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**Christina L. Perino**  
Manager  
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GNRO-2012/00069

June 27, 2012

U. S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, DC 20555-0001

SUBJECT: Licensee Event Report 2012-004-00 Weld Defect Indication Found in  
Residual Heat Removal System to Reactor Pressure Vessel Boundary  
Nozzle  
Grand Gulf Nuclear Station, Unit 1  
Docket No. 50-416  
License No. NPF-29

Dear Sir or Madam:

Attached is Licensee Event Report (LER) 2012-004-00 which is a final report. This report is submitted in accordance with 10 CFR 50.73(a)(2)(ii)(A).

This letter does not contain any commitments. Should you have any questions regarding the attached report, please call Christina L. Perino at 601-437-6299.

Sincerely,

A handwritten signature in black ink, appearing to read "Christina L. Perino".

CLP/ras

Attachment: Licensee Event Report (LER) 2012-004-00

cc: (see next page)



cc: Mr. Elmo Collins  
Regional Administrator, Region IV  
U. S. Nuclear Regulatory Commission  
1600 East Lamar Boulevard  
Arlington, TX 76011-4511

NRC Senior Resident Inspector  
Grand Gulf Nuclear Station  
Port Gibson, MS 39150

U. S. Nuclear Regulatory Commission  
ATTN: Mr. A. B. Wang, NRR/DORL (w/2)  
Mail Stop OWFN 8 B1  
Washington, DC 20555-0001

**Attachment  
To  
GNRO-2012/00069**

**Licensee Event Report (LER) 2012-004-00**

<b>NRC FORM 366</b> (10-2010)		<b>U.S. NUCLEAR REGULATORY COMMISSION</b>			APPROVED BY OMB: NO. 3150-0104      EXPIRES: 10/31/2013		Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA/Privacy Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to <a href="mailto:infocollects.resource@nrc.gov">infocollects.resource@nrc.gov</a> , and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.				
<b>LICENSEE EVENT REPORT (LER)</b> (See reverse for required number of digits/characters for each block)											
<b>1. FACILITY NAME</b> Grand Gulf Nuclear Station, Unit 1				<b>2. DOCKET NUMBER</b> 05000 416		<b>3. PAGE</b> 1 OF 5					
<b>4. TITLE</b> Weld Defect Indication Found in Residual Heat Removal System to Reactor Pressure Vessel Boundary Nozzle											
<b>5. EVENT DATE</b>			<b>6. LER NUMBER</b>			<b>7. REPORT DATE</b>			<b>8. OTHER FACILITIES INVOLVED</b>		
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME		N/A
04	28	2012	2012 - 004 - 00			06	27	2012	N/A		N/A
<b>9. OPERATING MODE</b> 4			<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)</b>								
<b>10. POWER LEVEL</b> 000			<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> 50.73(a)(2)(vii)					
			<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input checked="" type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)					
			<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)					
			<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)					
			<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)					
			<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)					
			<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)					
<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> OTHER								
<input type="checkbox"/> 20.2203(a)(2)(vi)	<input type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A								
<b>12. LICENSEE CONTACT FOR THIS LER</b>											
FACILITY NAME Christina L. Perino / Licensing Manager								TELEPHONE NUMBER (Include Area Code) (601) 437-6299			
<b>13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT</b>											
CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX		
B	BO	NZL	GEH	N	N/A	N/A	N/A	N/A	N/A		
<b>14. SUPPLEMENTAL REPORT EXPECTED</b>							<b>15. EXPECTED SUBMISSION DATE</b>		MONTH	DAY	YEAR
<input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE) <input checked="" type="checkbox"/> NO							DATE		N/A	N/A	N/A
<b>ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)</b>  <p>On 4/28/2012 with the plant in Mode 4 for refueling outage 18 (RF18) with the reactor shutdown, during In-Service Inspection (ISI) testing, the nozzle weld N6B-KB, Residual Heat Removal / Low Pressure Coolant Injection (RHR/LPCI) "C" Nozzle to Safe End Weld was ultrasonically (UT) tested. The UT examination revealed an indication indicative of intergranular stress corrosion cracking (IGSCC). The indication was evaluated by Entergy Engineering and Electric Power Research Institute (EPRI) personnel and confirmed to be a weld defect. Inservice Inspection (ISI) relief request (RR-ISI-17; ML12124A245) to repair the weld was submitted to, and approved by, the NRC (reference GTC 2012-00011).</p> <p>A full structural weld overlay repair to restore the weld to ASME Code requirements was completed on May 14, 2012. A post-weld UT test was completed satisfactorily on May 16, 2012.</p> <p>The event posed no threat to public health and safety.</p>											

