From: Habib, Donald
Sent: Friday, March 13, 2020 9:27 AM
To: Vogtle PEmails
Subject: FW: Audit Discussion Topics for LAR 19-019 Follow Up
Attachments: Audit Closeout Q5.pdf; Audit Closeout Q3.pdf

From: Arafeh, Yasmeen N. <YNARAFEH@southernco.com>
Sent: Thursday, March 12, 2020 4:05 PM
To: Habib, Donald <Donald.Habib@nrc.gov>
Cc: Patel, Pravin <Pravin.Patel@nrc.gov>; Lehman, Bryce <Bryce.Lehman@nrc.gov>
Subject: [External_Sender] Audit Discussion Topics for LAR 19-019 Follow Up

Hi Don,

To address the audit discussion question 3, we are proposing to modify Note 1 in UFSAR Table 3H.5-9 Sheets 1, 2a, and 2c, so that Note 1 becomes a clarification to the table instead of it being misinterpreted as an additional 2%. Please see attached for the markups from Q3 to Note 1. It was also noted during the discussion call that the footnote in the UFSAR should not be deleted, and I wanted to clarify that the markups in LAR-19-019 are an excerpt from the UFSAR, and that the footnote will remain during incorporation of the updated table values.

Additionally, after further consideration on audit discussion question 5, we believe that Change 3 in LAR-19-019 is not a change to the current methodology, and that updating the UFSAR to reflect the element size change would be an excessive detail. However, to address the Staff's concern, we are proposing to add the following statement to the technical justification for Change 3 (as shown in the attached PDF for Q5):

> "The seismic design of the AP1000 nuclear island relies on the analysis methods and FEA models described in DCD Chapter 3.7 and related appendixes. These ANSYS models (i.e., NI-05, NI-10, NI-20, etc.) are sufficiently detailed to capture global and in-structure response at key equipment and building locations. However, for detailed design, local FEA models with a refined mesh size different than the global seismic models are sometimes utilized to capture more detailed response needed to evaluate the effects of local demand and localized stresses to design reinforcement in localized areas. These subsystem models utilize the seismic inputs and boundary conditions consistent with the nuclear island model(s). The seismic analysis methods for local models are the same as those used for the Nuclear Island models and are described in DCD Section 3.7.2. "

Please let me know if these follow up actions address the Staff's concerns from our audit discussion call held on 3/11.

Best,

Yasmeen Arafeh
Nuclear Development, Licensing
Work: (205)992-7190

ynarafeh@southernco.com
Southern Nuclear

Hearing Identifier: Vogtle_COL_Docs_Public
Email Number: 546

Mail Envelope Properties (BN8PR09MB35249CDCDD00E6C024CE413497FA0)

Subject: FW: Audit Discussion Topics for LAR 19-019 Follow Up
Sent Date: 3/13/2020 9:27:24 AM
Received Date: 3/13/2020 9:27:27 AM
From: Habib, Donald

Created By: Donald.Habib@nrc.gov

Recipients:
"Vogtle PEmails" <Vogtle.PEmails@nrc.gov>
Tracking Status: None

Post Office: BN8PR09MB3524.namprd09.prod.outlook.com

Files	**Size**	**Date & Time**
MESSAGE	2467	3/13/2020 9:27:27 AM
image001.png	1703	
Audit Closeout Q5.pdf	136782	
Audit Closeout Q3.pdf	141275	

Options
Priority: Normal
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:

Southern Nuclear

Change 3 – Spent Fuel Pool West Wall Critical Section Table Update (Table 3H.5-8)
The SFP walls are module walls which are located on the south side of the auxiliary building from elevation 66'-6" to elevation 135'-3", enclosed by column lines 2 and 4, and L2 and K2, as shown in UFSAR Figure 3.8.4-4 Sheets 1-5. The SFP walls are similar to the module walls inside containment, which consist of steel faceplates, steel trusses, shear studs and concrete. The west wall of the SFP along column line L-2 is a critical section as defined in UFSAR Subsection 3H.5.5.1. UFSAR Table 3H.5-8 shows the demands and capacities of the SFP west wall at seven critical locations, which are defined in UFSAR Figure 3H.5-10. UFSAR Table 3H.5-8 shows forces and moments under critical load cases, including dead load, live load, hydrostatic load, normal thermal load and accident load, and shows moments and forces under representative load combinations, such as gravity load combination, gravity and seismic load combination, and load combinations with seismic and normal thermal loads combined. UFSAR Table 3H.5-8 also shows required steel plate thickness without thermal versus provided steel plate thickness, maximum principal stress versus yield stress, and maximum stress intensity versus allowable stress intensity. This activity proposes to revise demands in UFSAR Table 3H.5-8 to match the revise design evaluation of SFP walls.

