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September 4, 2008

SVP-08-055

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 DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Licensee Event Report 254/08-001, "Past Operation of Safe Shutdown Makeup Pump Outside Technical Specifications Surveillance Requirements"

Enclosed is Licensee Event Report (LER) 254/08-001, "Past Operation of Safe Shutdown Makeup Pump Outside Technical Specifications Surveillance Requirements," for Quad Cities Nuclear Power Station, Units 1 and 2.

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

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.

1. FACILITY NAME Quad Cities Nuclear Power Station Unit 1	2. DOCKET NUMBER 05000254	3. PAGE 1 OF 5
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4. TITLE
Past Operation of Safe Shutdown Makeup Pump Outside Technical Specifications Surveillance Requirements

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
07	10	08	2008	- 001 -	00	09	04	2008	Quad Cities Unit 2	05000265
									FACILITY NAME	DOCKET NUMBER
									N/A	N/A

9. OPERATING MODE 1	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)									
10. POWER LEVEL 99%	<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	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
B	BN	P	G200	Y					

14. SUPPLEMENTAL REPORT EXPECTED	15. EXPECTED SUBMISSION DATE	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 July 10, 2008, the Station Engineering Department identified an error in the calculation that determines required discharge pressure for the Safe Shutdown Makeup Pump (SSMP) to meet its applicable Technical Specifications (Tech Spec) Surveillance Requirement. As a result of an increased pressure drop across the discharge valves (due to reduced port design), the required SSMP discharge pressure necessary to meet the Surveillance Requirement for a flow rate of 400 gpm into the reactor at 1120 psig was calculated to increase from 1196.3 psig to 1215.0 psig when the identified error is corrected. The SSMP was tested most recently on August 4, 2008, and was observed to have a corrected discharge pressure of 1269.4 psig. Therefore, the identified error does not impact the current condition as the pump maintains more than 50 psig of operating margin. The SSMP is common system to both Units 1 and 2.

This calculation error resulted in historical Tech Spec Surveillance testing failures of the corrected required SSMP discharge pressure during two periods of time: Surveillances from November 1995 to November 1999, and Surveillances from September 2007 to January 2008. It was later determined that the discharge flow rate under safe shutdown conditions would have been adequate to ensure the SSMP provided its minimum Appendix R function (approximately 350 gpm). The SSMP was repaired on December 21, 2007 (wear ring degradation found, impeller replaced) and February 4, 2008 (new modified impeller installed due to limited margin in the prior pump impeller). When the pump was replaced in February 2008, this resulted in the current acceptable operating margin of more than 50 psig described above.

This issue was determined to have resulted in a past operation or condition prohibited by the plant Technical Specifications, and is reportable per 10CFR50.73(a)(2)(i)(B).

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NARRATIVE

PLANT AND SYSTEM IDENTIFICATION

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

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

EVENT IDENTIFICATION

Past Operation of Safe Shutdown Makeup Pump Outside Technical Specifications Surveillance Requirements

A. CONDITION PRIOR TO EVENT

Unit: 1	Event Date: July 10, 2008	Event Time: 1200 hours
Reactor Mode: 1	Mode Name: Power Operation	Power Level: 99%

B. DESCRIPTION OF EVENT

As a result of a self-assessment identified issue, Station Engineering¹ was revising calculation, "Determination of Pressure Required at PI 1/2-2941-8 [PI] for Safe Shutdown Makeup Pump System [BN] Injection Under Safe Shutdown Conditions," to address the required operation of SSMP during an Appendix R event. This calculation was created from an original vendor calculation which determined the SSMP discharge pressure and flow rate acceptance criteria for meeting Tech Spec Surveillance Requirement 3.7.9.2, quarterly pump [P] surveillance testing. The design inputs for the hydraulic resistance (K-value) of some piping components [PSX] in this vendor calculation included generic K-values from a standard reference, which is accepted practice for known component types when the specific K-values from the vendor are not known.

While revising the calculation, Station Engineering identified that there were errors in the K-values for the SSMP discharge valves [ISV]. These errors caused the calculation to result in providing a non-conservative pump discharge pressure requirement, which was utilized as the acceptance criteria for the Tech Spec Surveillance procedure. During the calculation revision (a major revision), an error was discovered in the calculation that resulted in an increase in the calculated pressure drop through the SSMP discharge. Specifically, the original design analyses for the SSMP did not recognize that discharge valves to Units 1 and 2 have a reduced port [OR] (approximately 2 inches as compared to the 4-inch line size). As a result of the increased pressure drop across the reduced port valve, the required SSMP discharge pressure necessary to meet the Tech Spec Surveillance Requirement 3.7.9.2 at a flow rate of 400 gpm against a reactor [RCT] pressure greater than 1120 psig was calculated to increase from 1196.3 psig to 1215.0 psig when the identified error is corrected (i.e., a required pressure increase of 18.7 psig).

