U. S. NUCLEAR REGULATORY COMMISSION
REGION I

DOCKET/REPORT NOS: 50-352/94-14
50-353/94-14

LICENSEE: PECO Energy

FACILITY: Limerick Generating Station, Units 1 & 2
Sanatoga, Pennsylvania, and Chesterbrook, Pennsylvania

DATES: June 6-13, 1994, at Sanatoga, Pennsylvania
June 15, 1994, at Chesterbrook, Pennsylvania

INSPECTORS: A. Lohmeier 7/1/94
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Materials Section
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Areas Inspected: A safety inspection was conducted of the Limerick Generating Station (LGS) engineering management oversight, site engineering self-assessment program, independent safety evaluation group assessment of engineering, and modification design, review, and implementation.

Results: The LGS post-NEEDS site engineering organization was found to have an effective, compact engineering organization. It has a unique self-as. ssment program that is effective in identifying problem areas and giving emphasis to areas where positive results are obtained. The independent safety evaluation group was found to provide an effective, independent focus on plant operation from which management can adjust its resources toward resolution of plant operation and engineering problems. LGS system managers provide for effective implementation of modifications at a high quality level. The system managers are well trained and found to be knowledgeable in the technological basis for the modifications and the procedural system necessary to implement the modifications.

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DETAILS

1.0 SCOPE OF THE INSPECTION

This inspection was directed toward the assessment of engineering management oversight, site engineering self-assessment program, independent safety evaluation group (ISEG) assessment of engineering, and modification design, review, and implementation.

2.0 FINDINGS

2.1 Engineering Organization Management Oversight

The inspectors reviewed the status of the engineering reorganization under the NEEDS program and found the reorganization to be complete. Under the present organization, senior management over each of four engineering departments (plant engineering, design engineering, component engineering, and performance and reliability), reports to the director of site engineering. Reporting to the plant engineering manager are branch heads for balance of plant systems, nuclear steam supply systems, electrical systems, and reactor engineering. Reporting to the design engineering manager are branch heads for civil, instruments and control, electrical, and mechanical engineering sections. The engineering sections have from eight to thirteen engineers qualified in the specializations of their assigned responsibilities.

The inspectors noted that the direction to the engineering organization is given through a series of objectives set by corporate management. Each department, branch, and section sets objectives consistent with the over-riding objectives of the next managed level. Performance throughout the organization is measured by the degree of satisfaction of these objectives.

The inspectors found the visions, values, mission statements, objectives, and goals to be clearly expressed in the Limerick Generating Station (LGS) Site Engineering Business Plan of November 4, 1993. Appendices to this plan define the LGS site engineering goals for each organization, and the horizontal linkages between LGS organizations and with off-site organizations.

The site engineering mission statement states that site engineering shall provide safe, responsive, effective, and efficient engineering support for operation of the nuclear power plant. Site engineering shall be recognized for the highest standards of excellence by interfacing departments, the nuclear utility industry, and regulatory groups.

Specific goals have been defined in numerical form for performance measurement relating to nuclear group strategic objectives and nuclear operational objectives. The base level of effort has been defined for each engineering section, together with the division of responsibilities between the site engineering sections and those of the Nuclear Engineering Division (NED).

The inspectors found the LGS post-NEEDS site engineering organization to be an effective, compact engineering organization with an optimal number of management personnel dedicated to the satisfaction of organizationally consistent objectives. The responsibilities, goals, and objectives provide for an effective management system of oversight.

2.2 Engineering Section Self-Assessment

2.2.1 Site Engineering Self-Assessment Program

The inspectors reviewed the site engineering self-assessment program as reflected in the October 1993 site engineering self-assessment document. This document provided for a unique systematic review of engineering personnel performance directed at evaluation of the "product" of engineering performance. The format of the system tabulates responses of the review to the evaluation questions:

What is the product?
Who does this?
What is the procedure?
Why is it done?
What are the goals?
What internal/external reports are reviewed?
What is the assessment methodology?
What grade does the performance merit (A, B, C, D)?
Who is the reviewer?
Who is the supervisor?
What corrective actions are to be taken?

