

R. L. Anderson
Vice President - Nuclear Operations

PPL Susquehanna, LLC
769 Salem Boulevard
Berwick, PA 18603
Tel. 570.542.3883 Fax 570.542-1504
rlanderson@pplweb.com



FEB 20 2004

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Stop O-P1-17
Washington, DC 20555 - 0001

**SUSQUEHANNA STEAM ELECTRIC STATION
LICENSEE EVENT REPORT 50-387/2002-006-01
LICENSE NO. NPF-14
PLA-5576**

Docket No. 50-387

*Reference: 1) PLA-5534, R. L. Anderson (PPL) to USNRC Document Control Desk,
"Licensee Event Report (LER) 50-387/2002-006-0," dated October 15, 2002.*

Attached is a supplement to Reference 1. This supplement conveys the results of PPL's investigation into the failure of startup transformer ST-20. There were no consequences to the health and safety of the public as a result of this event. This Licensee Event Report contains no new commitments.

Richard L. Anderson

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

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, NE0B-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 Susquehanna Steam Electric Station - Unit 1	2. DOCKET NUMBER 05000387	3. PAGE 1 OF 5
--	-------------------------------------	--------------------------

4. TITLE
Supplemental LER on Failure of Startup Transformer ST-20

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
10	03	2002	2002	006	01	02	20	2004	Susq. SES - Unit 2	05000388
									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)	x 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)	X 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)	x 50.73(a)(2)(i)(A)	50.73(a)(2)(v)(D)						
		20.2203(a)(2)(v)	x 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)						
		20.2203(a)(3)(i)	50.73(a)(2)(ii)(A)	50.73(a)(2)(viii)(B)						

12. LICENSEE CONTACT FOR THIS LER

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

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
B	FK	XFMR	F055	N	X	FK	86	G080	N

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

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

At approximately 0230 hours on October 3, 2002, a fire occurred on Startup Transformer (ST) No. 20. The transformer fire was extinguished by the transformer's automatic deluge system. Unit 1 was in MODE 1 - Power Operation operating at 100% power and Unit 2 was in MODE 2 -Startup. Unit 2 was manually scrammed due to a loss of both Reactor Recirculation pumps. Unit 1 continued operation at 100% power. The fire was extinguished quickly and caused no significant impact to adjacent systems or structures. An Emergency Plan Unusual Event was declared at 0315 when it was determined that two explosions also occurred. The Unusual Event was terminated at 0552 on October 3, 2002. ST No. 20 was replaced and declared operable on October 10, 2002. This event was reported in LER 50-387/2002-006-00, PLA-5534 dated October 15, 2002. This supplement to that LER provides the final conclusions of PPL's investigation of the transformer failure. The conclusion of this investigation was that the root cause was an undetectable internal fault. This internal fault could have originated from several possible sources. It was also determined that the primary and backup lockout relays did not actuate as expected during the event. The lockout relays provide electrical protection for the ST-20 Startup Transformer and function automatically to protect the transformer. The failure of the primary and backup lockout relays to actuate did not cause the event. Corrective actions have been developed and implemented with sufficient breadth to address the possible causes of both the transformer and the protective relay failures. No safety barriers were affected by this event. There were no consequences to the health and safety of the public as a result of this event.

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	2002	006	01	2 of 5

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

EVENT DESCRIPTION

At approximately 0230 hours on October 3, 2002, a fire occurred on Startup Transformer (ST) No. 20 (EIS Code: FK). Unit 1 was in MODE 1 - Power Operation operating at 100% power and Unit 2 was in MODE 2 - Startup. Unit 2 was manually scrammed due to a loss of both Reactor Recirculation (EIS Code: AD) pumps. Unit 1 continued operation at 100% power.

The fire brigade was immediately dispatched to ST No. 20 and off-site fire companies were called as a precautionary measure. The fire was extinguished by the transformer's automatic deluge system (EIS Code: KP) and the offsite companies were not needed. Subsequently, the Control Room received information that led to a determination that the transformer fire may have been accompanied by explosions. Emergency Action Level (EAL) 14.1 provides criteria to declare an Unusual Event for an explosion inside the security protected area with no significant damage to other station facilities. There was no potential to damage safe shutdown equipment. The Unusual Event was declared at 0315 on October 3, 2002 and appropriate notifications were made. The Unusual Event was terminated at 0552.

