NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), 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.

LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Limerick Generating Station, Unit 1	05000 352	1 OF 9

TITLE (4) Failure to Provide Sufficient Repair Actions Needed to Achieve Cold Shutdown for Fire Safe Shutdown Capability.

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
10	26	84	96	-- 021 --	01	04	11	97	Limerick, Unit 2	05000353
									FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	1
POWER LEVEL (10)	100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
	20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
	20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X OTHER
	20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	(Specify in Abstract below and in Text, NRC Form 366A)
	20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
	20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
J. L. Kantner, Manager - Experience Assessment, LGS	(610) 718-3400

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

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

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

On 12/5/96, a review associated with the Thermo-Lag reduction project determined that a fire Safe Shutdown (SSD) repair would not function as desired due to an incorrect assumption made in the fire SSD design analysis. Following proceduralized repairs, pressurized gas might not remain available to operate the Main Steam Relief Valves (MSRVs) which are required for depressurization control for Unit 1 and Unit 2 in the event of a postulated fire in certain areas of the plant. Actual pressurized gas system operating characteristics were not fully considered when developing the repair actions. This resulted in a failure to maintain the provisions of the Fire Protection Program (FPP) and is a violation of a License Condition. Sufficient plant equipment would have remained available to maintain the plant in a hot shutdown condition until necessary repairs could be made to achieve cold shutdown. The potential consequences of this event are further minimized by other permanent design and administrative features of the FPP. The ongoing Thermo-Lag reduction project includes a comprehensive review of all of the assumptions made in the fire SSD analysis, a verification of all of the fire SSD repairs, and a review of all the fire SSD systems to verify physical capability to perform as required.

Unit Conditions Prior to the Event

Unit 1 was in Operational Condition (OPCON) 1 (Power Operation) at 100% power when this event was discovered.

Unit 2 was in OPCON 1 at 90% power when this event was discovered. During the investigation and implementation of the immediate corrective actions for this event, Unit 2 was shut down to repair an Electro-Hydraulic Control system leak and to perform a planned maintenance outage. Unit 2 was restarted on December 13, 1996.

Unit 1 and Unit 2 have operated at various power levels since the concern described in this report first existed. There were no systems, components, or structures out of service which contributed to this event.

Background

As a result of concerns identified in NRC Bulletin 92-01 regarding Thermo-Lag fire barriers, a PECO Nuclear Engineering review was initiated to determine methods to restore fire barrier operability. Additional efforts were initiated by PECO Nuclear Engineering to identify safe cost effective solutions to resolve the Thermo-Lag operability issue by reducing the reliance on raceway encapsulations to protect safe shutdown (SSD) cables. This re-analysis effort includes verification and validation of SSD analysis inputs using inter-disciplinary reviews of system functions and fluid flow paths. These additional efforts were beyond the scope of actions included in the NRC Bulletin 92-01 and Generic Letter 92-08, and as further discussed in SECY-96-267 which assumed the Thermo-Lag would simply be qualified or replaced. PECO Nuclear procedures are utilized to evaluate concerns identified during the verification reviews. Prompt determinations for operability, reportability, the need for compensatory measures, and immediate corrective actions are performed in accordance with these procedures.

Description of the Event

On December 5, 1996, an engineering evaluation associated with the Thermo-Lag reduction project determined that a fire SSD repair action would not function as desired due to an incorrect assumption made in the design analysis for the repair. The repair action provides a flow

path for the Primary Containment Instrument Gas (PCIG) system (EIIS:CD) to provide gas pressure needed to operate the selected Main Steam Relief Valves (MSRVs, EIIS:RV). In the event of a significant fire in the Main Control Room (MCR), the common Auxiliary Equipment Room (AER), or the Unit 1 or Unit 2 Cable Spreading Rooms (CSRs), operators would need to shutdown both Unit 1 and Unit 2 from the Remote Shutdown Panels using Special Event (SE) procedure SE-1, "Remote Shutdown." This fire SSD method utilizes procedure SE-1-1, "Protected Depressurization Control," to operate the A, C, and N MSRVs to assist in achieving cold shutdown. However, the original analysis performed before 1984, and a re-analysis performed in 1985, did not adequately consider the availability of the PCIG system throughout the shutdown scenario. A review of actual PCIG system operation and the specific equipment protected from fire damage revealed that pressurized nitrogen from the PCIG system may only remain available for up to one (1) hour. The shutdown analysis relies on the PCIG system to operate the MSRVs for up to six (6) hours.