The scope of products assessed by the site engineering covers a wide range of issues. In reviewing the performance grades for 84 products, the inspectors noted 19 "A", 43 "B", 18 "C", and 2 "D." The spread of the ratings indicates a lack of bias. At all ratings, corrective actions are recommended with the greatest emphasis for the lower ratings. The two D ratings identified were directed at the manual data plotting system inadequacies and the nonplant system engineering interface with plant engineering.

Accompanying the self-assessment reviews are many trending tables and charts that assist site engineering in identifying problem areas for which adjustment of resources might be appropriate to reverse negative trends.

The inspectors find the unique self-assessment program at LGS to be effective in identifying problem areas and giving emphasis to areas where positive results are obtained.

2.2.2 Engineering Performance Oversight through the Independent Safety Evaluation Group

The inspectors reviewed the activities of the ISEG. This group is not a part of the LGS staff, but acts as an independent oversight of LGS operations reporting to the quality assurance division in Chesterbrook. Its oversight responsibility includes the engineering and technical support function. The inspection included a review of the ISEG annual summary assessment report for LGS.

The LGS engineering strengths noted by ISEG included the favorable effect of consolidating engineering support and movement of engineering responsibility for key day-to-day support to the site. As a result of this, it was noted by ISEG that backlogs of nonconformance reports (NCRs) and design equivalent changes (DECs) were reduced. Engineering self-assessment was improved.

Weaknesses identified by ISEG included technical adequacy of some products, program management, and management of contractors. It was noted that onsite engineering self-assessment did not identify deficiencies that had been observed by oversight organizations. As a result of the weaknesses identified, the nuclear group provided for assessment of the weakness by the management issue task team. They developed an action plan to enhance management practices.

In discussions with the ISEG manager, the inspectors found that requests for the ISEG inspections originate from all levels of management. Requests come from division managers, department managers, and section managers. The nuclear review board (NRB) has also requested an audit of its activity.

The inspectors reviewed a list of ISEG reviews performed from January 1993 through May 1994. There were 93 reviews conducted in 1993 and 10 through May 1994. These reports were found to be well written. The inspectors also noted that a computerized followup is maintained to determine whether the weaknesses noted in the ISEG inspections have been acted upon by local management.

The inspectors find the ISEG contribution to safe, reliable plant and engineering operation to be effective in providing an independent focus on plant operation from which management can adjust its resources toward resolution of plant operation and engineering problems.

2.3 Modification Design, Review, and Implementation

Limerick has several levels of modifications to control changes to the plant. The inspectors reviewed three of these types in various stages of completion. The reviewed modifications included one design equivalent change (DEC), one small modification, and two major modifications.

The normal method for initiating a modification is through the engineering change request (ECR) process, PECO Nuclear Engineering Procedure MOD-C-9, "Control and Processing of Engineering Change Requests." Some modifications may be initiated through an action request (AR), which is subsequently converted to an ECR. After engineering has decided to support the modification, a station modification management group I (SMMG I) screening package is created. This package includes a definition of the problem, assessment of alternatives, a proposed solution, cost of the modification, and a cost/benefit analysis (IMP). SMMG I is an interdisciplinary group of predominantly site personnel and includes members from engineering, operations, and other areas. SMMG I classifies the modification process level.

The three types of modifications inspected were DEC, small modifications, and major modifications. If the change may be accomplished by a procedure limited in scope, and is a permanent change to a system, structure, or component that does not change the plant design described in the updated final safety analysis report or technical specifications, it will be processed as a DEC. DECs are limited to the replacement of parts that are not identical to existing plant equipment, but perform the same function.

