KHNPDCDRAIsPEm Resource

From: Ciocco, Jeff
Sent: Monday, November 16, 2015 1:53 PM
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Cc: Yeshnik, Andrew; Mitchell, Matthew; Wunder, George; Umana, Jessica; Lee, Samuel
Subject: APR1400 Design Certification Application RAI 314-8378 (10.03.06 - Steam and Feedwater System Materials)
Attachments: APR1400 DC RAI 314 MCB 8378.pdf

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests, and we grant, the following days to respond to this RAI. We may adjust the schedule accordingly.

10.03.06-1: 30 days
10.03.06-2: 30 days
10.03.06-3: 30 days
10.03.06-4: 30 days
10.03.06-5: 30 days
10.03.06-6: 30 days
10.03.06-7: 30 days
10.03.06-8: 30 days
10.03.06-9: 30 days
10.03.06-10: 30 days
10.03.06-11: 45 days
10.03.06-12: 45 days
10.03.06-13: 45 days
10.03.06-14: 45 days
10.03.06-15: 45 days
10.03.06-16: 45 days
10.03.06-17: 45 days

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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United States Nuclear Regulatory Commission
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REQUEST FOR ADDITIONAL INFORMATION 314-8378

Issue Date: 11/16/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 10.03.06 - Steam and Feedwater System Materials
Application Section: 10.3.6

QUESTIONS

10.03.06-1

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 1 and 30; and 10 CFR Part 50.55a contain provisions regarding quality standards for material specifications that are met by compliance with the applicable provisions of the ASME Boiler and Pressure Vessel Code (ASME Code) and by acceptable application of materials Code Cases as described in Regulatory Guide (RG) 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III." Specifications for permitted materials are identified in the ASME Code, Section III, Appendix I, or described in detail in the ASME Code, Section II.

In FSAR Section 10.3.6.2, on page 10.3-25, the applicant states:

a. The materials that are used are included in Appendix I of the ASME Section III and conform with Parts A, Parts B, and Parts C of ASME Section II (Reference 11) and NRC RG 1.84 (Reference 12).

The staff has three issues this statement:

1. RG 1.84 contains a list of ASME Code Cases that the NRC finds acceptable or Code Cases that the NRC accepts with conditions. FSAR Section 10.3.6, including Tables 10.3.2-2, 10.3.2-3, and 10.3.2-4, does not provide information on which Code Cases the applicant intends to utilize.

   Provide the Code Cases specified in RG 1.84 that will apply to the APR1400 design, and include whether all the conditions for conditionally approved Code Cases in RG 1.84 will be utilized.

2. The statement above only requires the materials to meet the requirements of the fatigue table in ASME Code Section III and the requirements of ASME Code Section II. This statement does not meet 10 CFR 50.55a(d) and 50.55a(e) which requires that Quality Group B and C components meet the requirements of the ASME Code, including Article NC/ND-2000. The staff recommends the following modification to the paragraph above as follows:

   a. The materials that are used conform to ASME Section III including Appendix I and Part A, Part B, and Part C of ASME Section II (Reference 11) and NRC RG 1.84 (Reference 12).

3. The statement that materials conform to "…Part B… of ASME Section II" is not consistent with Tables 10.3.2-2, 10.3.2-3, and 10.3.2-4 because the tables contain only ferritic materials. ASME Code Section II, Part B addresses nonferrous material specifications. Provide a list of components that are fabricated with material specifications contained in ASME Code Section II-B or delete "Part B" from the FSAR paragraph above.

10.03.06-2

Title 10 of the Code of Federal Regulations (10 CFR) Part 50.65 requires monitoring of the condition and operation of Structures, Systems, and Components (SSCs) to ensure that they are capable of maintaining their intended function. The functions are established from design goals which are based on operating experience. The requirements of 10 CFR 50.65 are applicable to non-safety systems "whose failure could cause a reactor scram or actuation of a safety-related system;" a main steam-line or feed-line break would result in an Engineered Safety Feature (ESF) actuation. Generic Letter (GL) 89-08. "Erosion/Corrosion-Induced Pipe Wall Thinning," defined a Flow Accelerated Corrosion (FAC) program that would meet the requirements of 10 CFR 50.65 for secondary, non-safety related systems.

