MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 6.8

Issue #3 (AI 6-19.3)

The information in FSAR Subsection 6.8.4.5.7, “Chemical Effects,” does not provide enough information to describe the design basis for the chemical effects evaluation. Although the detailed description of the chemical effects analysis is in the GSI-191 technical report, revise FSAR Subsection 6.8.4.5.7 to:

- Identify the materials that potentially contribute to chemical effects and reference the FSAR sections that describe the source of these materials and how the amounts are controlled.

- Provide more description on the source materials being input to the WCAP-16530-NP-A, “Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191,” March 2008, (ADAMS No. ML081150379) spreadsheet used for calculating the material release rates and chemical precipitates and how the material quantities were specified to provide a conservative result.

Response

DCD Tier 2, Subsection 6.8.4.5.7 will be revised to identify materials that potentially contribute to chemical effects, and to reference other sections which describe the sources, amounts, and controls placed on those materials. A description of the source materials input to the WCAP-16530-NP-A spreadsheet, and how the material quantities used provide a conservative result, will also be added.

Impact on DCD

DCD Tier 2, Subsection 6.8.4.5.7 will be revised, as indicated in the attachment associated with this response.

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 Reports.

6.8.4.5.6 Vortexing, Flashing, and Deaeration

Vortexing, flashing and deaeration is one of the primary safety concerns about long-term recirculation cooling following a LOCA in RG 1.82 (Reference 3). Visual observation and analysis were conducted to verify the IRWST sump strainer performance.

For vortexing, visual observation during the strainer head loss test was performed at the submergence requirement of 0.61 m (2 ft) submergence and no vortices were observed. Additionally, there is no possibility to occur vortexing and air ingestion geometrically because the IRWST sump strainers are mounted at the top of the pit with the suction taken at the bottom of the pit.

For flashing, the strainer flashing requirement is conservatively met if the pressure drop across the debris bed is less than the submergence. Based on the IRWST minimum water level for ECC/CS pump NPSH, 0.61 m (2 ft) submergence under LOCA conditions is obtained and the maximum strainer head loss is 32.32 cm (1.06 ft) at 60 °C (140 °F) as result of the strainer head loss test. Therefore, flashing will not occur across the strainer surface.

For deaeration, the IRWST sump strainer submergence during post-LOCA is greater than the observed head loss under loss of coolant conditions. Since solubility of gas in water is directly proportional to the fluid pressure, the increase in solubility of air due to the static pressure increase of the water above the strainer is more than enough to compensate for the decrease in solubility of air due to the head loss across the strainer. Therefore, deaeration of fluid will not occur.

6.8.4.5.7 Chemical Effects

~~In order to assess potential chemical effects in the APR1400 sump, the materials in the containment building that may react with coolant in the post-accident containment environment have been identified. The primary corrosion products contributing to these chemical precipitates are calcium, silicon and aluminum, and the precipitates that can form are aluminum oxy-hydroxide, calcium phosphate and sodium aluminum silicate.~~

~~Surrogate suspensions of chemical precipitates representing this chemical debris can be included as an additional debris source to the strainer testing program to qualify the strainer for "chemical effects". The quantities of chemical precipitates are based on reactive material surface areas and quantities, temperature, water level, pH and other parameters related to the plant specific environment and postaccident evolution. The calculated result based on the WCAP-16530-NP (Reference 9) methodology referenced in RG 1.82 (Reference 3) is provided in Table 6.8-3.~~

The WCAP-16530-NP-A (Reference 9) referenced in NRC RG 1.82 (Reference 3) provides a conservative model to predict the corrosion and dissolution of containment materials in a post-LOCA environment and the formation of chemical precipitates for participating PWRs. The primary corrosion products contributing to these chemical precipitates are calcium, silicon, and aluminum, and the precipitates can form aluminum oxy-hydroxide, calcium phosphate, and sodium aluminum silicate. In addition, use of aluminum is described in Subsection 6.1.1.2.1.

