10 CFR 50.55a
Generic Letter 90-05

Boston Edison
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Request for NRC Review of a Proposed Non-ASME Code Pipe Repair

This letter reports degradation of a spool piece associated with Pilgrim Nuclear Power Station's (PNPS) salt service water (SSW) system. This moderate energy system provides the ultimate heat sink for containment heat removal.

In addition, a discussion of a temporary repair to be performed in accordance with Generic Letter (GL) 90-05 and, in part, ASME Code Case N-562 is provided. Relief to perform this repair is requested from the NRC under the purview of 10CFR50.55a (g)(6)(i).

Description

The piping immediately downstream of the MO-3806 butterfly valve has through-wall leaks due to localized delamination of the rubber lining and subsequent erosion and corrosion of the carbon steel pipe. The leaks are adjacent to the pipe slip-on flange that mates with the valve. This location is downstream of the reactor building closed cooling water (RBCCW) heat exchanger.

Evaluation

Boston Edison Company (BECo) performed a structural integrity evaluation of the affected piping using ultrasonic testing (UT) data for wall thickness in the vicinity of the leaks. The pipe evaluation is in accordance with the guidance provided in Generic Letter 90-05 for a through-wall flaw in American Society of Mechanical Engineers (ASME) Safety Class 3 piping. The method evaluates the stress intensity factor "K_I" in the pipe with the limiting circumferential length removed based on the pipe stresses from existing PNPS piping analysis of record for combined loads, including seismic (SSE). The maximum allowable flaw length was calculated using the GL90-05 fracture toughness criteria of K_{ic} = 35 thousand pounds/square inch(ksi)/(in)$^{0.5}$. There are three discrete through-wall flaws; all are within the stress criteria allowable flaw size.

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GL90-05 requires that individual flaw size be limited to 3 inches or 15% of the length of the circumference. Based on the measured flaw sizes, including the total length that is below t_{min} adjacent to the through-wall area, the flaws are within the criteria. The GL90-05 proximity requirement that the adjacent through wall flaws be spaced at greater than twice t_{min} was also considered. Therefore, the piping is structurally sound and capable of performing its design function.

Based on the known operating history, inspection, maintenance and test requirements for the SSW system as validated through interviews with the design engineers, system engineer, and QC/ISI inspectors, the preliminary root cause of the through-wall leaks has been attributed to delamination of the aging rubber pipe lining due to localized high flow velocities resulting from throttling of the butterfly valve immediately upstream. Rubber-lined steel piping flaws experience accelerated erosion and corrosion where the rubber lining has delaminated. Where the lining remains intact, the pipe remains at its nominal full wall thickness (t_{nom}). Hence, the wall thinning is local to the areas where lining has delaminated, while elsewhere there is no effect. Therefore, the through-wall leaks in this piping are due to a small area delamination of the lining resulting in localized erosion and corrosion. Further investigation in support of the root cause determination and contributory causes is ongoing.

PNPS performed an analysis using a hydraulic model for the SSW system to evaluate the actual pressure at the subject location in the SSW piping. This analysis showed the pressure at this location is usually slightly negative except at the highest yearly tides (above +11 ft). At the highest tides, this location has a slight positive pressure, resulting in service water leakage. No safety-related components are within the proximity of the piping flaw location that would be directly affected by this leakage. The leakage would be accommodated by the design of the auxiliary bay.

There is usually a small vacuum in the pipe at this location related to the changing tides. Air in-leakage has a negligible effect on the flow rate through the RBCCW heat exchanger.

Conclusion of Evaluation

The above discussion and associated calculations/operability evaluation demonstrate that the pipe structural integrity is acceptable. The effect from SSW leakage into the auxiliary equipment bay and/or air in-leakage into the flow stream (i.e., when the pressure is negative at this location) are acceptable. Therefore, the system associated with the degraded spool piece is capable of performing its safety function; hence, it is operable.

The preliminary root cause determination indicates the flaws can be attributed to delamination of the aging rubber pipe lining due to localized high flow velocities resulting from throttling of the butterfly valve immediately upstream.

Monitoring Measures

Immediate compensatory measures are not required to assure system operability or safe operation because the piping is currently structurally sound and leakage does not adversely impact system operability.

Ongoing pipe monitoring using UT is being performed weekly to ensure the pipe condition does not deteriorate beyond acceptable limits. In addition, operator tours performed once per shift will monitor for changes to the leakage rate.

In addition, GL90-05 requires that a minimum of 5 locations be subject to augmented inspections to evaluate other system locations for similar degradation. Auxiliary bay SSW piping is inspected on a programmatic basis. Therefore, the only locations that required immediate inspection are similar locations downstream of the other RBCCW and TBCCW heat exchanger outlet valves.