In FSAR Section 10.3.6.2, on page 10.3-25, the applicant states:

Oxygen-induced corrosion is minimized by providing the following component materials:
a. Steam reheater tubes are ferritic stainless steel or equivalent.
b. Feedwater heater tubes are type 304L stainless steel with carbon steel tube sheets.
c. Main steam piping, hot reheat piping, condensate piping, feedwater piping, and heater drain piping upstream of the drain control valves are carbon steel or equivalent.

The use of carbon steel in a piping system is not an effective tool in minimizing oxygen-induced corrosion. Therefore, delete item c.

In addition, for FSAR Section 10.3.6.2 a., the provision "or equivalent" is vague and not acceptable. The overall design of the APR1400 must be complete in order for the staff to make a reasonable assurance requirement. Provide additional information defining the scope of what materials may be deemed "equivalent" and the basis of how equivalency would be defined or revise the FSAR Section 10.3.6.2 to remove the "or equivalent" provision from the last sentence as noted below:

a. Steam reheater tubes are ferritic stainless steel.
b. Feedwater heater tubes are type 304L stainless steel.

10.03.06-3

Title 10 of the Code of Federal Regulations (10 CFR) Part 50.65 requires monitoring of the condition and operation of Structures, Systems, and Components (SSCs) to ensure that they are capable of maintaining their intended function. The functions are established from design goals which are based on operating experience. The requirements of 10 CFR 50.65 are applicable to non-safety systems "whose failure could cause a reactor scram or actuation of a safety-related system;" a main steam-line or feed-line break would result in an Engineered Safety Feature (ESF) actuation. Generic Letter (GL) 89-08. "Erosion/Corrosion-Induced Pipe Wall Thinning," defined a Flow Accelerated Corrosion (FAC) program that would meet the requirements of 10 CFR 50.65 for secondary, non-safety related systems.

In FSAR Section 10.3.6.3, on page 10.3-27, the applicant states:

Most of the piping on the steam and feedwater systems is made of carbon steel. Materials for the piping portions that are extremely susceptible to FAC are installed using an FAC-resistant alloy such as Cr-Mo steel.

And

b. As shown in Table 10.3.2-4, the main feedwater piping from the main feedwater isolation valve (MFIV) in the MSVH to SGs and the piping downstream of downcomer feedwater control valves are made of high-content chrome-moly materials. This portion of the feedwater system is potentially susceptible to FAC, and the design specifications require FAC-resistant piping materials as described above. Other feedwater system piping is generally made of carbon steel with 1.524 mm (0.06 in) additional margin in design.

The material specifications for the piping systems are contained in FSAR Tables 10.3.2-2, 10.3.2-3, and 10.3.2-4. The staff notes that there are no components with material specifications and grades consistent with Cr-Mo steels in FSAR Tables 10.3.2-2 and 10.3.2-3.

1. The only components susceptible to FAC are those contained in Table 10.3.2-4 (namely, piping and components in the feedwater systems that are downstream of the feedwater control valves). Confirm that Table 10.3.2-4 includes all systems where FAC is mitigated by material selection or update Tables 10.3.2-2, 10.3.2-3, and 10.3.2-4 as necessary.

2. The staff reviewed the OECD/NEA Piping Failure Database which documents failures of the following components and systems over the last 40 years. The staff noted the following number of events of FAC:

- 165 FAC instances in the Feedwater system
  - 127 FAC instances in the Feedwater system (not including the auxiliary feedwater, the condenser, or heater drain/vent systems)
  - 59 FAC instances of Feedwater components that are not ASME Section III components.
- 191 FAC instances in the Main Steam system
  - 46 FAC instances in the Main Steam Line (not including the Moisture Separator Reheater or Extraction Steam systems)
  - 50 FAC instances in the Moisture Separator Reheater systems

- 93 FAC instances in the Extraction Steam system

Tables 10.3.2-2, 10.3.2-3, and 10.3.2-4 do not utilize chrome-moly steels for the majority of piping and components of the secondary system. The significant use of chrome-moly steels is downstream of the feedwater control and isolation valves and in the extraction steam system. As stated above, there are significant amounts of operating events where FAC has occurred in the Main Steam system or in components in the Feedwater system KHNP chooses to use carbon steel for (Moisture Separator Reheater system not covered by extraction steam, Feedwater components before the control valves, etc.).

