Entergy Nuclear South
Entergy Operations, Inc.
17265 River Road
Killona, LA 70057-3093
Tel 504-739-6715
Fax 504-739-6698
rmurill@entergy.com

Robert J. Murillo
Licensing Manager, Acting
Waterford 3

10CFR50.73 (a)(2)(ii)(A)

W3F1-2005-0042

June 16, 2005

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

SUBJECT: Licensee Event Report 2005-001-00
Waterford Steam Electric Station, Unit 3
Docket No. 50-382
License No. NPF-38

Dear Sir or Madam:

Attached is Licensee Event Report (LER) 2005-001-00 for Waterford Steam Electric Station Unit 3. This report provides details of the discovery of evidence of Reactor Coolant System pressure boundary leakage. Two indications of leakage were initially identified at pressurizer heater sleeves C-4 and D-2 during inspections performed during Waterford 3's Refuel 13 Outage. Subsequent non-destructive examination confirmed the existence of only one leaking pressurizer heater sleeve at location C-4. This condition is being reported pursuant to 10CFR50.73 (a)(2)(ii)(A) due to a small amount of boric acid that was discovered in the annulus around one pressurizer heater sleeve during the scheduled Refuel 13 Outage.

There are no commitments contained in this submittal. If you have any questions, please contact Ron Williams at (504) 739-6255.

Very truly yours,

RJM/RLW/ssf

Attachment

IE22

cc: Dr. Bruce S. Mallett
U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011

NRC Senior Resident Inspector
Waterford 3
P.O. Box 822
Killona, LA 70066-0751

U.S. Nuclear Regulatory Commission
Attn: Mr. Nageswaran Kalyanam MS O-7D1
Washington, DC 20555-0001

Wise, Carter, Child & Caraway
Attn: J. Smith
P.O. Box 651
Jackson, MS 39205

Winston & Strawn
Attn: N.S. Reynolds
1700 K Street, NW
Washington, DC 20006-3817

Louisiana Department of Environmental Quality
Office of Environmental Compliance
Surveillance Division
P. O. Box 4312
Baton Rouge, LA 70821-4312

American Nuclear Insurers
Attn: Library
Town Center Suite 300S
29th S. Main Street
West Hartford, CT 06107-2445

Morgan, Lewis & Bockius LLP
ATTN: T.C. Poindexter
1111 Pennsylvania Avenue, NW
Washington, DC 20004

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, 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.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Waterford Steam Electric Station, Unit 3	05000 382	1 OF 4

4. TITLE

RCS Pressure Boundary Leakage Due to Primary Water Stress Corrosion Cracking of a Pressurizer Heater Sleeve

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
04	19	2005	2005	- 1 -	0	06	16	2005		05000
									FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE

5

10. POWER LEVEL

0%

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☑ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
Waterford 3 / Ronald L. Williams	(504) 739-6255

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED

○ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ◉ NO

15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR

ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

On April 19, 2005, following entry into Mode 5 for the scheduled Waterford 3 Refuel 13 Outage, a visual inspection of the pressurizer (PZR) nozzles and heater sleeves revealed indications of Reactor Coolant System pressure boundary leakage. A small amount of boric acid was discovered in the annulus around PZR heater sleeves C-4 and D-2. Inspection of the PZR carbon steel base metal material surrounding each penetration indicated that no boric acid material wastage had occurred. The boric acid is evidence of Primary Water Stress Corrosion Cracking (PWSCC) of the Alloy 600 heater sleeve and is consistent with industry operating experience for equivalent Alloy 600 PZR heater sleeve configurations and existing root cause analyses for PWSCC in RCS small bore nozzles. Non-destructive examination of the two penetrations revealed the presence of two axially oriented flaws in heater penetration C-4. NDE results of heater penetration D-2 did not identify any discernible defect, therefore, this penetration was excluded as a RCS pressure boundary leak. The one leaking heater penetration was repaired using Alloy 690 half-sleeve material replacement, as part of the scheduled refueling 13 outage preventive weld repair/replacement plan for all the Alloy 600 PZR sleeves and small bore instrument penetrations. There were three previous LERs submitted over the past five years involving evidence of leakage from a principal safety barrier attributed to PWSCC of Alloy 600 material. Plant operations were unaffected and this condition did not compromise the health and safety of the public or plant personnel. This condition is not considered a Safety System Functional Failure (SSFF).

