

Prairie Island Nuclear Generating Plant Operated by Nuclear Management Company, LLC

August 6, 2003

L-PI-03-063 10 CFR 50.54(f)

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

PRAIRIE ISLAND NUCLEAR GENERATING PLANT DOCKET NOS. 50-282 AND 50-306 LICENSE NOS. DPR-42 AND DPR-60

NUCLEAR REGULATORY COMMISSION BULLETIN 2003-01: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY SUMP RECIRCULATION AT PRESSURIZED-WATER REACTORS – 60-DAY RESPONSE

On June 9, 2003, the Nuclear Regulatory Commission (NRC) transmitted Bulletin (BL) 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors." The NRC required that specific information be provided within 60 days of the date of the bulletin. In accordance with this requirement, Nuclear Management Company, LLC (NMC) is providing the 60-day response for the Prairie Island Nuclear Generating Plant.

This letter contains seven new commitments and no revisions to existing commitments.

- 1. NMC will develop and administer training on sump clogging by January 31, 2004.
- NMC will conduct additional evaluations to determine an appropriate minimum Refueling Water Storage Tank (RWST) liquid level to secure Containment Spray (CS). The results of these evaluations will be factored into the procedures. This evaluation of securing CS and any subsequent procedure changes will be complete by January 31, 2004.
- 3. NMC will submit an implementation schedule for revising plant emergency operating procedures, where appropriate, to stop or throttle redundant pumps that are not necessary to provide required flows to cool containment and the reactor core within 30 days of issuance of the generic guidance by the Westinghouse Owners Group, currently expected by March 31, 2004.
- 4. NMC will implement a procedure to enhance operator guidance for refilling the RWST from alternative water sources. This procedure will be implemented by January 31, 2004.

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- 5. NMC will enhance containment closeout and foreign material controls beginning with the next Unit 2 refueling outage in 2003.
- 6. NMC will implement a procedure revision to address potential debris ingestion by January 31, 2004.
- 7. NMC will perform an evaluation to analyze the emergency core cooling system recirculation functions with respect to the potentially adverse post-accident debris blockage effects on the containment sump, taking into account the recent research findings, to determine compliance with all applicable regulatory requirements. NMC will continue to work with the Nuclear Energy Institute (NEI) to follow Generic Safety Issue 191 resolution methodology currently being developed by NEI. NMC will implement the methodology, as appropriate for Prairie Island.

The interim compensatory measures, Commitments 1 - 6 above, will remain in place until Commitment 7 is complete.

I declare under penalty of perjury that the foregoing is true and accurate. Executed on August 6, 2003.

Josebh M. Sòlvmodsv

Site Vice President, Prairie (Island Nuclear Generating Plant

CC Regional Administrator, USNRC, Region III Project Manager, Prairie Island Nuclear Generating Plant, USNRC, NRR NRC Resident Inspector – Prairie Island Nuclear Generating Plant

Attachment

ATTACHMENT

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NUCLEAR MANAGEMENT COMPANY, LLC

PRAIRIE ISLAND NUCLEAR GENERATING PLANT DOCKET NOS. 50-282, 50-306

August 6, 2003

NRC BULLETIN 2003-01: POTENTIAL IMPACT OF DEBRIS ON EMERGENCY SUMP RECIRCULATION AT PRESSURIZED-WATER REACTORS PRAIRIE ISLAND NUCLEAR GENERATING PLANT 60-DAY RESPONSE

10 Pages Follow

Requested Information

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All addressees are requested to provide a response within 60 days of the date of this bulletin that contains the information requested in Option 1 or Option 2.

Option 1: State that the ECCS and CSS recirculation functions have been analyzed with respect to the potentially adverse post-accident debris blockage effects identified in this bulletin, taking into account the recent research findings described in the Discussion section, and are in compliance with all existing applicable regulatory requirements.

Option 2: Describe any interim compensatory measures that have been implemented or will be implemented to reduce the risk which may be associated with potentially degraded or nonconforming ECCS and CSS recirculation functions until an evaluation to determine compliance is complete. If any of the interim compensatory measures listed in the Discussion section will not be implemented, provide justification. Additionally, for any planned interim measures that will not be in place prior to your response to this bulletin, submit an implementation schedule and provide the basis for concluding that their implementation is not practical until a later date.

Response

Nuclear Management Company, LLC (NMC) is providing a response in accordance with Option 2 of Nuclear Regulatory Commission (NRC) Bulletin (BL) 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," for the Prairie Island Nuclear Generating Plant. NMC selected Option 2 for Prairie Island, as the detailed analyses necessary to address Option 1 have not been performed.

