Robert A. Saccone
Vice President – Nuclear Operations

SEP 27 2006

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SUSQUEHANNA STEAM ELECTRIC STATION
LICENSEE EVENT REPORT 50-387/2006-004-01
LICENSE NO. NPF-14
PLA-6107 **Docket No. 50-387**

Licensee Event Report (LER) 50-387/2006-004, "Reactor Scram during transfer of RPS power supplies" was submitted August 10, 2006 in accordance with 10 CFR 50.73(a)(2)(iv)(A). The attached Revision 1 provides supplemental information regarding the root cause and corrective actions to prevent recurrence that were not available at the time of the original LER submittal.

No commitments are associated with this LER.

Robert Saccone
Vice President – Nuclear Operations

Attachment

cc: Mr. A. J. Blamey, Sr. Resident Inspector
Mr. S. J. Collins, Regional Administrator, Region I
Mr. R. R. Janati, DEP/BRP
Mr. R. Osborne, Allegheny Electric

IE22

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
Susquehanna Steam Electric Station Unit 1	05000387	1 OF 5

4. TITLE Reactor Scram during transfer of RPS power supplies

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
6	15	2006	2006	004	01	9	27	2006	FACILITY NAME	DOCKET NUMBER

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)	☐ 20.2203(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
☐ 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

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
Dayne R. Brophy, Senior Engineer – Nuclear Regulatory Affairs	(570) 542-3365

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

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 June 15, 2006 with Unit 1 in Mode 1 at 100% power, the Control Room completed preparations to transfer Division B of the Reactor Protection System (RPS) from its normal power supply to its alternate source. The transfer momentarily de-energizes that division of RPS and results in a half-scram. During the 2006 Refuel Outage, a new Power Range Neutron Monitoring System (PRNMS) was installed. Because of differences in the original monitoring system logic and PRNMS logic, the transfer resulted in a full scram. The event was determined to be reportable under 10 CFR 50.72; reference ENS Notification EN #42642.

Following the automatic scram, the Unit 1 reactor water level decreased to ~-36". Reactor Core Isolation Cooling (RCIC) initiated and was within the instrumentation tolerance for the Level 2 setpoint of -38" to initiate High Pressure Coolant Injection (HPCI). Once reactor water level recovered, the normal feedwater system was utilized to maintain the normal operating level (+35"). Level 3 (+13") and Level 2 (-38") Primary Containment Isolation signals were received and all safety systems functioned as expected. The actuation of RPS, RCIC and HPCI systems and Primary Containment isolations are unplanned actuations of systems that are designed to mitigate the consequences of significant events and are reportable per 10 CFR 50.73(a)(2)(iv)(A).

This event resulted in no actual adverse consequences to the health and safety of the public.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Susquehanna Steam Electric Station Unit 1	05000387	2006	-- 004	-- 01	2 OF 5

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

PLANT CONDITIONS AT TIME OF EVENT

Unit 1, Mode 1, 100%
Unit 2, Mode 1, 100%

BACKGROUND

The Reactor Protection System (RPS; EIIS Code: JC) contains two divisions, each with a normal and alternate power supply. A transfer of the RPS division power supply causes a momentary loss of power to the logic, resulting in a half scram. The RPS power supply also provides power to relays associated with the Mode switch position logic. During a RPS power supply swap, the divisionalized relays for this logic are also momentarily de-energized, resulting in indication that the Mode switch is no longer in RUN. During a reactor startup (with the mode switch not in RUN) an APRM will trip if the APRM senses power greater than 14%.

During the Spring 2006 Refueling Outage, a new Power Range Neutron Monitoring System (PRNMS; EIIS Code: I) was installed that changed the APRM (APRM; EIIS Code: I) logic input to RPS. The original design was an APRM divisionalized one-out-of-two taken twice input to RPS to produce a full scram. The design was changed to any two-out-of-four APRM trip signals to a PRNMS voter logic that would initiate a full scram.

EVENT DESCRIPTION

On June 15, 2006, Susquehanna Unit 1 was in Mode 1, operating at 100% power. Operations personnel (Licensed, Utility) had completed preparations in accordance with Procedure OP-158-001 to transfer Division B of RPS from its normal power supply to its alternate power supply to perform scheduled maintenance. These preparations involve initiating systems and aligning components to prevent spurious actuations caused by the momentary loss of power during the transfer. This was also the first time a RPS power supply had been transferred since the Spring 2006 Refuel Outage when PRNMS was installed.

At 0300 hours on June 15, 2006, when Operators transferred Division B RPS power supplies, a full RPS actuation occurred. The actuation was the result of an unintended APRM setdown signal initiated through the reactor mode switch logic input to the newly installed Power Range Neutron Monitoring System (PRNMS). The break-before-make RPS power transfer resulted in a momentary loss of power to the mode switch follower relays, opening their respective contacts. This provided indication that the mode switch was not in Run and with reactor power > 14%, APRM channels B and D tripped. The net result of the momentary loss of power was that when two of the four APRM channels tripped, all four PRNMS Voter Logic Modules signaled a trip to RPS.

