AmerGen[SM]

An Exelon Company

Clinton Power Station
R. R. 3, Box 228
Clinton, IL 61727

10 CFR 50.73
SRRS 5A.108

U-603826

August 16, 2007

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555-0001

Clinton Power Station, Unit 1
Facility Operating License No. NPF-62
NRC Docket No. 50-461

Subject: Licensee Event Report 2007-003-00

Enclosed is Licensee Event Report (LER) No. 2007-003-00: IGSCC Causes Pressure Boundary Leak and Reactor Shutdown. This report is being submitted in accordance with the requirements of 10 CFR 50.73.

This document has no regulatory commitments.

Should you have any questions concerning this report, please contact Mr. Duane Hupp, Component Specialist, at (217)-937-2509.

Respectfully,

Bryan Hanson
Site Vice President
Clinton Power Station

RSF/blf

Enclosures: Licensee Event Report 2007-003-00

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Clinton Power Station
Office of Nuclear Facility Safety – IEMA Division of Nuclear Safety

IE22

NRR

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007
LICENSEE EVENT REPORT (LER) (See reverse for required number of digits/characters for each block)	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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Clinton Power Station	05000 461	1 OF 4

4. TITLE
IGSCC Causes Pressure Boundary Leak and Reactor Shutdown

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: None	DOCKET NUMBER: 05000
06	18	2007	2007	- 003 -	00	08	16	2007	FACILITY NAME: None	DOCKET NUMBER: 05000

9. OPERATING MODE: 1

10. POWER LEVEL: 97

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 (10 CFR 21)
☐ 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

NAME	TELEPHONE NUMBER (Include Area Code)
D. E. Hupp, Component Specialist	(217) 937-2509

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
X	SB	PSX	M270	Y					

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

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

On 6/18/07, at 0433 hours, the Main Control Room (MCR) received alarms indicating a steam leak in the Drywell (DW). At 1241 hours, Operators decided to perform a plant shut down in order to assess the DW to identify and repair the steam leak. At 0635 hours on 6/19/07, with reactor power at about 1 percent, Maintenance personnel entered the DW and found pressure boundary leakage on a one-inch diameter ASME Section III Class II stainless steel braided, flexible hose assembly on the “C” Main Steam Line flow elbow low-pressure instrumentation tap. On this basis, operators entered the actions of Technical Specification 3.4.5, which required a plant shutdown due to reactor coolant pressure boundary leakage. The cause of this event was Intergranular Stress Corrosion Cracking (IGSCC). Corrective action for this event is to replace in-service flexible hose assemblies installed in IGSCC susceptible locations. Susceptible flexible hose assemblies not currently in service will be cut out and the lines will be capped. Preventive maintenance will be established to periodically replace susceptible flexible hose assemblies installed in IGSCC susceptible locations.

PLANT OPERATING CONDITIONS PRIOR TO THE EVENT

Unit: 1 Event Date: 6/18/07 Event Time: 0433 Central Daylight Time

Mode: 1 (Power Operation) Reactor Power: 97 percent

DESCRIPTION OF EVENT

On June 18, 2007, the plant was operating in Mode 1 at 97 percent power. At 0433 hours, the Main Control Room (MCR) received several alarms [ALM], including Transient Test system trouble, fission product particulate high radiation, fission product high iodine, and Drywell (DW) continuous air monitor iodine channel and low noble gas channel alarms. The Transient Test system showed the "C" Main Steam [SB] Line (MSL) elbow tap differential pressure spiked from 9.8 to 10.1 pounds per square inch differential.

Operators checked the MSL guard pipe temperatures and Reactor Recirculation [AD] seal [SEAL] parameters and found them unchanged. The DW head temperature increased from 200 degrees Fahrenheit (F) to 211 degrees F. The DW pressure rate of change also increased. At 0520 hours, the DW floor drain in-leakage was 0.3 gallons per minute (gpm) and slowly trending up. These conditions were indicative of a possible high energy leak in the drywell.

Operators entered the Abnormal Release of Airborne Radioactivity and the Reactor Coolant Leakage emergency operating procedures.

At 0800 hours, the unidentified leakage was less than the Technical Specification (TS) limits of 5 gpm (0.7 gpm) for unidentified leakage, of 30 gpm (2.7 gpm) for total leakage averaged over the previous 24 hour period, and of 2 gpm increase in identified leakage in the previous 24 hours (went from 0.09 to 0.6 gpm) in Mode 1.

Operators continued to monitor the steam leak indications, and at 1241 hours, Operators made a decision to perform a plant shut down starting at 2000 hours in order to access the DW to identify the source of the steam leak and make repairs. The shutdown process started at 2011 hours.

