U. S. NUCLEAR REGULATORY COMMISSION
REGION I

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Report No:	50-309/96-10
Licensee:	Maine Yankee Atomic Power Company (MYAPC)
Facility:	Maine Yankee Nuclear Power Station
Location:	Wiscasset, Maine
Dates:	August 6-9, 1996, & August 12-22, 1996 (in-office)
Inspector:	Leonard S. Cheung, Senior Reactor Engineer Electrical Engineering Branch Division of Reactor Safety
Approved by:	William H. Ruland, Chief, Electrical Engineering Branch Division of Reactor Safety

EXECUTIVE SUMMARY

Maine Yankee Nuclear Power Station
NRC Special Inspection Report 50-309/96-10

A special inspection was conducted: (1) to review and verify the licensee's interim corrective actions and justification for continued operation after the identification of electrical equipment that could be submerged following a loss-of-coolant accident; and (2) to review the licensee's qualification documents and justification for continued operation for the primary component cooling water and the secondary component cooling water pump motors following a postulated high energy line break in the Turbine Building.

The licensee identified 30 items (mostly for post-accident monitoring) that could become fully or partially submerged about 18 minutes following a postulated loss of coolant accident. The licensee relocated 12 items to above containment flood line and provided justification for operation for the unqualified and inoperable items. The justification was reviewed and determined to be acceptable by the inspector. However, Maine Yankee had been operating with multiple, unqualified electrical equipment important to safety for years. This constituted an apparent violation of 10 CFR 50.49, which requires that post-accident monitoring equipment be qualified to the environment with which they are expected to function, including submergence.

The two primary component cooling water pump motors and two secondary component cooling water pump motors were required to be environmentally qualified to the post-HELB (high energy line break) environment in the Turbine Building (TB). The originally-assumed, most severe HELB was the main steam line break, which would cause the TB to self relieve the pressure, resulting in a relatively mild environment near the pump motors. The licensee identified other size steam line breaks that could cause a more harsh environment because the TB would not self relieve the pressure under these conditions. The pump motors had not been qualified to this harsh environment. The licensee provided justification for operation for these pump motors, which had about 32% of their useful life left, based on pure analysis. The post-HELB temperature profiles used for this analysis were based on preliminary calculations that had not received a full QA review. The inspector determined that the analysis was unacceptable because the criteria (temperature profiles) used for the analysis were not based on firm data and were thus subject to change.

The licensee later submitted a letter to the NRC, stating that they had adopted a position that the licensing basis for the TB included main steam line breaks, main feedwater breaks, and a postulated slot break in other high energy lines in the TB. Thus, the postulated harsh environment described above was beyond that required to be assumed for environmental qualification purposes. This licensing basis would result in a relatively mild post-HELB environment in the TB during the summer condition ventilation lineup (certain panels in the TB remained open). The licensee agreed to submit to the NRC by October 1, 1996, more analyses for the winter condition ventilation lineup. The NRC agreed that the EQ of these pump motors was not a restart issue during the operation of the plant with the TB in the summer lineup condition. However, the EQ of these pump motors during the winter lineup condition is an unresolved item.

Report Details

E2 Engineering Support of Facility and Equipment

E2.1 Objectives (92903)

The objectives of this inspection were: (1) to review the licensee's interim corrective actions in response to the identification of electrical equipment that could be submerged following a loss-of-coolant accident (LOCA); (2) to review the licensee's justification for continued operation for unqualified electric equipment that could be submerged post-LOCA, and to determine the acceptability of the justification; and (3) to review the licensee's qualification documents and justification for continued operation for the primary component cooling water (PCCW) pump motors and the secondary component cooling water (SCCW) pump motors following a postulated high-energy line break (HELB) in the Turbine Building and to determine the acceptability of this justification.

E2.2 Electric Equipment Subject to Submergence

As a result of the NRC Independent Safety Assessment team's question pertaining to eiectric equipment important to safety that could become submerged following a LOCA, the licensee, in July 1996, performed a walkdown of electric equipment requiring environmental qualification (EQ) inside the reactor containment. The licensee identified 30 items that could become fully or partially submerged about 18 minutes post-LOCA. These items are for post-accident monitoring (Regulatory Guide 1.97 items and primary inventory trend system instruments (reactor vessel level measurement)). The equipment included Rosemount level transmitters and pigtails (cable), valve position (limit) switches and pigtails, and Rockbestos cable.