All control rods (EIIS Code: AA) fully inserted. Reactor water level dropped to approximately -36". Both Reactor Core Isolation Cooling (RCIC; EIIS Code: BN) and High Pressure Coolant Injection (HPCI; EIIS Code: BJ) initiated and injected as designed. Note, it was later confirmed that -36" was within the instrumentation tolerance for the Level 2 setpoint of -38" to be received. The resulting over-feed condition resulted in a level 8 (+54") trip of the steam driven pumps, RCIC, HPCI, and Feedwater (EIIS Code: SJ). Feedwater Pump 'A' was restored from the level 8 trip and provided normal water level control.

The scram and subsequent decrease in reactor water level resulted in receiving the level 3 (+13") and level 2 (-38") containment isolation and system actuation signals (EIIS Code: JM). Plant response was as anticipated, with some systems and components in other than their normal alignments as part of the procedural requirements for the power supply transfer under OP-158-001. This did not complicate Control Room operator response.

The Reactor Recirculation Pumps (EIIS Code: AD) tripped as designed on the receipt of a level 2 signal. The B Recirculation Pump was subsequently restarted to prevent thermal stratification of the reactor vessel coolant.

Due to exhaust steam from RCIC and HPCI, Suppression Pool temperatures exceeded 90 degrees requiring entry into Emergency Operating Procedures. The 'A' Loop of Residual Heat Removal (RHR; EIIS Code: BO) was placed in Suppression Pool Cooling to restore pool temperature below 90 degrees.

A post scram review of PRNMS confirmed that the system functioned properly and the scram was not a result of a component malfunction or human error.

This event resulted in no actual adverse consequences to the health and safety of the public.

CAUSE OF THE EVENT

The cause of the event was attributed to three root causes:

1) An analysis of power interruption effects, system interfaces, or site-specific differences were not specified or considered in development of the design change package. The investigation into the event revealed that PRNMS and RPS operated as designed, but there existed a latent design deficiency with the existing mode switch interface with PRNMS. Based on information supplied by the vendor, Susquehanna is the only PRNMS plant that does not have reactor mode switch contacts wired directly into PRNMS, but instead uses contacts from relays that follow the mode switch contact position. This distinction was not recognized by either PPL or the vendor during the preparation of the Engineering Change.

2) PPL placed an over-reliance on the vendor during the development of the design change and did not provide sufficient barriers to ensure adequacy/quality of final product.

3) The PRNMS design requirements specification provided by the vendor was less than adequate.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Susquehanna Steam Electric Station Unit 1	05000387	2006	-- 004	-- 01	4 OF 5

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

ANALYSIS / SAFETY SIGNIFICANCE

Actual Consequences

The invalid signal caused the trip of two APRMs resulting in a reactor scram. All control rods inserted and safety systems functioned as expected. The health and safety of the public was not affected.

Potential Consequences

A scram is an Initiating Event in the Susquehanna Probabilistic Risk Assessment (PRA). A scram with subsequent equipment failures and/or human errors can lead to core damage. The Susquehanna PRA identifies that a scram signal with an additional failure to scram (ATWS) is a significant contributor to the total core damage frequency. This accident sequence in the PRA assumes that the Main Turbine/Main Generator has tripped concurrent with the scram signal. In the event described in this LER, the main turbine did not trip until the main generator tripped on primary anti-motoring. The anti-motoring trip occurs because the steam flow from the reactor decreased rapidly after the control rods fully inserted. If an ATWS occurred during this event, the main turbine/ main generator would not have tripped, and the reactor core would continue to have adequate core cooling via Feedwater. The main turbine would have continued to operate, and the main condenser would have remained as the heat sink until Operations shut down the reactor per Emergency Operating Procedures. The PRA identifies some accident sequences that initiate with a successful scram; however, these accident sequences are an insignificant contributor to the total core damage frequency. Thus, the potential of this event to cause core damage and, hence, impact the health and safety of the public was not significant.

CORRECTIVE ACTIONS

Completed Actions

1) PPL performed an extent of condition review of the PRNMS modification to verify that no similar design deficiencies existed that could result in unplanned actuations during a RPS power interruption.

2) An additional modification was performed to re-configure the mode switch relay contacts to remove the full scram vulnerability. This included additional post-modification testing to insure proper response.

3) Procedural changes were made to reduce the potential of a full RPS actuation.

4) Completed a Root Cause Analysis.

5) Benchmarked other facilities' procedures and practices for guidance in assessing and managing technical risk.

6) Reviewed industry OE for incorporation into station procedures.

LICENSEE EVENT REPORT (LER)

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Susquehanna Steam Electric Station Unit 1	05000387	2006 --	004 --	01	5 OF 5

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

<u>Planned Actions</u>

1) Review and make the appropriate changes in the design of the Unit 2 PRNMS modification scheduled to be implemented during the Spring 2007 Refuel Outage;

2) Review and revise station procedures associated with the engineering change process to add additional reviews and analyses for power interruptions, system interfaces, and failure modes.

3) Create a new procedure to place additional controls on technical tasks commensurate with the risk associated with those tasks.

ADDITIONAL INFORMATION

None