If a requested modification is not a DEC and SMMG believes the change will involve little risk, it may be processed as a small modification. Small modifications typically involve minimal cost, limited engineering interfaces, and a short duration to completion. Both small modifications and DECs are led by onsite engineering with minimal corporate engineering involvement.

Major modifications involve substantial cost and scheduling risk, include significant corporate engineering interfaces, and require major field work and testing activities. All major modifications require an evaluation of possible alternatives and a project plan, neither of which is required for DECs or small modifications. The lead responsible engineer for major modifications is in corporate engineering, with site engineering providing necessary support. The two engineering organizations work closely throughout the major modification process.

Prior to January 1993, the modification process was tracked and controlled manually, following Limerick Administrative Procedure A-14, "Procedure for Control of Plant Modifications." The licensee's MOD-C procedures, which are common to Limerick and Peach Bottom, have been in effect since January 1993 to control the modification process. Concurrent with the procedure conversion, a more integrated approach is used with an electronic system of tracking through the plant information management system (PIMS). The licensee incorporates the design modification data into PIMS, allowing easy access to material procurement, work planning, and task tracking information. The inspectors reviewed modifications governed by both methods, and found the procedures to be comprehensive and well understood by plant personnel.

2.3.1 Modification of Residual Heat Removal Service Water (RHRSW) Isolation Valves - Major Modification 6194

The inspectors reviewed a modification package to install manual isolation valves on the RHRSW supply and discharge lines to the "A" and "B" RHR heat exchangers in both units. This modification was initiated as a result of findings made by the licensee's raw water task force. (This project is described in NRC Inspection Reports 50-352/93-20 and 50-353/93-20.) The modification involved installation of manual isolation valves to isolate large runs of RHRSW supply, discharge header piping, and permit throttle valve and heat exchanger maintenance without the use of freeze seals. The location of the isolation valves also allows the RHR, not being maintained, to remain operable. This modification was performed on both units during the Unit 1 refueling outage in early 1994.

Because the "A" loop and "B" loop of RHRSW were inoperable in series during the modification installation for a longer period than allowed by the technical specifications (TS) of the operating plant (Unit 2), a temporary change to the TS was requested. The inspectors reviewed the associated 50.59 evaluation and found it to be comprehensive and complete. The inspectors reviewed portions of the modification package including the project plan, design input document (DID), 50.59 evaluation, and completed modification acceptance tests (MAT). The inspectors also conducted a tour of the installed modification in the plant with the system manager.

This was a major modification and was governed by the A-14 procedure mentioned in Section 2.3 of this report. The inspectors found the system manager responsible for RHRSW to be familiar with the modification process, A-14 procedure, and knowledgeable of the technical aspects of the modification. All documents reviewed were thorough and showed good safety perspective.

2.3.2 Emergency Service Water (ESW) Isolation Valves - Major Modification P-000589

The purpose of this modification is to install 19 manual isolation valves on selected ESW supply and return branch lines. The licensee found corrosion of piping, resulting in wall thinning, and flow obstruction in areas of the ESW. Without this modification, major supply headers require isolation to permit repairs of much of the system piping. This could result in forced shutdowns due to the TS requirements for components cooled by ESW. These manual isolation valves will allow the licensee to isolate core spray, RHR, high pressure coolant injection, and main control room chillers on an individual basis without affecting other parts of the ESW system. This modification, recommended by the LGS raw water task force, was performed on Unit 1 during the outage in early 1994. Unit 2 will be modified in early 1995.

The inspectors discussed this modification with the responsible system manager and reviewed the conceptual design package, design input document, associated 50.59 review, UFSAR change request, and completed modification acceptance testing packages for Unit 1. The documents were found to be comprehensive and complete.

This was a major modification and was controlled by MOD-C procedures. The system manager was familiar with the associated process, and demonstrated proficiency in using the PIMS system to effectively track the activities associated with the modification. The inspectors noted good interfacing between the onsite system engineer and the NED engineer in charge of the modification from Chesterbrook.

