Bryce L. Shriver
Vice President – Nuclear Site Operations

PPL Susquehanna, LLC
P.O. Box 467, Berwick, PA 18603
Tel. 570.542.3120 Fax 570.542.1477
blshriver@pplweb.com

JAN 9 2002

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, DC 20555

SUSQUEHANNA STEAM ELECTRIC STATION
LICENSEE EVENT REPORT 50-387/2001-004-00
PLA - 5423 FILE R41-2

Docket No. 50-387
License No. NPF-14

Attached is Licensee Event Report 50-387/2001-004-00, which discusses the failure of a solenoid valve on the High Pressure Coolant Injection System. This event is reportable per 10CFR50.73(a)(2)(v)(D) as an event or condition that could have prevented the fulfillment of a safety function.

Bryce L. Shriver
Vice President – Nuclear Site Operations

Attachment

cc: Mr. H. J. Miller
Regional Administrator
U. S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

cc: Mr. S. L. Hansell
Sr. Resident Inspector
U.S. Nuclear Regulatory Commission
P. O. Box 35
Berwick, PA 18603-0035

IE22

NRC FORM 366 (7-2001)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004

Estimated burden per response to comply with this mandatory information 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 Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@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 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)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Susquehanna Steam Electric Station - Unit 1	05000387	1 OF 4

4. TITLE

High Pressure Coolant Injection Solenoid Valve Failure

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
11	11	2001	2001	004	00	01	09	2002	FACILITY NAME	DOCKET NUMBER
										05000

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)(ii)	50.73(a)(2)(ii)(B)	50.73(a)(2)(ix)(A)
20.2201(d)	20.2203(a)(4)	50.73(a)(2)(iii)	50.73(a)(2)(x)
20.2203(a)(1)	50.36(c)(1)(i)(A)	50.73(a)(2)(iv)(A)	73.71(a)(4)
20.2203(a)(2)(i)	50.36(c)(1)(ii)(A)	50.73(a)(2)(v)(A)	73.71(a)(5)
20.2203(a)(2)(ii)	50.36(c)(2)	50.73(a)(2)(v)(B)	OTHER
20.2203(a)(2)(iii)	50.46(a)(3)(ii)	50.73(a)(2)(v)(C)	Specify in Abstract below or in NRC Form 366A
20.2203(a)(2)(iv)	50.73(a)(2)(i)(A)	X 50.73(a)(2)(v)(D)	
20.2203(a)(2)(v)	50.73(a)(2)(i)(B)	50.73(a)(2)(vii)	
20.2203(a)(2)(vi)	50.73(a)(2)(i)(C)	50.73(a)(2)(viii)(A)	Maximum Power Level License Condition Exceeded
20.2203(a)(3)(i)	50.73(a)(2)(ii)(A)	50.73(a)(2)(viii)(B)	

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
John L. Tripoli - Nuclear Licensing	570 / 542-3021

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
A/B	BJ	SOL	C339	Y					

14. SUPPLEMENTAL REPORT EXPECTED				15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

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

On November 11, 2001, with Unit 1 in Mode 1 (Power Operation) at 100% power, the Control Room received the High Pressure Coolant Injection (HPCI) steam line drain pot high level alarm. Operations personnel observed that valve position indication was lost on the HPCI steam line drain to condenser inboard isolation valve and the HPCI barometric condenser pump discharge drain valve. Operations declared HPCI inoperable due to the formation of condensate at the turbine inlet with no drain path available. Maintenance personnel investigated the loss of indication and found a failed fuse. The failed fuse was caused by high current draw to a failed solenoid valve. The cause of the solenoid valve failure was accelerated aging due to a normally energized coil. The failed Unit 1 solenoid valve has been replaced. This event was of very low safety significance since redundant equipment was operable. HPCI was returned to service within the allowed outage time given by the Technical Specifications.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Susquehanna Steam Electric Station - Unit 1	05000387	2001	-- 004 --	00	2 OF 4

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

EVENT DESCRIPTION

On November 11, 2001, with Unit 1 in Mode 1 (Power Operation) at 100% power, the Control Room received the High Pressure Coolant Injection (HPCI; EIIS Code: BJ) steam line drain pot high level alarm. Operations personnel observed that valve position indication was lost on the HPCI steam line drain to condenser inboard isolation valve (Susquehanna component number HV-155-F028) and the HPCI barometric condenser pump discharge drain valve (HV-156-F026). Operations declared HPCI inoperable due to the formation of condensate at the turbine inlet with no drain path available. Maintenance personnel investigated the loss of indication and found a failed fuse. To determine the cause of the failed fuse, Maintenance personnel checked the resistances of solenoid coils supplied by the circuit. A failed solenoid valve coil was discovered (SV-15626). The system was restored. The restoration activities included replacing the failed solenoid valve with a better designed solenoid valve.

