



# PECO NUCLEAR

A Unit of PECO Energy

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10CFR50.73

March 31, 2000  
Docket No. 50-353  
License No. NPF-85

U.S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, DC 20555

**SUBJECT:** Licensee Event Report  
Limerick Generating Station (LGS) - Unit 2

This LER concerns the failure of the B main transformer surge arrester which caused a generator lockout/turbine trip and subsequent reactor scram.

Reference:	Docket No. 50-353
Report Number:	2-99-006
Revision Number:	01
Event Date:	December 31, 1999
Report Date:	March 31, 2000
Facility:	Limerick Generating Station P.O. Box 2300, Sanatoga, PA. 19464-2300

This LER is being submitted pursuant to the requirements of 10CFR50.73(a)(2)(iv).

Very truly yours,

lwh

cc: H. J. Miller, Administrator Region I, USNRC  
A. L. Burritt, USNRC Senior Resident Inspector, LGS

IE22

### LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

Estimated burden per response to comply with this mandatory information collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Forward comments regarding burden estimate to the Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503. If 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.

<b>FACILITY NAME (1)</b> Limerick Generating Station, Unit 2	<b>DOCKET NUMBER (2)</b> 05000353	<b>PAGE (3)</b> 1 OF 3
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**TITLE (4)**  
Generator Lockout and SCRAM due to Failure of B Phase Main Transformer Surge Arrester

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
12	31	1999	1999	-- 006	-- 01	03	31	2000		05000
									FACILITY NAME	DOCKET NUMBER
										05000

<b>OPERATING MODE (9)</b>	1	<b>THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5: (Check one or more) (11)</b>								
		20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)					
<b>POWER LEVEL (10)</b>	100	20.2203(a)(1)	20.2203(a)(3)(i)	50.73(a)(2)(ii)	50.73(a)(2)(x)					
		20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71					
		20.2203(a)(2)(ii)	20.2203(a)(4)	x 50.73(a)(2)(iv)	OTHER					
		20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A					
		20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)						

**LICENSEE CONTACT FOR THIS LER (12)**

<b>NAME</b> K. P. Bersticker, Manager - Experience Assessment	<b>TELEPHONE NUMBER (Include Area Code)</b> (610) 718-3400
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**COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)**

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
X	EA	LAR	O030	N					
X	EA	CB	A576	N					

<b>SUPPLEMENTAL REPORT EXPECTED (14)</b>			<b>EXPECTED SUBMISSION DATE (15)</b>		
<input type="checkbox"/> <b>YES</b> (If yes, complete EXPECTED SUBMISSION DATE).	<input checked="" type="checkbox"/> <b>NO</b>				

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

On December 31, 1999 at 01:11 hours Unit 2 reactor scrammed from 100% power on a main generator lockout/turbine trip when the generator protective relays detected a B phase-to-ground fault. The fault was initiated when a 500kV surge arrester located at the main step-up transformer failed. The fault was isolated from the 500 KV system through the automatic operation of the switchyard circuit breakers. Following the scram, it was discovered that one of the two grading capacitors located on the B-phase pole of the 355 circuit breaker had also failed when removing the 500 KV capacitor bank from service resulting in two successive restrikes of the 355 circuit breaker. No emergency core cooling systems (ECCS) were actuated. The surge arresters on all three (3) phases of the main transformer were replaced as were 5 grading capacitors. The unit was returned to service on January 2, 2000.

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	-353	1999	006	01	3

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

**Background**

At the time of the event Unit 2 was in Operational Condition (OPCON) 1 (Power Operation) at 100% power. Load dispatchers were removing the 500 KV capacitor bank from service, when the substation 355 circuit breaker B phase grading capacitor failed. No other major evolutions were underway and no structures, systems or components were out of service which contributed to the event.

**Event Description**

On December 31, 1999 at 01:11 hours Unit 2 reactor scrambled from 100% power on a main generator lockout/turbine trip(EIIS:TB) which was caused by a phase to ground fault on the B phase main transformer 500 kV (EIIS:EA) surge arrester. At the time of the event the substation 355 circuit breaker was being opened to remove the 3-1 capacitor bank from service. A failed grading capacitor on the 355 circuit breaker resulted in a voltage transient that actuated the surge arrester on the B-phase transformer and caused it to fail. The main transformer ground fault relay system (EIIS:EL) functioned normally to trip the unit. The reactor was stabilized and no emergency core cooling actuations occurred.

An unusual event was declared on 12/31/99 at 02:55 hours based on a report by plant personnel of an unanticipated explosion within protected area boundary resulting in visible damage to permanent structure or equipment and was terminated at 04:00 hours.