2.3.3 Power Rerate Feedwater Heater Drain Valve Modification - DEC P-000317

Studies by the licensee of the feedwater system revealed that, under operating conditions resulting from the 105% power rerate program, the fifth stage feedwater heater drain valves will not be adequate to handle the drain flow. The licensee gave consideration to several maximum flow capacity actions, including replacement with greater capacity valves, changing the valve cage internals with a cage, allowing greater flow capacity, or continuing operation with the same valve with dump valves partially open and accepting the deleterious effect on thermal performance.

A cost benefit analysis by the licensee revealed the change in internals to be the optimal change required. The inspectors reviewed the cost benefit analysis, 10 CFR 50.59 determination, and the action request for implementation of the modification. The inspectors found the responsible engineer to be familiar with the DEC implementation process and the technical aspects of the DEC. The licensee effectively evaluated the proposed DEC and provided for a well founded technical recommendation.

2.3.4 LPCI Valve Pressure Locking Mitigation Modification - P-000260

A generic problem reported in the nuclear power generation industry has been that of wedge binding due to pressure locking. Pressure locking is the result of high pressure fluid entrapment in the valve body bonnet when the valve is in a closed position. Under this condition, the valve motor drive may not have sufficient power to overcome the binding friction forces developed by the pressure differential across the disk. The licensee evaluation of this problem for safety-related gate valves indicated susceptibility of LPCI valves HV-051-1F017A and C to this problem.

On the basis of the licensee's evaluation, a modification was initiated to provide for a vent path from the valve bonnet area to the vessel side piping of the valve, thereby ensuring bonnet area depressurization following a loss of coolant accident event.

The inspectors reviewed the action request, design input documents, and the 10 CFR 50.59 safety evaluation, and found them to be well written and comprehensively covering the modification. The system manager demonstrated good knowledge of the technical aspects of the modification implementation.

2.3.5 Recirculation Pump Shaft Cracking Small Modification P-00206

In view of nuclear industry experience with recirculation pump shaft cracking in the thermal barrier region of the mechanical seal, General Electric Company and the BWR owner's group had shown concern for the recirculation pump cracking on BWR 2, 3, and 6 and on PWR applications. As a result of this concern, although having no shaft cracking history at LGS, LGS began an initiative to develop a pump shaft monitoring system to monitor pump shaft vibration such that shaft cracking could be detected in advance of any shaft failure.

Through discussion with the component engineer having responsibility for the modification, review of the SMMG 1 Screening Package M0016707, and review of plant data from GE Nuclear Energy, the inspectors noted the proactive nature of the licensee's pump shaft vibration monitoring to preclude the possibility of shaft failure, due to crack propagation. The responsible engineer demonstrated considerable depth of understanding of the technical issue.

2.3.6 Reactor Water Level Instrumentation Backfill System - Major Modification P-00132

This modification provides for continuous purging of the reference legs to prevent water containing high levels of noncondensible gases moving from the condensing chamber into the reference legs. This will eliminate the formation of gas bubbles leading to inaccuracies in the water level indication during depressurization of the reactor vessel. The issue was discussed in Information Notice 92-54, Generic Letter 92-04, Information Notice 93-27, and NRC Bulletin 93-03.

The inspector met in Chesterbrook with NED engineering and licensing personnel, and engineers from the contractor of choice (COC) responsible for fatigue evaluation of the system affected by the modification. The system manager of the modified system stated that LGS had operated at temperature levels and flow velocities within the recommendations of the reactor vendor, and presumed no problem would exist with fatigue of reference systems components.

Since the fatigue problem is a generic one, the reactor vendor has issued a report showing the fatigue evaluation approach to assessing the lifetime fatigue damage to the reactor water level instrumentation system with the backfill feature (GENE-637-019-0893). The analysis consisted of heat transfer, fluid flow, and stress calculations to determine the cyclic strain range for each significant operating condition. The fatigue usage was determined in accordance with the design analysis approach found in Section III of the ASME boiler and pressure vessel code.