Of the 30 items, 12 were used for narrow-range level indication for the 3 steam generators (4 channels for each steam generator), 3 were used for the wide-range level indications for steam generators (1 each), and 2 were used for the reactor vessel level indication. The rest were used for valve position indications.

The licensee's interim corrective actions were to relocate some of the unqualified and/or inoperable pigtails and connectors to above the flood line so that qualification for these items could be substantiated.

For equipment that qualification could not be established, the licensee provided justification for continued operation (JCO) in Maine Yankee's document, DBS No. 96-044, "Design Basis Screen to Assess the Results of Submergence on EQ Components on the -2ft. Elevation of the Reactor Containment and Review the Impact of their Submergence on Nuclear Safety," including Revision 1, dated August 8, 1996, and Revision 2, with Attachment F, dated August 27, 1996.

The licensee issued Licensee Event Report (LER) 96-026 on August 23, 1996, to report this deficient condition.

E2.2.1 Relocation of Unqualified Electric Equipment

Before commencement of the inspection, the licensee relocated nine items to above the containment flood line, except five Rosemount level transmitters, which remained in the location that could be partially submerged (¼ inch to ½ inch from the bottom of the instruments) and were justified to be operable.

During this inspection, the inspector raised several questions regarding the qualification of the Patel connector pigtails, which were used for the wide-range steam generator (SG) level measurement. The licensee later relocated the three pigtails to above the flood line. This relocation eliminated the qualification problem for the SG wide-range level measurement.

After the relocation, the licensee was able to qualify three wide-range SG level channels (one for each SG), and two channels of reactor vessel water level indication. The licensee declared seven narrow-range SG-level indication channels (Channels A, B, and C for SG #1; Channels A and C for SG #2; and Channels A and C for SG #3) operable as discussed in Section 2.2.2.1 of this report.

For those items that had been relocated to above the flood line (mainly Patel pigtails and connectors), the inspector conducted a walk down in the reactor containment and verified the relocation had been completed. The inspector reviewed the 10 CFR 50.59 safety determination and confirmed that there were no unreviewed safety questions. The inspector also reviewed the post-modification testing (PMT) records for those items. No test anomalies were noted.

The inspector concluded that the relocation of the 12 unqualified items (except the five Rosemount transmitters) was accomplished appropriately to above the potential containment flood line and that the qualification status for these items was restored.

E2.2.2 Review of Justification for Continued Operation

The inspector reviewed the justification for continued operation, as documented in DBS No. 96-044, to determine whether sufficient bases were provided. The justification for each item/component is briefly discussed below.

E2.2.2.1 Rosemount Level Transmitters

Rosemount level transmitters (Model 1154 transmitters) were required to function up to 30 days post-LOCA. The reasons given by the licensee for the transmitter operability were:

- Under the worst condition, the transmitters would only be partially submerged (½" or less). The cylindrical electronic housing (made of stainless steel) was mounted horizontally with conduit outlet at the upper part of the housing. The flood line would be below the O-ring (neck seal); and, therefore, it would be very unlikely for water to enter the electronic housing. One transmitter that could be submerged by 1 inch (LT-1233B) is discussed in Section E2.2.2 of this report.

- Rosemount Model 1154 transmitter had been type-tested successfully in fully-submerged condition (two feet under water) for two weeks following a LOCA test (Rosemount Test Report D8400323, submersion testing of Models 1153 and 1154 transmitters, dated January 10, 1985.)

- A letter from Babcock and Wilcox to Rosemount (JAS #79-1012), dated July 11, 1979, indicated that a Rosemount Model 1152 transmitter functioned for almost two months in submerged conditions following the March 1979 Three Mile Island Unit 2 accident. The electronic housing for both models (1152 and 1154) was the same, except the neck seal material, which would be above the flood line.

The licensee stated that the affected transmitters would be relocated to above flood line during the next refueling outage.

