented, and the schedule for implementing these compensatory measures.

OPPD Response:

OPPD has been an active participant in the development of the referenced WOG guidelines. As stated in response to Question 3 above, the WOG recommendations have been reviewed and those actions that provide a benefit for the FCS will be implemented in accordance with the schedule provided. The compensatory actions were evaluated in Engineering Analysis EA-FC-04-010, Recommendations for Implementing of Compensatory Actions in Response to NRC Bulletin 2003-01, Revision 0, and dated March 26, 2004.

A description of the procedure changes to be implemented at the FCS has been provided in response to Questions 1 and 3. These changes will be implemented per the schedule as described in our response to Question 3. The following Table lists the WOG final recommended Candidate Operator Actions (COA's) and the OPPD disposition of each of the COA's:

Summary of FCS Implementation of WCAP-16204, Revision 1 Candidate Operator Action (COA) Recommendations			
COA Number	**Description**	**Status**	**Comments**
A1a-CE	Operator action to secure 1 CS Pump (i.e., Reduce to only 1 CS Pump Operation)	Action to be implemented upon approval of LAR submitted by letter LIC-04-0050 on May 21, 2004	Reducing to one CS pump requires License Amendment
A1b	Operator action to secure all CS Pumps	Will not be Implemented at FCS	CS operation required for five hours post-LOCA per Radiological Consequence Analysis.
A3-CE	Terminate 1 train of HPSI after RAS	Will not be implemented at FCS	See discussion in response to Question 3
A5	Refill of refueling water storage tank	Implemented – March 2004	
A6	Inject more than 1 RWST volume from a refilled RWST or by bypassing the RWST	Procedures drafted – to be implemented by 9/17/2004	
A7	Provide more aggressive cooldown and depressurization following a small break LOCA	Procedures drafted – to be implemented by 9/17/2004	
A8-CE	Provide guidance on symptoms and identification of sump blockage	Procedures drafted – to be implemented by 9/17/2004	
A9-CE	Develop contingency actions in response to containment sump blockage, loss of suction, and cavitation.	Procedures drafted – to be implemented by 9/17/2004	
COA's A2, A4, and A10 were not included in the final proposed CEN-152 changes. COA A11 is not applicable to FCS.			

Question 5

NRC Bulletin 2003-01 provides possible interim compensatory measures licensees could consider to reduce risks associated with sump clogging. In addition to those compensatory measures listed in Bulletin 2003-01, licensees may also consider implementing unique or plant-specific compensatory measures, as applicable. Please discuss any possible unique or plant-specific compensatory measures you considered for implementation at FCS. Include a basis for rejecting any of these additional considered measures.

OPPD Response:

In addition to the compensatory measures listed in NRC Bulletin 2003-01, OPPD has considered the following unique or plant specific actions:

Preservation of SI and CS Pumps

OPPD evaluated actions to secure SI and CS pumps to preserve an operable pump in the event that sump screen blockage resulted in damage to the operating pumps.

The configuration of the FCS includes three HPSI and three CS pumps. All pumps start in response to the LOCA event; however, only one HPSI pump and one CS pump are credited in the LOCA analysis. Procedure changes to secure SI-2C prior to RAS if all SI pumps are running have been implemented. Procedure changes to secure one CS pump (i.e.; reduce to two CS pumps operating) prior to RAS if all CS pumps are running will be implemented in the upcoming EOP/AOP changes to be completed by September 30, 2004.

Sump Screen Differential Pressure Instrumentation

OPPD evaluated methods of providing direct differential pressure measurement instrumentation to aid in diagnosing the sump screen blockage condition.

This proposed action was not implemented. Addition of the capability to directly measure sump screen differential pressure would require extensive plant modification and was determined not to be cost effective as a compensatory action.

Procedure Changes to Backflush a Blocked Sump Screen

Existing plant configuration was evaluated to determine if a method to backflush the sump screens could be developed without modifying the existing SI/CS Suction Piping or sump screens.

The proposed action was not implemented because plant configuration does not allow an effective method of backflushing without implementation of significant plant modifications.

Removing the Automatic Start Feature for SI-2C

OPPD evaluated disabling the automatic start of HPSI pump SI-2C. The configuration of the FCS includes three HPSI that all start in response to the LOCA event. The HPSI pump SI-2C is not credited in the accident analysis. Preventing start of HPSI pump SI-2C would ensure its availability for future mitigation strategies should the operating pumps become damaged due to the effects of sump screen blockage.

This proposed action was not implemented. Procedural changes were implemented to take SI-2C control switch to the "pull-to-lock" position to disable the pump and preserve it for future mitigation strategies if all HPSI pumps start in response to the LOCA. This accomplishes the objective of the proposed action without implementing permanent plant design changes.

Methods of Removing Excess Water From Containment When Injecting From a Refilled SIRWT

OPPD evaluated methods to remove excess water from the containment if injection is established from a refilled SIRWT. This would provide the possible benefits of reuse of excess water, and minimize or delay water level exceeding the containment flood level.

This method was not implemented due to radiological considerations.