UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

ENCLOSURE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO GENERIC LETTER 83-28, ITEMS 3.1.1, 3.1.2, 3.2.1,

3.2.2, 4.1 AND 4.5.1

PUBLIC SERVICE ELECTRIC AND GAS COMPANY
PHILADELPHIA ELECTRIC COMPANY
DELMARVA POWER AND LIGHT COMPANY, AND
ATLANTIC CITY ELECTRIC COMPANY

SALEM NUCLEAR GENERATION STATION, UNIT NOS. 1 AND 2

DOCKET NOS. 50-272 AND 50-311

1.0 Introduction

On February 25, 1983, both of the scram circuit breakers at Unit 1 of the Salem Nuclear Power Plant failed to open upon an automatic reactor trip signal from the reactor protection system. This incident occurred during the plant startup, and the reactor was tripped manually by the operator about 30 seconds after the initiation of the automatic trip signal. The failure of the circuit breakers has been determined to be related to the sticking of the undervoltage trip attachment. Prior to this incident, on February 22, 1983, at Unit 1 of the Salem Nuclear Power Plant, an automatic trip signal was generated based on steam generator low-low level during plant startup. In this case, the reactor was tripped manually by the operator almost coincidentally with the automatic trip.

Following these incidents, on February 28, 1983, the NRC Executive Director for Operations (EDO), directed the staff to investigate and report on the generic implications of these occurrences at Unit 1 of the Salem Nuclear Power Plant. The results of the staff's inquiry into the generic implications of the Salem incidents are reported in NUREG-1000, "Generic Implications of ATWS Events at the Salem Nuclear Power Plant." As a result of this investigation, the Director, Division of Licensing, Office of Nuclear Reactor Regulation requested (by Generic Letter 83-28 dated July 8, 1983) all licensees of operating reactors, applicants for an operating license, and holders of construction permits to respond to certain generic concerns. These concerns are categorized into four areas: (1) Post-Trip Review, (2) Equipment Classification and Vendor Interface, (3) Post-Maintenance Testing, and (4) Reactor Trip System (RTS) Reliability Improvements. Within each of these areas, various specific actions were delineated.

This safety evaluation (SE) addresses the following actions of Generic Letter 83-28:

-- 3.1.1 and 3.1.2, Post Maintenance Testing (Reactor Trip System Components)

-- 3.2.1 and 3.2.2, Post Maintenance Testing (All Other Safety-Related Components)

-- 4.1, Reactor Trip System Reliability (Vendor-Related Modifications)

-- 4.5.1, Reactor Trip System Reliability (System Functional Testing)

By letters dated March 8, 14 and 23, 1983, April 7, 8 and 23, 1983; June 20, 1983; July 22, 1983 and November 7, 1983, PSE&G described their planned and completed actions regarding the above items for Salem Units 1 and 2. Subsequently, certain of these actions were reviewed during Region I inspections described in Inspection Reports 50-272/83-13, 84-03, -16 and -25 and 50-311/83-19, 84-03, -16 and -30.

2.0 Evaluation

2.1 General

Generic Letter 83-28 included various NRC staff positions regarding the specific actions to be taken by operating reactor licensees and operating license applicants. The Generic Letter 83-28 positions and discussions of licensee compliance regarding Actions 3.1.1, 3.1.2, 3.2.1, 3.2.2, 4.1 and 4.5.1 for Salem Units 1 and 2 are presented in the sections that follow.

2.2 Actions 3.1.1 and 3.1.2, Post-Maintenance Testing (Reactor Trip System Components)

Position

Licensees and applicants shall submit the results of their review of test and maintenance procedures and Technical Specifications to assure that post-maintenance operability testing of safety-related components in the reactor trip system (RTS) is required to be conducted and that the testing demonstrates that the equipment is capable of performing its safety functions before being returned to service.

Licensees and applicants shall submit the results of their check of vendor and engineering recommendations (regarding safety-related components in the RTS) to ensure that any appropriate test guidance is included in the test and maintenance procedures or the Technical Specifications, where required.

Discussion

The licensee, Public Service Electric and Gas Company (PSE&G), in a letter dated March 14, 1983, indicated satisfactorily completion of preoperational verification program which included:

-- Test of the undervoltage (U/V) trip attachment on the test circuit breaker by the manufacturer;

-- Test of U/V trip attachment installed on the reactor trip breaker in accordance with Maintenance Procedure M3Q-2; and

-- Response time test of the breaker actuated through the Solid State Protection System (SSPS), in accordance with technical department Test Procedure 1PD-18.4.002, (.005).

As a result of the evaluation of the incidents, the maintenance, surveillance and operability testing of the reactor trip and bypass breakers was augmented. The licensee's letter dated April 7, 1983, also indicated that operations, maintenance and technical department (I&C) procedures were revised to increase emphasis on quality assurance and inter-departmental interface for post-maintenance operability test activities. Operation Directive OD-10, "Removal and Return of Safety-Related Equipment to an Operable Status", was revised to incorporate Technical Specification - required surveillance testing, in-service testing and system functional testing, as appropriate, prior to putting safety-related equipment into service.

