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August 3, 2009

SVP-09-044

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 254/09-003, "Failure of RHR Torus Spray Isolation Valve to Open Due to Declutch Mechanism Problems"


Enclosed is Licensee Event Report (LER) 254/09-003, "Failure of RHR Torus Spray Isolation Valve to Open Due to Declutch Mechanism Problems," 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

JE22  
NRK

**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: 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.

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**4. TITLE**  
Failure of RHR Torus Spray Isolation Valve to Open Due to Declutch Mechanism Problems

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
05	30	09	2009	003	00	08	03	2009	N/A	N/A
									FACILITY NAME	DOCKET NUMBER
									N/A	N/A

<b>9. OPERATING MODE</b> 2	<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §:</b> (Check all that apply)									
<b>10. POWER LEVEL</b> 0%	<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> 50.73(a)(2)(vii)						
	<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)						
	<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)						
	<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)						
	<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)						
	<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)						
	<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)						
<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> OTHER							
<input type="checkbox"/> 20.2203(a)(2)(vi)	<input checked="" type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A							

**12. LICENSEE CONTACT FOR THIS LER**

FACILITY NAME Wally Beck – Regulatory Assurance Manager	TELEPHONE NUMBER (Include Area Code) (309) 227-2800
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**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
E	BO	84	L200	Y					

<b>14. SUPPLEMENTAL REPORT EXPECTED</b>	<b>15. EXPECTED SUBMISSION DATE</b>	MONTH	DAY	YEAR
<input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE)	<input checked="" type="checkbox"/> NO	N/A	N/A	N/A

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

On June 4, 2009 (Discovery Date) at 2010 hours, while in Mode 1 at 100% power after startup from Forced Outage Q1F59, the MO 1-1001-37B, torus [NH] spray shutoff valve [SHV] was found inoperable, in that it would not open while using the control switch [HS] during the performance of the Residual Heat Removal (RHR) [BO] Power Operated Valve Test surveillance procedure.

Investigation into the event determined that the valve motor actuator [84] declutch lever had been inadvertently bumped into the manual mode of operation during previous outage related work activities in the vicinity of the valve. When given the open signal from the control room the valve actuator did not return to the motor mode of operation from the manual mode of operation due to increased friction caused by degraded lubricant/grease in the area of the clutch return spring and clutch keys, and possible degradation/wear of the clutch keys.

The failure of the MO 1-1001-37B valve to open, although impacting the ability to achieve flow for RHR suppression pool spray, did not create any actual plant or safety consequences, since Unit 1 was not in an accident condition requiring RHR suppression pool spray during this event. Furthermore, the containment spray [NH] function (which consists of drywell spray and suppression chamber spray) is not required for proper performance of the containment pressure suppression system. This issue was, however, determined to have resulted in a past operation or condition prohibited by the plant Technical Specifications (TS), and is reportable per 10CFR 50.73(a)(2)(i)(B), because on May 30, 2009 (Event Date) while in Mode 2, at 0225 hours during startup from Q1F59, the activity of having changed modes to enter Mode 2 resulted in not meeting TS LCO 3.6.2.4 for two required operable RHR suppression pool spray subsystems while in Modes 1, 2 and 3.

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**PLANT AND SYSTEM IDENTIFICATION**

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

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

**EVENT IDENTIFICATION**

Failure of RHR Torus Spray Isolation Valve to Open Due to Declutch Mechanism Problems Preventing Actuator from Returning to Motor Mode of Operation That Resulted in a Condition Prohibited by Technical Specifications

**A. CONDITION PRIOR TO EVENT**

Unit: 1                      Event Date: May 30, 2009                      Event Time: 0225 hours  
 Reactor Mode: 2            Mode Name: Startup                                      Power Level: 0%

Unit: 1                      Discovery Date: June 4, 2009                      Discovery Time: 2010 hours  
 Reactor Mode: 1            Mode Name: Power Operation                              Power Level: 100%

**B. DESCRIPTION OF EVENT**

On June 4, 2009 at 2010 hours, while in Mode 1 at 100% power after startup from Forced Outage Q1F59, the MO 1-1001-37B, torus spray shutoff valve was found inoperable, in that it would not open while using the control switch during the performance of the RHR Power Operated Valve Test surveillance procedure (Inservice Testing procedure). Green light indication (closed) was never lost and the red light (open) never came on. The normal stroke time on the valve is 41.1 seconds and the control switch was held in the open position for over 80 seconds. The bulb in the red socket was verified to be in working condition.