The generic K-values were misapplied for the SSMP discharge valves in the original vendor calculation from 1989, and a subsequent minor revision in 1996. At that time, there was no owner's review process for external calculations that might have identified this misapplication. A new calculation was internally created in 1997 in order to determine the required discharge pressure using a different (more standard) friction loss equation, and the original calculation was superseded. The discharge valve K-values were carried over from the previous calculation into the new calculation, with no re-review of the existing K-values at that time, except to confirm via walk-down that the valve type that was modeled was correct. The procedural requirements in 1997 did not require the verification of design inputs when creating a new calculation from an existing reference.

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The K-value errors resulted in an historical failure of the corrected required SSMP discharge pressure during two periods: Surveillances from November 1995 to November 1999, and Surveillances from September 2007 to January 2008. The SSMP surveillance in June 2007 had a corrected discharge pressure of 1220.1 psig, which passes the new criteria of 1215.0 psig. However, the next Surveillance (September 2007) had a corrected discharge pressure of 1203.1 psig, and the Surveillance in December failed the old criteria of 1196.3 psig. The pump was replaced in December 2007 and the initial run of the new pump had a corrected discharge pressure of 1198.9 psig. The next Surveillance in January 2008 had a corrected discharge pressure of 1196.0 psig, which also failed the old criteria. Therefore, the Surveillance test results from November 1995 to November 1999, and September 2007 to January 2008 would have failed the new (corrected) acceptance criteria.

The SSMP Tech Specs 3.7.9 requires that while in Modes 1, 2, and 3 with reactor pressure greater than 150 psig, the system is provided a Limiting Condition for Operation (LCO) Completion Time of 14 days. Tech Specs Surveillance 3.7.9.2 requires that the pump be capable of delivering a 400 gpm flow against a reactor pressure greater than 1120 psig. Contrary to this, the SSMP pump was not capable of performing its specified safety function for a period of time longer than allowed by Tech Specs. This issue was therefore determined to have resulted in a past operation or condition prohibited by plant Technical Specifications, and is reportable per 10CFR50.73(a)(2)(i)(B).

The SSMP pump was repaired on December 21, 2007 (wear ring [SLV] degradation found, impeller [FE] replaced) and February 4, 2008 (new modified impeller installed due to limited margin in the prior pump impeller). The SSMP was tested most recently on August 4, 2008, and was observed to have a corrected discharge pressure of 1269.4 psig. When the pump was replaced in February 2008, this resulted in an operating margin of more than 50 psig. Therefore, the identified error does not impact the current condition as the pump maintains more than 50 psig of improved operating margin after the error is corrected.

It was later determined under an Engineering Evaluation that the discharge flow rate under safe shutdown conditions would have been adequate to ensure the SSMP provided its minimum Appendix R function.

It should be noted that a fleet-wide Common Cause Analysis (CCA) was completed in April 2007 focusing on design calculation errors. The top common group issue (45% of issues identified) was design input-related, and the lack of validation of design input was noted as the second most frequent cause of all identified issues. This is consistent with the calculation error issue described in this LER. The CCA determined the current calculation processes/procedures (Engineering Procedure CC-AA-309) contain the correct requirements to address these types of issues and as such the identified issues are considered historical. Prior to identification of this issue on July 10, 2008, all changes from 1997 to 2008 to this SSMP calculation were categorized as minor revisions.

C. CAUSE OF EVENT

- This event was an historical design input error.
- The design input associated with the discharge valve was not adequately verified during the issuance of the original calculation in 1989, and its subsequent minor revision in 1996. At that time, there was no owner's review process for external calculations that might have identified this misapplication. The lack of an owner's acceptance review was a latent organizational weakness.
- The discharge valve K-values were carried over from the previous calculation into the new calculation, with no re-review of the existing K-values at that time, except to confirm via walk-down that the valve type that was modeled was correct. The procedural requirements in 1997 did not require the verification of design inputs

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when creating a new calculation from an existing reference. The lack of adequate procedural guidance was a latent programmatic weakness

D. SAFETY ANALYSIS

The function of the SSMP System is to respond to transient Safety Analyses events by providing makeup coolant to the reactor. The SSMP System is not an Engineered Safety Feature System and no credit is taken in the safety analyses for SSMP System operation. The system provides a backup to the Unit 1 and 2 RCIC Systems [BN] to satisfy the requirements of criteria of 10 CFR 50, Appendix R, Section III.G (Ref. 1). Based on its contribution to the reduction of overall plant risk, the system satisfies Criterion 4 of 10 CFR 50.36 (c)(2)(ii) and is therefore included in the Technical Specifications.