The maintenance department testing manual had also been formalized to enhance test and retest requirements prior to issuance of a work order for safety-related and other Q-listed systems and components, in accordance with Procedure A-21. In NUREG-0995, the NRC staff concluded that the testing manual was comprehensive with respect to safety-related valves and other major mechanical equipment. A staff inspection conducted during July 23-27, 1984 (Inspection Report No. 50-272/84-25 and 50-311/84-30) examined the licensee's program to review safety-related vendor manuals against pertinent operating, maintenance and surveillance procedures. This program has been fully implemented and appeared adequate. The inspection also verified that the licensee has reviewed and evaluated vendors' post-maintenance testing recommendations in order to incorporate them into plant procedures, as applicable, or to resolve any discrepancy with the existing procedure.

Implementation of the Managed Maintenance Program (MMP) has increased the dimension and volume of the Inspection Order System covering computerized scheduling of preventive maintenance and surveillance tests. This MMP program was initiated, with the support of Westinghouse Electric Corporations, to develop a comprehensive systematic preventive maintenance program. Westinghouse collected data on all safety-related components selected from the Master Equipment List (MEL) and determined the frequency and type of preventive maintenance to be performed. The licensee reviewed the Westinghouse recommended preventive maintenance for safety-related components for its completeness, adequacy and accuracy. During the staff's inspection, it was noted that the licensee had completed MMP for all safety-related components. This constituted the licensee's review of approximately 13,000 components in 41 safety-related systems, and resulted in the issuance of 9,000 Inspection Order Requests. The staff's inspection found that MMP adequately addressed the preventive maintenance activities at Salem Units 1 and 2.

The licensee revised the Maintenance Department Procedure M3Z, "Electrical Equipment Trouble-shooting" to include QA/QC inspection hold points, test/retest requirements and inter-departmental interfaces. I&C Procedure PD 14.1.001, a general equipment trouble-shooting and repair procedure was also revised to ensure completion of test or repairs and proper documentation thereof for all safety-related instrumentation. The licensee also revised and updated administrative procedure AP-9 to ensure standardization of post-maintenance operability testing throughout the station. This was verified in the staff's Inspection Reports 50-272/84-03 and 50-311/84-03.

The licensee also reviewed vendors' and engineering recommendations and the related testing procedures. Consequently, sufficient investigation and evaluation had taken place to identify corrective action and programs to preclude recurrence of a reactor trip breaker failure and to satisfy the intent of GL 83-28 items 3.1.1 and 3.1.2.

The staff's Salem ATWS Event Follow-up inspection (50-272/84-16, 50-311/84-16) reviewed the licensee's post-maintenance testing program and verified that the licensee has established:

-- Written procedures for initiating requests for post-maintenance testing;

-- Criteria and responsibilities for review and approval of post-maintenance testing;

-- Criteria and responsibilities to perform inspection of post-maintenance testing activities;

-- Methods for performing functional testing following maintenance and prior to returning to service; and

-- Requirements for adequate documentation of the above reviews, approvals, inspections and tests.

Based on the above, the staff found that the licensee has complied with the NRC staff positions for Actions 3.1.1 and 3.1.2 of Generic Letter 83-28.

2.3 Actions 3.2.1 and 3.2.2, Post-Maintenance Testing (All Other Safety Related Components)

Position

Licensees and applicants shall submit a report documenting the extending of test and maintenance procedures and Technical Specifications review to assure that post-maintenance operability testing of all safety-related equipment is required to be conducted and that the testing demonstrates that the equipment is capable of performing its safety functions before being returned to service.

Licensees and applicants shall submit the results of their check of vendor and engineering recommendations (all other safety-related components) to assure that any appropriate test guidance is included in the test and maintenance procedures or the Technical Specifications, where required.

Discussion

As stated in the letter dated April 28, 1983, the licensee identified all major equipment and instrumentation in safety-related systems in their short-term vendor manual program. The long-term program was intended to include the balance of safety-related equipment in all safety-related systems. Consequently, procedures were developed to address the control of all Q and non-Q vendor documents. This ascertained that the latest vendor supplied information was used by the plant personnel in performing any activities on safety-related equipment. The program elements consisted of controlled processing of vendor information, periodic vendor follow-up, and PSE&G conducted vendor audits. In the letter dated April 7, 1983, the licensee committed to revise departmental procedures for maintenance activities to incorporate supervisory witness and inspection hold points. Consequently, Operation Department directives OD-10 was revised. This insures that all safety-related equipment is tested in accordance with the Technical Specification requirements, as applicable, prior to declaring equipment operable.

As discussed in paragraph 2.2, the licensee reviewed vendors' and engineering recommendations and the testing procedures. Based on the review, adequate emphasis was put on quality assurance, test/retest and inter-departmental interface requirements for the reactor trip breakers as well as all safety-related equipment.

Based on the above, the staff found that the licensee has complied with the NRC staff position for Actions 3.2.1 and 3.2.2 of Generic Letter 83-28.

2.4 Action 4.1, Reactor Trip System Reliability (Vendor-Related Modifications)

Position

All vendor-recommended reactor trip breaker modifications shall be reviewed to verify that either: (1) each modification has, in fact, been implemented; or (2) a written evaluation of the technical reasons for not implementing a modification exists.