SFP walls are subject to 212 °F of accident thermal during SFP boiling. As part of design finalization, the accident thermal load is combined with seismic load and other loads in accordance with UFSAR Tables 3.8.4-1 and 3.8.4-2, and ACI 349-01. The moments and forces under combined seismic and accident loads are added to the markups of UFSAR Table 3H.5-8. The original SFP wall analysis used finite element model with approximate 5' by 5' mesh and fixed-fixed boundary condition. The design finalization refines the finite element model by changing the mesh size to 1' by 1' and creating two finite element models with fixed-fixed and fixed-pinned boundary conditions. The seismic design of the AP1000 nuclear island relies on the analysis methods and FEA models described in DCD Chapter 3.7 and related appendixes. These ANSYS models (i.e., NI-05, NI-10, NI-20, etc.) are sufficiently detailed to capture global and in-structure response at key equipment and building locations. However, for detailed design, local FEA models with a refined mesh size different than the global seismic models are sometimes utilized to capture more detailed response needed to evaluate the effects of local demand and localized stresses to design reinforcement in localized areas. These subsystem models utilize the seismic inputs and boundary conditions consistent with the nuclear island model(s). The seismic analysis methods for local models are the same as those used for the Nuclear Island models and are described in DCD Section 3.7.2. The pinned connection is used at floor to wall connections where the bottom dowel is located above the bottom WT stiffeners on the floor to capture the potential rotation. The results from the two FEA models are enveloped to conservatively capture potential behavior of the floor to wall connection. The results from the refined FEA models are also averaged back to the original element size. SFP Wall L-2 is designed under load combinations with seismic and accident thermal loads combined by using results from refined FEA models. The markups of UFSAR Table 3H.5-8 show that the required plate thickness excluding thermal is smaller than the provided plate thickness, the maximum principal stress for the load combinations including thermal is smaller than the yield stress, and the maximum stress intensity range for the load combinations including thermal is smaller than the allowable stress intensity. The design of SFP Wall L-2 remains in compliance with the applicable requirements in ACI 349-01 and AISC N690-94. There is no reduction in margin of safety for the structure because the design of the SFP Wall L-2 continues to meet the applicable codes. The proposed changes do not have adverse impact on the global structural analysis of the nuclear island because the

Revise UFSAR Table 3H.5-9 (Sheet 1 of 3), Shield Building Roof Reinforcement Summary (Tension Ring) as shown below.

Tension Ring – Axial Force and Bending Verification								
Location		Seismic Maximum Stresses		Maximum Stresses ksi	F_y ksi	Maximum Steel Area Required~~(2)~~ (in^2/ft)	*[Steel Area Provided]**	*[Design Limit~~(1)~~ for Ratio Max Required/Provided]**
Section	Angles	Seismic L/C	f_a ksi					
2 lower	5.625°	~~9~~ 33	~~14.31~~ 28.11	~~15.35~~ 30.07	50	~~9.21~~ 18.00	*[Liner 1 1/2" = 18 (in^2/ft) (Min)]**	*[~~0.51 + 2%~~1.00]**
	84.375°	~~17~~ 41	~~13.15~~ 27.59					
1 lower	0°	~~9~~ 34	~~15.35~~ 30.07					
	90°	~~17~~ 43	~~14.46~~ 29.48					
Tension Ring – Shear Force and Torsion Verification								
Location		Seismic Maximum Stresses		Maximum Stresses ksi	F_y ksi	Maximum Steel Area Required~~(2)~~ (in^2/ft)	*[Steel Area Provided]**	*[Design Limit(1) for Ratio Max Required/Provided]**
Section	Angles	Seismic L/C	f_a ksi					
2 lower	5.625°	~~18~~ 42	~~4.83~~ 4.58	~~6.28~~ 7.27	50	~~5.65~~ 6.54	*[Liner 1 1/2" = 18 (in^2/ft) (Min)]**	*[~~0.31~~ 0.36+ 2%]**
	84.375°	~~11~~ 35	~~5.52~~ 4.24					
1 lower	0°	17	~~6.28~~ 7.27					
	90°	9	~~5.80~~ 6.78					

* * *

Notes:

1. *[~~Two~~ The two percent of the ratio value that may be added to the design limit ~~as~~ is an allowance for minor variances in analysis results.]**
2. ~~Thermal loads have been considered in the design of critical sections. The required reinforcement values shown do not include the load case where seismic and normal thermal loads are numerically combined as the normal thermal loads were assessed to be insignificant. When the seismic and normal thermal loads are numerically combined, the value of required reinforcement may increase; however, in all cases the required reinforcement is less than the provided reinforcement and thus the design of the critical section reinforcement is acceptable.~~ Not used.

Revise UFSAR Table 3H.5-9 (Sheet 2a of 3), Shield Building Roof Reinforcement Summary (Air Inlet) as shown below.