Provide justification for the use of carbon steel piping and components considering the failures that have occurred in the same systems that have used carbon steel at other nuclear power plants. The justification may include, but is not limited to, the recommendations in NSAC-202L, Section 4.2 (which describes a Susceptibility Analysis and rationale for exclusion criteria).

10.03.06-4

Title 10 of the Code of Federal Regulations (10 CFR) Part 50.65 requires monitoring of the condition and operation of Structures, Systems, and Components (SSCs) to ensure that they are capable of maintaining their intended function. The functions are established from design goals which are based on operating experience. The requirements of 10 CFR 50.65 are applicable to non-safety systems “whose failure could cause a reactor scram or actuation of a safety-related system;” a main steam-line or feed-line break would result in an Engineered Safety Feature (ESF) actuation. Generic Letter (GL) 89-08. “Erosion/Corrosion-Induced Pipe Wall Thinning,” defined a Flow Accelerated Corrosion (FAC) program that would meet the requirements of 10 CFR 50.65 for secondary, non-safety related systems. GL 89-08 states that a FAC program meeting all the requirements of EPRI NSAC-202L-R2 would be meet the produce reasonable assurance that adequate protection could be achieved.

In FSAR Section 10.3.6.3, on page 10.3-27, the applicant states:

> The following piping portions with potential for FAC are generally based on NSAC-202L-R3 (Reference 17) and NUREG-1344 (Reference 18) attached to GL 89-08 (References 19).
>
> a. For other safety/non-safety carbon steel piping with relatively mild FAC degradation identified in NUREG-1344 attached to GL 89-08, NSAC-202L-R3, and through experience, the average thinning rates of 2.54 × 10-6 mm/hr (0.1 × 10-6 in/hr) in steam system and 4.35 × 10-6 mm/hr (0.17 × 10-6 in/hr) in the water system are given based on the actual measurement records from Korea standard nuclear plants. The additional thickness of 0.889 mm (0.035 in) for the portion of steam system piping, and 1.524 mm (0.06 in) for the portion of water system piping in design are applied in consideration of the 40 years of design life.

The staff seeks information on the FAC program that is “generally based on NSAC-202L-R3” and FAC measurements on Korean standard nuclear power plants.

Specifically, the applicant should address the following:

1. Describe the Korea Hydro and Nuclear Power (KHNP) FAC program and how the program deviates from NSAC-202L.
2. How are the actual measurement records of wear from the standard nuclear power plants representative and bounding of the APR1400 design?
3. What are the differences in coolant conditions between the APR1400 and the “Korean standard design plants” in terms of material specifications, steam/feedwater flow, water chemistry, and temperatures? If there are differences in the coolant conditions for the APR1400 as built condition compared to the existing Korean standard design plants, discuss the impact of the different coolant conditions on the erosion rate described above in FSAR Section 10.3.6.3 a.

10.03.06-5

Title 10 of the Code of Federal Regulations (10 CFR) Part 50.65 requires monitoring of the condition and operation of Structures, Systems, and Components (SSCs) to ensure that they are capable of maintaining their intended function. The functions are established from design goals which are based on operating experience. The requirements of 10 CFR 50.65 are applicable to non-safety systems “whose failure could cause a reactor scram or actuation of a safety-related system;” a main steam-line or feed-line break would result in an Engineered Safety Feature (ESF) actuation. Generic Letter (GL) 89-08. “Erosion/Corrosion-Induced Pipe Wall Thinning,” defined a Flow Accelerated Corrosion (FAC) program that would meet the requirements of 10 CFR 50.65 for secondary, non-safety related systems.

