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May 29, 2008

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

Subject: Oconee Nuclear Station
Docket Nos. 50-270
Licensee Event Report 270/2008-01, Revision 0
Problem Investigation Process No.: O-08-1626

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 270/2008-01, Revision 0, regarding a Unit 2 reactor trip following an indicated loss of vacuum while calibrating a condenser pressure transmitter.

This report is being submitted in accordance with 10 CFR 50.73 (a)(2)(iv)(A).

This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

for Dave Baxter, Vice President
Oconee Nuclear Site

Attachment

IE22
NRR

NRC FORM 366 (9-2007) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 08/31/2010

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 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)

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4. TITLE

Unit 2 reactor trip due to indication of loss of vacuum during calibration of a condenser pressure transmitter

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
										05000
03	31	2008	2008	- 001 -	0	05	29	2008	FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE

Mode (1)

10. POWER LEVEL

100%

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

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☐ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☐ 50.73(a)(2)(ii)(A)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☒ 50.73(a)(2)(iv)(A)
- ☐ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☐ OTHER

Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
B.G Davenport, Regulatory Compliance Manager	(864) 885-3044

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
	EK	52	Westinghouse Elec Corp / Hagan	Yes					

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)*

At 1352 hours, on March 31, 2008, while operating at 100%, Oconee Nuclear Station Unit 2 experienced an indicated loss of condenser [SG] vacuum. The most probable cause for the loss of condenser vacuum indication was a combination of obstruction (corrosion or foreign material) in the impulse line to the vacuum instrumentation and leakage of the 2B condenser pressure isolation valve(s). The obstruction and leakage produced an indication of loss of vacuum that resulted in the trip of Unit 2 main turbine. The trip of the main turbine caused the Unit 2 reactor to trip. The post trip response was normal, with all major operating parameters remaining within expected limits. Operators took appropriate action to stabilize the unit in Mode 3.

Corrective actions address changes to procedures to restrict maintenance activities on vacuum and absolute pressure instruments while operating and also prevent the usage of B-6P4T Swagelok plug valve(s) for isolation in this particular application.

This event is considered to have no significance with respect to the health and safety of the public.

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

EVALUATION:

BACKGROUND

The Unit 2 main condenser is composed of three rectangular condenser shell sections interconnected by a 62" outer diameter equalizer pipe. The condenser collects and condenses turbine exhaust steam along with condensate from various drains. Each condenser shell section contains a vacuum pressure transmitter that provides indication of the condenser pressure. Also each condenser shell section has two pressure switches that share the same impulse line with its respective vacuum pressure transmitter. These switches provide input for the Vacuum Trip Logic.

The Vacuum Trip Logic design consists of one pressure switch from each condenser (total of three) wired in parallel which provides Vacuum Trip Input No. 1 into the Turbine Control System. A second pressure switch from each condenser (total of three) is also wired in parallel and provides Vacuum Trip Input No. 2 into the Turbine Control System. Turbine trip logic is two out of two (2/2) in that a turbine trip requires a signal from both Vacuum Trip Input No. 1 and Vacuum Trip Input No. 2. This logic protects against invalid trips due to false actuation of a single pressure switch. The interconnection between condenser sections via a 62" outer diameter equalizer pipe assures a turbine trip will occur concurrent with a single pressure switch failure to actuate.

This event is reportable per 10CFR 50.73(a)(2)(iv)(A) because a valid Reactor Protective System (RPS) [JC] actuation occurred, including reactor [RCT] trip.

Prior to this event ONS Unit 2 was operating at 100% power with the following activities in progress:

- 2A Motor Driven Emergency Feedwater Pump(MDEFWP) Breaker Check
- Condenser Vacuum Calibration
- 2CA Battery Charger PM

At the time of the trip no safety systems or components were out of service that would have contributed to this event.

EVENT DESCRIPTION

At approximately 1313 on March 31, 2008, an ONS maintenance crew began to perform calibration testing on the 2C Condenser Vacuum pressure transmitter. The maintenance crew performed the condenser instrumentation calibration per procedure (IP/0/B/0275/010A). The crew noted nothing unusual during the performance of the test.

At 1351, the crew that performed the calibration on 2C Condenser Vacuum pressure transmitter proceeded to conduct the same activity on 2B Condenser Vacuum pressure transmitter. The isolation valves were closed to isolate 2B Condenser Vacuum as part of calibration on the pressure transmitter. Upon loosening the

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vent plug for the pressure transmitter, the impulse line pressure increased from condenser vacuum to near atmospheric conditions.

At 1352, the indication only pressure switch and both vacuum trip inputs No. 1 and No. 2 actuated yielding an indication of loss of condenser vacuum. In the control room the Turbine Control Vacuum Trip signal actuated. The Unit 2 reactor tripped, and the Emergency Operating Procedure was entered.

Post trip response was normal. All control rods dropped into the core with the exception of Group 8 Axial Power Shaping rods which do not trip. The main turbine tripped as an expected response to the loss of vacuum indication received from the main condenser vacuum pressure switches. No actuation or actuation demands occurred related to emergency feedwater or engineered safeguards (i.e. Emergency Core Cooling, Containment Isolation, Containment Spray/Cooling, and Emergency Power). A second High Pressure Injection (HPI) pump was manually started and operated for a few minutes per procedure to maintain pressurizer level indication on scale. This is a routine action to compensate for post-trip RCS temperature and volume changes.

The post-trip investigation validated the plant response described above and confirmed the probable cause of the trip.