AIS Reinforcement Summary – Horizontal Sections						
Location (Figure 3H.5-11)		Required – Seismic Load Combinations (in^2/ft)		Maximum Required~~(2)~~ (in^2/ft)	*[Provided]**	*[Design Limit[(1)] for Ratio Max Required/Provided]**
Section	Angles	Seismic L/C	Values			
5+6	0°-5.625°	~~8~~ 32	~~1.91~~ 2.43	~~2.38~~ 5.03	*[Liner 1" = 12 (in^2/ft) (Min)]**	*[~~0.20~~ 0.42 + 2%]**
	84.375°-90°	~~8~~ 32	~~1.89~~ 2.31			
7	0°-5.625°	16	~~2.38~~ 4.19			
	84.375°-90°	~~8~~ 24	~~2.15~~ 4.27			
9	0°-5.625°	16	~~2.26~~ 5.02			
	84.375°-90°	24	~~2.27~~ 5.03			
11	0°-5.625°	16	~~1.73~~ 3.55	~~1.73~~ 3.57	*[Liner 1" = 12 (in^2/ft) (Min)]**	*[~~0.15~~ 0.30 + 2%]**
	84.375°-90°	24	~~1.53~~ 3.57			

Notes:

1. [*~~Two~~ The two percent of the ratio value that may be added to the design limit ~~as~~ is an allowance for minor variances in analysis results.*]*
2. ~~Thermal loads have been considered in the design of critical sections. The required reinforcement values shown do not include the load case where seismic and normal thermal loads are numerically combined as the normal thermal loads were assessed to be insignificant. When the seismic and normal thermal loads are numerically combined, the value of required reinforcement may increase; however, in all cases the required reinforcement is less than the provided reinforcement and thus the design of the critical section reinforcement is acceptable.~~ Not used.

Revise UFSAR Table 3H.5-9 (Sheet 2c of 3), Shield Building Roof Reinforcement Summary (Air Inlet) as shown below.

Out of Plane Shear Reinforcement Summary -AIS							
Location (Figure 3H.5-11)		Required – Seismic Load Combinations (in²/ft)			Maximum Required[(2)] (in²/ft)	*[Steel Area Provided]**	*[Design Limit[(1)] for Ratio Max Required/Provided]**
Angles	Sections	Seismic L/C	Values	Sum			
0°-5.625°	Max of Vertical Sections 3 upper - 4 upper	~~1~~ 25	~~0.13~~ 0.16	~~0.13~~ 0.16	~~0.34~~ 0.22	*[(3) 3/4" TIE BAR @2.8125° (41.36") (8 1/2" in vertical direction) = 0.50 (in2/ ft) (Min.)]**	*[0.68 + 2%]**
	~~Horizontal~~ Circumferential Section 5+6		0.00				
84.375°-90°	Max of Vertical Sections 3 upper - 4 upper	~~1~~ 25	~~0.12~~ 0.16	~~0.12~~ 0.16			
	~~Horizontal~~ Circumferential Section 5+6		0.00				
0°-5.625°	Max of Vertical Sections 3 upper - 4 upper	~~1~~ 25	~~0.10~~ 0.16	~~0.34~~ 0.16			
	~~Horizontal~~ Circumferential Section 7		~~0.24~~ 0.00				
84.375°-90°	Max of Vertical Sections 3 upper - 4 upper	~~1~~ 25	~~0.10~~ 0.16	~~0.30~~ 0.16			
	~~Horizontal~~ Circumferential Section 7		~~0.20~~ 0.00				
0°-5.625°	Max of Vertical Sections 3 lower - 4 lower	18	~~0.21~~ 0.22	~~0.21~~ 0.22			
	~~Horizontal~~ Circumferential Section 9		0.00				
84.375°-90°	Max of Vertical Sections 3 lower - 4 lower	11	~~0.21~~ 0.22	~~0.21~~ 0.22			
	~~Horizontal~~ Circumferential Section 9		0.00~~0~~				

Out of Plane Shear Reinforcement Summary -AIS							
Location (Figure 3H.5-11)		Required – Seismic Load Combinations (in^2/ft)			Maximum Required~~[(2)]~~ (in^2/ft)	*[Steel Area Provided]**	*[Design Limit[(1)] for Ratio Max Required/Provided]**
Angles	Sections	Seismic L/C	Values	Sum			
0°-5.625°	Max of Vertical Sections 3 lower - 4 lower	18	~~0.21~~ 0.22	~~0.21~~ 0.22			
	~~Horizontal~~ Circumferential Section 11		0.00~~0~~				
84.375°-90°	Max of Vertical Sections 3 lower - 4 lower	11	~~0.21~~ 0.22	~~0.21~~ 0.22			
	~~Horizontal~~ Circumferential Section 11		0.00				

Notes:

1. *[~~Two~~ The two percent of the ratio value that may be added to the design limit ~~as~~ is an allowance for minor variances in analysis results.]**
2. ~~Thermal loads have been considered in the design of critical sections. The required reinforcement values shown do not include the load case where seismic and normal thermal loads are numerically combined as the normal thermal loads were assessed to be insignificant. When the seismic and normal thermal loads are numerically combined, the value of required reinforcement may increase; however, in all cases the required reinforcement is less than the provided reinforcement and thus the design of the critical section reinforcement is acceptable.~~ Not used.