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October 27, 2003

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: Oconee Nuclear Station
Docket No. 50-269
Licensee Event Report 269/2003-02, Revision 0
Problem Investigation Process No.: O-03-05965

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 269/2003-02, Revision 0, addressing the discovery of apparent reactor coolant system leakage from three reactor vessel head penetrations.

This report is being submitted in accordance with 10 CFR 50.73 (a)(2)(i)(B) and (a)(2)(ii)(A). For this event, the overall safety significance of this event was minimal and there was no actual impact on the health and safety of the public.

Very truly yours,

R. A. Jones
Vice President
Oconee Nuclear Site

Attachment

IE22

cc: Mr. Luis A. Reyes
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INPO (via E-mail)

NRC FORM 366 (7-2001)	U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004
LICENSEE EVENT REPORT (LER) (See reverse for required number of digits/characters for each block)		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.

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Oconee Nuclear Station, Unit 1	050- 0269	1 OF 6

4. TITLE

Apparent Reactor Coolant System Leakage From Three Reactor Vessel Head Penetrations

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME: None	DOCKET NUMBER
09	23	03	2003	- 02	00	10	27	03	FACILITY NAME	DOCKET NUMBER

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)(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 Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)		
	20.2203(a)(2)(iv)		50.73(a)(2)(i)(A)		50.73(a)(2)(v)(D)		
	20.2203(a)(2)(v)	X	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)
L.E. Nicholson, Regulatory Compliance Manager	(864) 885-3292

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
B6a	RCS	NZL	B&W	Y					

14. SUPPLEMENTAL REPORT EXPECTED				15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

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

Oconee Nuclear Station Unit 1 (ONS-1) entered its scheduled end-of-cycle 21 refueling outage on September 20, 2003. On September 23, 2003, a visual inspection of the bare reactor vessel head was performed while bolted to the vessel in order to determine if reactor coolant system leakage had occurred during the previous operating cycle. This bare head visual inspection was performed looking through the nine access ports in the service structure support skirt on the reactor vessel head.

Results of the visual inspection identified two (2) control rod drive mechanism (CRDM) nozzles and one (1) thermocouple (T/C) nozzle that exhibited similar leakage characteristics as was found from previous nozzle inspection and repair campaigns. Consequently, these nozzles were conservatively classified as leaking. The total leakage from the nozzles did not exceed Technical Specification limits for unidentified reactor coolant system inventory loss. At no time during the operating cycle did the reactor building or area radiation alarms actuate as a result of this event. The small amount of boric acid deposits observed around the nozzles caused no visible head material loss (wastage) from erosion or corrosion.

The apparent root cause of the CRDM nozzle leaks is most likely primary water stress corrosion cracking. The minor leakage observed around the previously repaired T/C nozzle is most likely attributed to a welding defect. This reactor vessel head will be retired from service and replaced with a new reactor vessel head prior to unit restart. For this event, the overall safety significance of this event was minimal and there was no actual impact on the health and safety of the public.

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

EVALUATION:

BACKGROUND

Control Rod Drive Mechanisms

Oconee Nuclear Station Unit 1 (ONS-1) contains sixty-nine (69) Control Rod Drive (CRD) Mechanism (CRDM) [EIIS:AA] nozzles [EIIS:NZL] that penetrate the reactor vessel head [EIIS:RCT]. The CRDM nozzles are approximately 5-feet long and are welded to the head at various radial locations from the centerline of the reactor vessel head. The nozzles are constructed from 4-inch outside diameter (OD) Alloy 600 material. The lower end of the nozzle extends about 6-inches below the inside of the reactor vessel head.

The Alloy 600 used in the fabrication of CRDM nozzles was procured in accordance with the requirements of Specification SB-167, Section II to the 1965 Edition including Addenda through summer 1967 of the American Society of Mechanical Engineers Boiler and Pressure Vessel (ASME B&PV) Code. The product form is tubing and the material manufacturer for the Oconee Nuclear Station (ONS) CRDM nozzles was the Babcock and Wilcox (B&W) Tubular Products Division.

