U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report Nos. 50-387/88-15; 50-388/88-18

Docket Nos. 50-387; 50-388

License Nos. NPF-14; NPF-22

Licensee: Pennsylvania Power and Light Company
2 North Ninth Street
Allentown, Pennsylvania 18101

Facility Name: Susquehanna Steam Electric Station

Inspection At: Salem Township, Pennsylvania

Inspection Conducted: July 27, 1988 - August 4, 1988

Inspectors: F. Young, Senior Resident Inspector, SSES
J. Stair, Resident Inspector, SSES

Approved By: _____ 8/15/88
A. R. Blough, Chief Date
Reactor Projects Section No. 3B
Division of Reactor Projects

Inspection Summary: Combined Inspection Report No. 50-387/88-15 and 50-388/88-18 on July 27 - August 4, 1988

Areas Inspected: Special resident inspection (NRC Inspection Module 92700) associated with the operability of Susquehanna Steam Electric Station Units 1 & 2 Main Steam Tunnel differential temperature (delta T) isolation modules.

Results: This special inspection confirmed the licensee's determination that the plant had been operating with all eight (four per plant) Main Steam Tunnel delta T isolation modules miswired, rendering their isolation function inoperable. As configured, the automatic isolation of the main steam system from delta T signals during a small line break would not have occurred. Not having this isolation trip functional when the plant is in Modes 1, 2 and 3 is an apparent violation of Technical Specifications Limiting Conditions for Operation. Additionally, for Unit 2, the actual location of the thermocouples used to generate the delta T signal was noted to be different than the commitments in FSAR. The operability of the delta T isolation modules in Unit 2, independent of the miswiring problem, is thus in question and is considered an unresolved item.

Licensee investigations and corrective actions were still in progress at the end of the inspection. Inspector concerns about related administrative controls and compliance with regulations and licensee commitments for other portions of the primary containment isolation system were discussed with licensee senior management.

8808260409 880818
PDR ADOCK 05000387
Q PDC

TABLE OF CONTENTS

DETAILS

1. Introduction and Overview

On July 27, 1988, the NRC was informed of the discovery by the licensee that all eight of the Main Steam Tunnel differential temperature (delta T) modules (four per unit) were miswired rendering their associated isolation function inoperable. This left only the Main Steam Tunnel high temperature isolation modules in place to isolate the main steam system in event of a small line break in the reactor building portion of the steam tunnel. This condition appears to have existed since the initial startup of each plant. The Main Steam Tunnel delta T modules are required by Technical Specifications to be operable when the plants are in hot shutdown, hot standby and power operation.

The purpose of this inspection is to determine:

- -- the safety significance of the issue;
- -- whether the plant was operated in accordance with Technical Specifications;
- -- if plant conditions reflect the original plant design basis;
- -- why preoperational, startup and surveillance testing did not previously identify this problem.

2. System Description/Physical Arrangement and Requirements

2.1 Primary Containment Isolation System

As stated in FSAR Section 7.3.1.1.a.2.1, the purpose of the Primary Containment Isolation System (PCIS) is to prevent the release of radioactive materials in excess of specified limits through the reactor coolant pressure boundary by automatically isolating the appropriate pipelines that penetrate the primary containment. A secondary function of the system is to prevent damage to the reactor core in the event of a break in a major pipeline such as a main steam line.

The PCIS consists of the sensors, trip channels, logic circuits and valve actuating circuits necessary for automatic isolation of the primary containment and selected process lines. The basic logic arrangement is a "one out of two taken twice" logic. This arrangement requires four inputs of the parameter being used as an isolation signal. The Main Steam Leak Detection System is a portion of the PCIS which is designed to sense a main steam pipe break and isolate the break from the reactor by closing the main steam isolation valves. The Main Steam Tunnel High Temperature and Differential Temperature are two of the parameters used to close the MSIV's.