Interim compensatory measures that have been or will be implemented to reduce risk which may be associated with potentially degraded or nonconforming emergency core cooling system (ECCS) recirculation functions until an evaluation to determine compliance is complete are listed below:

• Operator training on Indications of responses to sump clogging

Interim compensatory measures that have been implemented

In the current plant procedures, following the transfer to recirculation, the operators direct the Technical Support Center (TSC) staff to monitor long-term recirculation operation. The background for this step indicates that parameters such as residual heat removal (RHR) pump suction pressure, discharge pressure, motor current, vibration and flow should be monitored and that appropriate actions be developed if degradation is detected. The operators are

thoroughly trained on the transfer to recirculation procedures, both in the classroom and in the simulator.

The following instrumentation is available for the Control Room and TSC staff to monitor ECCS performance during post-LOCA (loss of coolant accident) recirculation:

- Containment Sump Level*
- RHR Pump Suction Pressure*
- RHR Pump Discharge Pressure*
- > RHR Flow Rate*
- Safety Injection (SI) Pump Discharge Pressure*
- > SI Flow Rate*

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- > Thermocouples*
- Subcooling*
- Reactor Vessel Level Indication System (RVLIS)*
- RHR Pump Motor Vibrations
- > RHR Pump Motor Current

The above indications are available on Control Room Indicators and/or using the plant computer system. The indications identified with an * are available on a single computer display and can also be plotted to enhance trending capabilities. This single computer display provides the Operators and TSC staff with a means to monitor overall recirculation performance in an integrated manner.

Briefings of Operators and appropriate TSC Staff have been conducted to heighten sensitivity to the related concerns. This briefing includes awareness of the issues, compensatory measures that have been implemented, system indications that can be used to monitor recirculation system performance and guidance on mitigation strategies from postulated debris blockage.

Interim compensatory measures that will be implemented

NMC has reviewed existing operator training programs and determined an opportunity to enhance operator training relative to indications of and responses to sump clogging. Training will be developed and administered to licensed operators. The training will include, but not be limited to, the following topics:

- 1. A review of the response to LOCAs, using the emergency operating procedures (EOPs).
- 2. A review of the importance of aggressively cooling the RCS during post-LOCA cooldown and depressurization in order to transition to shut down cooling as soon as possible to avoid recirculation cooling.
- 3. A review of the indications of recirculation system performance and guidance provided in the event that degradation is indicated.
- 4. A review of the impact to the EOP safety functions due to diminished ECCS recirculation performance.

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- 5. A review of the implementation and content of the loss of emergency coolant recirculation EOP, including actions available within the EOP to respond to sump clogging or blockage in the recirculation system.
- 6. A review of any proposed changes or enhancements to operating procedures such as refilling the RWST and mitigation guidance for blockage in the recirculation system.

Following development of the compensatory measures, affected TSC staff will also receive additional training.

Implementation Schedule: The training will be administered by January 31, 2004. The basis for delaying implementation beyond the 60-day response date is to allow sufficient time to complete proposed procedure revisions, develop training materials and train affected personnel.

 Procedural modifications, if appropriate, that would delay the switchover to containment sump recirculation (e.g., shutting down redundant pumps that are not necessary to provide required flows to cool the containment and reactor core, and operating the CSS Intermittently)

Interim compensatory measures that have been implemented

NMC has reviewed existing procedures and implemented the following procedure modifications that would delay the switchover to containment sump recirculation.

- 1. The minimum refueling water storage tank (RWST) level for normal operation has been administratively increased. This was accomplished by revising the applicable Surveillance Procedures for operation above Mode 5 to raise the required minimum RWST volume from the Technical Specification value of greater than or equal to 68% (200,000 gallons) for Modes 1, 2, and 3. A new administrative limit has been implemented to require greater than or equal to 90%. This change will delay the switchover to containment sump recirculation since there will be at least an additional 64,570 gallons available as compared to the volume available at the minimum Technical Specification required 68% indicated level. This administrative limit also provides additional liquid in the containment basement during post-LOCA recirculation operation that will reduce the velocities and increase the probability that potential debris will settle prior to reaching the sump.
- 2. Evaluations have either been performed or are in process to assess the feasibility to revise plant emergency response procedures to delay the switchover to containment sump recirculation by securing engineered safety feature (ESF) pumps. The ESF pumps that take suction from the RWST during the injection phase are the RHR, SI and containment spray (CS) pumps. The RHR and SI pumps provide injection into the reactor coolant system (RCS) and the CS pumps provide spray flow into the top region of

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containment. Securing the RHR and SI pumps is addressed later in this response.

