REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.: **255-8285**

SRP Section: **03.08.05 – Foundations**

Application Section: **03.08.05**

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Question No. 03.08.05-13

10 CFR 50.55a and Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 16 and 50, provide the regulatory requirements for the design of the containment internal structures. Standard Review Plan (SRP) 3.8.5, Section II specifies analysis and design procedures applicable to the foundation of seismic Category I structures.

Technical Report (TR) APR1400-E-S-NR-14006-P, Rev 1, "Stability Check for NI Common Basemat," Section 3.2.6, "Load Combinations," states that, "The division of the basemat by code jurisdiction at the thickness transition is a logical choice, and the boundary of the code jurisdiction is conservatively designed using the greater forces from the analysis results of ASME and ACI codes." It is not clear to the staff as to how the applicant consider the loads and load combinations for the basemat of the containment and the Auxiliary building (AB), and how the applicant design the transition region. For example, it is not clear whether the division of the basemat code jurisdiction at the thickness transition is in accordance with the ASME Code Interpretation: 111-2-83-01, which covers this design configuration and how do they define the transition region. Per 10 CFR 50.55a; Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 16 and 50; and SRP 3.8.5, the applicant is requested to describe in more detail how the loads and load combinations for the basemat of the containment and the AB, were considered in the analysis and how the transition region is design.

Response - Rev. 1

Load combinations and load factors for the RCB and the AB basemats are selected based on their relevant design codes, ASME and ACI respectively. The boundary of code jurisdiction between the ASME code and the ACI code is shown in Figure 1. The details of the code jurisdiction boundary are presented in the response to RAI 199-8223, Question 03.08.01-11.

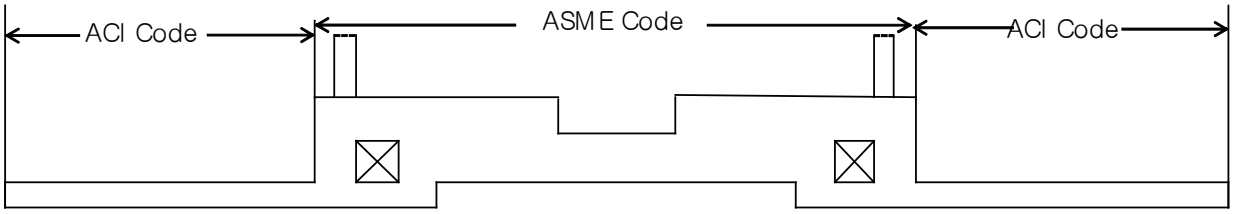

Figure 1 Jurisdictional Boundary for Design of Common Basemat

For the RCB basemat, the 5 loading combinations (test, normal, severe, abnormal, and abnormal/extreme environmental) are selected as the critical loading combinations in the analysis of the NI basemat. Table1 shows the selected load combinations and applicable load factors for analysis. The severe accident load is not consideredfor basemat analysis and design. As mentioned in the response of RAI 129-8085, Question 03.08.01-1 Rev.1, the terminology of "Severe Accident" was changed to "Combustible Gas Control inside Containment". This load combination is related to evaluation for structural integrity of containment under the pressure arising from the fuel cladding-water reaction. For the details of combustible gas control inside containment, refer to the response of RAI 199-8223, Question 03.08.01-8 Rev.1. The severe accident load combination is not considered to determine structural member forces because this load combination is considered to beyond the design.

As shown in Table 1, the loads, except for loads G, To, Ta, W, Ro, Ra, Yj, Ym and Pv, are considered in the basemat analysis. The polar crane load includes the self-weight and lifted loads in the basemat analysis.

- Valve actuation load (G), due to POSRV discharge, is a short transient pressure in expansion and collapse of the air bubble. The load from the spargers is locally applied in the IRWST. The load does not effect on the global behavior of the basemat. Based on the explanation above, this load was not considered in the basemat analysis.

- According to ACI 349, thermal gradients less than approximately 100°F need not be analyzed because such gradients will not cause significant stress in the reinforcement or strength deterioration. The effects of the temperature load in the basemat are negligible and not considered in the basemat analysis because the temperature gradient is approximately 50°F.