This valve provides the suppression pool spray function (open function ) for the "B" loop of RHR, and is also a Primary Containment Isolation Valve (PCIV) [ISV] (closed function). With the valve being unable to open and inoperable, this placed Unit 1 in TS 3.6.2.4 (RHR Suppression Pool Spray), a seven (7) day Action Completion Time for returning the affected RHR suppression pool spray subsystem to operable status.

Troubleshooting indicated that the MO 1-1001-37B valve motor actuator was declutched, and in the manual mode of operation. The declutch lever was found not in the fully raised position. The manual declutch lever was then manipulated and the declutch lever moved to the fully raised position. At this point the actuator functioned normally. MO 1-1001-37B was then timed satisfactorily, per RHR Power Operated Valve Test procedure (IST Surveillance), and TS 3.6.2.4, Condition A was exited on June 5, 2009 at 0050 hours. Subsequent investigation confirmed that the valve had not been manipulated by Operations personnel and that the declutch lever had been inadvertently bumped.

On May 30, 2009 while in Mode 2, at 0225 hours during startup from Q1F59, the activity of having changed modes to enter Mode 2 resulted in not meeting TS LCO 3.6.2.4 for two required operable RHR suppression pool spray subsystems while in Modes 1, 2 and 3. Since TS 3.6.2.4 Applicability has no TS LCO 3.0.4.c allowance (allows an exception to TS LCO 3.0.4) when changing modes, and no TS LCO 3.0.4.b prior risk assessment was performed, this

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resulted in non-compliance with TS LCO 3.6.2.4 and hence is reportable under 10CFR 50.73(a)(2)(i)(B), which requires the reporting of any operation or condition which was prohibited by the plant's Technical Specifications.

The MO 1-1001-37B valve had been successfully operated on April 29, 2009 to support the water test of the torus spray nozzles. Quad Cities refuel outage Q1R20 started April 27, 2009 and ended on May 24, 2009. Forced outage Q1F59 started on May 25, 2009 and ended on May 31, 2009.

An evaluation was initiated on June 10, 2009 to determine the cause for the failure of the motor actuator to operate the MO 1-1001-37B valve to the open position and is described below in the Cause of Event section. The failure of MO 1-1001-37B was determined to most likely have occurred during forced outage Q1F59.

**C. CAUSE OF EVENT**

An evaluation was performed on the MO 1-1001-37B valve motor actuator to determine the most probable cause for the valve to fail to open. The most probable cause for the actuator to fail to return to the motor mode of operation from the manual mode is due to increased friction resulting from degraded lubricant/grease in the area of the clutch return spring and the clutch keys, and possible degradation/wear of the clutch keys. The assigned Preventive Maintenance (PM) tasks for these valves are in accordance with the MOV Program requirements and have been performed satisfactorily to date.

The MO 1-1001-37B valve evaluation also included a review of the MO 1-1001-7C torus suction valve motor actuator, since this valve had similarly failed on May 28, 2009 during forced outage Q1F59, however, this event occurred and was corrected while still in forced outage Q1F59. The MO 1-1001-37B actuator and the MO 1-1001-7C actuator have Limatorque SMB-00 actuators, and they were both overhauled in the 1980's (MO1-1001-37B in 1989 and MO 1-1001-7C in 1986). As a result, the evaluation determined the SMB-00 actuator may be susceptible to the determined mode of failure due to the design of the declutch mechanism and the fact that the declutch keys have a machined 5 degree taper on the outside edges to decrease the sliding friction drag during the declutching/reclutching of the actuator. Over time, the taper may wear closer to flat. This increases the sliding friction and adds to the resistance of the mechanism that the clutch return spring must overcome.