Each nozzle was machined to final dimensions to assure a match between the reactor vessel head bore and the OD of each nozzle. The nozzles were shrunk fit by cooling to at least minus 140 degrees F., inserted into the closure head penetration and then allowed to warm to room temperature (70 degrees F minimum). The CRDM nozzles were tack welded and then permanently welded to the closure head using 182-weld metal. The manual shielded metal arc welding process was used for both the tack weld and the J-groove weld. During weld buildup, the weld was ground, and dye penetrant test (PT) inspected at each 9/32 inch of the weld. The final weld surface was ground and PT inspected.

The weld prep for installation of each nozzle in the reactor vessel head was accomplished by machining and buttering the J-groove with 182-weld metal. The reactor vessel head was subsequently stress relieved prior to the final installation of the nozzles.

In addition to the CRDM nozzles, a total of eight (8) thermocouple (T/C) [EIIS: THC] nozzles were installed in the ONS-1 reactor vessel head. A T/C nozzle is a three-quarter inch diameter schedule 160 pipe machined to a controlled diametrical fit with the bore in the reactor vessel head. The nozzle material is SB-167 (alloy 600). The material was procured to the 1965 Edition of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code. These nozzles are located outboard of the CRDMs (See Figure 1).

Thermocouple Nozzles

The original installation of the T/C nozzles was intended to provide instrumentation access into the vessel in order to verify that the internal reactor vessel plenum vent valves were not leaking. This action was subsequently determined to be unnecessary and blind flanges were added to the T/C nozzles that established the Reactor Coolant System (RCS) [EIIS: AB] pressure boundary. The nozzles serve no current function other than being part of the RCS pressure boundary. Similar T/C nozzles and penetrations do not exist on either the ONS-2 or ONS-3 reactor vessel heads.

A typical T/C head penetration consists of a 1.03-inch outside diameter (OD) by 0.218-inch nominal wall alloy 600 pipe that is inserted vertically into the reactor vessel head and connected to the inside diameter (ID) surface by a J-groove partial penetration weld. The alloy 600 was procured from Huntington alloys as cold drawn, ground and annealed pipe. While specific heat treatment records are not available, the typical final annealing temperature for alloy 600 materials produced by Huntington alloys is known to be 1600 degrees F. minimum

At initial installation, the eight (8) thermocouple penetrations had an overall length of approximately 62-inches. Approximately eight (8) inches of each penetration extended past the ID surface of the J-groove weld located on the inside surface of the head. Each thermocouple penetration had a flange welded to the top of the pipe that extends the penetration length by approximately 2-inches.

Note: The T/C penetrations had subsequently been modified after it was identified that RCS pressure boundary leakage had occurred (Ref. LER 269/2000-006-01).

EVENT DESCRIPTION

Oconee Nuclear Station Unit 1 (ONS-1) entered its scheduled end-of-cycle 21 refueling outage on September 20, 2003. On September 23, 2003, a visual inspection of the bare reactor vessel head was performed, while bolted to the vessel, to determine if any of the sixty-nine (69) Control Rod Drive (CRD) Mechanism (CRDM) and eight (8) Thermocouple (T/C) Nozzles had developed a reactor coolant leak during the previous operating cycle. This inspection was performed looking through the nine (9) access ports located in the service structure support skirt on the reactor vessel head.

Results of the visual inspection identified two (2) CRDM and one (1) T/C nozzles that were suspected of leakage (see Figure 1). From these, CRDM Nozzle 6 had a small deposit of boric acid crystals (approximately one-half cubic inch volume) on the downhill side of the nozzle, approximately 180 degrees in extent. The deposits were a dull white in color, appearing to be emanating from the annulus region of the penetration. CRDM Nozzle 16 had a larger deposit of dull white and brownish colored boric acid crystals with some evidence of having some outward spray associated with it. The deposits and spray appeared to emanate from the annulus region. The deposits were also on the downhill side of the nozzle, approximately 180 degrees in extent, and had an approximate volume of two (2) cubic inches. There was no evidence of head base material loss (wastage) from erosion or corrosion at either nozzle. There have not been any previous repairs made on these two nozzles.

Additionally, T/C Nozzle 7 (see Figure 1) exhibited leakage indications. There were thin trails of translucent white deposits streaming from the downhill side of the nozzle, with no apparent source. The amount was not quantifiable other than (approximately) one-quarter inch wide by six (6) inches long with no measurable depth. At Oconee, the eight (8) T/C nozzles are unique to ONS-1 and each was previously repaired/plugged during the December 2000 refueling outage (Ref. LER 269/2000-006-01). There was no evidence of head base material loss (wastage) from erosion or corrosion.