On June 19, at about 0635 hours, with the plant in Mode 2 (Startup/Hot Standby) and reactor power at about 1 percent, Maintenance personnel entered the DW and identified the source of the steam leak was a one-inch diameter ASME Section III Class II stainless steel braided, flexible hose assembly [PSX] on the "C" Main Steam Line flow elbow low-pressure instrumentation tap. Leakage from this source is classified as pressure boundary leakage; therefore, operators entered the actions of Technical Specification 3.4.5 that require the plant be in Mode 3 in 12 hours and Mode 4 in 36 hours. Operators fully inserted all control rods by 1103 hours on June 19.

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

The braided, flexible hose assembly had a steam leak mid-way through the side of the outer bellows, on the outside bend of the component. During disassembly and examination of the removed braided flexible hose assembly, the leak was found to be a circumferential crack on the inner bellows, approximately 180° and 1/16" wide on an outer convolution, located 2-1/2" from the steam end of the flexible hose assembly. Critical portions of the flexible hose assembly were sectioned and shipped to an off-site laboratory for failure analysis. The analysis by the off-site laboratory identified that Intergranular Stress Corrosion Cracking (IGSCC) was the cause of the braided flexible hose failure.

Specifically, IGSCC caused the inner bellows failure. The crack initiated from the inner diameter surface. After the inner bellows pressure boundary failed, the outer bellows was exposed to the instrument line environment and also failed due to IGSCC. The bellows failures do not appear to be associated with improper installation, external mechanical damage, or fabrication seam weld defects.

No other inoperable equipment or components directly affected this event.

The root cause investigation and corrective actions for this event are tracked under Issue Report 641375.

CAUSE OF EVENT

The cause of this event was IGSCC. IGSCC will eventually occur when a susceptible material is installed in susceptible environment. IGSCC cannot form in a location where any one of three elements, (susceptible material, tensile stress and corrosive environment) are not present. Contributing causes were: (1) The cold forming process required to manufacture bellows from straight tube produced a susceptible material by changing the material microstructure. The new microstructure is susceptible to IGSCC if the other elements for IGSCC are present. (2) The bellows has increased residual stresses due to cold forming process. High Tensile stress is a component required for IGSCC initiation. The high residual stress in the bellows allows IGSCC initiation with smaller contributions from the other two elements for IGSCC initiation. (3) The Main Steam line provides the corrosive environment necessary for IGSCC initiation. The low pressure side of the flow elbow contains a mostly steam environment with some condensate. The steam environment with a presence of condensate appears to provide an IGSCC initiation condition. Thus, the three elements necessary for IGSCC were present.

SAFETY ANALYSIS

This event is reportable under the provisions of 10 CFR 50.73 (a) (2) (i) (A) for the plant shutdown required by TS 3.4.5, 10 CFR 50.73 (a) (2) (ii) (A) for the condition of the nuclear power plant including its principal safety barriers being seriously degraded, and 10 CFR 50.73 (a) (2) (i) (B) for operation prohibited by Technical Specifications, in that TS 3.4.5 allows no pressure boundary leakage.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Clinton Power Station, Unit 1	05000461	2007	- 003 -	00	4 OF 4

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

This event had minimal safety significance. During this event, TS limits for RCS leakage were not exceeded. The initial leakage was considered to be unidentified leakage and was less than the TS limits of: 5 gpm for unidentified leakage; 30 gpm for total leakage averaged over the previous 24 hour period; and 2 gpm increase in identified leakage in the previous 24 hours in Mode 1.

Although the steam leak added heat load to the ventilation system and condensed water volume to the floor drain system, the leakage was within the system capabilities of the reactor coolant system inventory makeup, the drywell floor drain system, and the drywell ventilation system. There was no release of radioactive material to the environment. Operators continually monitored the leakage during this event.

This event report does not identify any safety system functional failures.

CORRECTIVE ACTION

The flexible hose assembly that failed has been replaced. Other in-service flexible hose assemblies installed in IGSCC susceptible locations are scheduled to be replaced. Susceptible flexible hose assemblies not currently in service are scheduled to be cut out and the lines capped. Additionally, preventive maintenance activities will be established to replace the susceptible hose assemblies at a frequency of 16 years. A modification will be required for the replacement hose assemblies since the original manufacturer is no longer in business. Engineering will evaluate replacement materials for the new hoses as part of the modification process.

PREVIOUS OCCURRENCES

None

COMPONENT FAILURE DATA

COMPONENT FAILURE DATA

Manufacturer	Nomenclature	Manufacturer Model Number
Metal Bellows Corporation	1-inch ASME III, Class II, Flexible Braided High Pressure Stainless Steel Hose	N/A Part Number 78664