For example, the modifications recommended by Westinghouse in NCD-Elec-18 for the DB-50 breakers and a March 31, 1983 letter for the DS-416 breakers shall be implemented or a justification for not implementing shall be made available. Modifications not previously made shall be incorporated or a written evaluation shall be provided.

Discussion

The licensee incorporated certain modifications as required by the NRC Order Modifying the License, dated May 6, 1983 for both Salem Units 1 and 2 facilities, prior to heatup and startup of the respective units. The staff's Inspection Reports 50-272/83-13 and 50-311/83-19 verified that the undervoltage trip attachment to the reactor trip breaker was modified in accordance with Westinghouse recommendations per document NCD-Elec-18. The test data were reviewed and found to meet the acceptance criteria. The licensee has revised Maintenance Procedure M30-2 to require that a sealant be applied to the head of the self-locking screw on the undervoltage attachment. The procedure also required that 3 points (including the self-locking screw) be sealed and not disturbed. The inspection verified that both trip switch handles had been replaced with non-removable handles. Also, the first-out annunciator panel in both units had been modified to facilitate first-out and demand signal alarms. The licensee in the letters dated March 14 and June 7, 1984 stated that the test procedure sequence used for independent verification of the U/V and shunt trip devices' operability, in response to an automatic reactor trip signal, was identical to the WOG test procedure. The modification addressed all design considerations including seismic, environmental and physical separation.

The licensee also addressed the Technical Specification changes for Salem Units 1 and 2 relative to the inclusion of the automatic shunt trip features. The NRC recommendation to incorporate independent testing of shunt and U/V trip features into their monthly functional test procedure was evaluated. They revised reactor trip breaker operating procedures; enhanced understanding of SSPS through increased training effectiveness; instituted a MEL program for maintenance and procurement activities; revised administrative procedures to include QA review of all maintenance work orders; and initiated a vendors manual update program. The licensee's action to increase testing and evaluation of test results, update procedures, and increase the scope of maintenance provided confidence for reliable operation of the reactor trip breakers.

Based on the above, the staff found that the licensee has complied with the NRC staff position for Action 4.1 of Generic Letter 83-28.

2.5 Action 4.5.1, Reactor Trip System Reliability (System Functional Testing)

Position

On-line functional testing of the reactor trip system, including independent testing of the diverse trip features, shall be performed on all plants. The diverse trip features to be tested include the breaker undervoltage and shunt trip features on Westinghouse, B&W and CE plants; the circuitry used for power interruption with the silicon controlled rectifiers on B&W plants; and the scram pilot valve and backup scram valves (including all initiating circuitry) on GE plants.

Discussion

The licensee's letter dated April 7, 1983 stated that PSE&G has developed Maintenance Procedure M3Q-2 for inspection and testing of the reactor trip and reactor trip bypass breakers. The implementation of the procedure insures the post-maintenance mechanical and electrical integrity of the breakers, control relays, shunt and undervoltage trip attachments. The procedure incorporates a range of acceptable dropout voltages and instructions to replace any devices which fall outside the specified range. The licensee's letter dated April 28, 1983, containing PSE&G Corrective Action Report (short and long term) indicated their commitment of periodic surveillance and maintenance of the reactor trip breakers and included it in the plant Technical Specification as follows:

(i) Pre-startup (<24 hours) - Main Trip Breakers

-- functional test of U/V (via SSPS)
-- functional test of shunt (manual control)
-- functional manual scram switch (Voltmeter)

(ii) Monthly Surveillance - Main Trip Breakers

-- SSPS functional tests of U/V
-- response time testing of U/V and breaker (event recorder)
-- functional test of shunt (manual control)

(iii) Six-Month Surveillance and Maintenance - Main and Bypass Breakers

-- response time testing (three times) trending data (visicorder)
-- trip bar lift force measurement
-- U/V output force measurement
-- drop-out voltage check
-- repeat preceding tests
-- servicing/lubricating/adjustment

Earlier, in a letter dated March 14, 1983, the licensee stated that the plant maintenance procedures had been revised to include: (a) improved maintenance on both the main and bypass breakers; (b) specific actions to be taken if the acceptable tolerances are not met, and (c) specific maintenance and testing frequency. This significantly improved the licensee's capability to detect and correct reactor protection system breaker problems. Subsequently, the licensee reviewed and revised procedures and practices, as necessary, to insure that the functional testing of overall components or systems was performed to demonstrate their operability prior to returning the equipment to service following maintenance or repair. In addition, revised procedures insured that operations department personnel reviewed the testing prior to returning such equipment to service. Operations Directive OD-10 mandated that equipment functional tests be performed and appropriate parameters verified prior to returning equipment to service following maintenance.

Based on the above, the staff found that the licensee complied with the NRC staff position for Action 4.5.1 of Generic Letter 83-28.

3.0 Conclusion

Based upon the foregoing discussions, the staff concludes that the licensee has complied with Actions 3.1.1, 3.1.2, 3.2.1, 3.2.2, 4.1, and 4.5.1 of Generic Letter 83-28.

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