E2.2.2.2 Steam Generator (SG) Narrow-Range Level Indication

For the five inoperable narrow-range level indication channels (Channel B for SG #1 and Channels B and D for both SG #2 and SG #3), reliable indications could be provided by other redundant channels.

E2.2.2.3 Valve Position Indications

For the 13 items that were used for valve position indications, 10 were used for inboard containment isolation valves, and 3 were used for the primary coolant sampling valves in the post-accident sampling system (PASS). These three valves (PS-A-1, 2, 3) were no longer used for containment isolation function. The isolation function was provided by two downstream valves (PS-A-15, 20). Operation of the three sampling valves was not required post-LOCA, when the primary coolant system was fully depressurized.

Valve Closure Confirmation

For the 10 inboard containment isolation valves, reliable valve position indication would be available post-LOCA until submergence occurs (about 18 minutes post-LOCA, but could be 10.6 minutes in the worst-case condition). Maine Yankee emergency operating procedure (E-O Step 7-d) required the operator to verify the valve closure green indicating light when containment isolation signal was initiated. The licensee estimated that (based on testing using the Maine Yankee simulator) this action would be completed in about 90 seconds. The affected valves were not expected to change position after closure because valve control circuits were not affected by submergence.

Estimated Time for Valve Closure Confirmation

There were discrepancies in licensee documents regarding the estimated time for completing the confirmation of the closure of the inboard containment isolation valves. According to the licensee, this "estimated time" was initially overestimated as a half-hour in DBS No. 96-044, Revision 1, and again as 10 minutes in DBS No. 96-044, Revision 2 without Attachment F, and also in LER 96-026.

On August 27, 1996, the licensee conducted a test using Maine Yankee simulator and demonstrated the 90-second completion time, as documented in Attachment F to DBS No. 96-044, Revision 2, dated August 27, 1996.

Additional Bases for Justification

Confirmation of containment isolation could also be provided by the indication of closure of the outboard containment isolation valves, which would not be affected by the submergence.

Failure mode analysis was also provided by the licensee to evaluate the consequence of cable and limit switch failures, including switch close/open and cable shorted to ground. The analysis indicated that the failure would not affect other safety-related circuits.

E2.2.2.4 Conclusion

The inspector's review of DBS No. 96-044 indicated sufficient bases were provided for the justifications. The inspector concluded that the justifications were acceptable for interim operation. The licensee stated that all items affected by submergence would be relocated to above the flood line during the next refueling outage scheduled for May 1997.

E2.2.3 Review of Other Supporting Documents

The inspector also reviewed other supporting documents to confirm the licensee's statement in their justification, as follows:

a). Steam Generator P&ID (11550-FM-73A) and Regulatory Guide 1.97 instrument data sheet for LT-1213 (A, B, C, D), LT-1223 (A, B, C, D) and LT-1233 (A, B, C, D) and confirmed SG narrow-range level indication redundancy.

b). Various P&ID and Regulatory Guide 1.97 instrument data sheets for containment isolation valves and confirmed the inboard/outboard valve redundancy.

c). Recent leakage test results of the outboard containment isolation valves identified from Item b) above and confirmed that the leakages were within the allowable limit. This confirmation indicated that the outboard isolation valve alone could complete the containment isolation function.

d). Operation Memo 9-G-19, EQ Submergence Issue, Revision 0, dated August 7, 1996, which confirmed that control room operators were instructed of the potentially unreliable valve indications and potentially incorrect steam generator narrow-range level indications. The affected instruments were marked in the control room.

e). Post-accident sampling system diagram, which confirmed that the three sampling valves in this system were not required for containment isolation.

E2.2.4 LER Review

The inspector also reviewed LER 96-026, dated August 23, 1996, and found the report generally consistent with Maine Yankee document DBS No. 96-044, except: (1) the LER stated that the submergence levels for the EQ components ranged from ½ inch to 31¼ inches below the maximum submergence level. This statement disagreed with Section 6.I.b.1 of DBS No. 96-044 for the condition of the Rosemount transmitters (¼ inch to ½ inch), which was discussed in Section E.2.1 and E.2.2.1 of this report. During a telephone conversation with the Maine Yankee Licensing Manager on September 12, 1996, the inspector was told that the LER would be revised to reflect the correct measurement (¼ inch to 31¼ inches, instead of ½ inch to 31¼ inches); and (2) the estimated time for the control room operator to confirm containment isolation valve closure, as described in Section 2.2.3 of this report, was conservatively stated as 10 minutes in the LER.