REPORTABLE OCCURRENCE

On April 19, 2005, following entry into Mode 5 for the scheduled Refuel Outage 13, a visual inspection of the Reactor Coolant System (RCS) [AB] pressurizer identified indications of leakage coming from two pressurizer heater sleeves C-4 and D-2. These indications of leakage constituted RCS pressure boundary leakage. The degraded condition was reported on April 19, 2005 to the NRC Operations Center within 8 hrs of its discovery (EN# 41617) in accordance with 10 CFR 50.72(b)(3)(ii)(A). This condition is being reported in accordance with the 60-day written reporting requirements of 10 CFR 50.73(a)(2)(ii)(A).

INITIAL CONDITIONS

Prior to the discovery of this condition, the plant was in Mode 5 for Refuel Outage 13 with pressurizer small and large bore "Bare Metal" inspections being performed in accordance with the Alloy 600 Program Inspection Plan.

EVENT DESCRIPTION

On April 19, 2005, following shutdown for scheduled refueling outage 13, visual inspection of the RCS [AB] was being conducted for evidence of boron in accordance with NRC Generic Letter 88-05, Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants" and NRC Bulletin 2004-01, "Inspection of Alloy 82/182/600 Materials used in the Fabrication of Pressurizer Penetrations and Steam Space Piping Connections at Pressurized-Water Reactors." A small amount of boric acid was discovered in the annulus around pressurizer heater sleeves C-4 and D-2. Pressurizer heater sleeve D-2 was conservatively identified as a leaking nozzle during the visual inspection due to the presence of white staining on the nozzle and adjacent carbon steel base metal. However, subsequent non-destructive examination of heater sleeve D-2 revealed no discernible defects were present, thus, it was excluded as an RCS pressure boundary leak.

CAUSAL FACTORS

The Waterford 3 pressurizer is designed with 30 electrical heaters penetrating the bottom head of the vessel. One of the 30 pressurizer heater sleeves was subsequently plugged during the Refuel 10 Outage. The penetrations consist of an Alloy 600 sleeve that is welded to the cladding on the inside surface of the vessel with an Alloy 82 (weld filler metal that is equivalent to Alloy 600) J-groove weld. The heater is inserted through the sleeve, and fillet welded to the outer end of the sleeve.

The apparent cause of the one identified leaking pressurizer heater sleeve is believed to be Primary Water Stress Corrosion Cracking (PWSCC) that produced axial flaws which resulted in RCS leakage. Non-destructive examinations (NDE) were performed from the inside of the two heater sleeves to characterize the orientation of the flaw, as required by NRC Bulletin 2004-01. The examinations confirmed the presence of two axially oriented flaws in pressurizer heater penetration C-4. The identified flaws are consistent with primary water stress corrosion cracking (PWSCC) that has been experienced throughout the industry.

Through extensive NSSS Owners Group and EPRI investigation and testing, it has been determined that Alloy 600 and Alloy 82 (including Alloy 182) materials, with chromium content that fosters grain boundary precipitates, are susceptible to PWSCC. The susceptibility to PWSCC increases with increased stress levels, increased temperature, and increased time in service. The temperature and stress levels in the RCS penetrations are a maximum at the J-groove weld.

CORRECTIVE ACTIONS

The one leaking heater sleeve penetrations C-4 was included in the Refueling Outage 13 preventative repair plan for all the Alloy 600 small bore nozzles on the pressurizer and hot legs. The pressurizer heater sleeve and instrument nozzle [NZL] repairs replaced the lower portion of the existing Alloy 600 sleeves/nozzles with new Alloy 690 materials. The new Alloy 690 sleeves/nozzles were welded to either the mid-wall of the pressurizer vessel or to weld pads at the outside of the pressurizer vessel using Alloy 52M weld filler material. The half-sleeve/half nozzle repair relocated the RCS pressure boundary from a partial penetration (J-groove) weld on the inside surface of the pressurizer to a partial penetration weld at either the mid-wall or the outside surface of the pressurizer. These repairs satisfied the design requirements of the ASME Boiler and Pressure Vessel Code, Section III, for Class 1 components.

