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Exelon Nuclear

March 29, 2010

10 CFR 50.73

SVP-10-016

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

Quad Cities Nuclear Power Station, Unit 1
Renewed Facility Operating License No. DPR-29
NRC Docket No. 50-254

Subject: Licensee Event Report 254/2010-001-00, "Electromatic Relief Valve Main Disc Failure"

Enclosed is Licensee Event Report (LER) 254/2010-001-00, "Electromatic Relief Valve Main Disc Failure," for Quad Cities Nuclear Power Station, Unit 1.

This report is submitted in accordance with the requirements of the Code of Federal Regulations, Title 10, Part 50.73(a)(2)(i)(B), which requires the reporting of any operation or condition which was prohibited by the plant's Technical Specifications.

There are no regulatory commitments contained in this letter.

Should you have any questions concerning this report, please contact Mr. W. J. Beck at (309) 227-2800.

Respectfully,

Timothy J. Tulon
Site Vice President
Quad Cities Nuclear Power Station

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station

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
Electromatic Relief Valve Main Disc Failure

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
									N/A	N/A
01	28	10	2010	- 001 -	00	03	29	2010	FACILITY NAME: N/A	DOCKET NUMBER: N/A

9. OPERATING 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)*
Tom Petersen – Regulatory Assurance	(309) 227-2825

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
E	SB	RV	D243	Y					

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ■ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR
N/A	N/A	N/A

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

On January 28, 2010 while performing refurbishment activities on Electromatic Relief Valve (ERV) [RV] 3C, recently removed from Unit 1, it was discovered that the valve main disc would not open during its inspection. During disassembly of the valve a slight gap was found between the disc retainer and the main disc guide. In addition, circumferential grooves were found worn into the main valve disc guide. This condition had allowed the main disc seal rings to slip into a groove in the disc guide which effectively locked the main disc in the closed position. With the ERV main disc locked in the closed position, the valve would not have operated in manual, automatic overpressure protection, or the Automatic Depressurization System (ADS) mode of operation.

Upon further investigation, the ERV disc retainer was determined to have been improperly torqued during manufacturing valve assembly, which allowed the gap between the disc retainer and the main disc guide to cause the main valve disc guide to be loosely seated in the valve cavity, allowing the fretting wear to occur over time.

The ERV was in service from April 2005 to April 2009. Although the exact time of failure of the ERV cannot be determined, the 3C ERV was estimated to be inoperable for greater than 14 days and likely caused the Required Actions and associated Completion Times to not be met for Technical Specifications (TS) 3.4.3 Action B (Safety and Relief Valves), TS 3.5.1 Action I (ECCS-Operating), and TS 3.6.1.6 Action B (Low Set Relief Valves). This event is therefore, a past operation or condition prohibited by the plant Technical Specifications, and is therefore reportable per 10 CFR 50.73(a)(2)(i)(B).

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PLANT AND SYSTEM IDENTIFICATION

General Electric - Boiling Water Reactor, 2957 Megawatts Thermal Rated Core Power

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

EVENT IDENTIFICATION

Electromatic Relief Valve Main Disc Failed to Open Due to Vibration Induced Fretting Wear Caused by Inadequate Manufacturer Assembly During Rebuild.

A. CONDITION PRIOR TO EVENT

Unit: 1 Event Date: January 28, 2010 Event Time: 1400 hours
Reactor Mode: 1 Mode Name: Power Operation Power Level: 100%

This issue was discovered on January 28, 2010, and hence is reported as the Event Date, since the actual occurrence date is not known. A best estimate of the potential Event Date (occurrence date) is April 2007. This potential event date is based on the following: The ERV was installed during Q1R18 (April 2005) and was removed from service during Q1R20 (April 2009), therefore the estimated date of failure is one-half the interval the ERV was in service, or approximately April 2007.