A 4 hour notification was made to NRC for RPS/ESF actuations [10CFR50.72(b)(2)(ii)] on 12/31/99 at 03:10 hours.

This event was determined to be reportable under the requirements of 10CFR50.73(a)(2)(iv). Unit 2 was returned to service on January 2, 2000.

**Cause of the Event**

The cause of the scram was a double restrike of the 355 circuit breaker at the capacitor bank. The double restrike was caused by a failed grading capacitor across the B phase contacts of the 355 circuit breaker. Test results for both new and previously installed grading capacitors were found to be acceptable, and there have historically been no known failures associated with this particular application.

During the first restrike the surge arrester apparently operated properly. However, during the second restrike, the surge arrester was unable to properly dissipate the energy associated with the high frequency transient caused by the capacitor bank switching. This rapid sequence of events resulted in severe erosion within the surge arrester which ultimately resulted in its failure. An Electromagnetic Transient Program (EMTP) study was performed which confirmed this sequence of events.

Inspection of certain portions of the failed surge arrester confirmed the severe erosion which is indicative of energy absorption in excess of the surge arrester's capability.

The silicon carbon style surge arrester is not designed to withstand multiple restrikes such as occurred in this event, and the design of the capacitor bank switching configuration(installed in 1993) did not anticipate the effects of a failed grading capacitor.

**Consequences of the Event**

The actual consequences of the event were minimal. The main transformer protective relay actuations, the main turbine trip and the RPS actuations all occurred per design and all control rods fully inserted. No release of radioactive material occurred and no ECCS actuations occurred as a result of this event.

The inservice Drywell Chiller(EIIS:KM) tripped resulting in increased drywell temperature and pressure. The Drywell Chiller (2A) was started and drywell cooling was maximized. The cause of the trip of the inservice Drywell Chiller was due to the cooling water isolation valve closing on undervoltage (voltage transient to the control logic). This then produced a low flow signal at the switch which tripped the chiller.

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

The Reactor Building Enclosure HVAC system (EIS:VA) tripped which was apparently caused by an undervoltage trip as a result of losing the B phase. The Turbine Building Enclosure HVAC system (EIS:VK) also tripped which was apparently caused by a undervoltage trip due to the voltage transient. Both HVAC systems were later restarted.

The Reactor Core Isolation Cooling (RCIC)(EIS:BM) initiation light came on but the system did not start. The signal was of a millisecond duration and allowed only the logic for the white light to energize. The results of the review indicate instrument line ringing was sufficient to account for the light to come on. Due to the high frequency of the level ringing the indicated swings in level are not actual level but the results of a pressure wave initiated upon turbine trip and stop valve closure. As a result, the duration that the transmitter actually exceeds the trip unit setpoint is a few milliseconds but does not actuate RCIC nor does it prevent actuation. The potential consequences of the event were also minimal since the plant is designed for a Generator Load rejection.

**Corrective Action Completed**

On December 31, 1999 Maintenance personnel performed Dissolved Gas Analysis (DGA) testing of the transformer oil on all three phases of the main transformer. The purpose of this test was to determine if there had been any internal arcing or overheating in the transformers. Test results indicated that there was no internal arcing or overheating. The surge arresters on all three phases of the main transformer were replaced with zinc oxide arresters which are appropriately sized and coordinated, and will operate properly through multiple breaker restrikes. The surge arresters were Doble tested satisfactory. The 3-1 capacitor bank was returned to service on March 17, 2000.

The grading capacitors were subjected to Doble tests and partial discharge tests at the vendor's test facility, and no abnormalities were observed. The 355 circuit breaker was inspected and diagnostically tested, and five new grading capacitors were installed. Design improvements and/or changes in maintenance practices for the grading capacitors are still under investigation.

The operation for switching the grading capacitor has been modified such that both the 345 and 355 breakers (in series at the capacitor bank) will be opened at the same time when deenergizing the capacitor bank. This will preclude the unlikely occurrence of a double restrike of a breaker, or the effects of a grading capacitor failure which could cause multiple restrikes. The 345 breaker will be closed before the 355 breaker when energizing the capacitor bank.

The unit was returned to service on January 2, 2000.

**Corrective Action Planned**

During the upcoming outage on Unit 1 the surge arresters on the main transformer will be replaced with the newer style MOV type arrester.

**Previous Similar Occurrences**

There has been a previous similar occurrence (LER-95-002) of an offsite transformer surge arrester problem which affected both units.

**Failure Data**

Surge Arrester  
Manufacturer-Ohio Brass  
Model-MPR-420 silicon carbide/gapped

**Circuit Breaker(Grading Capacitor)**

Manufacturer-ABB  
Model-Live-Tank ELF-SP7-2