Caponiti, Kathleen

From: Tsao, John (NRR)
Sent: Monday, April 26, 2010 4:15 PM
To: Manoly, Kamal
Cc: Lupold, Timothy; OHara, Timothy
Subject: FW: FEA of Degraded Salem Unit 1 AFW Piping
Attachments: 1000494_301_RC.doc; Salem buried pipe flaw analysis RAI 4-23-10 Doc1.docx; Salem buried pipe SIA .pdf; Salem unit 1 AFW Buried Pipe Evaluation draft.pdf

Importance: High

Kamal,

Tim O'Hara of Region I forwarded me the FEA report for the Salem buried AFW piping. Tim Lupold asked me to forward the FEA report to you (see the first attached file). Attachment No. 2 is my assessment of the FEA report that I sent to Tim O'Hara this morning. Attachments No. 3 and 4 are the preliminary information for the FEA report.

Thanks.

John

-----Original Message-----
From: OHara, Timothy (R1)
Sent: Friday, April 23, 2010 2:23 PM
To: Tsao, John
Cc: Lupold, Timothy; Conte, Richard; Gray, Harold; Burritt, Arthur; Schroeder, Daniel; Balian, Harry; Cline, Leonard; Sanders, Carleen; Ennis, Rick
Subject: FEA of Degraded Salem Unit 1 AFW Piping
Importance: High

Hello John,

Here is the FEA we've been discussing. Note that PSEG is still reviewing but they have provided this copy which will most likely not change. Please review this and let us know what you think. Thanks.

Tim OHara

-----Original Message-----
From: Berrick, Howard G. [mailto:Howard.Berrick@pseg.com]
Sent: Friday, April 23, 2010 2:11 PM
To: Schroeder, Daniel L.; OHara, Timothy
Subject: Evaluation of Degraded Underground Auxiliary Feedwater Piping (SIA Report 1000494_301_RC)
Importance: High

Attached ids the SIA Report RE: Evaluation of Degraded Underground Auxiliary Feedwater Piping

Please note: This report has not been through the PSEG Owners Acceptance or Third Party Review process.

Howard Berrick
PSEG Nuclear LLC

F-9

Salem Regulatory Assurance
PSEG Nuclear - Salem Generating Stations
(W) 856-339-1862
(Fax) 856-339-1448
(Bpr) (b)(6)

<<1000494_301_RC.doc>>

An Assessment of "ASME Code, Section III, Design by Analysis Evaluation of a 4-inch Auxiliary Feedwater Piping" for Salem Generating Station, Unit 1.

Background

The licensee identified localized wall thinning in several regions of the buried auxiliary feedwater (AFW) piping at Salem Generating Station, Unit 1, based on the guided wave technology. The licensee excavated the affected piping regions and found significant external corrosion. Subsequently the licensee inspected the affected piping segments using straight beam ultrasonic testing to determine the pipe wall thickness. Several measurement locations showed pipe wall thicknesses less than the design minimum wall thickness. The licensee performed stress calculations to demonstrate that the degraded AFW piping still meets allowable stresses of the ASME B31.1 Code of Construction and that the piping was operable during past operation.

Discussion

Under ASME Section XI, a planar or laminar flaw is dispositioned by the acceptance standards of IWB-3515. If the flaw is within the acceptance standards of IWB-3515, the flaw can be left in service. If the flaw exceeds IWB-3514, the flaw may be accepted by analysis of IWB-3600 followed by 3 successive examinations. A pipe that contains a flaw that exceeds IWB-3600 will need to be repaired or replaced. The ASME Code, Section XI, is stringent in that it minimizes flaws from growing uncontrollably to rupture. A pin hole leak that is caused by wall thinning, in general, does not lead to pipe rupture [I believe that a pipe rupture is defined as when the leak rate from a crack is so large that the pump cannot provide sufficient makeup to achieve the intended function of the pipe]. Salem's AFE pipe degradation mechanism is wall thinning.

The ASME Code, Section XI, does not have requirements for analyzing wall thinning condition except in Code Case N-513-2. However, N-513-2 is not applicable to high energy line such as AFW line. Code Case N-561-2, Alternative Requirements for Wall Thickness Restoration of Class 2 and High Energy Class 3 Carbon Steel Piping, provides guidance for high energy Class 3 piping. However, the NRC has not approved N-561 in Regulatory Guide 1.147, Revision 15.

Therefore, the licensee used the rules of the ASME Section III to satisfy 10 CFR 50.55a. Under the ASME Code, Section III, the same pipe would not need to be repaired as long as the pipe satisfies the allowable stresses of NB-3200 or NB-3600. The AFW piping is ASME Class 3 pipe and should follow the rule of ND-3000 for piping design. However, the licensee selected the rules of Class 1 piping, (i.e., NB-3200 and/or NB-3600) because rules in NB-3000 provide more detailed analysis procedures and allowables.

The licensee analyzed five pipe segments, 12AF, 14AF, 14AK, AF13T, AF4T/AF5T. The resultant stresses are shown on Pages 11 to 13 and page 16 of the report. As shown on those pages, each of the pipe segments has certain locations that exceed the allowable stresses. However, when the licensee linearized the stresses in all the nodes in the model and calculated a single stress, the linearized stress for each of the pipes is within the allowable as shown in Table 1 (page 8). In other words, even though localized stress at certain node in each of the pipes exceeds the allowable stress, the overall (global) stress of each of the pipe are within the allowable.

The licensee did not use the as-found pipe wall thickness (the thinnest wall thickness) for the entire pipe in calculating the stresses. For example, the licensee did not use 0.077 inch to calculate the stress for

the entire pipe segment. Instead, the licensee used the as-found wall thickness (0.077 inch) to calculate the local stresses at the node (location) where the wall thinning was found. For other nodal points of the pipe, the licensee used the nominal thickness or as-found pipe thickness at those nodes which may not be degraded. Although some pipe locations have severe wall thinning degradation, the licensee was able to demonstrate that the structural integrity of the pipe as a whole is acceptable.

Conclusion

The staff finds that the degraded AFW piping satisfies the requirements of ASME Code, Section III, NB-3213.10, NB-3221.2, and NB-3228.1. However, the staff concludes that the subject AFW piping is operable but degraded.

Recommendations

1. Page 4, last paragraph. The licensee stated that the worst wall thickness is 0.077 inch. Confirm that the minimum allowable pipe wall thickness is 0.190 inch as shown on page 5, second paragraph.

2. The stress analysis needs to include detailed pipe wall thickness measurements in all 5 subject AFW pipes so that the reviewer can understand the extent of the wall thinning.