Thermocouples are used to measure the temperature and the temperature change within the steam tunnel. For Unit 1, four thermocouples (TE 10A,B,C,D) located in the air inlet ducting monitor the inlet temperature to the steam tunnel. The outlet temperature of the tunnel is sensed by four thermocouples (TE 16A, B, C, D) at the inlet plenum to the main steam tunnel cooling system coolers. For Unit 2, four thermocouples (TE 16A, B, C, D) are located in the inlet to the main steam tunnel cooling system coolers and four thermocouples (TE 10A, B, C, D) are arranged with two located within each of the two closed main steam tunnel cooling system fan cooler rooms. Within Unit 2, the calculated temperature change for the steam tunnel is derived from the differential temperature across the main steam tunnel cooling system coolers. For both units, the high temperature trip associated with the reactor building portion of the steam tunnel is derived from four thermocouples per plant located in the steam tunnel.

The temperature signals are fed to indication and trip modules ("Riley Modules") within the control room. The delta T Riley Modules calculate the temperature change and compare this to a previously analyzed setpoint. If the setpoint is exceeded, a trip signal is generated and sent to the PCIS. Testing of the system is performed at the Riley modules.

2.2 Requirements

2.2.1 Technical Specifications

Technical Specification 3.3.2, Isolation Actuation Instrumentation, requires that the channels specified in Table 3.3.2-1 be operable and their trip setpoints be consistent with the values in Table 3.3.2-2. For Main Steam Line Tunnel delta T, the Technical Specifications require that a minimum of two channels in each of the two trip systems be operable or be in at least the startup mode with the associated isolation valves closed within 6 hours or be in at least Hot Shutdown within 12 hours and Cold Shutdown within the next 24 hours.

The above mentioned Technical Specifications became effective at Unit 1 on July 17, 1982 and Unit 2 on March 23, 1984.

2.2.2 Final Safety Analysis Report

Section 7.3.1.1a.2.4.1.3 of the FSAR, Main Steam line Tunnel High Temperature and Differential Temperature addresses the licensee's commitments and system bases. The FSAR states, in general, that the purpose of this portion of the PCIS is to isolate the main steam lines and associated drains to prevent excessive loss of reactor coolant

and the release of a significant amount of radioactive material. High temperature and delta T, derived from the difference between the outlet and inlet ventilation air temperatures are indicators of a breach of a main steam line. The location of the temperature elements provide the earliest practical detection of a main steam line break. The system is designed to detect leaks equivalent to 25 gpm water.

3.0 Licensee Initial Findings and Corrective Actions

On July 27, 1988, the licensee commenced an investigation of Main Steam Line Tunnel delta T logic circuit Riley modules to determine if the system was functioning properly. The investigation was initiated in response to recent actuations of reactor water cleanup system isolations, that were sensitive to Riley Module thermal operating characteristics. This investigation revealed that the temperature modules for both units were miswired. Plant technicians confirmed this for Unit 2 at approximately 1:00 p.m. and 4:00 p.m. for Unit 1. The licensee found the two temperature elements used to generate the delta T signal to be wired backwards, thus feeding the isolation circuitry a negative signal vice a positive signal. The licensee immediately rewired the modules on both units and verified that the readings were correct. Systems in both units were declared functional by 7:00 p.m.

On July 29, the licensee's continuing review revealed that the differential temperature (delta T) elements for unit 2 were not in the location specified in the FSAR. A reanalysis of the actual plant configuration was immediately performed and an appropriate setpoint was determined. The new setpoint was 48 degrees F as compared to 98 degrees F. In order to change the setpoint without placing the plant in a condition that could easily result in an automatic plant scram, the licensee requested, from NRC Region I, a one-time relief from Technical Specifications. The relief addresssed that portion of the technical specification which specifies placing a trip system in the trip condition if the requirement for the minimum number of operable channels is not met. The basis for this request was that performance of channel calibrations on one trip system while the other trip system is in the tripped condition would dramatically increase the potential for an unwarranted MSIV closure event. NRC Region I, after consulting the Office of Nuclear Reactor Regulation (NRR), informed the licensee that NRC granted the requested relief through exercise of enforcement discretion.

The licensee is currently reviewing licensing documentation, drawings and applicable codes and standards to determine if additional similar deficiencies exist with respect to other systems. In the short term, other temperature elements associated with the primary containment isolation system were checked. At the close of this inspection no similar miswiring problem had been identified. The licensee has also formed a task group to review the event and determine long term corrective actions. Proposed long term actions include relocating Unit 2 thermocouples to a location similar to Unit 1.