ST No. 20 was powering the Unit 2 reactor recirculation pumps when the event occurred. The transformer fault led to an isolation of this power supply and a Unit 2 shutdown was required since both reactor recirculation pumps tripped. A manual scram using the Reactor Protection system was utilized to complete this shutdown. Unit 2 was in MODE 2 - Startup at a reactor pressure of 435 psig and range 8 on the Intermediate Range Monitors (IRMs) (EIS Code: IG). All control rods inserted and the shutdown was completed successfully.

As a result of the failure of ST No. 20, one off-site power source for the station was not available. The remaining source of offsite power continued to be available via Startup Transformer (ST) No. 10 and provided power to each of the four 4.16 kV Engineered Safeguards System (ESS) (EIS Code: EB) buses (A, B, C and D) for both Unit 1 and Unit 2 (8 total buses). LCOs were entered on Unit 1 and Unit 2. Compensatory measures were taken to reduce the potential for the loss on ST No. 10 and to ensure that equipment required to mitigate the consequences of a loss of ST No. 10 were maintained available. Unit 1 continued to operate in MODE 1 - Power Operation. A number of Unit 1 systems were affected by the ST No. 20 failure. These systems functioned as designed and were recovered as applicable per plant procedures.

CAUSE OF EVENT

An Event Review Team was assigned to investigate this event. The conclusion of this team was that the root cause of the ST-20 Startup Transformer failure was an undetectable internal fault. The transformer failure does not correspond to an end of life failure. No common mode type of failure has been identified.

This internal fault could have originated from several possible sources. Determining the specific source has been complicated since the ST-20 Startup Transformer was re-energized two times after the first fault occurred. The attempted re-energizations caused additional damage. This circumstance makes it difficult to determine what damage occurred from the initial fault.

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	2002	006	01	3 of 5

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

CAUSE OF EVENT (continued)

In the team's judgment, the most likely cause of the first fault was a flashover between the H1 bushing and the main tank on phase #1. There are also indications in the main transformer cabinet that a flashover may have occurred internal to the transformer. There is relaying data indicating the first two faults may have been outside the bushing current transformers. This data indicates that these faults were external to the transformer tank. However, the team was unable to find any evidence of tracking on the external side of the H1 bushing. This lack of evidence supports the team's judgment. Possible causes of failures internal to the transformer include one or a combination of the following: electrode condition, contamination of the oil, high dielectric stress, and voltage transients.

Due to the nature of the failure and as a result of the evidence reviewed, the team was able to rule out failures caused by grid disturbances, excessive loading, transient loading, insulation at end of life, vibration fatigue, operating practices, maintenance practices, environmental conditions, and solar magnetic disturbances. The team did discover that the primary and backup lockout relays did not actuate as expected during the event.

The lockout relays provide electrical protection for the ST-20 Startup Transformer. The relays are designed to function automatically to protect the transformer. The primary lockout relay actuates on high differential current or the closure of the high speed ground switch. The backup lockout relay actuates on transformer overcurrent, transformer neutral overvoltage, or a trip of the transformer's sudden pressure relay.

The failure of the primary and backup lockout relays to actuate did not cause the event. Damage to the transformer had already occurred and would not have been prevented by proper operation of these relays. The Event Review Team identified several opportunities to learn from external operating experience on similar failures. In addition, an opportunity to identify the problem was missed in October, 2001 when a preventative maintenance step to operate the lockout relays was deleted from a work plan and not performed.

In conjunction with the Event Review Team's investigation, an outside transformer expert performed a detailed onsite review of the failure of the transformer and witnessed the subsequent disassembly of the failed transformer. These reviews resulted in several recommendations to improve our transformer condition monitoring, for additional investigation actions, and for design reviews on ST-10 & ST-20.

REPORTABILITY DETERMINATION/ASSESSMENT OF SAFETY CONSEQUENCES

This report was submitted as a voluntary LER per the Susquehanna Steam Electric Station Emergency Plan Table 5.2 in that an Unusual Event was declared after an onsite explosion occurred on ST No. 20. In accordance with the guidance provided in Susquehanna Steam Electric Station Emergency Plan Table 5.2, this report was submitted October 15, 2002. This event was also determined to be reportable per 10CFR50.73(a)(2)(i)(A) for the completion of a Unit 2 shutdown required by the Technical Specifications and per 10CFR50.73(a)(2)(iv)(A) in that an unplanned actuation occurred when the Reactor Protection System (EIS Code: JC) was manually initiated for a reactor scram.