Representative materials being input to the spreadsheet of WCAP-16530-NP-A (Reference 9) for producing the chemical precipitates are aluminum and concrete. Inputs for aluminum and concrete are conservatively considered to maximize the material release rates and chemical precipitates. The amounts of aluminum is assumed as actual amounts for all equipment plus margin. The concrete surface area is calculated using 10D ZOI instead of 4D. Detailed information is provided in Subsection 3.8.3 of Reference 4 and these amounts are programmatically controlled as described in Subsection 6.8.4.5.10.

The final precipitates produced from the spreadsheet of WCAP-16530-NP-A (Reference 9) are based on the reactive material surface areas and quantities, temperature, water level, pH, and other parameters related to the plant environment and post-accident evolution. Results are listed in Table 6.8-3.

Surrogate suspensions of chemical precipitates representing this chemical debris can be included as an additional debris source to the strainer testing program to qualify the strainer for chemical effects.

6.8.4.5.8 Upstream Effects

The evaluation of upstream effect is a review of the flow paths leading to the IRWST

pathways on the bottom floor of the containment, the debris will not clog these pathways. As a result of evaluation, no choke points that may block the flow paths of return water are identified. Therefore, only the hold-up volumes may challenge the minimum water level of the IRWST.

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 6.8

Issue #4 (AI 6-19.4)

The information in FSAR Subsection 6.8.4.5.7, “Chemical Effects,” does not provide enough information to understand the basis for FSAR Table 6.8-3 (“Design Basis Debris”) and the statement that, “The primary corrosion products contributing to these chemical precipitates are calcium, silicon and aluminum, and the precipitates that can form are aluminum oxy-hydroxide, calcium phosphate and sodium aluminum silicate.”

Revise FSAR Subsection 6.8.4.5.7 to justify this statement, for example by explaining that the WCAP-16530 methodology both identifies the contributing materials and calculates the amount of corrosion and chemical precipitation. In addition, revise FSAR Subsection 6.8.4.5.7 to reference the methodology as WCAP-16530-NP-A to indicate that it has been approved with a Safety Evaluation Report by the staff as an acceptable way to perform a conservative chemical effects analysis

Response

A description on the WCAP-16530 methodology will be provided in DCD Subsection 6.8.4.5.7 as a basis for the chemical effects evaluation. WCAP-16530-NP-A will be indicated as a reference. Please refer to the attachment associated with the response to AI 6-19.3.

Impact on DCD

DCD Tier 2, Subsection 6.8.4.5.7 will be revised, as indicated in the attachment associated with the response to Action Item 6-19.3.

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.

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 6.8

Issue #5 (AI 6-19.5)

The use of the term, “the plant specific environment and postaccident evolution,” in the second paragraph of FSAR Subsection 6.8.4.5.7 is potentially misleading because “plant-specific” usually refers to an individual operating plant. Since this paragraph is referring to the conditions for the standard plant design, the sentence should be revised accordingly.

Response

The word “specific” will be deleted. Please refer to the attachment associated with Action Item 6-19.3.

Impact on DCD

DCD Tier 2, Subsection 6.8.4.5.7 will be revised, as indicated in the attachment associated with the response to Action Item 6-19.3.

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.

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 6.8

Issue #6 (AI 6-19.6)

Section 3.8.2, paragraph “1” of the GSI-191 technical report states, “Using the maximum water volume ensures that the maximum material dissolution and quantity of precipitates are analyzed.”

Revise the report to provide the justification for this statement. For example, was the chemical effects calculation run with different water volumes to assess the effect of water volume?

Response

The maximum IRWST water volume is used instead of effective water volume (recirculating water volume) to maximize the material dissolution and quantity of precipitates for the chemical effects. The technical report will be revised to indicate this.

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, Section 3.8.2 will be revised as indicated in the attachment associated with this response.

3.8 Chemical Effects

In order to assess potential chemical effects in the APR1400 sump, the materials that are in the containment building that may react with coolant in the post-accident containment environment have been identified. Reactive plant materials in the containment building are categorized as metallic and non-metallic items and generally include insulation and concrete, as well as other potential sources of aluminum. The materials inventory includes the overall mass, location in containment and potential for being sprayed with or immersed in coolant following a LOCA.

