PP&L Pennsylvania Power & Light Company
Two North Ninth Street • Allentown, PA 18101 • 215 / 770-5151

Bruce D. Kenyon
Vice President-Nuclear Operations
215 / 770-4378

August 27, 1982

Mr. R. C. Haynes
Regional Administrator, Region I
U.S. Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, PA 19406

SUSQUEHANNA STEAM ELECTRIC STATION
SECOND INTERIM REPORT OF A DEFICIENCY INVOLVING
EMERGENCY SERVICE WATER (ESW) SYSTEM WATER HAMMER
PLA-1258 FILE 821-10

Reference PLA-1129

Dear Mr. Haynes:

This letter serves to provide the Commission with a second interim report on the deficiency involving Water Hammer in the ESW System.

This condition was identified as "Potentially Reportable" to Mr. S. Ebneter of NRC Region I by Mr. A. R. Sabol of PP&L during a telephone conversation on May 5, 1982. The reference PLA-1129 provided the Commission with an interim report which concluded that the subject deficiency was reportable under the provisions of 10CFR50.55(e).

The attachment to this letter contains a description of the deficiency, it's cause, safety impact and corrective actions taken and planned.

A final report on the deficiency is anticipated to be provided on March, 1983.

We trust the Commission will find this report to be satisfactory.

Very truly yours,

W W Curtis for

B. D. Kenyon
Vice President-Nuclear Operations

IE27

BMS/JS/dmm

Attachment

cc: Mr. Richard C. DeYoung (15)
Director-Office of Inspection & Enforcement
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Mr. G. McDonald, Director
Office of Management Information & Program Control
U.S. Nuclear Regulatory Commission
P. O. Box 52
Shickshinny, PA 18655

Mr. Gary Rhoads
U.S. Nuclear Regulatory Commission
P. O. Box 52
Shickshinny, PA 18655

Mr. R. Perch
Project Manager
U.S. Nuclear Regulatory Commission
Washington, DC 20555

SUSQUEHANNA STEAM ELECTRIC STATION
UNIT 1 AND COMMON
SECOND INTERIM REPORT

WATER HAMMER IN THE EMERGENCY SERVICE WATER SYSTEM

PURPOSE

This Report supplements our previous Interim Report transmitted in our letter PLA-1129; dated June 18, 1982.

DESCRIPTION OF DEFICIENCY

During preoperational testing at Susquehanna Steam Electric Station, water hammer occurred in the ESW System, which resulted in damage to three pipe hangers. An investigation into the cause of the hanger failures revealed that there are certain operating and test conditions under which the ESW system could be subjected to water hammer.

The water hammer occurs as a result of the following sequence of events:

(1) ESW System in operation-ESW pumps are on and the 36" Motor Operated Bypass Valves to the spray pond are open.

(2) Loss of Offsite Power (LOOP) occurs-ESW pumps trip; 36" MOVs remain open; ESW piping begins to drain down to spray pond.

(3) Power supply transfers from offsite source to onsite emergency diesel generators.

(4) Approximately 10 seconds after the diesel generators start the 36" bypass valves begin to close. The ESW System continues to drain down to the spray pond during the nominal 30 second closure time of the valves.

(5) 55 seconds after the start of the diesel generators the ESW pumps restart simultaneously.

The restart of the ESW pumps causes water to be accelerated through partially emptied ESW piping, resulting in water hammer. It has also been determined that the potential for water hammer exists on ESW (loop A only) due to an inadequate 1" keep fill cross tie with service water. This has been corrected by a change to a 4" crosstee and verified by test.

As a result of the above-described events, the potential exists for the ESW System to experience stresses which exceed the design allowables during a water hammer event.

CAUSE

Non-simultaneous LOCA/LOOP was not a design basis for the plant.

CORRECTIVE ACTION BEING TAKEN:

Three design change packages (DCP) have been issued and are scheduled for implementation prior to 5% power:

(1) DCP 82-346A. Motorization of ESW Pump Discharge Valves.

This DCP adds motor operators to each of the four 18" ESW pump discharge valves. These valves were previously manual only and locked in the open position. This change will allow the valves to throttle the initial flow from the ESW pumps thus mitigating the water hammer event. The control of these motor operators will be automated for maximum mitigation of water hammer event, however, local manual operability will be maintained.

(2) DCP 82-346B. Staggered Start of ESW Pumps.

This DCP staggers the start of the second pump in each loop of ESW by approximately 30 seconds. The pumps previously started simultaneously. This change coupled with the throttling of the pump discharge further mitigates system water hammer through a more gradual filling of the system.

(3) DCP 82-346C. Logic Change of 6" Control Structure Chiller Discharge Valves to Continuously Open.

This DCP changes the logic of the two 6" discharge valves so that they remain continuously open. These valves previously opened when the emergency condenser water circulating pumps started and closed when the emergency condenser water circulating pumps stopped. The former logic left these valves closed for the start of the ESW pumps thus increasing the severity of the water hammer event. The DCP logic change will allow these valves to remain open for the start of the ESW pumps thus mitigating the water hammer event.

(4) PRE-MODIFICATION TEST and SYSTEM ANALYSIS

A test was conducted on the "A" loop of the ESW System to simulate the dynamic flow conditions that will result from the events described previously, after the implementation of the modifications. Strain gages mounted on the piping indicated that piping stresses were within allowables. Additionally visual inspection indicated that the hangers were not subjected to stresses which exceeded their design yield values.

Preliminary analytical extrapolation of piping stresses to hanger stresses indicates that, on a theoretical basis, a significant number of anchor bolts exceed our specification allowable ($\sim$ 30). This analytical work is currently being refined and finalized. These preliminary analytical results appear to be conservative and are not supported by the conditions observed in the field, namely, that no actual stress condition was evident during or following the test, which exceeded the materials yield strength.

(5) VERIFICATION TESTS

Prior to 5% power, testing will be performed to ensure that expected results are achieved and that the modification does not reduce safety of operation.

(6) FUTURE ACTIONS

a. SHORT TERM - 5% POWER

The three DCPs discussed previously will be implemented and tested as described prior to reaching 5% thermal power.

b. INTERMEDIATE TERM - 5% POWER THROUGH 1st REFUELING

In light of the positive empirical results obtained from the test simulating, the modified system and the low probability of the system even being subjected to a water hammer event, the ESW system is considered capable of performing its design intent.

c. LONG TERM - 1st REFUELING and AFTER

PP&L is committed to demonstrating that all piping, hanger and anchor bolt loadings for this postulated abnormal event are within code and NRC allowables either by refinement of analysis, modification, or additional testing prior to startup following the first refueling outage.