B. DESCRIPTION OF EVENT

On January 28, 2010, during refurbishment activities on Unit 1 3C ERV (S/N BY94637), valve vendor, NWS Technologies, discovered that the valve main disc would not open during inspection. During disassembly of the valve a slight gap was found between the disc retainer and the main disc guide. In addition, circumferential grooves were found worn into the main valve disc guide. The grooves were determined to have been caused by naturally occurring main steam line (MSL) vibrations resulting in fretting wear of the main disc piston seal rings on the disc guide. This condition had allowed the main disc seal rings to slip into a groove in the disc guide which effectively locked the main disc in the closed position. With the ERV main disc locked in the closed position, the valve would not have operated in manual, automatic overpressure protection, or the Automatic Depressurization System (ADS) mode of operation.

Upon further investigation, the ERV disc retainer was determined to have been improperly torqued during manufacturing valve assembly, which allowed the gap between the disc retainer and the main disc guide to cause the main valve disc guide to be loosely seated in the valve cavity, allowing the fretting wear to occur over time.

The 3C ERV was purchased from Dresser Industries (OEM) in 2004 along with 6 other new ERVs. All new valves were steam tested by Wyle (testing lab) prior to Exelon receiving them. According to the test reports, BY94637 was the only valve to fail its first steam test due to main seat leakage and was therefore torn down and rebuilt by the OEM Field Service Technicians before passing the next steam test. The evidence from the NWS inspection/testing report indicated that the valve was inadequately rebuilt at that time by the OEM Field Service Personnel.

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The valve was then received by the Quad Cities Station and installed in the 1-0203-3C position during Q1R18 (April 2005). BY94637 was removed during Q1R20 (April 2009) due to a planned valve replacement preventative maintenance activity.

Quad Cities Station experienced a similar failure of an ERV in 2001. During an onsite valve rebuild the valve main disc was found stuck in the closed position. A Root Cause Analysis was performed and identified a corrective action to update the Quad Cities ERV refurbishment procedures to incorporate specific disc retainer torque requirements. As discussed below, these requirements were applied to outside vendor instructions when performing the station's valve refurbishments.

The valve manufacturer, Dresser Industries, uses a torque value of 25-30 ft-lbs on the disc retainer in their valve assembly procedures for new manufactured valves. The 25-30 ft-lbs may be sufficient for a brand new valve that has very little threading resistance, but it was found that when using this torque value on refurbished valves it did not adequately ensure that the disc guide was captured by the disc retainer. An increased torque value was identified in the Root Cause Analysis that was needed to overcome resistance from any thread wear. Therefore, corrective actions were implemented to update the station valve refurbishment procedures to provide an increased disc retainer torque value of 200 ft-lbs nominal torque, when assembling a refurbished valve. With a focus on refurbishment as the cause, the potential for this issue occurring when purchasing new valves was not addressed. The current instructions used today at NWS utilize a combination of precise measurements and torque requirements to ensure full capture of the disc guide.

This issue was identified by "as-found" testing. This ERV is not installed in the plant at this time. Currently all ERVs installed on Units 1 and 2 have been refurbished using the current NWS refurbishment procedures that include the correct (200 ft-lbs) specific disc retainer torque and measurement requirements to ensure that a gap is not present. In addition, all ERVs removed from both Units since 2005 that were set at the 200 ft-lbs torque have been found acceptable. Therefore, there is reasonable assurance that the installed valves in Unit 1 and Unit 2 are not susceptible to the same failure mechanism.

Since the ERV was in service from April 2005 to April 2009, and its failure occurred some time during that period, the 3C ERV was estimated to be inoperable for greater than 14 days and likely caused the Required Actions and associated Completion Times to not be met for Technical Specifications (TS) 3.4.3 Action B (Safety and Relief Valves), TS 3.5.1 Action I (ECCS-Operating), and TS 3.6.1.6 Action B (Low Set Relief Valves). This event is therefore, a past operation or condition prohibited by the plant Technical Specifications, and is therefore reportable per 10 CFR 50.73(a)(2)(i)(B).

C. CAUSE OF EVENT

In January 2010, NWS inspection results of the damaged 3C ERV (S/N BY94637) identified a gap between the disc retainer and the main disc guide. In addition, circumferential grooves were found worn into the main valve disc guide. The grooves were determined to have been caused by naturally occurring main steam line (MSL) vibrations resulting in fretting wear of the main disc piston seal rings on the disc guide. This condition had allowed the main disc seal rings to slip into a groove in the disc guide which effectively locked the main disc in the closed position. Upon further investigation, the ERV disc retainer was determined to have been improperly torqued during manufacturing valve assembly, which allowed the gap between the disc retainer and the main disc guide to cause the main valve disc guide to be loosely seated in the valve cavity, allowing the fretting wear to occur over time.

