Ziev, Tracey

From: Cahill, Christopher RJ
Sent: Friday, April 30, 2010 12:12 PM
To: Burritt, Arthur; Cline, Leonard
Subject: FW: AFW Missile Barrier
Attachments: AFW Missile Barrier.rtf

FYI - I'll look at FSAR after lunch. Based on what is there, I would believe that it is a low probability event, however that does not preclude them from being in compliance. What is compliance?

-----Original Message-----
From: OHara, Timothy RJ
Sent: Friday, April 30, 2010 12:01 PM
To: Arner, Frank; Cahill, Christopher
Cc: Conte, Richard; Schroeder, Daniel
Subject: FW: AFW Missile Barrier

Chris & Frank,

The DCP and the 50.59 for this piping mod. says they need a missle shield. The attached document is PSEGs evaluation that they don't need to do what the DCP and 50.59 said because the probability of damage is low. This has not been entered into the corrective action process and they don't intend to do so.

Any thoughts or opinions on this?

Tim OHara

-----Original Message-----
From: Berrick, Howard G. [mailto:Howard.Berrick@pseg.com]
Sent: Friday, April 30, 2010 11:55 AM
To: OHara, Timothy
Subject: AFW Missile Barrier

Per your request
<<AFW Missile Barrier.rtf>>

C/130

TE Uploaded to SAP.

**********Long Text Object Identification**********
Order 000060089848 Operation 0960 Confirmation 0008218743
Confirmation counter 00000004 Long text
****

TECHNICAL EVALUATION

DOCUMENT NUMBER: 60089848 Operation 0960

TITLE: Auxiliary Feedwater Piping Missile Barrier Exclusion

REASON/SCOPE:

During the S1R20 refueling outage, corrosion was found on the 4" Auxiliary Feedwater (AFW) buried carbon steel piping that supplies the 12 and 14 Steam Generators (SGs). To resolve the corrosion concern, this buried piping was replaced. Part of this replacement included rerouting the underground piping in the Fuel Transfer Tube Area (FTTA) between the Fuel Handling Building (FHB) and Containment to above ground (Reference 8). A missile barrier is planned to be installed to protect the new piping due to the potential for a missile to penetrate the seismic gap between the FTTA and Containment, but it will not be installed prior to entering Mode 1.

A previous evaluation (60089848-0205) was performed to allow entry into Mode 3 without a missile barrier being installed. This evaluation determined that the AFW System could be operated for a period of time during Mode 1 normal operation without an installed missile barrier.

EVALUATION:

The AFW piping to 12 & 14 SGs is 4-inch NPS, Schedule 80, A106 Grade B seamless carbon steel (Reference 8). It is classified as Nuclear 3, Seismic Category I. The new piping was routed underground (similar to the previous layout) from the Outer Penetration Area to The Fuel Handling Building. The new piping from FHB to the Auxiliary Building was routed above ground. The above ground piping is attached to the FHB wall and is enclosed within the FTTA. The FTTA is a narrow path between the Reactor Containment wall and the FHB wall. The distance between these two buildings varies approximately 3 to 9 feet due to the curvature of the Containment Building.

The roof and the wall of the FTTA consist of 24" concrete per Drawings 201083 and 207483 (References 2 & 3). There is a 6" gap (horizontal) between the roof and the Reactor Containment

wall. Also there is a 4" gap (vertical) is between the FTTA south wall and the Unit 1 Containment structure wall per Drawing 207808 (Reference 4). These gaps are filled with Styrofoam insulation and are called seismic gaps. The AFW piping in the FTTA is located on the far end opposite to the horizontal seismic gap.

Per UFSAR Section 3.5 (Reference 5), structures, shields, and barriers are provided as protection against the effects of both internally and externally generated missiles. UFSAR Section 3.5.2 (Reference 6) states that Category I structures including Reactor Containments, Auxiliary Building, and Fuel Handling Buildings are designed to withstand tornado missiles. These structures are also designed such that under the impact of the most damaging tornado missile, they will not create a secondary missile of enough mass or velocity to penetrate any adjacent Category I structure.

Routing of the piping above grade in the FTTA exposes it to potential tornado generated missiles penetrating the FTTA from either the roof or the south wall of the FTTA. The roof and the wall consist of approximately 24" concrete per References 2, 3 & 10. These walls are greater than the18" thickness specified in UFSAR Section 3.5.2.2 (Reference 7) for tornado missile protection; therefore the area is protected from a tornado generated missile of a 40 foot pole 12" in diameter.

The only way a missile can enter the FTTA area is through the seismic gap. Potential entry paths have been reviewed. The reviews have determined that entry from the south gap (the 4" gap) is not possible due to the Unit 1 Containment structure equipment hatch pedestal. The other potential path is for a 1" diameter steel rod to pass through the 6" gap between the side of the Containment and the edge of the roof extending out from the FHB and strike one of the above ground AFW pipes located near the FHB. This may also be a non-credible scenario.

If the 1" rod enters the seismic gap between the roof and Containment in a vertical direction, hitting the AFW piping is also a non-credible scenario. Any missile entering the 6" gap between the FHB roof and the Containment in this manner must fall nearly straight down along the Containment wall. The longer the rod, the less the angle of rotation from vertical it can have to pass through without contacting the wall or the roof. It can have spin about the center of the diameter of the rod and it can sideways spin about the center of the length of the rod as long as the rotation remains normal to the vertical axis to the ground. In essence, the missile has only one degree of rotation, which is to spin like an arrow about the center of its 1-inch diameter. For a missile being set in motion by the turbulence of a tornado, these are not likely conditions. If the rod strikes either the roof or the Containment wall, a large

amount of its energy will be dissipated and it would lack the force to damage the AFW pipe, even it could somehow hit it. In passing through the gap vertically, there is insufficient space to allow an angle for the missile to strike the AFW piping adjacent to the FHB without making a sudden change of course after exiting the 2 foot high gap. This is not a credible scenario.

