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Nuclear Management Company, LLC
Prairie Island Nuclear Generating Plant
1717 Wakonade Dr. East • Welch MN 55089

April 3, 2002

Bulletin 2002-01

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

15-Day Response to NRC Bulletin 2002-01, Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity

As required by NRC Bulletin 2002-01, "Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity," Prairie Island is providing the attached information.

In this letter we have made no new Nuclear Regulatory Commission commitments. Please contact Jeff Kivi (651-388-1121) if you have any questions related to this letter.

Mano K. Nazar
Site Vice President
Prairie Island Nuclear Generating Plant

A095

c: Regional Administrator - Region III, NRC
Senior Resident Inspector, NRC
NRR Project Manager, NRC

Attachments:
1. Affidavit
2. 15-Day Response to NRC Bulletin 2002-01, Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity

UNITED STATES NUCLEAR REGULATORY COMMISSION

NUCLEAR MANAGEMENT COMPANY, LLC

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

DOCKET NO. 50-282
50-306

15-DAY RESPONSE TO NRC BULLETIN 2002-01,
REACTOR PRESSURE VESSEL HEAD DEGRADATION AND REACTOR COOLANT PRESSURE BOUNDARY INTEGRITY

Nuclear Management Company, LLC, a Wisconsin corporation, with this letter is submitting information requested by NRC Bulletin 2002-01.

This letter contains no restricted or other defense information.

NUCLEAR MANAGEMENT COMPANY, LLC

By _____
Michael D. Werner
Plant Manager
Prairie Island Nuclear Generating Plant

On this 03 day of April 02 before me a notary public acting in said County, personally appeared Michael D. Werner, Plant Manager, Prairie Island Nuclear Generating Plant, and being first duly sworn acknowledged that he is authorized to execute this document on behalf of Nuclear Management Company, LLC, that he knows the contents thereof, and that to the best of his knowledge, information, and belief the statements made in it are true and that it is not interposed for delay.

CATHERINE S. MCEATHRON
NOTARY PUBLIC - MINNESOTA
My Commission Expires 1/31/2005

ATTACHMENT 2
15-Day Response to NRC Bulletin 2002-01, Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity

1. *Within 15 days of the date of this bulletin, all PWR addressees are required to provide the following:*
   A. *a summary of the reactor pressure vessel head inspection and maintenance programs that have been implemented at your plant,*

Prairie Island Response to 1.A

Description of Vessel Head Penetration (VHP) Nozzles

Each unit has a total of 40 penetrations and a 1-inch diameter head vent nozzle, with 29 penetrations for full-length rods, 4 spare penetrations previously used for part length rods, 4 plugged spare penetrations, and 3 penetrations for Core Exit Thermocouples. The penetrations are all nominal 4 inch O.D. SB-166 NiCr Fe alloy. The penetrations are spaced approximately 11 inches center-to-center.

Description of Reactor Pressure Vessel (RPV) Head Insulation

Both Prairie Island units have reflective horizontal insulation. The insulation is a nominal 3 inches thick and consists of thin stainless steel sheets. Clearance between the head and the insulation is approximately 1 inch at the center and 18 inches at the outside nozzles. The insulation was modified in 1997 and 1998 to add view ports that allow bare metal inspection of the reactor vessel head from four locations around the periphery. Each penetration is visible through at least 2 of the view ports. Three additional view ports in the control rod drive mechanism (CRDM) cooling shroud above the horizontal insulation allow visual inspection of the lower canopy seal welds and the top surface of the horizontal mirror insulation. The intermediate canopy seal welds can be viewed by looking over the top of the CRDM cooling shroud.

Description of RPV Head and Nozzle Inspections Within Past Four Years

A bare metal RPV head visual inspection has been performed at least once each refueling outage for the Prairie Islands units since 1997. These augmented inspections are typically performed by two Reactor Vessel System Engineers working together for safety and ALARA considerations. Except for the Unit 2 inspection of February 2002, the inspectors have not necessarily been qualified VT-2 examiners, but rather they have been the site reactor vessel subject matter experts. The inspections are typically done early in the outage to identify any indications as soon as possible. The inspections can be done with the head on the vessel and the unit in cold shut down, or when the head is on its storage stand during refueling. The only limitations of the inspection are due to the limited points of view available, since they are conducted

through discretely located view ports. However, all of the penetrations and the head surface can be clearly viewed through two or more of the four view ports. The only impediments to the inspection are the restricted lines of sight to the interior tubes caused by the curvature of the head and intervening peripheral tubes. However, because more than one perspective is available to view each tube, a thorough inspection of each tube-to-head interface and head ligament is achievable. The RV head of both units is very clean with no residual boric acid or other debris that would impede the ability to find a leak. There has been no indication of either a crack or leak at the nozzle penetration on either unit, and no evidence of boric acid accumulations.