In FSAR Section 10.3.6.3, page 10.3-28, the applicant states:

f. The entire portion of extraction steam piping is made of chrome-moly materials

Item f is prefaced by: "the following piping portions with potential for FAC are generally based on NSAC-202L-R3 and NUREG-1344 attached to GL 89-08." As such, the staff interprets that a chrome-moly steel is necessary to prevent FAC in this system.

In FSAR Table 10.3.2-3 the applicant states:

Main steam piping to moisture separator reheater	A106 Gr. B (seamless)	250 (10), 300 (12)	B31.1
Fittings	ASTM A-234, WPB	250 (10), 300 (12)	
Flanges	ASTM A-105	80 (3) and larger	
Valves (globe, gate, check)	ASTM A-216, WCB or WCC	65 (2.5) ~ 650 (26)	
HP turbine to moisture separator reheater	A588 Gr. C (welded)	1,050 (42)	B31.1
Moisture separator reheater to LP turbine	A588 Gr. C (welded)	1,050 (42)	B31.1
Fittings	ASTM A-234, WPB	1,050 (42)	

In Section 10.3.6.3, the DCD states that the extraction steam system is fabricated from chrome-moly steel. Table 10.3.2-3 has the extraction steam system made from "weathering steel" (A-588 Gr C) which contains no molybdenum.

Revise FSAR Section 10.3.6.3 and/or Table 10.3.2-3 to be consistent.

10.03.06-6

Title 10 of the Code of Federal Regulations (10 CFR) Part 50.65 requires monitoring of the condition and operation of Structures, Systems, and Components (SSCs) to ensure that they are capable of maintaining their intended function. The functions are established from design goals which are based on operating experience. The requirements of 10 CFR 50.65 are applicable to non-safety systems "whose failure could cause a reactor scram or actuation of a safety-related system;" a main steam-line or feed-line break would result in an Engineered Safety Feature (ESF) actuation. Generic Letter (GL) 89-08. "Erosion/Corrosion-Induced Pipe Wall Thinning," defined a Flow Accelerated Corrosion (FAC) program that would meet the requirements of 10 CFR 50.65 for secondary, non-safety related systems.

In FSAR Section 10.3.6.3, on page 10.3-27, the applicant states:

Most of the piping on steam and feedwater systems is made of carbon steel. Materials for the piping portions that are extremely susceptible to FAC are installed using an FAC- resistant alloy such as Cr-Mo steel.

And

c. SG blowdown piping from SG to the blowdown flash tank is made of chrome-moly materials. FAC-susceptible portions are made of stainless steel;

The staff believes this might be a translation error. If so, delete the word "extremely."

If this is not a translation error: provide the staff with a justification why "extremely susceptible" portions of steam and feedwater piping use Cr-Mo steel, while FAC-susceptible portions of the SG blowdown piping use stainless steel, which is more resistant to FAC than Cr-Mo steel.

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10.03.06-7

Title 10 of the Code of Federal Regulations (10 CFR) Part 52.6 requires that information submitted as part of a standard design certification under 10 CFR Part 52 shall be complete and accurate in all material respects.

Title 10 of the Code of Federal Regulations (10 CFR) Part 50.65 requires monitoring of the condition and operation of Structures, Systems, and Components (SSCs) to ensure that they are capable of maintaining their intended function. The functions are established from design goals which are based on operating experience. The requirements of 10 CFR 50.65 are applicable to non-safety systems “whose failure could cause a reactor scram or actuation of a safety-related system;” a main steam-line or feed-line break would result in an Engineered Safety Feature (ESF) actuation. Generic Letter (GL) 89-08. “Erosion/Corrosion-Induced Pipe Wall Thinning,” defined a Flow Accelerated Corrosion (FAC) program that would meet the requirements of 10 CFR 50.65 for secondary, non-safety related systems.

In FSAR Table 10.3.2-3 the applicant states:

HP turbine to moisture separator reheater	A588 Gr. C (welded)	1,050 (42)	B31.1
Moisture separator reheater to LP turbine	A588 Gr. C (welded)	1,050 (42)	B31.1

ASME Code B31.1 (2014), “Power Piping” Subsection 123.1 states that materials used for construction must be listed in Mandatory Appendix A of B31.1. Additionally, ASME Code B31.1 subparagraph 123.2.2 states that “Boiler External Piping” may be constructed out of materials that are acceptable per Mandatory Appendix A or ASME Code Section I as long as the material is also listed in ASME Code Section II-D.