NRC FORM 366A U.S. NUCLEAR REGULATORY COMMISSION
(7-2001)**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	2002	006	01	4 of 5

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

The loss of ST No. 20 reduced the station's available offsite power sources and resulted in a 72 hour limiting condition for operation (LCO) on Unit 1. A Notice of Enforcement Discretion (NOED) was requested and granted to allow Unit 1 to continue operation for a total of 7 days while ST No. 20 was replaced. Although enforcement discretion was granted, the operation of Unit 1 beyond the 72 hour LCO is a condition prohibited by the Technical Specifications and is still reportable per 10CFR50.73(a)(2)(i)(B).

The transformer is located adjacent to the Unit 2 Turbine Building. Neither the fire nor the explosions posed a potential danger to other equipment required for safe shutdown. No safety barriers were affected by this event. The fire was extinguished quickly and caused no impact to systems required for safe shutdown. Since Unit 2 was shutdown with no adverse circumstances and Unit 1 was maintained in safe operation, there were no consequences to the health and safety of the public as a result of this event.

CORRECTIVE ACTIONS

ST No. 20 was replaced and declared operable on October 10, 2002. In addition, several associated components were replaced. Prior to placing the new ST No. 20 Transformer in service, extensive testing was performed to ensure the new transformer was in satisfactory condition.

ST No. 10 was replaced and declared operable on October 18, 2003.

Additional corrective actions were identified as a result of an Event Review Team's review of the ST No. 20 failure. Corrective actions have been developed and implemented with sufficient breadth to address the possible causes of both the transformer and the protective relay failures. These corrective actions include the following:

- Implemented appropriate recommendations from outside transformer expert and new transformer vendors:
 - A detailed dielectric stress/strength analysis of the flashover region around the High Voltage Bushing was performed. This resulted in dielectric strength improvements in the design of both transformer replacements.
 - Additional insulating boards were added in several locations to improve the dielectric strength.
 - The design of the tertiary winding associated with the tap changer was made more robust.
 - Surge suppressors were added to the tertiary winding to prevent a similar failure of the tap changer.
- Identified other similar lockout relays. A systematic review of these lockout relays is in progress to ensure adequate relay exercising and to evaluate routine PM changes.
- Strengthened the review and approval process for the deletion of steps in Preventive Maintenance Work Documents.

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	2002	- 006	- 01	5 of 5

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

ADDITIONAL INFORMATION

Failed Component Information: Transformer - Startup Transformer ST-20 (OX104)
 Manufacturer – Federal Pacific Electric
 Model Number - OLTC 45MVA 60MVA 75MVA Power Transformer

Lockout Relays – primary, 86A1-10401A; backup, 86A1-10401B
 Manufacturer – General Electric
 Model Number – GE Type HEA61 Right Angle Drive Manually Rest

Notice of Enforcement Discretion: PLA-5533 dated 10/5/2002

Past Similar Events:

Previous Events with similar results, but with dissimilar causes:

Docket No. 50-387 LER 84-034-00 - Phase-to-phase fault on 230kV line.

Docket No. 50-388 LER 85-025-00 - Generator load reject, reactor scram. Lightning strike on 500 kV line caused logic relay failure.

Docket No. 50-387 LER 88-006-00 - Generator load reject, reactor scram. Worker bumped 230 kV yard span protection relay.

Docket No. 50-388 LER 88-010-00 - Generator load reject, reactor scram. Lightning strike on 500 kV line caused misoperation of ground fault relay.

Docket No. 50-387 LER 89-027-00 - Generator load reject, reactor scram. Loss of electrical services to the 230 kV switchyard caused tripping of main distribution breakers resulting in the generator load reject.

Docket No. 50-388 LER 90-002-00 - Generator load reject, reactor scram. Actuation of 500 kV line protective circuitry caused tripping of the main distribution breakers resulting in the generation load reject.

Docket No. 50-388 LER 95-005-00 - Generator load reject, reactor scram. Actuation of 500 kV line protective circuitry caused tripping of the main distribution breakers resulting in the generation load reject.

Docket No. 50-388 LER 99-003-00 - Generator load reject, reactor scram. Unit 2 "A" main transformer experienced a failure of a neutral bushing.