The SMB series actuator is the nuclear industry standard for motor operated valves. Other failures of this size actuator have occurred within the industry, but few were based on this LER failure mechanism of increased friction due to degraded/aging grease and clutch key wear.

The evaluation also identified that a contributing factor to the event was the mispositioning of the declutch lever on the MO 1-1001-37B valve motor actuator and that it most probably occurred due to inadvertent bumping of the declutch lever due to high personnel traffic in the valve vicinity during Q1F59 work activities. The MO 1-1001-37B valve is located at the bottom of the ladder that drops down to the top of the torus. This ladder was used to support torus diving operations during the outage.

The declutch actuator lever having been bumped caused the actuator to be mispositioned to the declutched position and to move from the motor mode of operation to the manual mode of operation. When in the manual mode, an actuator is designed to return to the motor mode of operation when electrically actuated from the control circuit, but in this event due to increased friction in the actuator as caused by degraded lubricant/grease in the area of the clutch return spring and the clutch keys, the actuator was unable to return to the motor mode of operation to allow opening of the valve when given an open signal from the control circuit.

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The evaluation determined that the MO 1-1001-37B valve motor actuator being found unexpectedly in the manual mode of operation (declutched) was an isolated incident. A Limitorque actuator is not able to transition from the motor mode of operation to the manual mode without external (human) intervention.

**D. SAFETY ANALYSIS**

The containment cooling mode of RHR is a safety function and consists of two cooling functions: containment spray which consists of drywell spray and suppression chamber spray, and suppression pool cooling. The MO 1-1001-37B torus spray shutoff valve is an isolation valve in the RHR suppression pool (chamber) spray flowpath. During containment spray operation, water pumped through the RHR heat exchangers [HX] is diverted to spray headers in the drywell and above the suppression pool. Approximately 5% of the containment spray flow may be directed to the suppression chamber spray ring to cool noncondensable gases collected in the free volume above the suppression pool. The containment spray function is not required for proper performance of the containment pressure suppression system. [UFSAR 6.2.2]

The MO 1-1001-37B valve has safety functions to open and to close.

The safety function to open is to allow flow for RHR suppression pool spray. This normally closed motor operated valve must open to provide a flow path from the RHR system to the suppression chamber spray nozzles when the suppression chamber spray mode of RHR is initiated. This mode of RHR is manually initiated by the operator and is not an automatic function. This valve is interlocked such that it cannot be opened until low pressure coolant injection requirements are met. Additionally, this valve is interlocked closed when drywell pressure is too low.

The safety function to close is to ensure Low Pressure Coolant Injection (LPCI) [BO] flow is not diverted to the torus, and to provide containment isolation. The MO 1-1001-37B valve must close to provide containment isolation for Penetration X-211A/B, however it does not receive an automatic containment isolation signal and no maximum closure time is specified since the suppression pool cooling may be used post Loss of Coolant Accident (LOCA). This valve must close to prevent diversion of LPCI flow during injection. The MO 1-1001-37B was found in the closed position which is the safety position for the LPCI mode of operation.

Other redundant safety systems, such as drywell spray and suppression pool cooling, were available during the time MO 1-1001-37B valve was inoperable, and the valve could have been locally manually operated to the open position to allow flow for suppression pool spray if required. In addition, the MO 1-1001-37B valve was quickly returned to operable status once discovered in its declutched condition.

The MO 1-1001-37B valve is included in the Station risk assessment model (Paragon) in the Safety Function Assessment Tree for Containment Pressure Control. This is a defense-in-depth tree, giving credit for reactor-building [NG]-to-torus vacuum breakers [VACB], at least one train of torus spray, drywell spray, and containment vent. Because the maximum credit this tree gives is for one train of suppression pool spray, and since the "A" train was available, the Containment Pressure Control tree gives full credit and the result is Green (satisfactory low risk).

