Nuclear Operating Company

South Texas Project Electric Generating Station  P.O. Box 289  Wadsworth, Texas 77483

June 11, 2003
NOC-AE-03001548
File No.: G25
10CFR50.73

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

South Texas Project
Unit 1
Docket Nos. STN 50-498, STN 50-499
Licensee Event Report 03-003
Bottom Mounted Instrumentation Penetration Indications

Pursuant to 10CFR50.73, the South Texas Project submits the attached Unit 1 Licensee Event Report 03-003 regarding boric acid residue discovered on two bottom-mounted instrumentation nozzles of the Unit 1 reactor vessel on April 12, 2003. This event did not have an adverse effect on the health and safety of the public.

Commitments are listed in the Corrective Actions section of the attached report.

If there are any questions on this submittal, please contact S. M. Head at (361) 972-7136 or me at (361) 972-7849.

E. D. Halpin
Plant General Manager

jrm

Attachment: LER 03-003 (South Texas, Unit 1)

cc:
(paper copy)

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NRC FORM 366 (7-2001) | U.S. NUCLEAR REGULATORY COMMISSION | APPROVED BY OMB NO. 3150-0104 | EXPIRES 7-31-2004

Estimated burden per response to comply with this mandatory information 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 Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@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 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)

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| South Texas Unit 1 | 05000 498 | 1 OF 4 |

**4. TITLE**

Bottom Mounted Instrumentation Penetrations Indications

| 5. EVENT DATE | | | 6. LER NUMBER | | | 7. REPORT DATE | | | 8. OTHER FACILITIES INVOLVED | |
|---|---|---|---|---|---|---|---|---|---|---|
| MONTH | DAY | YEAR | YEAR | SEQUENTIAL NUMBER | REV NO | MO | DAY | YEAR | FACILITY NAME | DOCKET NUMBER |
| | | | | | | | | | | 05000 |
| 04 | 12 | 2003 | 2003 | - 03 | - 00 | 06 | 11 | 2003 | FACILITY NAME | DOCKET NUMBER 05000 |

| 9. OPERATING MODE | 6 |
|---|---|
| 10. POWER LEVEL | 000 |

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

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

**12. LICENSEE CONTACT FOR THIS LER**

| NAME | TELEPHONE NUMBER (Include Area Code) |
|---|---|
| James R. Morris | 361-972-8652 |

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

| CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO EPIX | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO EPIX |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

| 14. SUPPLEMENTAL REPORT EXPECTED | | 15. EXPECTED SUBMISSION DATE | MONTH | DAY | YEAR |
|---|---|---|---|---|---|
| X | YES (If yes, complete EXPECTED SUBMISSION DATE) / NO | | 10 | 31 | 2003 |


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

On April 12, 2003, with South Texas Project Unit 1 in a refueling outage, personnel discovered deposits at two Bottom Mounted Instrument (BMI) nozzles of the reactor vessel. This condition was identified during the station's regular bare metal inspection of the reactor vessel bottom penetrations, which is done as part of the RCS Pressure Boundary Inspection for Boric Acid Leaks Program. A small amount of residue was noted around the circumference of BMI nozzles number 1 and 46 where they enter the reactor vessel.

The residue consisted of approximately 150 milligrams of material from penetration number 1 and approximately 3 milligrams from penetration number 46. No wastage was observed on the outside of the bottom head, and samples of the residue were collected and analyzed. Both deposits contained boron and elevated levels of lithium so the station concluded that these deposits were caused by reactor coolant system (RCS) leakage. Cesium isotopic analysis indicated an approximate age of 4 years for each sample.

Ultrasonic testing was performed on 57 of the 58 BMI penetrations. Penetration 31 has a thimble stuck in it and will be tested after the thimble is removed. Cracks were found in nozzles 1 and 46; however, no cracks were found in any other penetration. The root cause of the cracks in penetrations 1 and 46 is unknown at this time. Root cause information will be provided in a supplement to this LER.

Nozzles 1 and 46 will be repaired prior to restart of Unit 1.

This event resulted in no personnel injuries, offsite radiological releases, or damage to safety-related equipment other than the affected BMI penetrations. There were no challenges to plant safety.

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**NARRATIVE** *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

DESCRIPTION OF EVENT

The bottom head of the reactor was visually inspected on April 12, 2003 as a routine part of the refueling outage. The bottom head of the reactor is contained in an insulating box structure with no insulation directly in contact with the bottom head. The inspection is accomplished by removing three of the insulation panels forming the insulating box. Three different vantage points are used to inspect all 58 BMI nozzles. The inspection found small amounts of white residue around BMI nozzles number 1 and 46 at the junction where the nozzle meets the bottom reactor vessel head.

The BMI nozzles are Inconel Alloy 600 machined from 1.75-inch diameter bar stock. The nozzles have a nominal outside diameter of 1.5 inches and an inside diameter of 0.60 inches. The nozzles are attached to the interior of the reactor vessel by an Alloy 82/182 J-groove weld. The reactor vessel itself is a 5.38-inch thick low alloy carbon steel with 0.22 inches of stainless steel cladding on the interior surface. There is an annulus between the nozzle and the reactor head below the J-groove Weld of 0.001 to 0.004 inches.