This condition resulted in a failure to maintain the provisions of the approved Fire Protection Program and is a violation of Facility Operating License Conditions 2.C.(3) for the Limerick Generating Station (LGS) Units 1 and 2.

Engineering personnel evaluated the significance of this issue upon its discovery and immediately contacted station personnel to implement appropriate compensatory measures. It was concluded that an hourly fire watch patrol was a sufficient immediate compensatory measure. The basis for this is discussed in the Analysis Section of this report.

Station personnel then verified that the AER and the CSRs were already included on the hourly fire watch patrol rounds and the list of fire protection equipment impairments was revised to include this non-conforming issue. Operations personnel were notified of this concern and the potential impact on the availability of the PCIG system.

A twenty-four (24) hour notification was made to the NRC at 1402 hours on December 6, 1996, in accordance with the requirements of License Conditions 2.F and 2.E for Units 1 and 2, respectively, to report the failure to comply with License Condition 2.C.(3). This report is submitted in accordance with requirements of License Conditions 2.F and 2.E for Units 1 and 2, respectively.

Analysis of the Event

The actual consequences for this condition are minimal since a fire did not occur challenging the fire protection program or requiring the safe shutdown of either unit. The potential for a fire and the impact of a fire in the MCR, AER, or CSRs is minimized by a combination of many factors. The design of the Fire Protection Program relies on a 'defense-in-depth' approach which serves to:

1. prevent a fire from starting,
2. quickly detect and suppress fires which do start,
3. provide reasonable electrical isolation and separation of circuits to minimize the plant system challenge of fires prior to detection and suppression,
4. prevent the rapid spread of fires by selecting fire retardant construction materials, and
5. protect safety related equipment so that a fire will not prevent SSD of the plant.

The potential for a fire and the consequences of postulated fire damage in the specific areas of concern are further mitigated by the specific factors indicated below.

1. Automatic fire detection (EIIS:IC) and suppression equipment (EIIS:KP)exists in all three areas as outlined below:
   a) The MCR is continually manned and provided with manual fire suppression equipment.
   b) The AER is protected by an automatic under-floor halon suppression system.
   c) The CSRs are protected by an automatic water sprinkler system and manually initiated room flooding carbon dioxide system.

2. Divisional separation of equipment and cabling associated with independent trains of SSD equipment per the design reduces the likelihood of damage to the independent trains of equipment in these areas.

3. The transient combustible loading and fire hazard control of these rooms is well established including an existing hourly fire watch patrol in the AER and CSRs as a result of the inoperable Thermo-Lag fire barriers. The use of an hourly fire watch patrol is consistent with the defense-in-depth philosophy in the Branch Technical Position (BTP) CMEB 9.5.1, the LGS Technical Requirements Manual (TRM), and commitments associated with the inoperable Thermo-Lag fire barriers.

4. The CSRs are controlled such that no transient combustible materials are permitted in the areas.

5. A designed solution to provide a protected supply of pressurized gas for operation of the MSRVs to achieve cold shutdown was quickly identified by engineering, approved and implemented by station personnel. Instructions and equipment were staged immediately to facilitate the necessary field repairs, should an actual fire have occurred, prior to the implementation of the permanent solution.

6. Other methods of providing pressurized gas to the MSRVs and several other methods of depressurization control would be available with existing procedural guidance for their use in the event of a limited fire in one of these areas (e.g., other MSRVs, the Automatic Depressurization System (ADS), High Pressure Coolant Injection (HPCI) System (EIIS:BJ), and Reactor Core Isolation Cooling (RCIC) System (EIIS:BN).