CAUSE OF EVENT

The cause of the failure was accelerated aging due to a normally energized coil. This failure mechanism is described in EPRI NP-7414, *Solenoid Valve Maintenance and Application Guide,* as a dominant electrical failure mechanism. The heat from the coil degraded the insulation on the coil windings. This reduced coil resistance and increased current draw and heat. This promoted further degradation until the coil resistance had degraded from 275 Ohms to 2 Ohms. The current draw of the degraded coil on SV-15626 after nine years of operation was high enough to exceed the capacity of the 10 amp fuse protecting the circuit.

The failed fuse caused the circuit including SV-15628 to lose power. When SV-15628 lost power, the HPCI steam line drain to condenser inboard isolation valve (HV-155-F028) closed, isolating the inlet steam line drain pot from the Main Condenser. The inlet steam line drain pot then began to fill up with condensate from the steam supply line. After a period of time, the water level in the drain pot was high enough to bring in the HPCI steam line drain pot high level alarm.

ANALYSIS / SAFETY SIGNIFICANCE

The loss of Unit 1 HPCI System had very low significance. The redundant safety systems were available for the period of time that HPCI was not available. There were no actual demands on HPCI during that period of time. Given the short duration of the event compared to an entire cycle, the total cycle Core Damage Frequency was increased less that one-half of one percent. The 9.6 hours that HPCI was not available was much less than the allowed outage time given by Technical Specification 3.5.1 (14 days). This out of service time was an insignificant portion of the 2.5% unavailability assumed by plant PRA analysis. Therefore, this event has very low significance.

PREVIOUS OCCURENCES

A similar failure occurred on the corresponding Unit 2 solenoid valve (SV-25626) in December 1998

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Susquehanna Steam Electric Station - Unit 1	05000387	2001	-- 004 --	00	3 OF 4

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

while HPCI was out of service. This failure was an important consideration in the review of the most recent event. Together these failures prompted a broader review of the status of normally energized Circle Seal solenoid valves.

On December 15, 1993, PPL issued a letter to the NRC, R. G. Byram to C. L. Miller, entitled "Failures of and Continuing Service Problems with Circle Seal Controls Solenoid Valves". This letter covered problems encountered with non-functioning of the solenoid due to coil shorting and subsequent burnout. Many of these failures occurred within a short time of installation, typically in as little as hours or days. The root cause of these failures was faulty design and manufacturing. These were a different model of Circle Seal solenoid valves and the failures were not due to accelerated aging. One of these valves did fail while in service and LER 93-009 was issued dated 9/20/1993.

CORRECTIVE ACTIONS

Corrective actions that have been completed are:

- The failed solenoid valve and fuse were replaced and HPCI was restored. The original solenoid valve used in this application was a Circle Seal Model SV31S-9101-4. This solenoid had a coil resistance of 275 Ohms. The replacement solenoid valve is manufactured by Automatic Valve Company (AVCO) and has a coil resistance of 948 Ohms. This higher coil resistance results in lower current and allows the replacement solenoid valve to function while generating one-third the heat.

- A failure analysis was performed on the failed solenoid valve. The physical appearance and terminal resistance indicated heat damage to the insulation. Therefore, the short was coil winding to coil winding.

- A broad review was conducted of the status of Circle Seal solenoid valves currently in service on both units. Modification work was planned and in progress to replace certain Circle Seal solenoid valves (model SV31S-9101-4). Of the eight valves that remain to be replaced under this modification, only one solenoid is normally energized. This solenoid valve is the corresponding valve on Unit 2 HPCI (SV-25626). This valve was replaced with a Circle Seal solenoid valve (same model) in December of 1998.

Corrective Actions to be completed are:

- Replace the Circle Seal model SV31S-9101-4 solenoid valve on Unit 2 HPCI (SV-25626) with an AVCO solenoid valve. Expected completion is 9/30/2002. This completion date was selected since this valve will have less than four years of service when it is replaced, and the Unit 1 valve had accumulated nine years of service before it failed.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Susquehanna Steam Electric Station - Unit 1	05000387	2001	-- 004 --	00	4 OF 4

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

ADDITIONAL INFORMATION

Past Similar Events: See Previous Occurrences above.

Failed Component: SV15626

Manufacturer: Circle Seal

Model: SV31S-9101-4