- Wind (W) and tornado (Wt) loads are not considered. From the loading conditions, wind and tornado loads are not considered simultaneously with the seismic load. A comparison of the loads shows the seismic load is larger than the wind and tornado loads.

- The reactions of piping, cable trays (Ro, Ra), jet impingment load (Yj), and missile impact load (Ym) are considered in local analyses.

- The external pressure load (Pv) in the normal loading condition is negligible compared with the accident pressure (Pa) in the abnormal loading condition. So, it does not effect on global behavior of the basemat.

For the AB basemat, the 4 loading combinations (test, normal, abnormal, and abnormal/extreme environmental) are selected as the critical loading combinations in the analysis of the NI basemat. Table 2 shows the selected load combinations and applicable load factors for the analysis. For detailed description related to the construction sequence load combination, refer to the RAI 255-8285 Question 03.08.05-7.

As shown in Table 2, the loads, except for loads Ra, To, Po, Mo, Pa, Ta and Ma which do not have an effect on the global behavior of the basemat, are considered in the basemat analysis. For the crane and trolley loads, the self-weight of the fuel handling overhead crane is considered in the basemat analysis.

Additionally, the seismic load is conservatively divided into 8 cases to account for each superstructure's behavior. Therefore, the load combinations are summarized in technical report (TR) APR1400-E-S-NR-14006-P, Rev 1, "Stability Check for NI Common Basemat," Table 3-5.

For the design of the basemat, at the interface between the ASME and ACI codes, the lager amount of reinforcement required by either code was used.

Table 1 Selected Loading Conditions of Superstructures for Basmat Analysis (RCB)

Loading Condition	D	L	F	Pt	G	Pa	Tt	To	Ta	Es	W	Wt	Ro	Ra	Yr	Yj	Ym	Yf	H	Hs	Pv	Ha	Ps	Analysis
Test	1.0	1.0	1.0	1.0	-	-	(1.0)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	yes
Construction	1.0	1.0	1.0	-	-	-	-	1.0	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	no(①)
Normal	1.0	1.0	1.0	-	(1.0)	-	-	(1.0)	-	-	-	-	(1.0)	-	-	-	-	-	-	-	(1.0)	-	-	yes
Severe Environmental	1.0	1.3	1.0	-	(1.0)	-	-	(1.0)	-	-	(1.5)	-	(1.0)	-	-	-	-	-	-	-	(1.0)	-	-	yes
	1.0	1.3	1.0	-	1.0	-	-	1.0	-	-	-	-	1.0	-	-	-	-	-	1.5	-	1.0	-	-	no(②)
Extreme Environmental	1.0	1.0	1.0	-	1.0	-	-	1.0	-	1.0	-	-	1.0	-	-	-	-	-	-	-	1.0	-	-	no(③)
	1.0	1.0	1.0	-	1.0	-	-	1.0	-	-	-	1.0	1.0	-	-	-	-	-	-	-	1.0	-	-	no(④)
	1.0	1.0	1.0	-	1.0	-	-	1.0	-	-	-	-	1.0	-	-	-	-	-	-	1.0	1.0	-	-	no(⑤)
Abnormal	1.0	1.0	1.0	-	(1.0)	1.5	-	-	(1.0)	-	-	-	-	(1.0)	-	-	-	-	-	-	-	-	-	yes
	1.0	1.0	1.0	-	1.0	1.0	-	-	1.0	-	-	-	-	1.25	-	-	-	-	-	-	-	-	-	no(⑥)
	1.0	1.0	1.0	-	1.25	1.25	-	-	1.0	-	-	-	-	1.0	-	-	-	-	-	-	-	-	-	no(⑦)
Abnormal/Severe Environmental	1.0	1.0	1.0	-	1.0	1.25	-	-	1.0	-	1.25	-	-	1.0	-	-	-	-	-	-	-	-	-	no(⑧)
	1.0	1.0	1.0	-	1.0	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	-	no(⑨)
	1.0	1.0	1.0	-	1.0	-	-	1.0	-	-	1.0	-	-	-	-	-	-	-	-	-	-	1.0	-	no(⑩)
Abnormal/Extreme Environmental	1.0	1.0	1.0	-	(1.0)	1.0	-	-	(1.0)	1.0	-	-	-	(1.0)	1.0	(1.0)	(1.0)	-	-	-	-	-	-	yes
Severe Accident	1.0	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	no(⑪)

* ( ) : load not considered in basemat analysis. * yellow column : considered load combination in basemat analysis.