To address this, the following 5 locations were inspected in accordance with GL 90-05 guidance. All augmented inspection results at these locations found values greater than the manufacturer's t_{min}:

- MO-3805 - downstream piping adjacent to valve and flange. This 12" "B" TBCCW outlet valve is used for throttling.

- 29-HO-3833 - downstream piping adjacent to the valve and flange. This valve's downstream pipe liner required rubber lining repairs during refueling outage (RFO) 11.

- MO-3808 - downstream piping adjacent to the valve and flange. This valve is not used for throttling.

- MO-3800 - downstream piping adjacent to the valve and flange. This 18" "A" RBCCW outlet valve is used for throttling. This valve is the sister valve to MO-3806.

- MO-3801 - downstream piping adjacent to the valve and flange. This 12" "A" TBCCW outlet valve is used for throttling.

Reason for Non-Code Temporary Repair

The impact a code repair would have on plant operation has been assessed. Also assessed was the impact of a number of non-code repair methods. The code repair methods require removing one loop of the SSW system from service and cross tying the RBCCW systems during power operation, placing Pilgrim in a 24 hour limiting condition for operation (LCO) under Technical Specification section 3.5.B.3. The code repair we considered viable (spool replacement, preliminary installation schedule estimates are 4 to 5 days) requires removing a loop from service for greater than the LCO's 24 hours,

resulting in a plant shutdown. Hence, we are requesting relief in accordance with the guidance of GL 90-05 for a non-code repair that can be executed with the loop in-service.

Description of Proposed Temporary Repair

A temporary non-code repair is proposed to stop the leak and maintain structural integrity until the piping spool can be replaced during an outage of sufficient duration. The proposed temporary repair will be a cover plate fillet-welded to the pipe at the leak location.

The guidance provided in GL 90-05 applies to this temporary modification. A 3/8 inch cover plate will be fillet-welded to the 18 inch SSW pipe and flange where erosion and corrosion have occurred. ASME Code Case N-562, although written as guidance for the weld overlay repair method, will be used as a technical guide to attach the cover plate. The cover plate method was selected as the preferred temporary repair instead of the overlay method for the following reasons:

- The cover plate repair method will stop the leak with less risk of enlarging the flaws than the overlay method. All other guidance of N-562 will be followed as applicable. For example, the cover plate will be UT examined periodically for erosion until the pipe is replaced in RFO#12.

- The cover plate is acceptable for 100 psi, although the pressure at the leak's location ranges from a slight vacuum to a slight positive pressure. (It is dependent on tide level because the line discharges to the sea.) The line's 100 psi design specification was selected at Pilgrim's construction to make it uniform to other parts of the system that are subjected to higher pressures; therefore, 100 psi is a conservative value for this application.

- The pipe's stress is low (4 ksi) as shown by BECo's calculation M747 (attached). If it is intensified by a factor of 2.1, as prescribed by N-562, it is still within the allowable limit of 18 ksi.

- The cover plate method is less intrusive to the structural integrity of the pipe because it exposes the pipe to less heat from the welding process. Existing procedures for welding the cover plate to a water backed pipe are qualified.

- The cover plate method does not affect plant operations.

Repair's Safety Impact

Pilgrim has performed a safety impact evaluation of this proposed repair which determined the following:

- The safety-related functions of the SSW system remain qualified for plant design bases loads after completion of this temporary repair.

- The proposed temporary repair does not increase the probability of occurrence or consequences of an accident or malfunction of equipment important to safety. The possibility of creating an accident or malfunction other than those evaluated in the UFSAR is not increased because the temporary modification does not introduce any interaction with other safety-related systems.

- This temporary repair does not increase the probability of occurrence or consequences of failure of equipment important to safety because no new failure mechanisms are introduced.

Commitments

This letter makes the following commitments:

- Operators will visually monitor for changes to the degraded pipe's leakage rate once per shift during operator tours until the permanent ASME code repair is completed.

- A temporary non-code pipe repair will be performed in accordance with GL 90-05 following receipt of NRC's relief to implement the non-code repair.

- Weekly monitoring (ultrasonic testing) of the degraded pipe will continue until test results show the test frequency can be changed. The maximum allowed frequency will be once/3 months.

- The permanent ASME code repair will be performed at the next scheduled outage exceeding 30 days and no later than startup from our next scheduled refueling outage (RFO#12).

Should you require further information on this issue, please contact P.M.Kahler at (508) 830-7939.

E. J. Olivier

PMK/dmc/pipe

Attachments 1) BECo Calculation M747
2) BECo Engineering Evaluation in Response to PR 97.9399

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Attachment 1

BECO Calculation M747