The WCAP-16530-NP methodology (Reference [3-11]) referenced in NRC RG 1.82 (Reference [1-1]) provides a conservative model to predict the corrosion and dissolution of containment materials in a post-LOCA environment and the formation of chemical precipitates for participating PWRs. The primary corrosion products contributing to these chemical precipitates are calcium, silicon, aluminum, and the precipitates that can form aluminum oxy-hydroxide, calcium phosphate, and sodium aluminum silicate. Surrogate suspensions of chemical precipitates representing this chemical debris can be included as an additional debris source to the strainer testing program to qualify the strainer for “chemical effects.” The quantities of chemical precipitates are based on reactive material surface areas and quantities, temperature, water level, pH, and other parameters related to the plant specific environment and post-accident evolution.

3.8.1 Containment Spray pH Control

The pH of IRWST water is evaluated to provide reasonable assurance that the calculated minimum and maximum pH values under any possible water chemistry conditions caused by a LOCA are between 7.0 and 8.5. The calculated minimum and maximum IRWST pH during operation of the CSS is 7 and 10, respectively. The minimum time to reach a minimum pH of 7.0 is 157 minutes, as shown in Figure 3.8-1. The IRWST pH ranges are included in Table 3.8-1.

3.8.2 Assumptions

1) ~~The maximum IRWST water volume is used for the chemical effects analysis. Using the maximum water volume ensures that the maximum material dissolution and quantity of precipitates are analyzed~~.

2) Temperature data is only available from zero to 1,000,000 seconds post-LOCA. Since the mission time is 30 days (2,592,000 seconds), the containment air temperature and IRWST temperatures are extrapolated using a logarithmic fit of the last 9 days of available temperature data to predict the containment air and IRWST temperatures from 1,000,000 seconds to 2,592,000 seconds. This time period is chosen due to the consistently logarithmic temperature decrease for the entire time period.

3) The maximum IRWST and spray pH profile is used to conservatively maximize dissolution and precipitate generation.

4) The minimum ECCS flow case is used because it results in the highest sump temperatures, and therefore the highest corrosion rate of reactive materials in the sump. Both the minimum and maximum ECCS flow cases result in the comparable containment air temperature profiles.

The maximum IRWST water volume is used instead of effective water volume (recirculating water volume) to maximize the material dissolution and quantity of precipitates for the chemical effects. The WCAP-16530-NP-A methodology is used.

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 6.8

Issue #7 (AI 6-19.7)

Section 3.8.2, paragraph “3)” of the GSI-191 technical report states, “The maximum IRWST and spray pH profile is used to conservatively maximize dissolution and precipitate generation.”

Revise the report to explain how “maximum pH profile” was defined and determined, and explain how this pH profile ensured maximum dissolution and precipitate generation.

Response

For the short-term DBA condition, the RCS pH design limit (between 4.2 and 10.7) listed in Table 5.2-5 of the DCD (Reference [3-1]) is conservatively used to maximize dissolution and precipitate generation. For the long-term DBA condition, the pH of the IRWST water was evaluated and the evaluation shows that the pH range is maintained between 7.0 and 8.5. The pH ranges and the evaluation results will be revised in Table 3.8-1 and Table 3.8-5, respectively. For changes to Tables 3.8-1 and 3.8-5, please refer to the attachment associated with Action Item 6-19.8.

Therefore, the maximum pH values of 10.7 for short-term DBA and 8.5 for long-term DBA are conservatively used because total dissolution and precipitate generation increase as pH increases, as shown in Figure 6.5-5 of WCAP-16530-NP-A (Reference [3-11]). Section 3.8.2, paragraph “3)” will be revised as indicated in the attachment associated with Action Item 6-19.8.

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, Section 3.8.1 and 3.8.2, and Tables 3.8-1 and 3.8-5 will be revised as indicated in the attachment associated with the response to Action Item 6-19.8.