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**NARRATIVE**

**A. Reportable Occurrence**

This LER is being submitted pursuant to 10 CFR 50.73(a)(2)(ii)(A) as a degraded or unanalyzed condition when an indication indicative of intergranular stress corrosion cracking (IGSCC) was detected, and confirmed, in the weld root area of N6B-KB reactor coolant system pressure boundary weld on 4/28/2012.

**B. Description of Structure(s), System(s) and Component(s)**

The N6B nozzle connects the Residual Heat Removal C (EIS:BO) system to the reactor pressure vessel (RPV). The Residual Heat Removal (RHR) system is comprised of three independent loops. Each loop contains its own motor-driven pump, piping, valves, instrumentation and controls. Each loop has a suction source from the suppression pool and is capable of discharging water to the reactor vessel via a separate nozzle, or back to the suppression pool via a full flow test line. The RHR/LPCI system removes decay and sensible heat from the reactor during shutdown, accident, and refueling conditions. The system also cools the suppression pool and the containment and maintains the required water level in the reactor vessel following a loss of cooling accident (LOCA).

**C. Initial Conditions**

The reactor was in Refueling Outage Mode 4 with reactor shutdown. There were no inoperable structures, systems, or components that contributed to this event.

**D. Description of Occurrence**

During refueling outage 18 (RF18), as part of the In-Service Inspection (ISI) program, weld N6B-KB, the Residual Heat Removal (RHR)/Low Pressure Injection (LPCI) "C" Nozzle to Safe End Weld, was ultrasonically (UT) examined to comply with the inspection requirements of the Boiling Water Reactor Vessel Internals Program (BWRVIP) 75A for Category "C" welds. The UT examination was performed in accordance with American Society of Mechanical Engineers (ASME) Section XI, Appendix VIII, Supplement 10 as implemented by the Performance Demonstration Initiative (PDI).

In performing this UT examination, an indication indicative of intergranular stress corrosion cracking (IGSCC) was detected. The indication was axially oriented and wholly located within the weld and butter. The length of the indication was 0.94 inches. The depth of the indication was 0.47 inches with a remaining ligament from the outside surface of 0.90 inches. The indication was located circumferentially 8.1 inches from top-dead-center looking into the vessel.

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**NARRATIVE**

**Description of Occurrence (continued)**

The outside diameter (OD) of the nozzle at the affected weld is approximately 14.5 inches. The nozzle is approximately 1.4 inches thick. The safe end connected to the nozzle is approximately 14.3 inches OD and approximately 1.3 inches thick. The weld is considered a dissimilar metal (DM) weld due to the design of nozzle carbon steel to Inconel safe end with Inconel weld metal.

**E. Cause of Occurrence**

The apparent cause of the weld indication is that the weld and weld butter were fabricated with material susceptible to IGSCC type cracking. Actions were taken to mitigate this condition through the stress relieving process of Induction Heating Stress Improvement (IHSI). A contributing cause for identification of this condition in 2012 (versus earlier) is the development and use of improved ultrasonic examination procedures, improved surface preparation and better qualified technicians.

