
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.: 391-8462
SRP Section: 06.02.02 - Containment Heat Removal Systems
Application Section:
Date of RAI Issue: 02/01/2016

Question No. 06.02.02-35

In order to evaluate the applicant's use of the WCAP-16530-NP-A methodology, the staff requests the following information about the temperature transient for the design-basis case:

- Provide the source of the temperature profile used for the chemical effects evaluation shown in Table 3.8-5 of the GSI-191 technical report (TR) (APR1400-E-N-NR-14001-P, Rev. 0). The staff was not able to match the temperature profile with the temperature profiles shown in the figures in FSAR Tier 2, Section 6.2.
- Provide the temperature profiles for both the submerged and unsubmerged materials. The results of the chemical effects analysis in the TR show one temperature profile but state that it was conservative to treat unsubmerged materials as if they were submerged.
- Clarify the source of the temperature profiles used in the chemical effects calculation and evaluation of deposition on the fuel (LOCADM). The TR refers to temperature "data." TR Section 3.8.2 indicates it is a combination of data and extrapolation, while TR Table 4.3-6 calls it data.

Response

1. The temperature profiles used for the chemical effects analysis in Section 3.8 of the Technical Report APR1400-E-N-NR-14001-P/NP, Rev. 0 are no longer valid. The temperature profiles for the chemical effects analysis have been updated for 30 days post-LOCA without use of the assumption of logarithmic temperatures from 1,000,000 seconds to 2,592,000 seconds post-LOCA. This is the GOTHIC code analysis results extended to 30 days, as depicted in DCD Figure 6.2.1-4.

The chemical effects analysis has been performed based on the updated temperature profiles and the results will be updated in Tables 3.8-4 and 3.8-5 of the TR. The

updated chemical effects analysis results do not affect the strainer design and associated testing results, as described below.

The prototype tank testing conducted for the APR1400 strainer design showed that the debris bed did not respond to chemical precipitate loadings past 100-150 gal. Both tests that were conducted resulted in a maximum head loss after the first ~2 batches of chemical precipitate (AIOOH) were added - the head loss change was inconsequential due to the additional precipitate additions for each test. This indicates that the debris bed was saturated with precipitate to a point where adding more chemical debris would not increase the head loss, or the strainer and debris bed had open area(s) where the extra precipitate was passing through the bed without increasing head loss. Based on these observations, the additional chemical precipitate from the higher temperatures would not affect the final strainer head loss; therefore, the existing test results are still valid.

2. The updated temperature profiles contain the temperature profiles for both the submerged and unsubmerged materials. The updated results of the chemical effects consider the temperature profiles for both the submerged and unsubmerged materials in accordance with the WCAP-16530-NP-A methodology.
3. The temperature profiles used in the chemical effects calculation and evaluation of deposition on the fuel (LOCADM) are the same. Thus, the updated temperature profiles are used for the evaluation of deposition on the fuel (LOCADM) and the updated evaluation results have been provided in response to RAI 404-8488 Question 15.06.05-11 (Refer to MKD/NW-16-0780L).

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

Technical Report APR1400-E-N-NR-14001-P/NP, Tables 3.8-4 and 3.8-5 will be revised as indicated in the Attachment.

Table 3.8-4 WCAP-16530 Results Summary

Component	Quantity (kg / lbm)
Aluminum oxy-hydroxide	180.6 / 398.2 ← 240.1 / 529.3
Sodium aluminum silicate	4.3 / 9.5
Calcium phosphate	0.7 / 1.5 ← 0.68 / 1.5

Design Features to Address GSI-191

APR1400-E-N-NR-14001-NP, Rev.0

AI 6-19_6.8_#8 Attachment (3/3)

AI 6-19_6.8_#8 Rev.1 Attachment (3/3)

Insert next page.