In addition to the reactor vessel head, these inspections have also included the lower and intermediate canopy seal welds of the CRDMs, and observation of the topside of the horizontal mirror insulation for signs of leakage. There has been some history of small volume canopy seal weld leaks as outlined in the response to part 1.C, below. In all cases, the leaks were repaired. In all cases, boric acid residue resulting from the leak was cleaned from the insulation and the penetrations, where accessible. If the source of the leak created a possibility that boric acid could have come into contact with the head, then the horizontal insulation was removed to allow inspection and cleaning of the carbon steel surfaces.

Following is a summary of inspections with completion date and associated work order number. The listed inspections date back to the last time the insulation was completely removed from each unit's head to verify the head was free of boric acid residue. In addition, digital photographs have been taken through the view ports of both units during recent inspections (the last Unit 2 head inspection was videotaped).

Unit One Inspections

Date Completed	Work Order	Notes
8/01	0109313	Mid-cycle visual inspection with photos
1/01	0004462	Refueling bare-metal inspection
4/99	9901828	Refueling bare-metal inspection
11/97	9712250	Installed View Ports
11/97	9708267	Removed Insulation

Unit Two Inspections

Date Completed	Work Order	Notes
2/02	0107685	Bulletin 2001-01 inspection with photos and video
5/00	9912396	Refueling bare-metal inspection
11/98	9809962	Refueling bare-metal inspection
2/98	9708268	Installed View Ports

In addition to the inspections performed under the referenced work orders, the reactor vessel head is also inspected each outage in accordance with Prairie Island procedure H2, "Program for Identification and Disposition of Small Reactor Coolant Leakage On Low Alloy Reactor Coolant Pressure Boundary Components."

Procedure H2 references inspection of the reactor vessel head (with the insulation in place) as part of surveillance procedure SP 1070 (Unit 1) and SP 2070 (Unit 2), "Reactor Coolant System Integrity Test." These surveillance procedures require VT-2 inspection of all accessible ASME Code Class 1 pressure boundary components, and include specific steps for at-pressure inspection of the three instrument port conoseals, the lower canopy seal welds, and the intermediate canopy seal welds.

The reactor vessel heads of both units are also included in the Inservice Inspection Program in accordance with ASME Section XI, 1989 edition. Required inspections include surface and volumetric inspections of the RPV closure studs, surface inspection of the closure nuts, visual inspection of the closure washers, surface and volumetric inspection of the head to flange circumferential weld, and visual inspection of the conoseal clamp assemblies. The partial penetration welds for the penetration tubes are VT-2 inspected during the system hydrostatic test once per ten-year interval. Additionally, the full penetration welds for peripheral CRDMs (Category B-O) are inspected by surface and volumetric examination.

Reactor coolant system (RCS) leak rate testing per surveillance procedure SP 1001A-series (Unit 1) and SP 2001A-series (Unit 2) serves as a means of leakage detection for power operations. Additionally, containment sump pump run times, containment radiation levels, and containment humidity are tracked for early indication of RCS leakage.

B. *an evaluation of the ability of your inspection and maintenance programs to identify degradation of the reactor pressure vessel head including, thinning, pitting, or other forms of degradation such as the degradation of the reactor pressure vessel head observed at Davis-Besse,*

Prairie Island Response to 1.B

The inspections of the head surface performed from the view ports in the mirror insulation are capable of identifying minute quantities of boric acid accumulation. The insulation design, which is essentially a right vertical cylinder with a flat roof, provides no impediment to a complete examination of the head surface and the penetration tube-to-head interface at the head's outer surface.