Steam line vibration was determined to be the motive force that caused movement in the gap between the disc retainer and the main disc guide which resulted in fretting wear of the main disc piston seal rings on the disc guide.

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This condition allowed the main disc seal rings to slip into a groove in the disc guide which effectively locked the main disc in the closed position. It is not possible to determine the specific date the fretting wear reached a level that prevented movement of the main disc.

ERV BY94637 (Dresser Model 6"-1525VX) was purchased by Exelon from Dresser Industries (OEM) in 2004 along with 6 other new ERVs. All the new valves were steam tested by Wyle Labs prior to Exelon receiving them. According to the Wyle test reports, BY94637 was the only valve to fail its first steam test due to main seat leakage. It was then torn down and rebuilt by OEM Field Service Technicians while observing at Wyle before passing the next steam test. The valve was then sent to Quad Cities Station for installation.

The timeline below describes the service life of BY94637 for its 2 full operating cycles:

- Valve was installed in the 1-0203-3C position during Q1R18 (April 2005).
- Removed the valve for the replacement PM activity during Q1R20 (April 2009).
- Valve sent to NWS Technologies for refurbishment where it was identified that the valve main disc would not open (January 28, 2010).

Prior to the ERV being manufactured in 2004, Quad Cities Station had experienced a similar failure of an ERV in 2001. During an onsite valve refurbishment the valve main disc was found stuck in the closed position. A Root Cause Analysis was performed in 2001 and identified that a gap between the ERV disc retainer and the main disc guide was the failure mechanism for this valve. The valve manufacturer, Dresser (OEM), was contacted in 2001 regarding this issue.

The OEM provided a revised torque value for the disc retainer to support valve refurbishment at Quad Cities. The OEM used a torque value of 25-30 ft-lbs in their valve assembly procedures. The 25-30 ft-lbs was sufficient for a brand new valve that had very little threading resistance but it was found that when using this torque value on refurbished valves it did not adequately ensure that the disc guide was captured by the disc retainer. As a result, an increased torque value of 200 ft-lbs was identified as needed to overcome resistance from any thread wear.

Root Cause corrective actions were then completed to update the ERV refurbishment procedures to incorporate the new specific disc retainer torque requirements. These requirements were applied to outside vendor instructions when performing the station's valve refurbishments. These corrective actions have been successful in preventing this failure mechanism in all refurbished valves by the site and NWS Technologies. However, impacts on purchasing new valves were not considered in the corrective actions. There is also no evidence that the OEM had applied this revised torque value to their standard manufacturing procedures.

The NWS testing report of 2010 indicated that the valve was inadequately re-assembled in 2004 by the OEM Field Service Personnel prior to its acceptance by Exelon, in that the revised torque value for the ERV disc retainer had not been applied when the valve was refurbished after its initial test failure.

D. SAFETY ANALYSIS

System Operation

The ERVs serve as relief valves to control reactor pressure [AC] during transient conditions to prevent the need for safety valve actuation, and as ADS valves. ADS is designed to provide depressurization of the reactor during a small break Loss of Coolant Accident (LOCA) if High Pressure Coolant Injection (HPCI) [BJ] fails or is unable to maintain

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the required water level in the reactor. ADS operation reduces the reactor pressure to within the operating pressure range of the low pressure ECCS [B] subsystems (core spray [BM] and low pressure coolant injection [BO]), so that these subsystems can provide coolant inventory makeup.

For each Unit there are 5 relief valves (4 electromatic relief valves and 1 safety/relief valve), and 8 safety valves, all of which are closed during normal plant operation. The relief valves can be opened and closed with electrical control signals. The relief valves may be individually opened and closed or from individual pressure controllers associated with each individual valve. The relief valves may also be opened by a signal from ADS. An ADS Signal following a small break LOCA concurrent with HPCI unavailable, will open all five relief valves and maintain these valves open until reactor pressure decreases sufficiently to allow low pressure coolant injection systems to cool the reactor.