Table 3.8-5 Results for the APR1400, Maximum Water Volume, Minimum ECCS Flow

Interval Duration (min)	Start of Interval (hrs)	End of Interval (hrs)	Average Interval pH	Average Temp (°F)	NaAlSi3O8 Precipitate (kg)	AlOOH Precipitate (kg)	Ca3(PO4)2 Precipitate (kg)
2.0	0.00	0.0	10	135.6	0.001	0.561	0.000
1.6	0.04	0.1	10	139.2	0.0	1.1	0.00
1.2	0.06	0.1	10.7	141.0	0.0	1.5	0.00
3.0	0.08	0.1	10	143.8	0.0	2.6	0.00
3.2	0.13	0.2	10	147.9	0.0	3.7	0.00
4.9	0.19	0.3	10	153.0	0.0	5.3	0.00
5.5	0.27	0.4	10	158.9	0.0	7.1	0.00
9.4	0.36	0.5	10	165.5	0.0	10.1	0.01
11.6	0.52	0.7	10	173.0	0.0	13.6	0.01
22.9	0.71	1.1	10	183.1	0.4	20.0	0.02
76.1	1.09	2.4	10	202.2	1.0	38.7	0.05
98.4	2.36	4.0	10	222.6	0.8	58.6	0.09
0.0	4.00	4.0	9.25	230.0	0.8	58.6	0.09
241.9	4.00	8.0	8.5	233.6	1.6	69.9	0.20
210.9	8.03	11.5	8.5	235.0	2.3	77.6	0.30
237.8	11.55	15.5	8.5	229.4	1.8	84.4	0.39
291.4	15.51	20.4	8.5	221.6	2.5	90.8	0.40
617.2	20.37	30.7	8.5	209.7	3.3	100.5	0.40
746.4	30.66	43.1	8.5	196.2	4.0	108.2	0.41
1578.7	43.10	69.4	8.5	183.5	4.2	119.0	0.43
2392.0	69.41	109.3	8.5	172.0	4.2	129.6	0.45
3306.3	109.27	164.4	8.5	162.8	4.2	139.5	0.47
3382.5	164.38	220.8	8.5	156.2	4.2	147.2	0.49
2635.0	220.75	264.7	8.5	152.1	4.2	152.2	0.51
3035.5	264.67	315.3	8.5	148.4	4.2	157.1	0.53
3035.5	315.26	365.9	8.5	144.9	4.3	161.3	0.55
3035.5	365.86	416.4	8.5	142.2	4.3	164.9	0.56
3035.5	416.45	467.0	8.5	139.8	4.3	168.2	0.58
3035.5	467.04	517.6	8.5	137.6	4.3	171.1	0.60
3035.5	517.63	568.2	8.5	135.7	4.3	173.8	0.61
3035.5	568.22	618.8	8.5	133.9	4.3	176.2	0.63
3035.5	618.82	669.4	8.5	132.3	4.3	178.5	0.64
3035.5	669.41	720.0	8.5	130.8	4.3	180.6	0.66

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77.5
84.3

This Table will be updated in the response to RAI 391-8462 Question 06.02.02-35

Revised Table 3.8-5

Interval Duration (min)	Start of Interval (hrs)	End of Interval (hrs)	Average Interval pH	Average Temp (°F)	NaAlSi ₃ O ₈ Precipitate (kg)	AlOOH Precipitate (kg)	Ca ₃ (PO ₄) ₂ Precipitate (kg)
2.0	0.00	0.0	10	129.8	0.001	0.533	0.000
1.6	0.04	0.1	10	142.3	0.0	1.0	0.00
1.2	0.06	0.1	10	148.0	0.0	1.4	0.00
3.0	0.08	0.1	10	157.0	0.0	2.4	0.00
3.2	0.13	0.2	10	167.6	0.0	3.5	0.00
4.9	0.19	0.3	10	176.0	0.0	5.0	0.00
5.5	0.27	0.4	10	183.3	0.0	6.5	0.01
9.4	0.36	0.5	10	191.2	0.0	9.0	0.01
11.6	0.52	0.7	10	200.5	0.1	11.9	0.01
23.0	0.71	1.1	10	211.9	0.2	17.3	0.02
75.9	1.09	2.4	10	228.9	0.6	33.3	0.06
96.9	2.36	4.0	10	242.1	1.3	51.6	0.11
1.7	3.97	4.0	9.25	245.1	1.3	51.8	0.11
242.0	4.00	8.0	8.5	243.3	2.3	63.5	0.23
210.3	8.03	11.5	8.5	238.7	3.1	72.0	0.33
238.6	11.54	15.5	8.5	232.8	3.9	80.2	0.39
292.1	15.52	20.4	8.5	226.5	4.2	88.9	0.40
610.3	20.39	30.6	8.5	215.6	4.2	102.2	0.41
750.1	30.56	43.1	8.5	201.7	4.2	113.0	0.41
1566.9	43.06	69.2	8.5	189.4	4.2	128.5	0.43
2400.4	69.17	109.2	8.5	177.9	4.2	144.8	0.45
3300.6	109.18	164.2	8.5	168.1	4.2	160.7	0.48
3384.1	164.19	220.6	8.5	160.7	4.2	173.1	0.50
2650.6	220.59	264.8	8.5	156.2	4.2	181.4	0.52
2947.2	264.77	313.9	8.5	153.5	4.2	189.7	0.54
3166.8	313.89	366.7	8.5	151.3	4.3	197.9	0.56
3000.1	366.67	416.7	8.5	149.5	4.3	205.1	0.58
3000.1	416.67	466.7	8.5	147.7	4.3	211.8	0.59
3000.1	466.67	516.7	8.5	145.9	4.3	218.1	0.61
3000.1	516.67	566.7	8.5	144.2	4.3	223.9	0.63
3000.1	566.67	616.7	8.5	142.9	4.3	229.5	0.65
3000.1	616.68	666.7	8.5	142.1	4.3	234.9	0.66
3000.1	666.68	716.7	8.5	141.4	4.3	240.1	0.68