Since the condensing chamber designs vary from plant to plant, it is necessary to evaluate the lifetime fatigue damage for each specific design. However, there are two types of fatigue possible in the back fill system: high and low cycle fatigue. High cycle fatigue occurs due to the oscillation of fluid in the reference pipe system, running only partially full. In this case, cold water touches the otherwise heated pipe and an oscillating thermal stress is developed. A large number of thermal stress cycles can be developed over short operating periods. The level of this stress must be kept below the material endurance limit stress such that fatigue failure will not occur. Low cycle fatigue results from slow changes in thermal stress moving from one steady state thermal stress distribution to another. These stresses are typically higher, but can experience fewer cycles at the higher levels before fatigue failure.

The inspector reviewed the status of fatigue calculations performed by the COC and found that they had determined that flow rates below 45 lbm/hr np fatigue failure would occur below 45 lbs./hr. Since the temperature differential between the pipe wall and the oscillating fluid would be less than 50°F, there is no concern for fatigue failure at the estimated flow rate of approximately 4 lbs./hr.

The COC is presently determining the estimated fatigue usage before the end of licensed life due to low cycle. Since the rate of application of this type of fatigue mechanism is low, there is less urgency in evaluating the low cycle fatigue stress. The results of this analysis will be reviewed by the NRC in a later inspection report during this cycle.

The inspector found the analytic techniques utilized to evaluate the high and low cyclic stresses for fatigue evaluation to be appropriate and comprehensive. The 10 CFR 50.59 safety evaluation for this modification was detailed and comprehensive. It provided a thermal stress resolution plan to be followed in precluding fatigue failure of the backfill modification hardware.

3.0 SUMMARY OF CONCLUSIONS

(1) The LGS post-NEEDS site engineering organization is an effective, compact engineering organization with an optimal number of management personnel dedicated to satisfaction of organizationally consistent objectives. The responsibilities, goals, and objectives provide for an effective management system of oversight.

(2) LGS has a unique self-assessment program that is effective in identifying problem areas and giving emphasis to areas where positive results are obtained.

(3) The ISEG provides an effective, independent focus on plant operation from which management can adjust its resources toward resolution of plant operation and engineering problems.

(4) LGS system management provides for effective implementation of modifications at a high quality level. The system managers are knowledgeable in the technological basis for the modifications and the procedural system necessary to implement the modifications.

4.0 MANAGEMENT MEETINGS

Licensee management was informed of the scope and purpose of the inspection at the beginning of the inspection. The findings of the inspection were discussed with the licensee management at the June 13, 1994, exit meeting, and at the supplementary meeting on June 15, 1994. See Attachment 1 for a list of attendees.

Attachment: Persons Contacted

ATTACHMENT 1

Persons Contacted

Philadelphia Electric Company

	T. Bell	CRD System Manager
	J. Cornell	PECO Engineer - Chesterbrook
*	M. C. Gallagher	Senior Manager - Plant Engineering
	B. Galunic	MGSR - United Engineering & Construction
*	J. Hufnagel	Manager - ISEG
*	J. Krais	Manager - Design Engineering
	T. P. Mundy	Engineer - ISEG
*	J. A. Muntz	Director - Site Engineering
*	J. O'Rourke	Senior Manager - Design Engineering
	G. Reid	Manager - BOP Engineering - Chesterbrook
	K. Selby	Engineer - Experience Assessment
	L. R. Scott	SDE United Engineering & Construction
*	G. Stewart	Engineer - Experience Assessment
*	G. Schweizer	Manager - Component Engineering
*	R. Selverian	Manager - Performance and Reliability
*	K. Walsh	Manager - Reactor Engineering

U. S. Nuclear Regulatory Commission

*	T. A. Easlick	Resident Inspector
*	M. C. Modes	Chief, Materials Section

* Denotes those present at the exit meeting.