① - Effect on the basemat due to wind is less than that of Pt, and To is negligible

② - H is not considered to be critical for the basemat (Containment building roof could not contain any rainwater.)

③, ④, ⑤ - Abnormal/ Extreme Environmental combination is more limiting than these combinations.

⑥ - 0.25 x Ra is less critical than 0.5 x Pa for the basemat

⑦, ⑧ - 0.25 x G and 1.25W are less critical than 0.25 x Pa for the basemat

⑨, ⑩ - 1.0 x W is less critical than 1.5 x Pa for the basemat

⑪ - Beyond design load combination

Table 2 Selected Loading Conditions of Superstructures for Basmat Analysis (AB)

Loading Condition	Normal									Severe		Abnormal					Extreme			Analysis
	D	D_d	L	L_h	T_o	R_o	C	P_o	M_o	W	H	P_a	T_a	R_a	Y	M_a	E_s	W_t	H_s	
Construction	1.1	-	1.3	1.1	-	1.1	1.3	-	1.3	1.6	-	-	-	-	-	-	-	-	-	no(①)
	-	0.9	-	1.1	-	-	1.3	-	1.3	1.6	-	-	-	-	-	-	-	-	-	no(②)
Test	1.1	-	1.3	1.1	(1.3)	(1.1)	1.3	(1.3)	(1.3)	-	-	-	-	-	-	-	-	-	-	yes
Normal	1.4	-	1.7	1.4	(1.3)	(1.4)	1.7	(1.7)	(1.7)	-	-	-	-	-	-	-	-	-	-	yes
Severe Environmental	1.4	-	1.7	1.4	1.3	1.4	1.7	1.7	1.7	1.7	-	-	-	-	-	-	-	-	-	no(③)
	1.2	-	-	1.4	1.3	1.2	1.7	1.7	1.7	1.7	-	-	-	-	-	-	-	-	-	no(④)
	1.4	-	1.7	1.4	1.3	1.4	1.7	1.7	1.7	-	1.7	-	-	-	-	-	-	-	-	no(⑤)
	1.2	-	-	1.4	1.3	1.2	1.7	1.7	1.7	-	1.7	-	-	-	-	-	-	-	-	no(⑥)
Abnormal	1.0	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-	1.0	-	-	-	no(⑦)
	1.0	-	1.0	1.0	-	-	1.0	-	(1.0)	-	-	(1.4)	(1.0)	(1.0)	-	-	-	-	-	yes
Extreme Environmental	1.0	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-	-	1.0	-	-	no(⑧)
	1.0	-	1.0	1.0	1.0	1.0	-	1.0	1.0	-	-	-	-	-	-	-	-	1.0	-	no(⑨)
	1.0	-	1.0	1.0	1.0	1.0	-	1.0	1.0	-	-	-	-	-	-	-	-	-	1.0	no(⑩)
Abnormal / Extreme Environmental	1.0	-	1.0	1.0	-	-	1.0	-	(1.0)	-	-	(1.0)	(1.0)	(1.0)	(1.0)	(1.0)	1.0	-	-	Yes

* ( ) : load not considered in basemat analysis. * yellow column : considered load combination in basemat analysis.

①, ② - Governed by the severe environmental load combination

③ - It is the same as Normal loading condition except wind load which is not critical in basemat design.

④ - Governed by the severe environmental load combination

⑤, ⑥ - H is not considered critical for the basemat

⑦, ⑧, ⑨, ⑩ - Abnormal/Extreme Environmental combination is more critical than these combinations

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.