North Anna Unit 3 Issues for Chapter 9, "Auxiliary Systems"

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1.0 SUMMARY

On January, 30, 2013, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an audit at the Mitsubishi Heavy Industries, Ltd. (MHI) and Mitsubishi Nuclear Energy Services (MNES) office in Arlington, Virginia. The focus of the audit was to review selected areas related to the North Anna Unit 3 United States - Advanced Pressurized Water Reactor (US-APWR) Combined License Application (COLA), Final Safety Analysis Report, Chapter 9, "Auxiliary Systems," (including supporting calculations), submitted to the NRC on March 16, 2012. The audit was necessary in order to review supporting calculations related to the latest revision of COLA and the applicant's Request for Additional Information (RAI) response. The audit was primarily focused on three systems: the essential service water system (Section 9.2.1), component cooling water system (Section 9.2.2), and ultimate heat sink (Section 9.2.5).

During the audit, the staff reviewed MHI documentation such as system calculations that supported previous RAI responses.

2.0 BASIS

During the audit, the staff performed a comprehensive review of the calculations that supported the design information contained in the latest revision of the COLA and in the applicant's responses to the staff's requests for additional information (RAIs).

The staff concluded that the information and calculations provided by the applicant supported the applicant's COLA and previous responses to the staff's RAIs. However, the staff found several minor items that need to be addressed. The staff presented these minor items to the applicant at the conclusion of the audit.

3.0 OBSERVATIONS AND RESULTS

The issues discussed at the audit are as follows:

9.2.1 Essential Service Water

The applicant identified three calculation documents (NA3-M10-ESW-502 R/C, NA3-M10-ESW-514 R/A, and NA3-M10-UHS-513 R/A) to address five audit items, 9.2.1-1 through 9.2.1-5.

1. Calculation NA3-M10-ESW-502 R/C, "ESW-Line and Pump Sizing" This calculation document addresses Items 9.2.1-1 "ESW Pump NPSH", 9.2.1-3 "ESW Pump Head" and 9.2.1-4 "ESW Flow Velocities." The staff reviewed input, assumptions, methodology, calculation results, margins, and found the calculations adequate.

(a) The ESW pump net positive suction head (NPSH) calculation shows that there is an available NPSH of 42.03 feet. This was based on the lowest expected water level in the intake basin of approximately 12 feet and at 95 °F water temperature.

(b) The results show the flow velocities at different locations. The maximum velocity is 9.81 feet per second (fps).

(c) The total head losses for the ESW system were calculated to be 182 feet. The ESW pump has a total dynamic head of 220 feet.

2. Calculation NA3-M10-ESW-514 R/A, "ESW Pump Vortex"

This calculation addresses Item 9.2.1-2, "ESW Pump Vortex." The staff reviewed input, assumptions, methodology, and calculation results. Results showed that if the pump bell suction is above 22 inches in diameter, then no air ingestion can occur. The staff found this calculation to be adequate.

Observations noted during the review:

The staff was concerned that the calculation conclusion stated that the ESWS suction bell was to be purchased between 20" and 40". Dominion Virginia Power (Dominion) stated that will be part of the purchase order requirements. This item is closed.

3. Calculation NA3-M10-UHS-513 R/A, "Fire Protection Supply from ESW"

This calculation document addresses Items 9.2.1-5, "Fire Protection Supply from ESW." The staff reviewed input, assumptions, methodology, calculation results and found the calculations to be adequate. There is sufficient basin inventory to remove the required heat load after Fire Protection Supply makeup.

9.2.2 Component Cooling Water

The applicant identified two calculation documents (4BS-UAP-100196 R/4 and NA3A-KC0-CVS-0002 R/B) to address audit items 9.2.2-1 and 9.2.2-2.

1. Calculation 4BS-UAP-100196 R/4, "Tank Size Calculation"

This calculation document addresses Item 9.2.2-1, "Tank Size Calculation." The staff reviewed inputs, assumptions, methodology, calculation results and found the calculations adequate.

Observations noted during the review:

Calculation 4BS-UAP-100196 R/4 discusses the boric acid evaporation package (BAEP), which is part of the US-APWR standard design. However, it was unclear to the staff what component cooling water (CCW) header provides

cooling water to the BAEP. During the audit, MNES clarified that cooling water is supplied by the CCWS A2 header and stated the document will be revised to make the clarification. No further NRC action is necessary because this change is simply for clarification and does not affect the calculation.

2. Calculation NA3A-KC0-CVS-0002 R/B, "Chemical and Volume Control System (CVS) Degasifier Column Sizing Calculation"

This calculation document addresses Item 9.2.2-2, "Chemical and Volume Control System (CVS) Degasifier Column Sizing Calculation." The calculation was reviewed to verify that COL departure 9.2(1) to replace the BEAP with a degasifier was within the parameters of the CCWS and did not invalidate calculation 4BS-UAP-100196 R/4, "Tank Size Calculation". The staff reviewed objectives, design criteria/design basis, assumptions, methodology, calculation results and found the calculations to be adequate. In addition, it was spot checked for math.