The current plant procedures have provisions to secure CS during the injection phase if containment pressure has been reduced below a predetermined value. Recent questions have been raised whether or not this is consistent with the considerations for iodine scrubbing in the dose analysis and providing a basic (pH > 7) solution in the sump liquid. Evaluations (discussed below) are in process to ensure that an appropriate criterion based on RWST liquid level and containment pressure is provided. Preliminary evaluations conclude that the current procedures to secure CS early are adequate. Thus, NMC has implemented actions to secure CS early that result in an increase in the time frame for the injection phase and subsequent delay in switchover to the recirculation phase.

3. For smaller LOCAs guidance to delay depletion of the RWST before switchover to sump recirculation currently exists in the Prairie Island EOPs consistent with the Westinghouse Owners Group (WOG) Emergency Response Guidelines (ERG) guidance, "Post LOCA Cooldown and Depressurization." This procedure provides actions to cooldown and depressurize the RCS to reduce the break flow, thereby reducing the injection flow necessary to maintain RCS subcooling and inventory. The operating SI pumps are sequentially stopped to reduce injection flow, based on pre-established criteria that maintain core cooling, resulting in slower depletion of the RWST. For smaller LOCAs, it is possible to cooldown and depressurize the RCS to cold shutdown conditions before the RWST is drained to the switchover level. Therefore, in this case, recirculation from the containment sump is not required, and sump blockage is not an issue.

Interim compensatory measures that will be implemented

NMC will evaluate revising EOPs to stop or throttle redundant pumps that are not necessary to provide required flows to cool the containment and reactor core prior to the initiation of containment sump recirculation. This change would delay the switchover to containment sump recirculation by reducing the depletion of RWST inventory during the initial stages of the LOCA.

Implementation Schedule: As discussed above, the current procedures already have actions to secure CS during the injection phase providing specific criteria for containment pressure are satisfied. Additional detailed evaluations are being conducted to determine an appropriate minimum RWST liquid level to secure CS. The results of these evaluations will be factored into the procedures. It is expected that this evaluation of securing CS and any subsequent procedure changes (including training) will be complete by January 31, 2004.

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With regards to securing SI and RHR Pumps early, preliminary assessment by NMC, in consultation with the WOG, indicates that this change may have an adverse effect on plant safety by substituting manual action for existing automatic action and introducing a potential for a single active failure vulnerability. At the present time, it appears that the overall safety benefit is to maintain as much core cooling as possible. Thus, depending on the outcome of these evaluations, these actions may not be implemented.

Nevertheless, implementing changes to procedures to take pre-emptive operator actions to shut off RHR and SI will be considered after WOG programs have been completed to evaluate the generic impact of these changes. Pre-emptive operator actions to stop pumps or throttle flow solely for the purpose of delaying switchover to containment sump recirculation will not be implemented until the impact of the changes can be evaluated on a generic basis for the following reasons:

- Operator actions to stop RHR or SI pumps or throttle flow may result in conditions that are either outside of the design basis safety analyses assumptions or violate the design basis safety analyses assumptions (single failure). This would result in the potential for creating conditions that would make the optimal recovery more challenging.
- 2. These actions would be inconsistent with the overall WOG ERG philosophy. The WOG ERGs are symptom-based procedures that provide for the monitoring of plant parameters and prescribe actions based on the response of those parameters. To avoid the risk of taking an incorrect action for an actual event, the WOG ERGs do not prescribe contingency actions until symptoms that warrant those contingency actions are identified.
- 3. These actions would be inconsistent with the current operator response using the WOG ERGs that has been established through extensive operator training. The expected operator response is based on the optimal set of actions considering both design basis accidents and accidents outside the design basis. The WOG ERG operator response is not limited to a specific accident progression in order to provide optimal guidance for a wide range of possible accidents.
- 4. To be effective in delaying the switchover to containment sump recirculation, operator actions to stop RHR or SI pumps must be taken in the first few minutes of an accident. This introduces a significant opportunity for operator errors based on other actions that may be required during this time frame. Any new operator actions to stop RHR or SI pumps, when modeled in the PRA, are likely to result in increased risk due to operator error.