Safety Impact

For Fuel Cycles 19 and 20 on Unit 1 (April 2005 to April 2009) the transient analysis included one of the safety or relief valves being out of service for both cycles. Similarly, the LOCA analysis considers a spectrum of single failures including one ADS valve. Therefore the failure of the 3C ERV during Fuel Cycles 19 and 20 did not affect the ability to control reactor pressure during transient conditions, or of the ADS system to function during that time frame.

It is not possible to determine the specific date the fretting wear reached a level that prevented movement of the main disc. As a result, the uncertainty as to the timing of when this event occurred prevents the ability to definitively state any further potential consequences of having one ERV unavailable during the assumed failure period of this event (April 2007 to April 2009).

Risk Insights

The risk evaluation included the following key inputs:

1. Impacts of unavailable ERVs are on ADS and on overpressure protection including Anticipated Transient Without Scram (ATWS). Success criterion used for ATWS overpressurization is the existing baseline PRA success criterion of 12/13 valves required for success.
2. While ERVs provide overpressure protection for transients, the PRA success criterion for non-ATWS overpressure protection is successful operation of only 1 of the total of 5 relief valves plus 8 safety valves. With 13 valves available and only 1 required, unavailability of 1 ERV will have a negligible impact on overpressure protection for non-ATWS transients.
3. The failure of 3C ERV was due to a unique set of circumstances which do not apply to any other installed ERVs. Therefore Common Cause Failure terms were not adjusted in this evaluation.

The risk calculation concluded the change in Core Damage Frequency (CDF) risk was an increase of only 1.35E-7 CDF or 2.433% increase in risk from the baseline PRA. The change in Large Early Release Frequency (LERF) risk was an increase of only 8.17E-8 LERF or 12.614% increase in risk from the baseline PRA. The increase in both CDF and LERF is dominated by the risk impact on the ATWS overpressure safety function. Note the risk calculation used the baseline PRA model includes recognition that over the exposure period, plant safety systems may be unavailable due to maintenance with a random probability.

In conclusion, this event resulted in a minimal impact on plant risk, and the overall safety significance of this event was minimal.

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E. CORRECTIVE ACTIONS

1. The ERV will be repaired and refurbished and the disc retainer set to the required torque value by NWS Technologies, Inc.
2. The specific torque value for the ERV disc retainer has been incorporated into the Exelon Procurement Specifications. This will ensure all refurbished and purchased new valves will meet the required higher torque valves to ensure ERVs are not susceptible to this failure mechanism in the future.
3. Dresser has been notified of this 2010 event and Exelon's associated corrective actions.

F. PREVIOUS OCCURRENCES

The station events database, EPIX, NPRDS, and LERs were reviewed for similar events. This event was caused by ERV main disc failure to open due to vibration induced fretting wear caused by inadequate manufacturer assembly during rebuild.

- Station Event Database – Quad Cities CR Q2001-01693 - Groove Found Worn Into Disc Guide in ERV (5/31/01) – IR 53678 - Quad Cities Station experienced a similar failure of an ERV in 2001. During an onsite ERV rebuild the valve main disc was found stuck in the closed position. Circumferential grooves were found inside of the disc guide and further investigation found that the disc retainer was not fully installed to contact the disc guide effectively. A Root Cause Analysis identified a corrective action to update the ERV refurbishment procedures to incorporate specific disc retainer torque requirements of 200 ft-lbs. These requirements were applied to NWS instructions when NWS began performing the station's valve refurbishments. These corrective actions, however, did not include the potential for purchasing new valves. This station event is relevant to this LER because it identified essentially the same ERV disc failure mechanism, however corrective actions at that time were believed to only apply when refurbishing valves.
- EPIX/ NPRDS – No similar events identified for Quad Cities.
- LERs - No similar events identified for Quad Cities.

G. COMPONENT FAILURE DATA

This event has been reported to EPIX as Failure Report No. 1036.

The component that failed was a Dresser Industries Electromatic Relief Valve, Model number 6"-1525VX, S/N BY94637.