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October 4, 2012

10 CFR 50.73

SVP-12-099

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

Quad Cities Nuclear Power Station, Units 1 and 2
Renewed Facility Operating License Nos. DPR-29 and 30
NRC Docket Nos. 50-254 and 50-265

Subject: Licensee Event Report 254/2012-003-00, Degraded Flood Protection Barrier

Enclosed is Licensee Event Report (LER) 254/2012-003-00, "Degraded Flood Protection Barrier," 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,

Tim Hanley
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 (10-2010) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2013

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 FOIA/Privacy Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects.resource@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**

Degraded Flood Protection Barrier

| 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 |
| | | | | | | | | | Quad Cities Nuclear Power Station Unit 2 | 05000265 |
| 08 | 05 | 2012 | 2012 | - 003 - | 00 | 10 | 04 | 2012 | 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 | WK | ISV | N/A | 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 August 5, 2012, station operating personnel initiated surveillance, Reactor Building Floor Drain Sump Ball Valve Leakage Testing. This surveillance verifies the leak tightness of the Reactor Building Floor Drain Sump Ball Valves for Unit 1 and Unit 2. The drain sump ball valves (one associated with each Emergency Core Cooling System (ECCS) corner room, four per unit) are normally closed to isolate the four-inch drain line between the ECCS corner room and associated reactor building basement sump. During the surveillance, two of the eight sump ball valves exhibited a small amount of leakage (pencil size stream). The associated ECCS equipment was declared inoperable upon discovery in accordance with Station procedures.

For the Unit 1 drain sump ball valve leak identified on August 5, 2012, Technical Specifications (TS) 3.5.1 Condition B was entered for the 1B Core Spray subsystem. For the subsequent Unit 2 drain sump ball valve leak identified on August 6, 2012, TS 3.5.1 Condition B was entered for the 1A and 2B Core Spray subsystems, and TS 3.5.3 Condition A was entered for the Unit 1 and Unit 2 Reactor Core Isolation Cooling (RCIC) systems. A temporary plug was installed in the drain path to restore operability and facilitate repairs.

The cause of the 1B and 2B Core Spray Room Floor Drain Ball Valves to fail their leakage test was due to wear related degradation that occurred at the valve-to-actuator coupling that allowed the valve to not be fully seated despite the actuator indicating full travel closed.

Corrective actions included adjusting the ball valves to allow an additional 1.5 turns of the operator to achieve full closure. The associated Preventive Maintenance (PM) frequency was increased from 4 years to 2 years. New PMs will be developed to perform periodic repair/replacements of the valve-actuator coupling and gearbox, and the valve internals.

The safety significance of this event was minimal since the remaining operable ECCS systems were capable of supporting safe shutdown. Further, the leakage rate was small and would not pose an immediate threat to ECCS equipment during a postulated flooding event. Since the as-found leakage was the result of the valve actuator not properly indicating the valve position, the as-found leakage condition also likely existed prior to discovery, therefore this event is reportable (Units 1 and 2) per 10 CFR 50.73(a)(2)(i)(B), which requires the reporting of any operation or condition which was prohibited by the plant's Technical Specifications.

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NARRATIVE

## 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

Degraded Flood Protection Barrier

## A. CONDITION PRIOR TO EVENT

Unit: 1 Event Date: August 5, 2012 Event Time: 2350 hrs
Reactor Mode: 1 Mode Name: Power Operation Power Level: 100%

## B. DESCRIPTION OF EVENT

On August 5, 2012, station operating personnel initiated surveillance, Reactor Building [NG] Floor Drain [DRN] Sump Ball Valve [ISV] Leakage Testing. This surveillance verifies the leak tightness of the Reactor Building Floor Drain Sump Ball Valves for Unit 1 and Unit 2. The drain sump ball valves (one associated with each Emergency Core Cooling System corner rooms, four per unit) are normally closed to isolate the four-inch drain line between the ECCS corner room and associated reactor building basement sump. Each Unit has four ECCS corner rooms, the drain sump ball valve prevents propagation of water from the reactor building basement into the associated ECCS corner room during a postulated flooding condition (the drain valves also prevent water propagation between ECCS corner rooms should a leak initiate inside a corner room).

During the performance of the surveillance on Unit 1 on August 5, 2012, the drain sump ball valve associated with the 1B Core Spray [BM] corner room exhibited leakage (pencil sized stream). Operations declared the 1B Core Spray subsystem inoperable at 2350 hours on August 5, 2012, in accordance with procedure, "Control of In-Plant Flood Barriers and Watertight Submarine Doors." An engineering evaluation was completed supporting a temporary drain plug, which was installed in the 1B Core Spray corner room floor drain; the 1B Core Spray subsystem was then declared operable at 1615 hours on August 6, 2012. This was completed prior to performing the surveillance on the 2B Core Spray Room.