4.0 NRC Review and Findings

In assessing the significance and the cause of the miswiring of the main steam tunnel delta T modules, the inspector reviewed the construction/ initial design package, startup testing and present surveillance procedures. The inspector also interviewed key plant and corporate personnel who were involved in plant construction and testing to obtain information not contained in the above documents.

Starting with the initial design the inspector reviewed the process of installing and testing this system. Based upon a review of the nuclear steam supplier (GE) design document, the inspector found that GE appeared to mistranslate the written system design description and basis into the system elementary one-line diagram. Because the same GE generic documents and drawings were used for both units, the conceptual error occurred for both units. The architect engineer (AE) using the one-line diagram, then developed the installation package which continued to reflect the error. This error appeared to reverse the function of the two temperature elements. The original design showed temperature elements (TE) 10A, 10B, 10C, and 10D (TE10's) as the inlet temperature sources and TE 16A, 16B, 16C, and 16D (TE16's) as the outlet temperature sources. The one-line diagram used the TE10's as the outlet sources and the TE16's as the inlet sources. The field installation package appears to have been developed using the written description, thus the TE10's were installed correctly as the inlet sources and the TE16's as the outlet sources. However, the actual field wiring packages reflected the one-line diagram resulting in the reverse wiring.

The inspector also noted that the locations of the thermocouples for Unit 2 were changed, apparently by the AE, with no documentation to demonstrate why the configuration was changed. Further, an analysis to demonstrate that the technical specification setpoint was consistent with the design basis was not available. The licensee was unable to provide the inspector with any supplier, AE or licensee documents that validated the technical specification setpoints associated with main steam tunnel delta T for either unit.

As part of the installation/testing, the licensee's administrative control program required a final verification of the AE work and T.S. setpoints. At the conclusion of the inspection, the licensee was unable to locate documentation associated with the verification.

A review, by the inspector, of the system startup test procedure (P 83.4A; P 283.4A) indicated that the scope of the test was too narrow to identify the miswiring problem. The test procedure required that heat be applied to the TE16s and verification made that the corresponding delta T trip signal was received at the correct value. The test did not recognize that heat was applied to the temperature element that should have been used to sense the lower temperature used in developing the delta T signal. In addition, the startup test did not require that a delta T value be determined using actual ambient conditions.

The inspector reviewed the surveillance tests (Procedure Nos. S1-183-209, S1-283-209) currently being performed on these modules. The surveillance in place basically reflects the startup test and uses the same testing methodology. The surveillance does, however, require the technician to verify that, at the completion of the surveillance, a "normal" reading is displayed. Apparently, the technician did not recognize a problem with the reading because the module (which will not register any negative valve) always read zero and this was considered to be the normal condition. Routine channel checks of the instrument are not required by the Technical Specifications.

5.0 Summary of Findings

The inspector concluded that all eight main steam tunnel delta T modules were inoperable since initial startup of each plant. This condition caused the plant to be in a condition that violated a Technical Specification Limiting Condition For Operation (LCO) 3.3.2, referenced above. This is an apparent violation (387/88-15-01; 388/88-18-01). The system in its as found configuration would not have been able to perform its intended safety function if called upon to do so. This function appears to be prescribed by the GE standard design and was incorporated into the protection system for both plants. The inspector noted that the original design incorporated a high temperature trip which is a redundant diverse trip to the delta T trip.

The inspector also determined that the configuration of Unit 2 did not reflect the design as stated in the FSAR. The inspector questioned whether the delta T modules for Unit 2, independent of the miswiring problem, could have performed their intended safety function. As of the end of the inspection, the licensee had not determined the impact of the thermocouple locations on system operability. The inspector considered this to be a unresolved item (388/88-18-02).

6.0 Exit Meeting

On August 3, 1988, the inspector summarized the findings of this inspection with senior licensee management. Inspector concerns about related administrative controls and compliance with regulations and licensee commitments for other portions of the primary containment isolation system were discussed; in particular, the concern with the apparent failure to adequately control activities which impact the operability of safety systems. Based on NRC Region I review of this report and discussions held with licensee representatives, it was determined that this report does not contain information subject to 10 CFR 2.790 information. At the conclusion, the licensee acknowledged the NRC findings and did not disagree with the findings or their initial characterization.