9.2.5 Ultimate Heat Sink

The applicant identified seven calculation documents (NA3-M10-UHS-500, NA3-M10-UHS-503, NA3-M10-UHS-505, NA3-M10-UHS-511, NA3-M10-UHS-515, 4BS-UAP-100220, and DM-RFI-0149) to address four audit items 9.2.5-1 through 9.2.5-4.

1. Calculation NA3-M10-ESW 500 R/A, "UHS – 30 Days Capacity and Basin Sizing"

This calculation document addresses Items 9.2.1-1, "UHS – 30 Days Capacity and Basin Sizing." The staff reviewed input, assumptions, methodology, calculation results and found the calculations adequate. Calculations were spot checked for math.

- The conclusion stated that 3.06 E^6 gallons are needed to support Safe Shutdown + LOOP heat loads which assume 16 years of spent fuel in the spent fuel pool.
- The conclusion stated that 3.09 E^6 gallons are needed to support loss-of-coolant accident (LOCA) heat loads which assume 16 years of spent fuel in the spent fuel pool.
- Normal water level of 29 feet in the cooling tower basins would provide 3.12 E^6 gallons.
- The US-APWR is designed to provide a minimum of 30 days water without makeup in accordance with Regulatory Guide (RG) 1.27, "Ultimate Heat Sink for Nuclear Power Plants (for Comment)." The staff confirmed in Design Control Document (DCD) Section 9.2.5.1 regarding the 30-day water requirement. It is acceptable based on RG 1.27.

Observations noted during the review:

- MHI was in the process of issuance of a Final Safety Analysis Report change to the US-APWR DCD to address changes to the bounding ultimate heat sink (UHS) heat load. It was noted during the Comanche Peak Nuclear Power Plant (CPNPP) COLA audit that the MHI staff notified the NRC staff that LOCA heat load is slightly higher than safe shutdown+ loss of offsite power (LOOP). The calculation for North Anna Nuclear Power Plant will be reviewed for this change once this is issued by MHI. This item maybe revisited by the staff in a future audit.

- The one foot silt accumulation in the UHS cooling tower basin should be added as a design input and not be only located in the calculation attachment. Dominion has taken steps to correct this and showed the NRC staff a red line markup of the calculation. This item is closed.

2. Calculation NA3-M10-ESW 511 R/B, "UHS – 30 Days Capacity and Basin Sizing"

This calculation document addresses Items 9.2.1-1, "UHS – 30 days Capacity and Basin Sizing." This calculation points to ESW-15-05-502-001 R/B which was reviewed during the CPNPP Audit between August 29 - 30, 2012. The staff reviewed input, assumptions, methodology, calculation results and found the calculations adequate. Calculations were spot checked for math.

- The conclusion stated that 2.8 E^6 gallons are needed to support Safe Shutdown+LOOP or LOCA heat loads which assume 10 years of spent fuel in the spent fuel pool.

- Normal water level of 29 feet in the cooling tower basins would provide 3.12 E^6 gallons.

- The US-APWR is designed to provide minimum of 30 days water without makeup in accordance with RG 1.27. The staff confirmed in DCD Section 9.2.5.1 regarding the 30-day water requirement. It is acceptable based on RG 1.27.

3. Calculation DM-RFI-0149 R/0, "UHS Design Input"

This calculation document addresses Item 9.2.5-2, "Cooling Tower Calculation including Wet-Bulb Determination." The staff reviewed input, assumptions, methodology, calculation results and found the calculations to be adequate.

- Twenty-five years of meteorological data was used and it was determined that 2 °F wet bulb margin will be added for cooling tower recirculation.

4. Calculation NA3-M10-UHS-505 R/A, "UHS- Cooling Tower Basin Water Temperature Analysis"

This calculation document addresses Items 9.2.1-2, "UHS-Cooling Tower Basin Water Temperature Analysis during Safe Shutdown and LOCA." The staff reviewed input, assumptions, methodology, calculation results and found the calculations to be adequate. Calculations were spot checked for math.

- Cooling tower performance is based on 84.9 °F wet bulb (0 percent exceedance).

- It was confirmed that safe shutdown peak temperature of 94.3 °F at the sixth hour (starting with the basin with 2.8 million gallons) is less than the UHS Technical Specification (TS) return temperature limit of 95 °F (starting with the basin at 95 °F with 2.8 million gallons).

- The LOCA peak temperature of 94.5 °F at the fourth hour is less than the TS. temperature limit of 95 °F (starting with the basin 93 °F with 2.8 million gallons).