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 6.8

Issue #8 (AI 6-19.8)

The pH of the post-loss-of-coolant-accident (LOCA) water is not clear to the staff. Section 3.8.1 (“Containment Spray pH Control”) of the GSI-191 technical report contains the following statements:

- “…the calculated minimum and maximum pH values under any possible water chemistry conditions caused by a LOCA are between 7.0 and 8.5.”
- “The calculated minimum and maximum IRWST pH during operation of the CSS is 7 and 10, respectively…The IRWST pH ranges are included in Table 3.8-1.”

Report Table 3.8-1 lists the following post-LOCA pH values:

- pH between 4 and 10 for short-term design-basis accident (DBA) (up to 4 hours)
- pH between 7.2 and 8.5 for long-term DBA (4 hours to 30 days)

Report Table 3.8-5, which summarizes the chemical precipitate calculation, shows a pH value of 10 after 2 minutes and a minimum value of 8.5 from 4 hours to 30 days.

Some of these statements appear to be contradictory. For example, it is not clear how there can be a pH value of 10 if the minimum and maximum values under any possible conditions are 7.0 and 8.5. Clarify the descriptions of the pH values given in the GSI-191 technical report and explain how the pH transient represented in report Table 3.8-5 was derived.

Response

For the short-term DBA condition, the RCS pH design limit (between 4.2 and 10.7) listed in Table 5.2-5 of the DCD (Reference [3-1]) is conservatively used to maximize dissolution and precipitate generation. For the long-term DBA condition, the pH of the IRWST water was evaluated and the evaluation shows that the pH range is maintained between 7.0 and 8.5. The pH ranges and the evaluation results will be revised in Table 3.8-1 and Table 3.8-5, respectively.

Statements in Sections 3.8.1 and 3.8.2 of the TeR will be revised to clarify the containment spray pH control and it’s assumptions.

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

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 6.8

Sections 3.8.1 and 3.8.2, and Tables 3.8-1 and 3.8-5 of APR1400-E-N-NR-14001-P/NP will be revised, as indicated in the attachment associated with this response.

AI 6-19_6.8_#8

Attachment (1/3)

3.8 Chemical Effects

In order to assess potential chemical effects in the APR1400 sump, the materials that are in the containment building that may react with coolant in the post-accident containment environment have been identified. Reactive plant materials in the containment building are categorized as metallic and non-metallic items and generally include insulation and concrete, as well as other potential sources of aluminum. The materials inventory includes the overall mass, location in containment and potential for being sprayed with or immersed in coolant following a LOCA.

The WCAP-16530-NP methodology (Reference [3-11]) referenced in NRC RG 1.82 (Reference [1-1]) provides a conservative model to predict the corrosion and dissolution of containment materials in a post-LOCA environment and the formation of chemical precipitates for participating PWRs. The primary corrosion products contributing to these chemical precipitates are calcium, silicon, aluminum, and the precipitates that can form aluminum oxy-hydroxide, calcium phosphate, and sodium aluminum silicate. Surrogate suspensions of chemical precipitates representing this chemical debris can be included as an additional debris source to the strainer testing program to qualify the strainer for “chemical effects.” The quantities of chemical precipitates are based on reactive material surface areas and quantities, temperature, water level, pH, and other parameters related to the plant specific environment and post-accident evolution.

The results of the calculations show that the time required to reach a pH of 7.0 for the minimum pH condition is estimated to be 157 minutes after the onset of a LOCA, as shown in Figure 3.8-1.

3.8.1 Containment Spray pH Control

The pH of IRWST water is evaluated to provide reasonable assurance that the calculated minimum and maximum pH values under any possible water chemistry conditions caused by a LOCA are between 7.0 and 8.5. ~~The calculated minimum and maximum IRWST pH during operation of the CSS is 7 and 10, respectively.~~ ~~The minimum time to reach a minimum pH of 7.0 is 157 minutes, as shown in Figure 3.8-1.~~ The IRWST pH ranges are included in Table 3.8-1.

3) For short-term DBA condition, the RCS pH design limit (between 4.2 and 10.7) listed in Table 5.2-5 of the DCD (Reference [3-1]) is conservatively used to maximize dissolution and precipitate generation.