The safety significance of this event was minimal. This issue reduced the available operating margin for the SSMP and also resulted in past instances of SSMP operation that did not meet the requirements of Technical Specifications. The SSMP maintained adequate performance to support its function to maintain reactor inventory above the top of active fuel in an Appendix R fire event, which is the only design event in which the SSMP is credited. Additionally, if the SSMP would have been utilized in other events to restore and maintain reactor level, even though the flow rate may have been reduced below 400 gpm at a reactor pressure in excess of 1120 psig, the SSMP would have provided at least 350 gpm under these conditions, which is considered a successful SSMP injection in the Probabilistic Risk Assessment model. For these reasons, the SSMP would have continued to support its function for maintaining vessel inventory.

E. CORRECTIVE ACTIONS

- The calculation and associated surveillance procedure were corrected.
- The current calculation guidance procedures have been reviewed and determined to contain sufficient guidance to prevent these types of errors during major revisions or when new calculations are developed. Engineering Procedure, CC-AA-309, has been issued delineating requirements for owner's acceptance reviews. The Nuclear Engineering Standard for pressure drop calculations, NES-MS-01.1, recommends that valves be modeled based on specific vendor information, but use of generic loss coefficients is allowed, provided that the port size of the valve is confirmed and adequately addressed.
- Additional hydraulic calculations, especially hydraulic calculations in support of Technical Specifications surveillances were reviewed to verify the extent of condition was limited to the one calculation.
- The error was communicated to the site Design Mechanical Group and to the Exelon Fleet to capture lessons learned and prevent future errors.
- With respect to the actual pump performance, maintenance was performed on this pump in December 2007 and February 2008 to gain additional pressure/flow margin and now meets Tech Spec requirements.
- Similar instances of erroneous design input had been observed fleet-wide, and a fleet-wide Common Cause Analysis (CCA) was completed in 2007 to determine causes and corrective measures. Since the CCA was completed, the calculation process has been revised to provide more focus and challenge to design inputs during a revision (increased emphasis on Technical Human Performance). The error discussed in this LER was discovered using the current calculation process, including its mandate to challenge and verify the associated design inputs.

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F. PREVIOUS OCCURRENCES

Although no errors have been previously identified that have caused the SSMP to fail its Tech Spec Surveillance due to design calculation errors, similar instances of erroneous design input have been observed fleet-wide and were identified and corrected under the 2007 Fleet CCA.

The station event database, LERs, EPIX, and NPRDS were reviewed for similar events. Due to the event type, event causes, or event ages, the below listed events are not considered station experience that would have prevented the SSMP failure type as described in this LER:

- Station Event Database - On December 17, 2007 the SSMP failed to meet the acceptance criteria for discharge pressure during a quarterly surveillance. Upon disassembly, damage to several pump wear rings was identified and a new rotating element was installed and tested and the 14-day LCO Completion Time was met. Personnel reviewed historical data and subsequently determined that an adverse trend in discharge pressure had existed for greater than one year. This data point was trended by neither the Inservice Testing Engineer nor the System Engineer. It was considered a missed opportunity to identify this trend. This event is not related to a SSMP failure caused by a design calculation error.
- EPIX - Quad Cities Unit 1 - Failure Number: 889, 12/17/2007 - No Plant Effect from power operation. No generation capability was lost. A Goulds Pumps, Inc. Model 3310H failure caused the event. While performing, "Safe Shutdown Makeup Pump Flow Rate Test," the pump failed to develop the required discharge pressure of 1215 psig at a flow rate of 400 gpm or greater. The measured discharge pressure was 1210 psig at 400 gpm. The Safe Shutdown Makeup Pump (SSMP) was declared inoperable and Technical Specification (TS) 3.7.9 Condition A was entered as well as a 14-day administrative technical requirement (ATR) for the 10CFR50 Appendix R program. The scope of this evaluation is limited to the equipment issues associated with this event. This event is not related to a SSMP failure caused by a design calculation error.
- LER 254-93015 - 09/24/1993, Compensatory Actions Not Put In Place After Safe Shutdown Pump Room Cooler [CLR] Declared Inoperable. This event is not related to a SSMP failure caused by a design calculation error.
- LER 265-00001 - 02/18/2000, SAFE SHUTDOWN MAKEUP PUMP INJECTION VALVE INOPERABLE DUE TO FAILURE TO USE VENDOR MANUAL FOR CORRECT STAKING OF YOKE BUSHING. This event is not related to a SSMP failure caused by a design calculation error.
- LER 254-00007 - 11/27/2000, Safe Shutdown Makeup Pump Trip Due to Failed Capacitor [CAP]. This event is not related to a SSMP failure caused by a design calculation error.

G. COMPONENT FAILURE DATA

The SSMP pump is a Goulds Pump, Inc. / Enertech, Model No: 3310H - 8 Stage Centrifugal Pump, Part No: C272B619.