The MO 1-1001-37B valve, however, does not appear in the Station PRA model. This is because suppression pool spray is considered too small to be of help for containment pressure control for a core-damage event. Drywell spray is valuable for this purpose in the PRA, but suppression-pool spray is too small. This modeling is consistent with other industry BWRs.

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Therefore, failure of MO 1-1001-37B to open has no impact on Paragon and has no impact on the Station PRA. The PRA risk of this valve failure to open is, therefore, zero.

The failure of the MO 1-1001-37B valve to open, although impacting the ability to achieve flow for RHR suppression pool spray, did not create any actual plant or safety consequences, since Unit 1 was not in an accident condition requiring RHR suppression pool spray during this event. Furthermore, the containment spray function (which consists of drywell spray and suppression chamber spray) is not required for proper performance of the containment pressure suppression system.

Based on the above, the increase in risk due to the unavailability of the MO 1-1001-37B valve for RHR suppression pool spray, was negligible, therefore, the overall safety significance of this event is minimal.

**E. CORRECTIVE ACTIONS**

Immediate:

1. Manually manipulated the declutch lever of the MO 1-1001-37B valve actuator to the fully raised position to engage the motor mode of operation. Stroke tested the valve. The valve and actuator operated normally and met IST stroke time requirements. TS 3.6.4.2 Condition A was exited on 06/05/2009 at 0050 hours.

Follow-up:

1. MO 1-1001-37B valve will be overhauled during refueling Q1R21. Lubricant samples will be taken in areas around the clutch return spring and clutch keys.
2. Long-term actions such as procedure changes and an overhaul project for all Limitorque actuators at Quad Cities are being investigated.
3. Operations will investigate methods to prevent inadvertent bumping of MOVs in high traffic work areas.

**F. PREVIOUS OCCURRENCES**

The station events database, EPIX, NPRDS, and LERs were reviewed for similar events. This event was caused by excessive friction due to degraded/aged grease in the area of the clutch return spring and the clutch keys and possible wear to the 5-degree taper on the sides of the clutch keys of the valve motor actuator.

- Station Event Database – Report IR 924666 (05/28/09). During the closure of a Clearance Order, attempted to open the torus suction valve MO 1-1001-7C to the C RHR Pump. Control switch was placed to open for several minutes, closed indication remained lit, open indication remained extinguished. The 1-1001-7C was taken out of service in the closed position. During troubleshooting when the tripper fingers were released from the declutch pawl, the declutch lever moved upwards in a sluggish manner. A wrench was placed on the worm shaft locknut to simulate the motor and the worm shaft turned enough revolutions that the valve should have changed positions to motor mode. The valve did not change position. Since the actuator would not operate into the motor mode, even after it was visually and manually verified that the tripper finger mechanism was not preventing the change, an actuator overhaul was required. The MO 1-1001-7C valve actuator received a full overhaul and grease replacement using MOV Long Life grease. The valve actuator was diagnostically tested satisfactorily and returned to operable status. Based on the work performed, the

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successful completion of the tripper finger checks, and the fact the actuator was challenged with going to motor mode from manual mode several times during the functional and diagnostic testing process, the likely cause was excessive friction due to degraded/aging grease in the area of the clutch compression spring and the clutch keys. Although the MO 1-1001-7C valve was identified to not spring return to the motor mode of operation as expected, it had been placed in the manual mode of operation by Operations personnel as part of placing an Out of Service.

- EPIX/ NPRDS – None identified.
- LER – No relevant Station LERs were identified.

Other than the Station IR 924666, above, no other previous events have occurred at Quad Cities where a motor operated valve failed to spring return to the motor mode from the manual mode due to degraded/aging grease issues.

In addition, investigations determined that the MO 1-1001-37B valve being found in the manual mode of operation (declutched) was an isolated incident. A review of previous events at Quad Cities did not identify any other incidents of inadvertent mispositioning of an MOV actuator to the manual mode of operation (declutching).

**G. COMPONENT FAILURE DATA**

This event has been reported to EPIX as Failure Report No. 970.

The 1-1001-37B valve is a 6-inch flow under the seat Crane globe valve mounted horizontally with and SMB-00-15 Limitorque motor actuator.