3.8.2 Assumptions

1) The maximum IRWST water volume is used for the chemical effects analysis. Using the maximum water volume ensures that the maximum material dissolution and quantity of precipitates are analyzed.

2) Temperature data is only available from zero to 1,000,000 seconds post-LOCA. Since the mission time is 30 days (2,592,000 seconds), the containment air temperature and IRWST temperatures are extrapolated using a logarithmic fit of the last 9 days of available temperature data to predict the containment air and IRWST temperatures from 1,000,000 seconds to 2,592,000 seconds. This time period is chosen due to the consistently logarithmic temperature decrease for the entire time period.

~~3)~~ ~~The maximum IRWST and spray pH profile is used to conservatively maximize dissolution and precipitate generation.~~

5) ~~4)~~ The minimum ECCS flow case is used because it results in the highest sump temperatures, and therefore the highest corrosion rate of reactive materials in the sump. Both the minimum and maximum ECCS flow cases result in the comparable containment air temperature profiles.

4) The maximum IRWST and spray pH values of 10.7 for short-term DBA and 8.5 for long-term DBA from Table 3.8-1 are conservatively used because total dissolution and precipitate generation increase as pH increases, as shown in Figure 6.5-5 of Reference [3-11].

Table 3.8-1 Post-LOCA IRWST Chemistry

Short-Term DBA (Accident Initiation up to 4 hours)	Long-Term DBA (4 hours up to 30 days)
• 4,400 ppm boron as H_3BO_3 • 0 - 50 ppm hydrazine as N_2H_4 • ~~4~~ 4.2 ≤ pH ≤ ~~10~~ 10.7	• 4,400 ppm boron as H_3BO_3 • 0 - 50 ppm hydrazine as N_2H_4 • ~~7.2~~ 7.0 ≤ pH ≤ 8.5 • Tri-sodium phosphate as buffering agent

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	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 10.7	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~~ 0.1	13.6	0.01
22.9	0.71	1.1	10	183.1	0.1	20.0	0.02
76.1	1.09	2.4	10	202.2	0.3 0.4	38.7	0.05
98.4	2.36	4.0	10	222.6	0.8 1.0	~~58.6~~ 58.5	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 1.8	69.9	~~0.20~~ 0.21
210.9	8.03	11.5	8.5	235.0	2.3 2.5	77.6 77.5	0.30
237.8	11.55	15.5	8.5	229.4	3.0 3.3	84.4 84.3	0.39
291.4	15.51	20.4	8.5	221.6	3.8 4.0	90.8	0.40
617.2	20.37	30.7	8.5	209.7	4.2	100.5	0.40
746.4	30.66	43.1	8.5	~~196.2~~ 196.1	4.2	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

Delete this row for AI 6-19.11.

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 6.8

Issue #9 (AI 6-19.9)

In the GSI-191 technical report, the chemical effects analysis includes both aluminum and concrete that is unsubmerged. Since corrosion of the unsubmerged materials is a result of containment spray system (CSS) operation, revise the report to clarify the operating time of the CSS used in the analysis and how it was determined to be conservative with respect to chemical precipitation.

Response

Even though there is unsubmerged aluminum and concrete in containment, it is conservatively assumed that the materials are submerged to maximize chemical precipitate generation. Technical report Section 3.8.2 will be revised to include this assumption.

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, Section 3.8.2 will be revised as indicated in the attachment associated with this response.

3.8 Chemical Effects

In order to assess potential chemical effects in the APR1400 sump, the materials that are in the containment building that may react with coolant in the post-accident containment environment have been identified. Reactive plant materials in the containment building are categorized as metallic and non-metallic items and generally include insulation and concrete, as well as other potential sources of aluminum. The materials inventory includes the overall mass, location in containment and potential for being sprayed with or immersed in coolant following a LOCA.

