BROOKHAVEN NATIONAL LABORATORY

TECHNICAL REVIEW REPORT

DATES OF INSPECTION: August 27-31, 1984

ORGANIZATION: Limerick Generating Station (LGS)

LICENSEE: Philadelphia Electric Company (PECo)

LOCATION: Limerick, PA

BNL TECHNICAL SPECIALIST:

J. C. Higgins	9/13/84 (Date)
S. M. Wong	9/14/84 (Date)

1. Personnel Contacted

The following persons were contacted during the on-site review of the LGS Emergency Service Water (ESW) System:

W. Borchardt	Reactor Engineer	USNRC
J. Chung	Technical Assistant	USNRC
A. Diederich	Supervisor, Mech. Engr.	PECo
J. Doering	Operations Engineer	PECo
D. Helwig	Supervisor, Mech. Engr.	PECo
L. Hopkins	Performance Engineer	PECo
W. Kirschner	Asst. Project Startup Engr.	Bechtel
G. Leitch	Plant Superintendent	PECo
C. Lucha	Startup Engineer	Bechtel
S. Lynch	Deputy Resident Project Engr.	Bechtel
K. Meck	Quality Assurance Engineer	PECo
K. Murphy	Technical Assistant	USNRC
J. Spencer	Startup Director	PECo
L. White	Startup Group Supervisor	Bechtel
C. Wiedersum	Mechanical Engineer	PECo
J. Wiggins	Senior Resident Inspector	USNRC

2. Documents Reviewed

The following materials or documents were reviewed:

(1) Limerick Final Safety Analysis Report (FSAR), Rev. 34

(2) Limerick Probabilistic Risk Assessment (PRA)

(3) Proof & Review Edition of Limerick Technical Specifications (Tech. Specs.), 8/3/84

(4) Emergency Service Water (ESW) System Description

(5) Off-Normal, Operational Transients, and Trip Procedures

(6) Limerick Response Package for NRC Bulletin 80-06

(7) Limerick Safety Evaluation Report

(8) IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations"

(9) IEEE Standard 379-1972, "IEEE Trial-Use Guide for the Application of the Single-Failure Criterion to Nuclear Power Generating Station Protection Systems"

(10) Procedures S11.8.A, B, C: Alternate Cooling of Reactor Enclosure Cooling Water (RECW) Heat Exchangers, Turbine Enclosure Cooling Water (TECW) Heat Exchanger, and Reactor Recirculation Pump Seal/Motor Coolers.

(12) Flow Balance Procedure: ESW, 1FB54.1-0

(13) Preoperational Test Procedure: ESW System, 1P-54.1

(14) Surveillance Test: ST-1-011-490-1, Rev. 0; ESW Valve Leakage Test
ST-6-011-451-0, Rev. 0; "A" Loop ESW Lineup Verification
ST-6-011-401-0, Rev. 0; "A" Loop ESW Valves Automatic Actuation Test
ST-6-011-231-0, Rev. 0 & Rev. 1; "A" Loop ESW Pump, Valve & Flow Test

(15) Limerick Tech. Specs. Improvement Study

(16) Peach Bottom Tech. Specs.

(17) BWR Standard Tech. Specs.

(18) Piping & Instrumentation Diagrams: M-10, Normal Service Water (NSW)
M-11, Emergency Service Water (ESW)
M-12, RHR Service Water (RHR SW)

(19) Startup Field Report: 54A-22 & 54A-25, Emergency Service Water

(20) Startup-Test Change Notice: 1-12, Emergency Service Water

(21) Startup-Test Exception Log: Emergency Service Water

(22) Safety Evaluation Report (SER) for LGS

3. Scope

During this review of the Emergency Service Water System the following areas and items were addressed:

1. Preoperational Testing - including test procedures review, witnessing of system operation, and test results evaluation.

2. System Hardware Review - including a system walkdown and a review and evaluation of pumps, valves, piping, control room annunicators, controls, and indications, Remote Shutdown Panel controls and indications, electrical supplies, spray pond, and cross-connects to other systems (NSW, RHR SW, TECW, RECW, and the Spent Fuel Pool).

3. Operating Procedures Review - including system operations procedures, surveillance test procedures, inservice testing procedures, proposed tech specs, and alarm response procedures.

4. Review of the above items against the major ESW system failure modes identified in the PRA to determine the extent that these failure modes have been minimized.

4. Plant Tour

During the system review a tour was made of the ESW system in order to determine equipment and plant conditions. The following areas were observed: Control Room, Remote Shutdown Room, Auxiliary Equipment Room, RHR Pump Rooms, Core Spray Rooms, Reactor Core Isolation Cooling (RCIC) Room, Spray Pond Pump House, Spray Pond, Pipe Tunnels, and ESW Valve Areas. With the exception of items previously identified by the licensee, equipment appeared to be in good condition. Overall plant condition appeared appropriate for the stage of construction with the exception of the control room cabinets which had an excessive amount of debris including paper, loose fuses, fires stop material, old tie wraps, coils of cable, and loose pieces of metal. The licensee cleaned the ESW cabinets prior to the completion of the inspection.