In the event of a significant fire in the MCR, AER, or CSRs, operators would have been able to maintain hot shutdown indefinitely from the Remote Shutdown Panel using the RCIC system and the suppression pool cooling mode of the Residual Heat Removal system (EIIS:BO). This would assure integrity of the fuel and primary containment until the necessary cold shutdown repairs (i.e., providing gas pressure to the MSRVs) could be implemented. The mechanical, overpressure-relief Capability of the MSRVs does not require PCIG to operate, and is unaffected by this issue.

The combination of these factors also provide the basis for the adequacy of the interim compensatory actions taken for this discovered condition (i.e., hourly fire watch patrol, control of transient combustible materials, and notification of the licensed operators).

Cause of the Event

The original fire SSD analysis, prior to issuance of the Unit 1 Operating License in 1984, incorrectly assumed that the PCIG system would provide a continuous supply of compressed gas and that the only repair needed to assure continued availability of the PCIG system to the MSRVs was an air jumper to open a Primary Containment Isolation Valve. The PCIG system was not designed to be leak tight and the PCIG compressors are needed to maintain the PCIG system headers pressurized for extended periods. The PCIG system air compressors, certain PCIG

system valves, and support sub-systems were not protected from postulated fire damage. During a subsequent re-analysis in 1985, as a result of an open item in the LGS Safety Evaluation Report, Supplement 2, the PCIG system was further reviewed for fire SSD considerations. This review incorrectly determined that adequate nitrogen pressure could be maintained using the system receiver tank, obviating the need to analyze the equipment and cabling necessary for operation of the PCIG compressors. This analysis did not take into account actual PCIG system operating characteristics and that the PCIG system is not designed to be leak tight (some limited end user gas consumption is desired to maintain the cleanliness & lubrication of the end devices).

The following contributing factors to this deficiency in the fire SSD analysis were also identified.

1. A lack of systems engineering (cross functional) involvement in fire SSD analysis. Historically, the lead for the fire SSD analysis has been an electrical engineering function and mechanical and plant system engineering support was requested as deemed necessary.

2. Documentation of the subject fire SSD design analysis and subsequent reviews were less than adequate. Verification of assumptions were not easily performed since key assumptions were not documented in the design analysis.

The investigation concluded that none of these causes involve willful errors.

Corrective Actions

On December 12, 1996, a protected source of pressurized gas was provided for Unit 1 and Unit 2. This revised fire SSD repair included an air jumper with quick disconnect connectors and a supply of pressurized nitrogen cylinders. Revisions to procedure SE-1-1 were also implemented. A Plant Operations Review Committee (PORC) review of the revised fire SSD repair, the revision to procedure SE-1-1, the changes to the Updated Final Safety Analysis Report (UFSAR), and the associated 10CFR50.59 Safety Evaluation were also completed on December 12, 1996. This restored both Unit 1 and Unit 2 to full compliance with the Operating License Conditions. These actions were completed prior to the restart of Unit 2 from the concurrent planned maintenance outage.

The following corrective actions are being implemented. These reviews are expected to be completed by December 1, 1997.

1. All of the repair actions in the fire SSD analysis will be reviewed to confirm that the repair will achieve the desired effect, there is sufficient specificity in the procedures for the operator, and the repair is capable of being implemented. These activities are expected to be completed by July 1, 1997.

2. The scope of the ongoing Thermo-Lag reduction project includes a verification of the assumptions made in the fire SSD analysis and will provide a fire SSD analysis that meets current regulatory requirements. This project provides for traceable and maintainable documentation for verification and future use. The verification and documentation activities are expected to be completed by September 1, 1997 and December 1, 1997, respectively.

3. A review of the fire SSD systems will be performed to confirm the physical capability of each system to perform as required in the fire SSD analysis. Cross functional systems engineering involvement is included in the review effort. These activities are expected to be completed by September 1, 1997.