E2.2.5 Root Cause Evaluation and Duration of Deficient Condition

At the time of the inspection, the licensee was still working on the root-cause evaluation and had not determined when the deficient condition started. The licensee postulated that the affected equipment might had been installed in the 1980's to implement the Regulatory Guide 1.97 program.

E2.2.6 Conclusion

The inspector concluded that the licensee's interim corrective actions, following the identification of EQ deficiencies, were in accordance with the safety issue section of Generic Letter 88-07, Modified Enforcement Policy Pertaining to 10 CFR 50.49, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants." The justification for continued operation was determined to be acceptable. However, Maine Yankee had been operating with multiple unqualified electric equipment important to safety for many years. This constitutes an apparent violation of 10 CFR 50.49, Section b.3 and Section e.6, which requires post-accident monitoring equipment be qualified to the environment in which they are expected to function, including submergence. **(50-309/96-10-01)**

E2.3 Qualification of PCCW and SCCW Pump Motors

There were two primary component cooling water (PCCW) pumps and two secondary component cooling water (SCCW) pumps that supplied cooling water to the emergency diesel generators and other safety-related components. Normally, each system has one pump running and the remaining pump in standby. All four pumps were located on the lower floor of the Turbine Building (TB). All four pump motors were on the Maine Yankee EQ master list, indicating environmental qualification of these motors was required. Review of the EQ work sheets for these motors (P-9A, B, and P-10A, B) revealed that the motors had not been qualified for a harsh environment because the area where these motors were located was not subject to harsh environment. Three motors were Allis-Chalmers 350 HP, Class B insulated motors. The fourth motor was a Siemens 350 HP Class F insulated motor.

E2.3.1 Existing Qualification of Pump Motors

The licensee stated that the original licensing basis only assumed a guillotine-type main steam line break in the TB to be the most severe high energy line break (HELB). Under this condition, the TB would rupture shortly afterwards (less than a minute), releasing most of the energy to the atmosphere. The resulting environment in the PCCW and SCCW pump area remained relatively mild and within the allowable operating temperature of the pump motors. Therefore, the licensee concluded that these motors were never required to be type-tested to harsh environments for their qualification.

E2.3.2 Identification of New Qualification Concerns

During the review of beyond-design-basis events for Maine Yankee's Individual Plant Evaluation - External Event (IPEEE), the licensee identified that other types of HELBs (e.g., 14-in. steam line guillotine breaks) could cause harsher environments in the TB than the main steam line break. A preliminary calculation by the licensee indicated that the TB temperature could reach 275°F for a 14" guillotine-type steam line break. The PCCW and SCCW pump motors had not been qualified to this harsh environment. The licensee promptly sent a spare motor to a contract testing laboratory for type-testing to the newly-defined harsh environment. The test could not be completed until late August or September.

E2.3.3 Review of Justification for Operation

To justify continued operation for the pump motors and other safety-related equipment, the licensee issued DBS No. 96-06, Design Basis Screen to Assess the Results of the Analysis of a Spectrum of Main Steam Line Break Within the Turbine Building, Revision 2, dated July 12, 1996.

The inspector reviewed the part of DBS No. 96-06 that pertained to the qualification of the PCCW and SCCW pump motors. This review is discussed below.

Because very limited test data was available for harsh environment for these motors, the licensee used a relatively thorough analysis to justify the motor operability. The analysis covered motor lubrication, motor insulation, and motor aging. Based on the licensee's estimate, about 68% of the motor insulation life had been expended. The licensee used the thermal aging formula, provided by the motor manufacturer, $L = 90{,}000e^{-0.07t}$ (where L = life in years and t = temperature in °C) to justify the operability at peak temperature. The analysis used 200°F plateau temperature instead of the post-HELB peak temperature of 275°F shown in the preliminary temperature profiles. The licensee did not discuss the relationship between the plateau temperature and the peak temperature based on a thermal lag calculation. The licensee did not discuss the limitation of using the thermal aging formula for justifying peak temperature. The licensee also used operating data from NUMARC 87-100, Guidelines and Technical Basis for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors, Revision 1, dated August 1991; however, the licensee did not clarify whether those data were for new motors or for used motors, like the ones used at Maine Yankee.