The flat-roof design results in a significant offset between the insulation and most portions of the dome. The insulation comes nearest the top of the dome, where the offset is reduced to approximately an inch. There are four view ports, spaced around the periphery, cut into the vertical insulation panels, such that each penetration is visible from at least two perspectives, since fully half of the dome is visible from each view port. The number and spacing of the view ports makes possible a very thorough inspection of the head surface and tube-to-head interfaces.

The only limitations result from the points-of-view being limited to the peripheral locations combined with the curvature of the head, meaning that exterior tubes can mask the line-of-sight to interior tubes from some angles. Despite this limitation, each penetration tube can be thoroughly interrogated by visual examination because of the multiple perspectives available. Additionally, the head surface is free of debris or any residual boric acid from previous leaks higher up on the CRDMs, due to the insulation having been completely removed in 1997 and 1998 on Units 1 and 2, respectively. The completeness of the examinations that have been performed on both units assures that no significant accumulations of boric acid could have gone undetected, and therefore no wastage of the carbon steel material is occurring on the top of the head. We conclude there is a very high degree of confidence that there is no pitting, thinning, or general or localized corrosion of the carbon steel pressure-retaining membrane similar to what was discovered at Davis-Besse.

C. *a description of any conditions identified (chemical deposits, head degradation) through the inspection and maintenance programs described in 1.A that could have led to degradation and the corrective actions taken to address such conditions,*

Prairie Island Response to 1.C

Both Prairie Island units have a history of canopy seal leakage. These leaks have primarily been identified through RCS leak rate testing and via non-code visual

inspections of the canopy seals, although some have been identified during ASME Section XI System Pressure Tests. Based on available documentation, in all cases, once a leak was identified, repairs of the canopy seal have been performed, and in no case was the resultant boric acid residue allowed to remain on carbon steel surfaces. The documentation that exists regarding these early canopy seal leaks indicates that whenever a possibility of boric acid contact with the head existed, the horizontal insulation was removed to facilitate inspection and cleaning. The history of canopy seal leaks motivated the establishment of an active program of inspection of the CRDM's in order to allow early detection and correction of potential leaks during scheduled refueling outages. One incident that did result in a significant amount of boric acid on the bare head was the Part Length CRDM leak at location G9 of the Unit 2 head in 1998. This leak resulted in removal of all of the insulation, followed by complete cleaning of the head surface and an inspection for wastage. This inspection indicated no degradation.

The industry issue of Alloy 600 degradation led to the installation of view ports in the mirror insulation in 1997 and 1998. The view ports were installed in conjunction with complete insulation removal and cleaning of the heads. Therefore, 1997 and 1998 for Units 1 and 2, respectively, serve as a baseline at which time both heads were known to be clean and in good condition. No conditions have been identified since that time by any inspection or maintenance program that could have resulted in head degradation or boric acid deposition on the bare head metal. Additionally, subsequent inspections facilitated by the view ports since that time provide significant assurance of continued cleanliness and continued good condition since the baseline was established.

D. *your schedule, plans, and basis for future inspections of the reactor pressure vessel head and penetration nozzles. This should include the inspection method(s), scope, frequency, qualification requirements, and acceptance criteria, and*

<u>Prairie Island Response to 1.D</u>

Plans for Future Inspections

As committed to in the Prairie Island response to Bulletin 2001-01, Prairie Island has performed "effective visual examination" of the RPV head and nozzles of Unit 2 (performed by a VT-2 qualified examiner) and will complete the Unit 1 inspection during the next Unit 1 refueling outage (scheduled for late 2002). The acceptance criterion for the "effective visual examination" is no visual indications of cracks or leaks.

Following the next Unit 1 refueling outage, Prairie Island plans to continue periodic inspection of the bare metal RPV head and nozzles via the view ports in the insulation once per cycle. The inspections will be documented in the work control process. Prairie Island also plans to continue to include inspection of the RPV nozzle canopy seal welds and observation of the reactor head insulation for signs of leakage.

If leakage is detected it will be investigated and repaired as needed in accordance with the current Prairie Island repair/replacement program including applicable codes and standards. Any indication of leakage or cracks in head penetration nozzles will be evaluated and characterized utilizing some combination of surface and/or volumetric examinations. These examinations could include Visual, Dye Penetrant, Eddy Current, Ultrasonic, or Radiography. The inspection technologies selected would depend on the location and orientation of the indication, and the available examination techniques.