If the 1" rod enters the seismic gap between the roof and Containment at an angle, there's a possibility that it could strike the AFW piping on the FHB wall due to the curvature of the Containment wall. The path of the rod would be tangential to the Containment. Based on a preliminary three dimensional model, a possible path does exist for a missile following a straight line trajectory to strike the AFW piping. However, the angle of the rod has to be within a very narrow range and the effects of drag and gravity on the missiles trajectory are neglected. Furthermore, it would have to enter on the outer part of the FTTA enclosure, because if it enters further in, the tangential path would lead to the Auxiliary Building wall.

Also, hitting the AFW piping by entering the seismic gap from the inner part of the FTTA enclosure is non-credible due to the presence of the Auxiliary Building. Therefore, the only potential credible means for a 1" rod to enter the seismic gap between the FHB roof and the Containment wall and to strike the AFW piping is if the path is within a narrow angular range, tangential to the Containment, on the outer part of the FTTA enclosure.

Reference 11 determines the probability of a missile created by a tornado entering an opening anywhere in the plant, and includes openings in every building containing safety related components, but the calculation does not include the FTTA enclosure. However, the additional area in the seismic gap for this enclosure is insignificant compared to the total area of the openings included in the calculation. Therefore, the impact on total probability for the unit is insignificant, although there is some reduction in margin. For Unit 1, the total probability for entering any opening is 4.14E-7 per year (page 208). This is less than the NRC value of 1E-6 per year for credible events. In addition, the probability of a missile entering an individual opening is less than the total probability of 4.14E-7 per year. Thus, the probability of a missile entering the seismic gap between the FTTA enclosure and Containment is also less than 4.14E-7 per year.

A missile generated by a tornado striking the AFW pipe is possible but it is a non-credible scenario. However, in order to absolutely preclude the possibility of a tornado-generated missile striking the above-ground piping, a steel plate will be installed over the seismic gap to prevent tornado generated

missiles from striking the AFW piping. Based on a preliminary three dimensional model and consideration of a multitude of possible missile angles, the possibility a missile can strike the AFW pipe exists. The many factors that would have to fit into place to permit such an event from occurring are extremely unlikely, making such an event possible but not probable. In fact, the probability is less than that which is considered credible. However, to preclude any possibility of a missile striking the AFW piping and to maintain total probability margin for the plant, the plate should be installed. Determination of the plate thickness will be based on the method described in UFSAR section 3.5.2.2 (Reference 7).

CONCLUSIONS/FINDINGS:

Having no missile shield is an acceptable condition based on the following:

> As discussed above the probability of a missile striking the AFW piping is possible but of such low probability as to be not credible. The missile has to penetrate through a narrow gap of 6" (seismic gap) at a specific angle and with very limited degrees of rotation. The roof is approximately 24 inches thick making the 6-inch gap even more difficult to penetrate without making contact. The only potential credible means for a 1" rod entering the seismic gap between the roof and Containment to strike the AFW piping is if the path is within a narrow angular range, tangential to the Containment, on the outer part of the FTTA enclosure. For any other trajectory, the missile has to travel through this restriction without striking any structure and then suddenly change course toward the FHB to reach the AFW piping at full velocity, which is not credible.

> The only source of missile would be a tornado of very high intensity occurring in the area. The probability of severe weather (hurricane) or unstable conditions that could create a tornado are very low.

> The probability of a missile entering the seismic gap has insignificant impact on the total probability for entering any opening in the unit as determined in Reference 11. Also, the probability of a missile entering the seismic gap is less than the NRC value of 1E-6 per year as being a credible event.

REFERENCES:

1. Notification 204569991R20 AF Buried Pipe Inspection Results
   Notification 20457262 1R20 AF Buried Pipe Inspection Results
   Notification 20457854 UT AFW pipe in Fuel Transfer tube area
   Notification 20458568 1R20 AF Buried Pipe Inspection Results

Notification 20459204 UT inspection result below Min Wall
Notification 20459691 UT inspect result below Min Wall

2. Drawing 201083, Revision 8, Unit 1 Fuel Handling Area - Sections
3. Drawing 207483, Revision 11, Reactor Containment Auxiliary Feedwater Plan & Sections
4. Drawing 207808, Revision 6, Unit 1 & 2 Reactor Cont. Fuel Handling & Aux Building Water Stop Joint
5. UFSAR Section 3.5 Missile Protection
6. UFSAR Section 3.5.2 Tornado Missiles
7. UFSAR Section 3.5.2.2 Missile Protection Methods
8. DCP 80101382, Salem Unit 1 12/14 AF Piping Reroute DCP
9. NOAA National Weather Service for Hancocks Bridge, NJ
10. Drawing 201078, Revision 4, Fuel Handling Area Plan at Elevation 130`-0

PREPARER: Kevin C. King DATE: See SAP

INDEPENDENT REVIEWER: Michael E. Crawford DATE: See SAP

APPROVAL: Alan A. Johnson DATE: See SAP