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

These nozzles, based primarily on past experiences from earlier ONS-1, 2, and 3 reactor vessel head inspection and repair campaigns, are typical of through-wall leakage pathways and as such, these nozzles were conservatively classified as leaking. On September 23, 2003, after confirming that the leaks represented an unanalyzed condition while at power, an 8-hour notification (No. 40192) was made at 1115 hours (Eastern Time) in accordance with 10 CFR 50.72(b)(3)(ii)(B) reporting requirements.

Reportability

Technical Specification Limiting Condition for Operation 3.4.13(a) limits RCS operational leakage to "No pressure boundary leakage" while in MODES 1 through 4. This event also represents a degradation of one of the plant's principal safety barriers. Consequently, this event is being reported pursuant to 10 CFR 50.73(a)(2)(i)(B) and 10 CFR 50.73(a)(2)(ii)(A) reporting requirements.

No operator intervention was required as a result of this event. Prior to the discovery of this event, Unit 1 was in cold shutdown (Mode 5) at 0 percent power and Units 2 and 3 were in Mode 1 operating at approximately 100 percent power.

ROOT CAUSE

Based on prior reactor vessel head evaluations described in previous, similar reported events (see Similar Events section below), the apparent root cause of the leaking CRDM nozzles is most likely Primary Water Stress Corrosion Cracking (PWSCC). The minor leakage observed around the T/C nozzle is most likely attributed to a welding defect during the overlay repair process or not completely overlaying the original Alloy 600 weld material.

CORRECTIVE ACTIONS

The current reactor vessel head will be retired and replaced with a new reactor vessel head prior to ONS-1 restart. The replacement reactor vessel head is fabricated of PWSCC resistant materials. No thermocouple nozzles were included in the replacement head design.

SAFETY ANALYSIS

Minor leakage was observed around T/C nozzle seven (7) although this nozzle was repaired during the end-of-cycle 19 refueling outage. The original nozzle repair included removing indications in the existing partial penetration weld and installing a 4-inch long alloy 690 plug. The plug was welded using 152 filler material to the existing J-groove weld metal from the underside of the head and sized such that it could not be ejected if the repair weld completely failed.

There were no actual safety consequences as a result of this event. The leakage of primary reactor coolant through the CRDM and thermocouple nozzles was so small that it was detectable only by the extremely small accumulation of boric acid crystals observed on the reactor vessel head. The total

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

leakage from these nozzles did not exceed Technical Specification limits for unidentified RCS inventory loss. At no time during the operating cycle did the reactor building or area radiation alarms actuate as a result of this event. The small amount of boric acid deposits observed around the nozzles caused no visible head material loss (wastage) from erosion or corrosion.

Since the current reactor vessel head will be retired from service and encapsulated for storage in the newly constructed steam generator / reactor head retirement facility, non-destructive examination (NDE) of the leaking nozzles was not performed primarily for personnel safety reasons and to minimize radiation exposure to workers in accordance with ALARA principles. The CRDM and T/C nozzle repairs completed during previous refueling outages are depicted in Figure 1.

ADDITIONAL INFORMATION

This event did not include a Safety System Functional Failure nor involve a personnel error. There were no releases of radioactive materials, radiation exposures in excess of limits or personnel injuries associated with this event. This event is considered reportable under the Equipment Performance and Information Exchange (EPIX) program. Energy Industry Identification System (EIIS) codes are identified in the text as [EIIS:XX].

SIMILAR EVENTS

Over the last three years, similar event LERs have been submitted for all three Oconee units beginning with ONS-1 in December 2000 (LER 269/2000-06) and the last for ONS-3 in May 2003 (LER 287/2003-01). To date, including this report, three (3) ONS-1, two (2) ONS-2, and three (3) ONS-3 LERs, have been submitted which have reported PWSSC of Alloy 600 CRDM and/or thermocouple nozzles. Prior to these LERS, there have been no other reportable events that involved PWSCC of Alloy 600 components or reactor vessel head penetration leaks.