Based on the philosophy adopted in the current WOG ERGs (and Prairie Island EOPs) to take actions based on plant symptoms, it is more appropriate to address actions to "delay RWST inventory depletion" once the loss of recirculation capability is diagnosed. Any generic changes to the WOG ERGs will be evaluated as part of an Owners Group program. These procedures currently exist (for example, loss of emergency coolant recirculation EOP) and the licensed operators are thoroughly trained on their use.

For these reasons, this proposed change might require a revision to the safety analysis and a license amendment. Due to the complexity of justification for this proposed change, the WOG has scheduled to change and issue revisions to the ERGs to provide generic guidance for containment sump blockage issues by March 31, 2004. Within 30 days after the issuance of generic guidance by the WOG, NMC will evaluate the changes recommended and submit an implementation schedule for the applicable EOP revisions. The basis for delaying implementation beyond the 60-day response date is to allow sufficient time to resolve any potential inconsistencies with existing safety analysis assumptions and obtain prior NRC approval, if required.

 Ensuring that alternative water sources are available to refill the RWST or to otherwise provide inventory to inject into the reactor core and spray into the containment atmosphere

Interim compensatory measures that will be implemented

NMC has reviewed the availability of alternative water sources to refill the RWST or to otherwise provide inventory to inject into the reactor core and spray into the containment atmosphere. Guidance in current plant procedure for loss of recirculation addresses RWST refill once it has been determined that loss of SI recirculation capability has occurred. The following sources for refilling the RWST are identified in this procedure and other current standing procedures:

- Normal Makeup using the Boric Acid Blender
- Spent Fuel Pool

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- Reactor Coolant Drain Tank
- Unaffected Unit's RWST
- Chemical and Volume Control System Hold-Up Tank
- Chemical and Volume Control System Monitor Tank

Although the guidance for refilling the RWST to re-establish injection flow currently exists, the evaluation for this Bulletin response has concluded that the procedural guidance can be enhanced by providing instructions to begin refilling

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the RWST after recirculation has been commenced in lieu of waiting until a problem with recirculation develops.

Implementation Schedule: This procedure revision will be implemented by January 31, 2004. Once training has been completed, the procedure revisions will be issued for use. The basis for delaying implementation beyond the 60-day response date is to allow sufficient time to complete proposed procedure revisions, develop training materials, appropriately train licensed operators and incorporate any feedback from training into the procedure revisions prior to issuance for use.

More aggressive containment cleaning and increased foreign material controls

Interim compensatory measures that will be implemented

NMC has reviewed existing procedure requirements for containment closeout and foreign material controls. This review indicated that extensive procedure requirements currently exist to reduce the possibility of containment sump blockage due to debris and foreign material. These requirements are implemented through a detailed checklist performed prior to commencing power operations. In addition, foreign material inside of containment is minimized by the use of Service I level coatings. Service level I coatings are applied using plant procedures. Consistent with these procedures, only Service level I coatings can be applied inside of containment.

The review of the containment closeout procedures indicates that the controls and requirements can be enhanced. Additional measures will be implemented to provide more aggressive requirements for containment closeout and foreign material controls to further reduce the potential for resident debris source terms.

Implementation Schedule: The enhanced containment closeout and foreign material control requirements will be implemented by the Prairie Island 2003 Unit 2 refueling outage. The basis for delaying implementation beyond the 60-day response date is that these controls will be implemented during outages and the next outage is not scheduled until after the 60-day response date.

• Ensuring containment drainage paths are unblocked

Interim compensatory measures that have been implemented

In general, the containment floor plans are clear of major obstructions that could prevent flow from reaching the containment sump screens. The configuration of the containment basement elevation is conducive to directing flow to the

containment sump. The entire basement elevation of the containment building serves as the ECCS sump for collection of water introduced to the containment following a LOCA. The basement floor elevation is essentially an open area except for the primary reactor shield wall, the walls and supports for the loop compartments (vaults) and the refueling cavity. The flow paths from the upper levels of containment to the lower levels are relatively free; i.e., open stairways and/or floor grating. The vaults contain the Reactor Coolant Pumps and Steam Generators. These vaults have large openings that allow all liquid to spill to the containment basement elevation.

The following are areas inside of containment that liquid could collect.

Sump A

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Liquid from floor and equipment drains inside Containment drains to Containment Sump A. Sump A eventually overflows to the containment basement floor. This overflow will transport to recirculation Sump B.

Sump B

The Residual Heat Removal pumps take suction from Containment Sump B, the recirculation sump.