The residue at nozzles number 1 and 46 was collected for laboratory analysis to determine the source of the residue material. Approximately 150 milligrams and 3 milligrams were collected from penetrations number 1 and 46, respectively. The presence of lithium and boron in the samples was the initial indicator that the source of these samples was operational reactor coolant since these comprise the majority of the dissolved solids during power operations. To validate that the lithium concentration was not due to a source of lithium other than the reactor coolant system, a lithium isotopic analysis was also performed. The analysis demonstrated that the lithium was approximately 99.9% Lithium-7, which indicated that the reactor coolant system was the source of the residue.

To determine the approximate age of the residue, the ratio of Cesium -134/ Cesium -137 was calculated. Cesium-134 has a half-life of 2.06 years and Cesium-137 has a half-life of 30.10 years. The ratio of Cesium-134 to 137 in the primary cooling system is approximately 1. The Cesium -134/ Cesium -137 ratios in the samples were 0.30 and 0.25 for penetrations number1 and 46, respectively. These Cesium ratios indicate that the average age of the residues collected are between 3 and 5 years. These residues were not visible during the most recent previous inspection on November 20, 2002, confirming very small leak rates requiring considerable time to push leakage residue through the small annulus until it became visible.

The bottom head of the reactor is inspected every refueling outage. Additionally, the bottom of the reactor vessel head is inspected every outage if the unit has been at operating temperature and pressure for more than 90 days since the last bottom head inspection and the outage is expected to last more than 72 hours. It is important to note that the inspection program did discover these extremely small leaks when they became visible on the outside of the reactor vessel, long before wastage of the carbon-steel could take place, and well within structural safety margins for the nozzle material and wall thickness.

Ultrasonic Testing

Initial ultrasonic inspections of 57 nozzles and visual inspections of all 58 BMI nozzles were completed on May 23, 2003. Cracks were identified in only nozzles number 1 and 46. Nozzles number 1 and 46 are the same two nozzles identified by the April 12, 2003 visual inspection. Nozzles number 1 and 46 contained a total of five cracks. No cracks were identified in any other BMI nozzle. Penetration 31 has a thimble stuck in it and will be tested after the thimble is removed.

Nozzle number 1 contains 3 cracks, all of which are axial. Only one of the cracks provides a leakage path from either the outside of the nozzle above the J-groove weld or from inside the nozzle to the annulus.

Nozzle number 46 contains 2 cracks, both of which are axial. Only one of the cracks provides a leakage path from outside the nozzle above the J-groove weld through the nozzle material to the annulus. Nozzle 46 cracks do not extend through the surface of the nozzle inner wall.

Eddy Current Testing

Eddy current tests were performed on nozzles number 1 and 46. These tests confirmed that only Nozzle 1 crack 1 penetrates the inner wall of the nozzle. Nozzle 46 crack 1 was confirmed as a subsurface crack to the nozzle inside wall. Eddy current testing of the nozzles identified no other surface cracks.

Eddy current testing was performed on the surface of the J-groove welds for all 58 nozzles. No surface breaking cracks were identified.

Other Testing

A helium pressure test was performed on nozzles 1 and 46 from the underside of the reactor vessel to confirm the crack locations by observing bubbles rising from the cracks. The helium test identified a leak path in the fillet of the J-groove weld for nozzle number 1. No bubbles were observed during the helium test of nozzle number 46.

To facilitate resolution of the nature of the cracks, the bottom half of the nozzles that will be removed during the repair of nozzles 1 and 46 will undergo comprehensive metallurgical analysis. In addition, STPNOC is evaluating the feasibility of extracting "boat" samples of the nozzles and welds containing the cracks.

## Event Significance

There were no adverse safety or radiological consequences associated with this event. Other than the degradation of the two affected BMI penetrations, no equipment damage occurred as a result of this event and the event did not affect the operability of any other safety-related equipment. This event is reportable pursuant to 10CFR50.73(a)(2)(ii)(A).

Since the Unit 1 leak indications were discovered during a refueling outage and did not require additional RCS inventory control actions or a plant shutdown evolution, there was no actual risk increase associated with this condition.

## Causes of the Event

The root cause of the cracks in penetrations number 1 and 46 is unknown at this time. Additional analysis is being performed and root cause information will be provided in a supplement to this LER.

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**NARRATIVE** *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

## Corrective Actions

1. BMI penetrations 1 and 46 will be repaired prior to restart of Unit 1.
2. Additional corrective actions are expected to be identified in a LER supplement to be submitted upon completion of the root cause investigation efforts.

## Generic Implications

The determination of the generic implications will not be completed until the root cause investigation of the problem has been concluded.

Recent bare-metal inspections of the Unit 2 bottom-mounted instrumentation penetrations showed no evidence of leakage.

## Additional Information

There have been no previous bottom-mounted instrumentation tube leaks at the South Texas Project.

Service experience with bottom mounted instrumentation nozzles has generally been excellent to date, with only a few incidents reported. Until the year 2000, with only one exception, the only incidents involved thimble tubes bent during handling. The exception was at Catawba Unit 1, which occurred during hot functional testing in February 1984. A part of the lower internals (instrumentation column) into which one of the BMI tubes had been inserted, came loose, with the result that the BMI penetration eventually suffered a fatigue failure and was severed. After the repair of this condition, there were no recurrences of the problem at Catawba.

STPNOC will submit a report to the NRC in mid-July addressing the actions agreed upon and documented in STPNOC's April 24, 2003 letter to NRC (NOC-AE-03001521). This will include the initial assessment of cause, the extent of the condition, and the expected scope of the corrective action.