5. Control Boards

The review of the ESW System included an evaluation of the control room and remote shutdown panel control boards to determine their conformance with commitments made in the FSAR, their compatibility with procedures, and their overall effectiveness for safe system operation. The panels appeared reasonably configured and labeled for safe operation despite their lack of an ESW system mimic on the panel. The annunciator panels were reviewed and comments are in paragraph 8 on procedures. The inside of system cabinets were observed. No lifted leads were identified without proper control tags. One loose untaped spare lead was identified in the Remote Shutdown Panel. The licensee taped it promptly. One meter (FID-11-012A) was noted with confusing positive and negative scales. The meter measures differential ESW flow to give an indication of a system pipe break. Control Room operators did not know which end of the scale represented a loss of water. The licensee evaluated this and corrected the situation with red tape on the gage face to indicate that position of the positive scale which corresponded to an unsafe situation (namely a pipe break). Finally, panel mounted gage calibration was reviewed and it was noted that some meters had calibrations over a year old. Upon questioning, it was determined that the licensee had not yet finalized a program, to determine instruments that must be recalibrated prior to fuel load.

6. System Design

The actual ESW system design as installed in the plant and as described in system operating and test procedures, and plant P&ID's was compared with the design of the FSAR, PRA, SER and pertinent industry standards listed in paragraph 2. With the exception of the below items no discrepancies or unsafe conditions were identified.

The ESW system consists of 2 loops, each with 2 pumps and is normally in standby. The ESW pumps are actuated in the event of a loss of offsite power or a loss of coolant accident via signals from the diesel generators and the emergency busses. All automatic ESW system valves are in turn actuated by contacts off the ESW pump breakers. That is, the actuation signal for the system's valves is the ESW pump start. There are four ESW pumps (A, B, C and D) and four corresponding divisions of automatic valves which realign the system to its safety configuration. If the A ESW pump were to trip (opening the pump breaker

and removing the valve actuation signal) all of the A division valves automatically realign to their non-safety position. This reduces the valving redundancy in the A loop although it does not incapacitate the loop. This design arrangement also appears contrary to both IEEE-279 (1971), paragraph 4.16 and the guidance of NRC Bulletin 80-06, "ESF Reset Controls". Specifically; item 2 of the Bulletin specifies that all equipment should remain in its emergency mode upon removal of the actuating signal; and paragraph 4.16 of IEEE-279 states that return to operation (of the protection system) shall require subsequent deliberate operator action.

The ESW pumps are located in the Spray Pond Pump House in the Wet Pit, which is supplied with water from the cooling towers or directly from the spray pond. The spray pond is the seismic, safety related water source. Water is delivered from the cooling towers through valves and from the spray pond through motor-operated sluice gates. The control room operator is provided with a low level alarm sensing spray pond level, however, there is no level instrument or alarm sensing Wet Pit level. If the wet pit were isolated from the cooling towers and spray pond (there have been sluice gate failures during preoperational testing), then the operator would have no warning, prior to the ESW pumps failing to pump due to low suction pressure. Additionally, with about 41,000 gallons in one wet pit and an average ESW loop flow of about 2900 gpm (or even less if flow to room coolers is not needed due to cool temperatures) during Unit 1 operation, the operator would have sufficient time to react to a low level alarm. Thus although not a regulatory requirement, it appears that a wet pit level detector and alarm could be a prudent addition to the ESW/RHRSW systems.

7. Preoperational Testing

The preoperational test program for the Emergency Service Water (ESW) system was reviewed to ensure that proper operation of the system has been demonstrated. The objectives of this review included verification and assessment of licensee activities associated with the demonstration of:

1. ESW system capability to automatically supply cooling water to essential safeguards equipment; and

2. The ability of system controls to function properly in the automatic mode and by actuation from the control room or the remote shutdown panel.

Based on the audit of ESW loop A components in Preoperational Test Procedure 1P-54.1, Rev. 0, documenting the performance of the ESW system from 7/6/84 through 7/16/84, no discrepancies were identified with the exception of the following items:

1. The closing times for Diesel Generator (D.G.) ESW Outlet valves (HV-11-132A, HV-11-132B, HV-11-132C, HV-11-132D, HV-11-134A, HV-11-134B, HV-11-134V, HV-11-134D) exceeded the maximum by 8-15%. Also, the closing times for TECW motor-operated valves (HV-11-107, HV-11-105, HV-12-110) exceeded the maximum by 43-56%. The opening times for the same valves exceeded the maximum by 50%.

2. There was no functional testing (stroking, cycling, or leak rate testing) of system check valves documented during the preoperational tests. Also there was no cycling documented for manual valve 1006, a main header stop valve.