Since the engineering bases for repair-type actions were not reviewed as a part of LER 1-88-031, item 1 above is scheduled to be performed in the near-term. The individual repairs credited by the SSD analysis are diverse in nature, and have been developed over a period of several years. Based on the reviews performed for LER 1-88-031, there does not appear to be significant opportunities for similar type of errors to exist in other areas of the fire SSD analysis. Therefore, it is unlikely that a single bad assumption or individual error could render all repair actions suspect. Corrective Action 1 above represents an increase in scope of the Thermo-Lag reduction project.

LER 1-96-015 reported the failure to provide all the necessary repair equipment needed for fire SSD in certain areas of the plant. The generic implications reviews for LER 1-96-015 have been completed and have confirmed that all procedurally required equipment and tools necessary to facilitate fire SSD operator actions and repairs are identified, properly staged, tested, and inventoried. This review did not identify significant deficiencies in the implementation of repair actions.

Based on the depth of review performed for LER 1-88-031, Items 2 and 3 above, are viewed to be confirmatory in nature. Item 2 is part of the original Thermo-Lag reduction project scope and item 3 will be added to the project scope and will be performed consistent with the existing Thermo-Lag resolution project schedule so as to not impact the compliance schedule committed to in the responses to GL 92-08. A description of the Thermo-Lag reduction project and its schedule can be found in the seven (7) PECO Energy responses to NRC Requests for Additional Information (RAI) regarding Generic Letter 92-08 dated 4/16/93, 12/29/93, 2/4/94, 12/19/94, 3/29/95, 8/2/95 and 3/24/96. The breadth of the review by the Thermo-Lag reduction project will cover the work performed during the original analysis before initial plant startup and any subsequent review or changes made since then.

A review of previously identified non-conformances has been performed to assess the validity of the LGS fire SSD analysis. A review of the findings identified to date by the Thermo-Lag reduction project reveals that compared to the size and depth of the analysis, the number and breadth of the issues is very small. Furthermore, generic implication reviews performed for the identified issues have not led to the conclusion that major design or programmatic deficiencies exist.

It has been concluded that the potential generic implications of the root causes of this event are isolated to the fire SSD design area. This is based on a review of the following items along with the other issues reviewed regarding the adequacy and availability of design basis information (10CFR50.54(f) Response). The following items along with many others were included in the review effort.

- LER's and Event Investigations
- UFSAR Verification Project
- Safety System Functional Inspections (SSFI's)
- Field Verification of the Environmental Qualification Program
- High Energy Line Break (HELB) Barrier Verification
- Motor Operated Valve (MOV) Program Review (GNL 89-10)

Therefore, no additional corrective actions outside the fire SSD design area are planned at this time.

Previous Similar Occurrences

There have been several LERs that report non-conformances with the fire SSD analysis (e.g., 1-96-015, 1-96-012). These recent issues were also identified during the Thermo-Lag reduction project which includes a complete re-review of the fire SSD analysis. The previously reported issues did not involve the capability of the PCIG system and therefore are not expected to have identified the concern discussed in this report. The previous corrective actions were not intended to address incorrect assumptions in the original SSD analysis and, therefore, are not expected to have corrected the non-conformance identified in this report.

Subsequent reviews and verifications of the Safe Shutdown Analysis, performed as a result of LER 1-88-031 did identify the need to include existing repair actions described in the fire SSD analysis into the UFSAR for completeness. One repair action added to the Final Safety Analysis Report (FSAR) in 1985 was the manual action to repair a PCIG valve to supply gas to operate the MSRVs. The technical basis for this action was included in the approved Safe Shutdown analysis and did not require technical verification for incorporation into the FSAR.

As the result of other corrective actions for LER 1-88-031, the feasibility of the implementation of repairs and manual actions were verified with respect to a timeline of operator actions. Many other corrective actions were pursued based on the root cause analysis and self assessment initiated for LER 1-88-031. The technical adequacy of the repair actions was not implicated in the reviews and therefore the validity of the PCIG system repair was not challenged. Based on the results of the investigation it is not expected that the inaccurate assumption of the PCIG system repair would have been identified during the corrective actions.