NRC FORM 366A U.S. NUCLEAR REGULATORY COMMISSION
(1-2001)

LICENSEE EVENT REPORT (LER)

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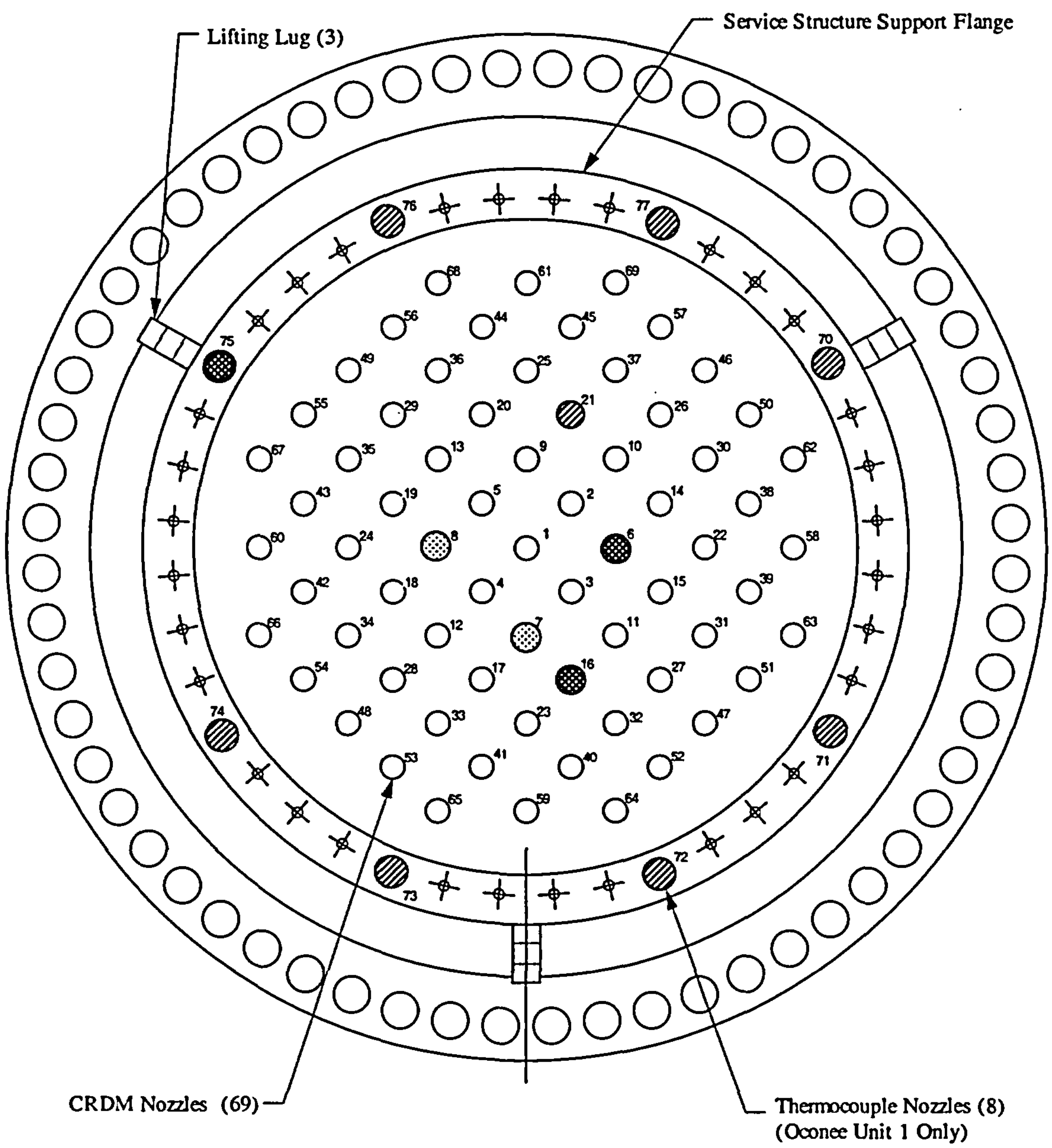
<u>Figure 1 – Oconee Unit 1 reactor vessel head Map</u>



From 1EOC21: CRDM Nozzles 6, 16 & Thermocouple Nozzle 7 (shown as # 75 from above, found leaking and not repaired - RVH Retired)

From 1EOC20: CRDM Nozzles 7 and 8 (found leaking and repaired)

From 1EOC19: CRDM Nozzle 21 (leaking/repaired) and 8 Thermocouple Nozzles (leaking/plugged)