The weld and weld butter were fabricated with Inconel 82/182 which has been shown to be susceptible to IGSCC-type cracking. The indication was detected in the weld butter and weld root area.

IHSI was performed in refueling outage four (RF04 in 1990) on the N6B nozzle to relieve stress and prevent and/or mitigate nozzle cracks. BWRVIP 61, "Induction Heating Stress Improvement Effectiveness on Crack Growth in Operating Plants," documents the results of an investigation into the most likely causes for post-IHSI IGSCC. Per the report, the apparent new cracking reported after IHSI can be attributed to existing cracking that initially went undetected following application of IHSI. Another possible explanation is that the flaw existed at the time of IHSI treatment and did not grow post-IHSI, but was later detected with better examination methods and better trained personnel.

Per BWRVIP 75A, extensive reviews of IHSI and UT data have concluded that the likely cause of "new IGSCC" is the existence of IGSCC that was undetected until later examinations were performed using better procedures. Automated examination is being utilized. The data is indexed and can be retrieved later for multiple reviews. Additionally, Electric Power Research Institute (EPRI) provided an independent review of the Grand Gulf Nuclear Station (GGNS) data for the N6B-KB nozzle weld.

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**NARRATIVE**

**F. Corrective Actions**

An ISI Relief Request was prepared and submitted to the NRC. The NRC granted verbal approval of relief request to allow installation of a weld overlay.

A full structural overlay repair to restore the weld to ASME Code requirements in accordance with Relief Request ISI-17 was completed on May 14, 2012.

Post weld UT testing and Liquid Penetrant Examination were completed on May 16, 2012. No indications associated with IGSCC were recorded during the post-weld UT testing and no relevant indications were noted during the Liquid Penetrant Examination.

**G. Safety Assessment**

The event posed no threat to public health and safety.

The indication found in the N6B-KB nozzle weld does represent an actual or likely increased challenge to nuclear safety. The indication is indicative of the IGSCC cracks that have been found in dissimilar metal welds at Boiling Water Reactors (BWRs). IGSCC-type axial cracking typically does not lead to structural failure of the weld as typically this would follow a "leak before break scenario." If the flaw had breached the outside diameter, some leakage would have occurred. This leakage would be detected by installed drywell leak detection systems.

Limits on unidentified leakage in the drywell would force reactor shutdown before there is any threat of crack growth that would jeopardize the overall structural integrity of the reactor coolant boundary piping (i.e., guillotine failure).

IHSI was performed on all dissimilar metal (DM) welds in RF04 (1990) by NUTECH Engineers Inc. The IHSI treatment on the DM welds was performed on the N6B nozzle. A post-UT examination was completed and no indications were identified.

Effective programs in accordance with the ISI Program/BWRVIP 75A requirements are in place to manage the age-related degradation of flaws in the reactor coolant pressure boundary and avoid any undue risk to nuclear safety.

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**NARRATIVE**

**H. Additional Information**

Grand Gulf has thirty-four (34) DM welds in the ISI program which require inspection under BWRVIP 75A (October 2005). Inspection requirements for these welds are detailed in BWRVIP 75A, Table 3-1, page 3-2. Due to industry concerns with cracking incidents in DM welds, the industry committed to an accelerated inspection program. Details of this program and requirements are detailed in BWRVIP 222, "Accelerated Inspection Program for BWRVIP 75A Category C Dissimilar Metal Welds Containing Alloy 182", July 2009. Twenty (20) DM Category C welds were inspected prior to RF18 to comply with the PDI requirements which became effective in November, 2002. The remaining fourteen (14) welds in the program were inspected during RF18. All BWRVIP Category C welds at Grand Gulf have been inspected using the ASME Section XI, Appendix VIII, Supplement 10 qualified techniques. The N6B nozzle was the last nozzle requiring inspection.

**I. Previous Occurrences**

There are no previous occurrences. All welds of this type have been inspected at Grand Gulf utilizing the PDI criteria with no other flaws noted.