The WCAP-16530-NP methodology (Reference [3-11]) referenced in NRC RG 1.82 (Reference [1-1]) provides a conservative model to predict the corrosion and dissolution of containment materials in a post-LOCA environment and the formation of chemical precipitates for participating PWRs. The primary corrosion products contributing to these chemical precipitates are calcium, silicon, aluminum, and the precipitates that can form aluminum oxy-hydroxide, calcium phosphate, and sodium aluminum silicate. Surrogate suspensions of chemical precipitates representing this chemical debris can be included as an additional debris source to the strainer testing program to qualify the strainer for “chemical effects.” The quantities of chemical precipitates are based on reactive material surface areas and quantities, temperature, water level, pH, and other parameters related to the plant specific environment and post-accident evolution.

3.8.1 Containment Spray pH Control

The pH of IRWST water is evaluated to provide reasonable assurance that the calculated minimum and maximum pH values under any possible water chemistry conditions caused by a LOCA are between 7.0 and 8.5. The calculated minimum and maximum IRWST pH during operation of the CSS is 7 and 10, respectively. The minimum time to reach a minimum pH of 7.0 is 157 minutes, as shown in Figure 3.8-1. The IRWST pH ranges are included in Table 3.8-1.

3.8.2 Assumptions

1) The maximum IRWST water volume is used for the chemical effects analysis. Using the maximum water volume ensures that the maximum material dissolution and quantity of precipitates are analyzed.

2) Temperature data is only available from zero to 1,000,000 seconds post-LOCA. Since the mission time is 30 days (2,592,000 seconds), the containment air temperature and IRWST temperatures are extrapolated using a logarithmic fit of the last 9 days of available temperature data to predict the containment air and IRWST temperatures from 1,000,000 seconds to 2,592,000 seconds. This time period is chosen due to the consistently logarithmic temperature decrease for the entire time period.

3) The maximum IRWST and spray pH profile is used to conservatively maximize dissolution and precipitate generation.

4) The minimum ECCS flow case is used because it results in the highest sump temperatures, and therefore the highest corrosion rate of reactive materials in the sump. Both the minimum and maximum ECCS flow cases result in the comparable containment air temperature profiles.

6) Aluminum and concrete which are not submerged are conservatively assumed to be submerged to maximize chemical precipitate generation.

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 6.8

Issue #10 (AI 6-19.10)

According to GSI-191 technical report Table 3.8-2, “Material Potentially Produced Corrosion Products”, a 10% margin is included in the duct insulation area to conservatively account for uncertainty. Revise the report to describe how 10% was determined to be a conservative value

Response

10% margin of duct insulation area is for future detailed design to deal with uncertainty. It is just based on the engineering judgment.

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, Table 3.8-2 will be revised as indicated in the attachment associated with this response.

Table 3.8-2 Material Potentially Produced Corrosion Products

Material	Submerged Pool Zone (m^2 / ft^2)	Un-submerged Spray Zone (m^2 / ft^2)	Remark
1. Concrete	193.89 / 2,087	674.20 / 7,257	
2. Aluminum	N/A	216.09 / 2,326	
• HVAC Equipment - 4 Reactor Containment Fan Coolers - 4 SG Enclosure Recirculation Fans - 4 Annulus Area Recirculation Fans - Duct Insulation	N/A	154.87 / 1,667 (1)	
• Ex-core Detectors	N/A	0.25 / 2.67	
• Refueling Equipment	N/A	12.08 / 130	
• CEDM Cooling Fan	N/A	23.24 / 250.2	
• Surveillance Capsule - Retrieval Tool - Remote Positioning Tool	N/A	22.30 / 240	
• POSRV SIEKA-Actuators	N/A	3.36 / 36.2	

Note :

(1) Considering uncertainty of duct insulation area, 10% margin is added.

based on the engineering judgment.

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 6.8

Issue #11 (AI 6-19.11)

In the GSI-191 technical report, the chemical effects results table, Table 3.8-5, contains a time interval at four hours with no duration. Revise the technical report to explain the reason for performing the calculation this way and how it affects the results.

Response

The time interval at four hours with no duration indicates a dummy for the change of pH from the short-term DBA condition to the long-term DBA condition and has no effects on the results. Therefore, the row with no duration will be deleted form Table 3.8-5 of the TeR.

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, Table 3.8-5 will be revised as indicated in the attachment associated with Action Item 6-19.8.