During the Unit 2 portion of the surveillance on August 6, 2012, the drain sump ball valve associated with the 2B Core Spray corner room exhibited similar leakage (pencil-sized stream). Operations declared the 2B Core Spray subsystem and the Unit 2 RCIC [BN] system (which shares the same ECCS corner room) inoperable at 1758 hours on August 6, 2012. In addition, given that the fire door between the 2B Core Spray corner room and 1A Core Spray corner room is not designed to be leak tight, the 1A Core Spray subsystem and Unit 1 RCIC system were concurrently declared inoperable. A temporary plug was installed in the 2B Core Spray corner room floor drain and the ECCS equipment associated with the 2B and 1A Core Spray corner rooms was declared operable at 1814 hours on August 6, 2012.

Surveillance, Reactor Building Floor Drain Sump Ball Valve Leakage Testing, was completed on August 9, 2012. The remaining drain sump ball valves on Unit 1 and Unit 2 tested successfully.

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An apparent cause investigation was initiated to determine the causes of the failed leak tests of the 1B and 2B Core Spray Room Floor Drain Ball Valves.

Subsequent inspections on both failed valves (1B and 2B Core Spray Room Floor Drain Ball Valves) found that due to wear between the valve stem and associated actuator the valves were not completely closed when at the actuator travel stop, which prevented further hand-wheel closure. Since the same condition was found for each valve at the time of the surveillance (i.e., valve actuator stop prevented full closure), this evidence would indicate that the condition existed prior to the surveillance. Since the as-found leakage was the result of the valve actuator not properly indicating the valve position, the as-found leakage condition also likely existed prior to discovery, therefore this event is reportable (Units 1 and 2) per 10 CFR 50.73(a)(2)(i)(B), which requires the reporting of any operation or condition which was prohibited by the plant's Technical Specifications.

## C. CAUSE OF EVENT

The drain sump ball valves were previously float-operated globe valves. These valves failed to provide adequate flood protection due to debris collecting on the seat and not allowing the valve to fully seat. A 1998 modification installed the manual ball valves on the floor drain lines from each ECCS room. The drain sump ball valves are four-inch valves manufactured by Apollo Valves. An extension connects the valve to a hand wheel operator. The extension interfaces with the valve using a valve-to-actuator coupling. The hand wheel operator has a local indicator displaying whether the valve is open or closed.

Subsequent inspections discovered wear between the valve stem and associated valve actuator; therefore, the valves were not completely closed when the actuator was at its travel 'stop' position, which prevented further hand-wheel closure. The actuator stop set screw was out of adjustment due to service wear, which induced play in the actuator-to-valve coupling such that the position indicator indicated full close even though the valves were slightly open (this was visually verified using a bore-scope). This condition resulted in the as-found leakage. The actuator gearing located outside the sump had no visible play or wear. The actuator stops were subsequently adjusted allowing additional turns of the hand wheel to achieve full valve closure. Full closure was visually verified by use of a bore-scope.

The apparent cause of the 1B and 2B Core Spray Room Floor Drain Ball Valves to fail their leakage test was due to a failure to anticipate during design development that wear related degradation would occur at the valve-to-actuator coupling utilized in this unique configuration, allowing the valve to not be fully seated despite the actuator indicating full travel. A contributing cause to this event was wear-related degradation of the lubrication of the valve internals, which led to increased friction, contributing to the wear induced degradation of the valve-to-actuator coupling that was not anticipated during design development.

## D. SAFETY ANALYSIS

**System Design**

The design basis for ECCS corner room flood protection is discussed in Updated Final Safety Analysis Report (UFSAR) Section 3.4.1.2.2 (Protection of the Emergency Core Cooling System). The internal flood protection features ensure a single failure (flood) will not preclude safe shutdown. The ball valves prevent propagation of water from the reactor building basement into the associated corner room during a postulated flooding condition (the drain valves also prevent water propagation between ECCS corner rooms should a leak initiate inside a corner room). The drain sump ball valves will not mitigate flooding from potential overhead sources since there are open stairwells down

into the corner rooms. The ball valves are normally closed, but may be opened temporarily to facilitate maintenance activities (such as system draining).

**Safety Impact**

Reactor Building Floor Drain Sump Ball valve leakage tests were performed on both units on August 5 and 6, 2012. The ball check valve that prevents backflow from the drain into a corner room was found to leak in the 1B Core Spray and the 2B Core Spray/RCIC rooms. This means that a flood in the Unit 1 Torus Room could also flood the 1B Core Spray Room, and a flood in the Unit 2 Torus Room could flood the 2B Core Spray/RCIC Room. In the case of flooding in the Unit 2 Torus Room and 2B Core Spray/RCIC Room, the 1A Core Spray/RCIC Room would also flood because the door between the 1A Core Spray Room and the 2B Core Spray Room is a fire door and not a flood barrier.