Sump C

Containment Sump C is the compartment below the reactor (Reactor Cavity). Following a LOCA, some flow will be diverted to Reactor Cavity Containment Sump C due to an opening in the personnel access hatch approximately two feet above the containment basement floor elevation. The flooding of Sump C and submergence of the lower reactor vessel head was a recommendation from the Severe Accident Management Guidelines. This diversion was accounted for when calculating the available NPSH for the RHR pumps.

Refueling Pool

Post-accident, following the onset of containment spray, some spray could collect in the refueling pool. The drain valve for the refueling pool is maintained locked open during plant operation. In response to this Bulletin, during the monthly containment entries in both Units, it was verified that the screen on this drain is not blocked nor are there any potential debris sources nearby that could block the screen.

Interim compensatory measures that will be implemented

As discussed above, NMC has taken actions to ensure that containment drainage paths are not blocked. This review also indicated that to ensure this flow path is not blocked following future refueling outages, the containment

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closeout procedures could be enhanced to include specific verifications that these containment drainage paths are not blocked.

Implementation Schedule: The enhanced containment closeout and foreign material control requirements will be implemented by the Prairie Island 2003 Unit 2 refueling outage.

• Ensuring sump screens are free of adverse gaps and breaches

Interim compensatory measures that have been implemented

NMC currently performs a Technical Specification surveillance test as part of the post-outage containment inspection procedure that specifically looks at the sump screen for evidence of structural distress or abnormal corrosion. Furthermore, in response to this Bulletin, during the monthly containment entry, the screen was inspected specifically for any adverse gaps or breaches. No adverse gaps or breaches were noted during this inspection that would prevent the screen from performing its design function.

Prairie Island Plant Specific Compensatory Measures

Interim compensatory measures that will be implemented

Due to the relatively large opening size in the sump screens at Prairie Island, debris ingestion is likely a greater potential concern than sump screen blockage. Based on the types of debris sources inside of containment, ingestion of significant quantities of debris is not expected; however, it is considered prudent to implement contingencies. The compensatory measures to increase RWST level and secure CS (discussed above) help to reduce the probability for debris ingestion.

In addition to the above discussion actions, additional procedural measures are being considered to specifically address the potential for debris entering the recirculation systems. These procedures provide specific indications that the operators and TSC staff can use to detect that blockage is occurring and strategies to mitigate this potential blockage. A sufficient number of the indications for the operators and TSC staff to use to monitor recirculation system performance are available on a single computer display. This allows personnel to monitor the indications in an integrated manner and makes detecting trends easier. Mitigation strategies can be placed into the following groupings:

• Operators maintain flow using an alternate injection flow path. In this case, the charging system could be used. Within the first few hours following the event the decay heat boil-off rate is within the capacity of the charging system. The ECCS pumps could be realigned to draw suction

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from the RWST. However, if it is postulated that the recirculation system is adversely affected by debris ingestion then this same debris could also affect the ECCS injection flow path. The advantage of the charging system is that it would provide flow paths that would not be affected by the postulated debris ingestion.

 Operators secure the recirculation flow for a limited period of time may allow the postulated debris to settle out of the blockage location and free the flow path. Or the re-initiation of the recirculation flow may dislodge the debris.

• Operators realign the system to provide a different flow path. For example, normal high head recirculation returns the liquid to the RCS cold legs. As an option, the high head recirculation could be aligned to the reactor vessel injection flow paths. Or, as another example, the high head recirculation flow path could be used in lieu of the low head recirculation flow path.

• If blockage cannot be cleared, then the operators would transition to the EOP for a loss of emergency coolant recirculation.

Implementation Schedule: This procedure revision will be implemented by January 31, 2004. Once training has been completed, the procedure revisions will be issued for use. The basis for delaying implementation beyond the 60-day response date is to allow sufficient time to complete proposed procedure revisions, develop training materials, appropriately train licensed operators and incorporate any feedback from training into the procedure revisions prior to issuance for use.

NMC has addressed each of the six compensatory measures as discussed in the Bulletin. Therefore, there are no compensatory measures, as listed in the Discussion section of the Bulletin, that have not been addressed.

In addition, NMC is committing to perform an evaluation to analyze the emergency core cooling system recirculation functions with respect to the potentially adverse post-accident debris blockage effects on the containment sump, taking into account the recent research findings, to determine compliance with all applicable regulatory requirements. NMC will continue to work with the Nuclear Energy Institute (NEI) to follow Generic Safety Issue 191 resolution methodology, currently being developed by NEI. NMC will implement the methodology, as determined appropriate for Prairie Island. The commitments made in relation to the compensatory measures will remain in effect until an evaluation to determine compliance is complete.