As committed in Entergy letter W3F1-2004-0058 dated July 27, 2004, Waterford 3 will continue to perform bare metal visual inspections of pressurizer heater and steam space penetrations in accordance with site procedures during future refueling outages for penetrations that contain Alloy 600 material.

Based on the Alloy 600 preventative repairs of all small bore sleeves / nozzles and continued visual inspection of Alloy 600 locations, no additional corrective actions are warranted.

SAFETY SIGNIFICANCE

The leakage from the pressurizer heater penetration identified in Refuel 13 outage did not result in any corrosion or wastage to the carbon steel pressurizer vessel. The typical crack resulting from PWSCC is located along the axis of the nozzle which will not cause the nozzle to eject. Also, due to the crack development characteristics of PWSCC, and the length of time required for significant wastage of the carbon steel materials, a bare metal visual examination performed every refueling outage provides adequate assurance against degradation that would be safety significant. The actual leakage through the typical crack is limited to extremely low leak rates that do not challenge the ability to operate the plant safely, or impact systems required to mitigate accidents.

Detailed analyses and safety assessments related to PWSSCC cracking in pressurizer heater sleeves have been performed by the Westinghouse Owners Group as documented in WCAP-15973 and WCAP-16180. These evaluations conclude that the PWSCC conditions similar to that reported in this LER do not significantly impact nuclear safety.

This condition is not a Safety System Functional Failure (SSFF). The emergency core cooling system (ECCS) is designed to provide sufficient core cooling for all line breaks in the reactor coolant system up to and including the unlikely double-ended guillotine break at the RCP discharge. Therefore, failure of a small bore nozzle in the RCS is bounded by the existing safety analysis for the plant.

SIMILAR EVENTS

Waterford 3 has previously submitted three Licensee Event Reports over the past five years involving evidence of leakage from a principal safety barrier attributed to PWSCC of Alloy 600 material. They are as follows:

LER 03-003-00 reported on October 24 and 26, 2003 during Refuel 12 Outage identified RCS leakage at two pressurizer heater sleeves (C-1 and C-3) and one hot leg #2 instrument nozzle (RC-IPT-0106B). Ultrasonic and ID eddy current examination of the two sleeves determined the presence of axially oriented flaws, which are typical of PWSCC. The two heater sleeves were repaired using second generation Mechanical Nozzle Seal Assemblies (MNSA-2).

LER 00-011-00 reported on October 17, 2000 during Refuel 10 Outage identified RCS leakage at one pressurizer heater sleeve (F-4) and two of the three MNSA clamps that had been temporarily installed during the Refuel 9 outage. The apparent cause of the leakage was PWSCC, a MNSA clamp flange not being flat against the pipe, and a MNSA clamp seating itself. The conditions were corrected by plugging the pressurizer heater sleeve, and by removing the MNSA clamps and making permanent weld repairs on the nozzles.

LER 99-002-00 reported on February 25, 1999 during Refuel 9 Outage, identified RCS leakage on two Inconel 600 instrument nozzles on the top head of the Pressurizer, one on RCS Hot Leg #1 RTD nozzle, one on RCS hot leg #1 sampling line, and one on RCS hot leg #2 differential pressure instrument nozzle. The apparent cause of the leaks was determined to be axial cracks near the heat-affected zone of the nozzle partial penetration welds resulting from PWSCC. The two leaking nozzles located on the pressurizer were repaired using welded nozzle replacements in accordance with ASME Section XI. The three leaking hot leg nozzles were temporarily repaired using MNSAs and subsequently corrected in Refuel 10 Outage, as indicated in LER 00-011-00 above.

ADDITIONAL INFORMATION

Energy Industry Identification System (EIIS) codes are identified in the text within brackets [ ].