Contrary to requirements of ASME B31.1, materials meeting the specification of ASTM A588 “Standard Specification For High-Strength Low-Alloy Structural Steel, Up to 50 ksi [345 Mpa] Minimum Yield Point, With Atmospheric Corrosion Resistance” are not listed in Appendix A of ASME B31.1 and are not listed in ASME Section II-D. Revise FSAR Table 10.3.2-3 to use material that is listed in Appendix A of ASME B31.1 or ASME Code Section II-D or provide more information on the selection of this material.

The information should include a justification for using commercial structural steel for power plant applications, operating experience with this material in power plant applications, deterioration mechanisms of this material in steam power conversions systems, information on the quality assurance that will be associated with this component. It is important to note that the steam in these systems will not be "high quality" and FAC will need to be addressed.

10.03.06-8

Title 10 of the Code of Federal Regulations (10 CFR) Part 52.6 requires that information submitted as part of a standard design certification under 10 CFR Part 52 shall be complete and accurate in all material respects.

Table 10.3.2-1, on page 10.3-32, states:

Main Steam Isolation Valves (MSIVs)	
Valve type	EH (electro-hydraulic)
Valve size, mm (in)	813 (32)
Number of MSSVs per main steam line	1
Total number of MSSVs	4

Revise this table to state “MSIV” instead of “MSSV” where appropriate to correct the typographical error.

10.03.06-9

Title 10 of the Code of Federal Regulations (10 CFR) Part 50.65 requires monitoring of the condition and operation of Structures, Systems, and Components (SSCs) to ensure that they are capable of maintaining their intended function. The functions are established from design goals which are based on operating experience. The requirements of 10 CFR 50.65 are applicable to non-safety systems "whose failure could cause a reactor scram or actuation of a safety-related system;" a main steam-line or feed-line break would result in an Engineered Safety Feature (ESF) actuation. Generic Letter (GL) 89-08. "Erosion/Corrosion-Induced Pipe Wall Thinning," defined a Flow Accelerated Corrosion (FAC) program that would meet the requirements of 10 CFR 50.65 for secondary, non-safety related systems.

In FSAR Section 10.3.6.3, on page 10.3-27, the applicant states:

> As shown in Table 10.3.2-4, the main feedwater piping from the main feedwater isolation valve (MFIV) in the MSVH to SGs and the piping downstream of downcomer feedwater control valves are made of high-content chrome-moly materials.

In FSAR Table 10.3.2-4 the applicant has the following information on this material:

MFIV to SG	SA-335 Gr. P22 (seamless)	150 (6), 250 (10), 350 (14), 600 (24)	Section III, Class 2
Fittings	SA-420 WPL6, SA-234 WP22	150 (6), 250 (10), 350 (14), 600 (24)	
Flanges	SA-350 LF2, SA-182 F22	150 (6) ~ 600 (24)	
Valves (globe, gate, check)	SA-182 F22 or SA-217 WC9, SA-350 LF2	150 (6) ~ 600 (24)	

Material specifications ASME SA-420 WPL6 and SA-350 LF2 are not chrome-moly steels. Material specifications ASME SA-182 F22 and SA-217 WC9 are chrome-moly steels. As written, Table 10.3.2-4 allows for fittings and flanges to be used that are not consistent with the paragraph on FSAR page 10.3-27.

Revise FSAR to address this inconsistency.

10.03.06-10

Title 10 of the Code of Federal Regulations (10 CFR) Part 50.65 requires monitoring of the condition and operation of Structures, Systems, and Components (SSCs) to ensure that they are capable of maintaining their intended function. The functions are established from design goals which are based on operating experience. The requirements of 10 CFR 50.65 are applicable to non-safety systems "whose failure could cause a reactor scram or actuation of a safety-related system;" a main steam-line or feed-line break would result in an Engineered Safety Feature (ESF) actuation. Generic Letter (GL) 89-08. "Erosion/Corrosion-Induced Pipe Wall Thinning," defined a Flow Accelerated Corrosion (FAC) program that would meet the requirements of 10 CFR 50.65 for secondary, non-safety related systems.