The inspector noticed that the post-HELB temperature profiles (for summer conditions) used for this analysis were based on preliminary calculations, which, according to the licensee, had not received a full QA review. The licensee stated that the finalized temperature profiles would not be ready until a much later date (weeks after inspection).

The inspector determined that the analysis (operability justification) was unacceptable, because the criteria (temperature profiles) used for this analysis were not based on firm data and were thus subject to change.

Following the inspection, the licensee submitted a letter to the NRC on August 14, 1996. In this letter, the licensee stated that they had adopted a position that the licensing basis for the TB Environmental Qualification Service conditions included the postulated guillotine rupture of the main steam line and main feed line, and also included a postulated *slot* break (½" diameter in length and ½" wall thickness in width) in other high energy lines in the turbine hall. These breaks would result in a mild environment in the vicinity of the PCCW and SCCW pump motors during the summer condition when certain panels of turbine building remained open. Analysis of these postulated breaks during the winter condition would be submitted to the NRC by October 1, 1996. The licensee also stated that a schedule to furtner improve the plant ability to mitigate postulated guillotine ruptures in high energy lines in the turbine building would also be submitted to the NRC by October 1, 1996.

The licensee did not argue for the acceptability of the operability justification for the PCCW and SCCW pump motors; rather, the licensee claimed that the more severe LOCAs that could cause harsh environment in the turbine building were outside the licensing basis. In a letter, dated August 21, 1996, the NRC acknowledged receipt of the licensee's August 14, 1996, letter, and agreed that the EQ of these pump motors was not a restart issue.

The inspector concluded that this item (EQ and operability of the PCCW and SCCW pump motors) was unresolved pending further NRC review of licensee corrective actions. **(URI 50-309/96-10-02)**

E2.4 UFSAR Reviews

A recent discovery of a licensee operating their facility in a manner contrary to the updated final safety analysis report (UFSAR) description highlighted the need for a special focused review that compares plant practices, procedures and/or parameters to the UFSAR descriptions.

While performing the inspections discussed in this report, the inspector reviewed the applicable portions of the UFSAR that related to the areas inspected. The inspector verified that the UFSAR wording was consistent with the observed plant practices, procedures and/or parameters. Specifically, the inspector reviewed Section 1.3.8, "Environmental qualification of Electrical Equipment," which discussed briefly Maine Yankee's EQ program; Section 5.1.2 and Table 5.1.2.1, Containment Isolation, which discussed containment isolation valves; and Section 9.5.7, "Post Accident Sampling Systems," which included the primary coolant sampling system.

V. Management Meetings

X1 Exit Meeting

The inspector met with the licensee personnel at the conclusion of the site inspection on August 9, 1996, and summarized the scope of the inspection and the inspection results. No proprietary materials were reviewed during this inspection. The licensee acknowledged the inspection findings at the August 9, 1996, exit meeting.

The inspector amended the exit meeting in a August 22, 1996, telephone call to Messrs. G. Leitch and D. Whittier, and other licensee representatives. The inspector stated that after NRC review of additional licensee supplied documents, an apparent violation and an unresolved item were identified.

Other activities that occurred after the August 22, 1996, exit meeting included: (1) LER 96-026 that was reviewed (Section E2.2.4) was issued on August 23, 1996; (2) estimated time for the control room operators to confirm closure of inboard containment isolation valves was demonstrated to be 90 seconds on August 27, 1996 (Section E2.2.2.3); and (3) the inspector was told during a September 12, 1996, telephone conversation with the Maine Yankee licensing manager that LER 96-026 would be revised to reflect the correct measurement of submergence (Section E2.2.4). These activities did not affect the inspector's overall conclusions.

PARTIAL LIST OF PERSONS CONTACTED

Maine Yankee Atomic Power Corporation

* R. Arsenault, Assistant Manager, Maintenance
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U. S. Nuclear Regulatory Commission

W. Olsen, Resident Inspector
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* Indicates those present at the August 9, 1996, site exit meeting.