- The SPX data sheet only had 80.9 °F for an input for wet bulb. The applicant explained that this is the initial design parameter and the calculation does include cooling tower performance curves that include the maximum wet-bulb temperature of 84.9 °F. No further NRC actions required.

- The cooling tower performance curve for safe shutdown design is based on wet-bulb ranges of 65° F to 85 °F. The cold water return for safe shutdown is ~86 °F for 65 °F wet-bulb and ~97 °F for 85 °F wet-bulb. The cold water return for a LOCA is ~84 °F for 65 °F wet-bulb and ~95 °F for 85 °F wet-bulb.

Observations noted during the review:

- Labels where missing from the wet bulb vs. water return temperatures in the calculation attachment. Dominion has taken steps to correct this and showed the NRC staff a red line markup of the calculation. This item is closed.

- The SPX data sheet only had 80.9 °F for an input wet-bulb. The applicant explained that this is the initial design parameter and the calculation includes cooling tower performance curves that include the maximum wet-blub temperature of 84.9 °F. This item is closed.

5. Calculation 4BS-UAP-100220 R/3, "Basis of ESWS Heat Load"

This calculation document addresses Items 9.2.5-3, "Basis of ESWS Heat Load." The staff reviewed input, assumptions, methodology, calculation results and found the calculations adequate. Calculations were spot checked for math.

6. Calculation NA3-M10-UHS-503 R/3, "UHS Transfer Pump and Line Sizing"

This calculation document addresses Item 9.2.5-4, "UHS transfer pumps, NPSH, vortex, head, flow velocities." The staff reviewed input, assumptions, methodology, calculation results and found the calculations to be adequate.

- Maximum evaporative and draft losses are assumed to be 363 gallons per minute (gpm) per cooling tower thus a minimum 726 gpm transfer pump is required. 800 gpm pumps are selected for 10 percent margin.

- The UHS transfer pump NPSH calculation shows that there is an available NPSH of 42.03 feet. This was based on the lowest expected water level in the intake basin of approximately 10 feet and 95 °F water temperature.

- The results show the flow velocities at different locations. The maximum velocity is 5.12 fps.

- Pump head was calculated at 45 feet at 800 gpm at the minimum water level of 10 feet.

7. Calculation NA3-M10-UHS-515 R/A, "Evaluation of Vortex Formation at UHS Transfer Pumps"

This calculation document addresses Item 9.2.5-4, "UHS Transfer Pumps, NPSH, vortex, head, flow velocities." The staff reviewed input, assumptions, methodology, calculation results and found the calculations to be adequate.

- With a pump bell line size of three inches or more, there is no possibility of air intrusion into the suction with an assumed water level of 10 feet in the UHS basin at 800 gpm pump flow.

4.0 CONCLUSION

The staff concluded that the information and calculations provided by the applicant supported the applicant's DCD and previous responses to the staff's RAIs. However, the staff has found several minor items that need to be addressed. The staff presented these items to the applicant at the conclusion of the audit. The following summarizes these items and provides a list of the calculations that were reviewed:

1. ESWS Calculation NA3-M10-ESW-514: The staff was concerned that the calculation conclusion stated that the ESWS suction bell was to be purchased between 20" and 40". Dominion stated that will be part of the purchase order requirements. This item is closed.

2. UHS Calculation NA3-M10-UHS-500: MHI was in the process of issuance of a FSAR change to the US-APWR DCD to address changes to the bounding UHS heat load, It was noted during the CPNPP COL audit that the MHI staff notified

the NRC staff that the LOCA heat load is slightly higher than safe shutdown+LOOP. The calculation for North Anna will be reviewed for this change once this is issued by MHI. This item maybe revisited by the staff in a future audit.

3. UHS Calculation NA3-M10-UHS-500: the one foot silt accumulation in the UHS cooling tower basin should be added as a design input and not be only located in the calculation attachment. Dominion has taken steps to correct this and showed the NRC staff a red line markup of the calculation. This item is closed.

4. UHS Calculation NA3-M10-UHS-505: Labels where missing from the wet bulb versus water return temperatures in the calculation attachment. Dominion has taken steps to correct this and showed the NRC staff a red line markup of the calculation. This item is close.

5. UHS Calculation NA3-M10-UHS-505: The SPX data sheet only had 80.9 °F for an input wet-bulb. The applicant explained that this is the initial design parameter and the calculation includes cooling tower performance curves that include the maximum wet-blub temperature of 84.9 °F. This item is closed.

6. CCWS Calculation 4BS-UAP-100196: It was unclear what CCW header provides cooling water to the BAEP. The applicant stated that cooling water is supplied by the CCWS A2 header and will be revised to make the clarification. No further NRC action is necessary.