Basis for Future Inspections

Prairie Island Units 1 and 2 were ranked for the potential for primary water stress corrosion cracking (PWSCC) of the Alloy 600 head penetration tubes using the time-at-temperature model and plant specific input data as reported in MRP-48. As shown in Table 2-1 of MRP-48, this indicated that Unit 1 required 26.6 effective full power years (EFPY) and Unit 2 required 26.7 EFPY from March 1, 2001, to reach the same time-at-temperature as Oconee 3 had at the time its leaking nozzles were discovered in February of 2001. The plant staff believes the current visual inspections meet the criteria for "effective visual inspection" of 100% of the VHP nozzles as referenced in NRC Bulletin 2001-01.

The NRC responded to the Prairie Island Bulletin 2001-01 submittal by letter dated November 8, 2001. The letter notes, "The NRC finds that you have provided the requested information and there is reasonable assurance the public health and safety will be maintained. Your proposed inspection scope and schedule described in your response ... were integral to the NRC staff's finding." In addition, as described in the response to 1.E, below, the NRC has reviewed by inspection our activities in response to Bulletin 2001-01 to verify compliance with applicable regulatory requirements with no findings of significance identified.

E. your conclusion regarding whether there is reasonable assurance that regulatory requirements are currently being met (see the Applicable Regulatory Requirements, above). This discussion should also explain your basis for concluding that the inspections discussed in response to Item 1.D will provide reasonable assurance that these regulatory requirements will continue to be met. Include the following specific information in this discussion:

(1) If your evaluation does not support the conclusion that there is reasonable assurance that regulatory requirements are being met, discuss your plans for plant shutdown and inspection.

(2) If your evaluation supports the conclusion that there is reasonable assurance that regulatory requirements are being met, provide your basis for concluding that all regulatory requirements discussed in the Applicable Regulatory Requirements section will continue to be met until the inspections are performed.

Prairie Island Response to 1.E

Prairie Island staff has reviewed the Applicable Regulatory Requirements of Bulletin 2002-01 and concluded that there is reasonable assurance that these regulatory requirements are currently being met and will continue to be met. Our conclusion is based on the following:

1. each of the regulatory requirements is reflected in a site program document, procedure, or the operating license,
2. the history of inspections of the vessel head (including the most recent inspections) indicate no degradation of the vessel head,
3. the physical layout of the head and insulation is such that significant indication of degradation would not be hidden from inspection by insulation, and
4. Prairie Island practice is to clean residual boric acid deposits, such that residual boric acid accumulation does not preclude inspections from identifying significant degradation.

In addition, further assurance comes from a review performed by NRC Inspectors, documented in Inspection Report No. 50-282/01-19; 50-306/01-19. The Inspection Report notes that this review was conducted per Temporary Instruction 2515/145 to verify compliance with applicable regulatory requirements. The Inspection Report further notes, "The inspectors interviewed inspection personnel, reviewed procedures and inspection reports, including photographic documentation, to assess the licensee's efforts in conducting an 'effective' visual examination of the reactor vessel head." The review noted the following with respect to the most recent vessel head and nozzle

inspection (Unit 2) at Prairie Island:

- Examinations were performed by an individual certified as a Level II in the VT-1, VT-2, and VT-3 Methods.
- Examinations were performed in accordance with approved plant procedures that were appropriate for the examinations.
- Examinations were sufficient to identify any deficiencies and that the examinations did not identify any deficiencies.
- Licensee's efforts were capable of identifying the primary stress corrosion cracking phenomenon identified in NRC Bulletin 2001-01 and that inspection personnel had access to all head penetrations, with no obstructions or interferences.
- Licensee had complete viewable coverage of the vessel head and that the as-found condition was clean.
- Small boron deposits, as described in Bulletin 2001-01, could be identified given the cleanliness and accessibility of the pressure vessel head penetration. However, no indications were found on the penetrations.
- Licensee inspection personnel did not identify any materiel deficiencies associated with any of the vessel head penetrations.
- Inspectors conducted reviews to verify that there were no impediments to the examinations.

The review noted that no findings of significance were identified.