The safety impact is considered minimal given the following:

- The as-found condition would not have impacted safe shutdown capability. Given an internal flooding event on either Unit 1 or Unit 2, with no credit for operator action, at the time of discovery at least one division of low pressure and one high pressure ECCS system would have been available to support safe shutdown (i.e., for each unit, two (2) Residual Heat Removal (RHR) [BO] subsystems, one (1) Core Spray subsystem, and the High Pressure Coolant Injection [BJ] system were unaffected).
- The as-found drain sump valve leakage was small (pencil sized stream). Given the size of a typical ECCS corner room, significant flooding is not an immediate threat to ECCS equipment.
- Flooding in the reactor building basement would generate a control room alarm [LA] from high-level in the reactor building floor drain sump. The control room alarm would prompt an investigation of the area by operating personnel. It is reasonable to conclude the leakage would have been detected and mitigated as part of the expected operator response.

**Risk Insights**

A risk assessment was completed based on the as-found conditions. Unavailability for the 1B Core Spray pump needs to be considered for the case of a Unit 1 reactor building basement flood. Similarly, unavailability for the 2B Core Spray pump, Unit 2 RCIC, 1A Core Spray pump, and Unit 1 RCIC needs to be considered for a Unit 2 reactor building basement flood. The reactor building basement flooding Core Damage Frequency (CDF) contribution combined with RCIC unavailability is 4.30E-08/yr (Core Spray unavailability does not impact this contribution). This results in a change in CDF of 6.2E-09/year which is considered negligible.

In conclusion, the overall safety significance and impact on risk of this event were minimal.

## E. CORRECTIVE ACTIONS

Immediate:

1. The 1B Core Spray and 2B Core Spray (CS) room floor drain sump ball valves were adjusted allowing an additional 1.5 turns of the operator to achieve full closure. Full closure was visually verified by use of a bore-scope. The subsequent leakage tests were successful.
2. Revised Reactor Building Sump Ball valve leak test PM frequency from 4 years to 2 years.

Follow-up:

1. A PM requirement will be developed for the drain sump ball valves of the 1(2) A RHR, 1(2) B RHR, 1(2) A CS, and 1(2) B CS, to perform periodic repair/replacements of the valve-actuator coupling and gearbox, and a PM will be developed to perform periodic repair/replacements of the valve internals.

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## F. PREVIOUS OCCURRENCES

The station events database, LERs, EPIX, and NPRDS were reviewed for similar events at Quad Cities Nuclear Power Station. This event was the 1B and 2B Core Spray Room Floor Drain Ball Valves failed their leakage test due wear related degradation that occurred at the valve-to-actuator coupling that allowed the valve to not be fully seated despite the actuator indicating full travel closed. Based on the cause of this event and associated corrective actions, the events listed below, although similar in topic, are not considered significant station experiences that would have directly contributed to preventing this event.

- Station Events Database – Issue Report 931415 (06/15/09), RHR A Room Floor Drain Ball Valve Will Not Fully Stroke. Operations performed a leak check on the 2A Residual Heat Removal (RHR) Room drain valve (2-4899-124) to verify the valve holds water when closed to perform its function as a flood barrier. The valve was cycled full open to verify the ability to pass and then closed. The linkage was found to bind during stroking the valve fully open, and required adjustment or lubrication. The valve operator (hand wheel gear box) was rebuilt, but the valve still did not open properly. The valve and actuator were ultimately replaced. Following replacement of the ball valve and actuator, the components were inspected and noticeable wear (mushrooming) within the valve coupling was visible. Slop, or play, was also noted in the valve coupling to the point where one and one-half turns of the hand wheel were noted before any movement occurred within the valve. This event is similar in that a valve actuator was not properly indicating the valve position, however in this event the valve position indication error occurred while in the open position and did not impact the leak tightness of the valve, hence this event did not result in a station investigation or LER. Therefore this event is not directly applicable and is not considered a significant station experience that would have directly contributed to preventing the event of this current LER.
- LERs - A review of LERs at Quad Cities Nuclear Power Station over the past 10 years did not identify any similar events that were associated with leakage due to valve actuators not properly indicating the valve position.

## G. COMPONENT FAILURE DATA

The primary cause of the event was the valve actuator (stem extension) was not properly indicating the valve position.

The stem extension manufacturer is AVK-Carbo-Bond, Inc., Model No. 7'-3" extension. The valve manufacturer is Apollo, Part No. 88A-24A-21-TC. The valve operator manufacturer is Mastergear, Part No. 9804.

This event has been reported to ICES as Failure Report No. 300769.