At approximately 1425 hours Keowee Hydro Units (KHU) 1 and 2 were shut down from commercial operations for reasons, unrelated to the reactor trip. During the shutdown, KHU-1 output breaker, ACB-1, failed to open as expected, and KHU-1 was manually locked out. The lockout removed KHU-1 and the Overhead Power Path from service due to the failed ACB. Even though this event is unrelated to the unit trip, it did affect the availability of KHU-1 as an alternate source of power during the post trip recovery time period. KHU-2 was available as an alternate power source.

CAUSAL FACTORS

The most probable cause for the reactor trip was the presence of an obstruction in the impulse line to the pressure switches which, combined with minor seat leakage from both isolation valves, provided an indication of loss of condenser vacuum, actuating the pressure switches.

The impulse line is 1/2 inch schedule 80 carbon steel pipe and is subject to corrosion, particularly at or near the connection to the impingement baffle (used to deflect steam and protect the inlet to the impulse line) due to condensate drainage back into the condenser. Compressible fluid flow models were created to predict the impulse line response to various leak sizes and obstruction flow areas in the impulse line where it enters the condenser. Per the steady state model, if significant corrosion buildup and/or foreign material were present in the impulse line between the piping tee to all the vacuum instruments and the impingement plate, relatively minor seat leakage through both valves could be enough to actuate the pressure switches. It should be noted that if significant corrosion buildup and/or foreign material existed at the time of the trip, it was not present after the trip based on the results of testing conducted after the trip.

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Because the trip switches share the impulse line with the vacuum pressure transmitter being calibrated, the post-trip cause investigation considered the potential for the technicians to have failed to close the isolation valves for the transmitter prior to removing the calibration test tee cap. During, interviews, all of the involved technicians consistently stated that the isolation valves had been closed. Post trip testing demonstrated that, even with both isolation valves left open and the test tee cap removed, the pressure in the impulse line as seen by the test switches actuated only one of the two switches on the 2B condenser and neither of the two corresponding switches when the test was repeated on the 2A condenser and 2C condenser. Thus it appears that inappropriate action alone would not have resulted in the unit trip, and the post-trip cause investigation correctly concluded that no inappropriate action was involved.

Contributing factors for the minor seat leakage of the isolation valves were improper application of the isolation valves coupled with the isolation valves being installed in a reverse flow configuration. The isolation valves are designed for forward flow throttling, but qualified for reverse flow provided the differential pressure is limited to 150 psid. In the reverse flow configuration the vacuum pressure acts to unseat the seat o-ring versus applying positive pressure to seat the o-ring when closing the valve and opening the test tee cap. In this case, atmospheric pressure is on one side of the valve and vacuum on the other side. Per the vendor the valves were never tested nor intended to be used for vacuum application.

CORRECTIVE ACTIONS

Immediate:

1. Emergency Operating Procedures (EOP) (EP/2/A/1800/01) was entered on Unit 2. Immediate manual actions were taken as prescribed by the EOP to place the plant in a safe and stable operating condition.

Subsequent:

1. The calibration procedures in use during this activity were placed on technical hold (which prevents their use) to address risk issues associated with performing this activity while the main turbine is on-line.

2. The instrument isolation valves, the pressure switches, vacuum pressure transmitters, and absolute pressure transmitters for all three condenser sections for unit 1, 2, and 3 were tagged to caution plant personnel. White tags are normally attached to devices which, if repositioned or operated, could result in inadequate configuration control of plant equipment.

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Planned:

1. Remove vacuum and absolute pressure instruments from procedure IP/0/B/0275/010A which is performed on-line to procedure IP/0/B/0275/010A1 which is performed during refueling outage. Also, the procedure will be revised to incorporate precaution and a note that states these instruments share a common impulse line with vacuum trip pressure switches and that the procedure should not be performed while turbine is operating. In addition, instruments requiring double isolation will specify valve number in separate steps for each valve.

2. Inspect Units 1, 2 and 3 impulse line inlets to condenser for corrosion and fouling.

3. Submit an engineering request to replace the isolation valves used in this application on all 3 units with an acceptable valve.

There are no NRC Commitments contained in this LER.

SAFETY ANALYSIS

This event did not include a safety system functional failure. A risk evaluation of the Oconee Unit 2 reactor trip of March 31, 2008 has been conducted. The Unit 2 trip was modeled as a reactor trip/turbine trip transient since an actual loss of condenser vacuum did not occur during the event. Shutdown of Keowee Hydro Unit 1 following routine grid generation was also considered in the risk analysis because it rendered the Overhead Path from Keowee unavailable. The reactor trip event challenged no accident mitigation systems. This event has been evaluated to have a Conditional Core Damage Probability (CCDP) that is less than 1.0E-06. The Conditional Large Early Release Probability (CLERP) is approximately a factor of 100 lower than the CCDP and therefore the CCDP; therefore, the CCDP result is limiting.

Given the above, this event is considered to be of no significance with respect to the health and safety of the public.

ADDITIONAL INFORMATION

A review of prior reactor trips, unscheduled power reductions, and improper component selection yielded that this type of event has not previously occurred at Oconee.

There were no releases of radioactive materials, radiation exposures or personnel injuries associated with this event.

The following failure is reportable under the Equipment Performance and Information Exchange (EPIX) program:

Keowee Unit 1 ACB1 Circuit Breaker Failure

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This failure caused an emergency lockout which prevented Keowee Unit 1 from being able to meet its safety function. The component ID is ONK1ELKBK ACB1. The circuit breaker is a Westinghouse Elec Corp / Hagan model number 150CA1500. The The EPIX report number is 928, dated March 31, 2008.