3. The pump discharge flowrates were demonstrated to be 3900 gpm, 2700 gpm, 3000 gpm and 2900 gpm for pumps 0AP548, 0BP548, 0CP548 and 0DP548 respectively. These flowrates are lower than the design flowrate of 6400 gpm for each pump. The full capacity requirements for supply to 4 D.G.'s and ESW loop-A equipment exceeds 4000 gpm for unit 1 operation and is considerably higher if two unit operation or supply to non-essential components is considered.

Licensee Response:

In the case of item 1, the excessive stroke times for the valves in concern appear to be system specific. This matter is being addressed by PECo/Bechtel engineering staff as documented by Startup Field Reports. For item 2, system check valves will be tested as part of Limerick In-service Inspection Program. The licensee's representative stated that they would consider running this test for the check valves prior to fuel load. In the case of item 3, PECo/Bechtel Startup Group at Limerick will write a procedure and perform a test to demonstrate the full-load capability of the system, and/or establish the limits of cooling supply requirements for different flowpaths. This test should be performed for each pump using conservative loads and the most restrictive flowpaths.

8. System Operation

The plans for ESW system operation as outlined in plant procedures and training documents were reviewed. Specific findings follow.

During a review of the PRA and system P&ID's, a number of valves and control room hand switches were identified as being locked. It was determined that the program for lock/key control for control room handswitches was not finalized and that system valve lineup check-off-lists did not fully reflect the valve locking commitments.

The licensee uses Annunciator Response Cards (ARCs) to describe control room alarms/annunciators and to specify operator action in response to these. The ARCs being used in the control room for the ESW system were reviewed for technical adequacy and a number of errors and omissions were identified. The licensee stated that those ARCs had not yet been formally approved. During the week, the ESW ARCs were rewritten, reviewed, and approved to address the identified concerns. Other system ARCs are scheduled for review and approval prior to fuel load. One item of particular concern in a number of cases, in the ARCs, was the lack of alarm setpoints as committed to in Chapter 13 of the FSAR.

During the review of the operating procedures it was noted that there were no off-normal procedures for the ESW system to address potential situations such as realignment on loss of an ESW loop or use of normal service water on failure of the ESW system. It was also noted that the potential exists to supply any Diesel Generator (D.G.) with ESW from either or both ESW loops. If a D.G. were

aligned to both loops simultaneously, a single failure at a D.G. could fail both ESW loops. There were no interlocks or procedural precautions to prevent this line-up. After this was identified during the week, the licensee had permanent signs made up and installed on the control board to warn against this line-up.

During a review of the Draft Technical Specifications for ESW it was noted that allowable ESW pump outage times appeared excessive as compared with BWR Standard Tech Specs and with outage times assumed in the Limerick PRA. The licensee stated that the ESW system is one system with four pumps designed to serve both units at Limerick. However, all four pumps are installed and are to be available to serve only Unit 1 during the period before Unit 2 is to be operated. Thus due to this extra equipment, the Tech Spec outage times were increased. In light of this method of drafting the Unit 1 Tech Specs for shared Unit 1 - Unit 2 systems, it appears that a thorough review of Limerick Unit 1 Tech Specs for shared systems will be required before Unit 2 becomes operational.

9. Surveillance Testing

The ESW system surveillance testing, planned for implementation once the plant is operational, was reviewed. Surveillance procedures for Technical Specifications and Inservice Testing per the ASME Code, Section XI were reviewed. With the exception of the below items, which were corrected during the review, no discrepancies were identified.

Procedure ST-6-011-231, Rev. 0, "Pump, Valve, and Flow Test" had three discrepancies:

1. Step 6.5.4 in the procedure called for a pump flow of 3000 gpm, while step 6.5.4 in the data sheet called for 2600 gpm.

2. Check valves number 1011, 0064A, and 0065A were not tested.

3. The procedure used visual observation of the check valve manual operation levers to verify proper check valve stroking. However, discussions with the system startup engineer during the system walkdown disclosed that the levers do not move as the valves stroke.

The procedure was revised and re-approved to correct these problems.

10. Summary of Findings

10.1 Open Findings

Below are listed in summary fashion the items identified which were not resolved during the review.

1. Dirt and debris in control room cabinets (para. 4)
2. Recalibration of panel-mounted instruments (para. 5)
3. Automatic return of ESW valves to non-safety position (para. 6)
4. Lack of level detector/alarm for Wet Pit (para. 6)
5. Ability of one ESW pump to provide design flow rate (para. 7)

6. No preoperational test of ESW check valves (para. 7)
7. Setpoints not included in all Annunciator Response Cards (para. 8)
8. No off-normal procedures for ESW (para. 8)
9. Program for locked valves and control room keylocked handswitches (para. 8)
10. Technical Specification Outage time review for shared systems (para. 8)

10.2 Resolved Findings

Below are listed in summary fashion the items identified which were corrected during the review.

1. Loose bare lead in Remote Shutdown Panel (para. 5)
2. Confusing control room indicator (para. 5)
3. Precaution for D.G. supply from both ESW loops (para. 8)
4. Discrepancies in ESW Surveillance Test Procedure (para. 9)