In FSAR Section 10.3.7, on page 10.3-29, the applicant states:

> COL 10.3(3) The COL applicant is to provide a description of the FAC monitoring program for carbon steel portions of the steam and power conversion systems that contain water or wet steam and are susceptible to erosion- corrosion damage. The description is to address consistency with GL 89-08 and NSAC-202L-R3 and provide a milestone schedule for implementation of the program.

In FSAR Section 10.3.6.3 the applicant describes the FAC program as being based on NSAC-202L-R3, but modified by operating experience from Korean standard design nuclear power plants.

1. The statement “monitoring program for carbon steel portions of the steam and power conversation systems…” inappropriately narrows the scope of the FAC program. NSAC-202L, Section 4.2.2 provides recommendations for excluding lines; the guidance states that it is inappropriate to exclude stainless steel or chrome-moly lines under certain conditions (the line contains some carbon steel piping or components or a wear mechanism has not been identified). The staff recommends that the statement “carbon steel portions of” be removed from the COL items. Otherwise, provide an explanation on how the APR-1400 design meets all the provisions of NSAC-202L, Section 4.2.2.

2. Would a COL applicant using the APR1400 design have a FAC program that is consistent with the KHNP FAC program or the EPRI program without modifications? Revise COL 10.3 (3) accordingly.

10.03.06-11

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 1 and 30; and 10 CFR Part 50.55a contain provisions regarding quality standards for material specifications that are met by compliance with the applicable provisions of the ASME Boiler and Pressure Vessel Code (ASME Code) and by acceptable application of materials Code Cases as described in Regulatory Guide (RG) 1.84, “Design, Fabrication, and Materials Code Case Acceptability, ASME Section III.” Specifications for permitted materials are identified in the ASME Code, Section III, Appendix I, or described in detail in the ASME Code, Section II.

In table 10.3.2-3, the applicant states that the material specification for flanges within the “Pipe chase to AF pump turbine steam isolation valve” system is SA-350 LF2 or ASTM A-105. The ASME Class of these components is Section III, Class 2.

While NCA-1200 permits the procurement of ASTM material (if certain conditions are met) it also requires that the material be provided by a CMTR or CoC from an ASME Materials Organization. The quality assurance requirements of a certified Materials Organization is a requirement for ASME Section III, Class 2 components.

Revise Table 10.3.2-3 to change the material specification to ASME SA-105 or add a note to the table stating that the ASTM material must meet the requirements of ASME Section III, NCA-1200.

10.03.06-12

Title 10 of the Code of Federal Regulations (10 CFR) Part 52.47(a)(9) requires that information submitted as part of the FSAR for a standard design certification shall describe differences in design features that deviate from the acceptance criteria in the SRP.

NUREG-0800 (Standard Review Plan, SRP) Section 10.3.6, Acceptance Criteria requires that “The materials specified for use in Class 2 and 3 components should conform to … Parts A, B, and C of Section II of the Code.”

Tables 10.3.2-2, 10.3.2-3, and 10.3.2-4 do not contain information on the welding materials to be used. Welding materials specifications for ASME Class 2 and 3 components are located in ASME Section II Part C.

Provide the ASME Section II-C welding material specifications that will be used or information on the proposed alternative.

10.03.06-13

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 1 and 30; and 10 CFR Part 50.55a contain provisions regarding quality standards for material specifications that are met by compliance with the applicable provisions of the ASME Boiler and Pressure Vessel Code (ASME Code) and by acceptable application of materials Code Cases as described in Regulatory Guide (RG) 1.84, “Design, Fabrication, and Materials Code Case Acceptability, ASME Section III.” Specifications for permitted materials are identified in the ASME Code, Section III, Appendix I, or described in detail in the ASME Code, Section II.

Figure 10.4.7-1 shows a “CF FW Chemical Injection Line” that contains an ASME Class 2 break. The line contains a control and check valve but does not appear to meet the criteria for a “Main Feed Isolation Valve.” Additionally, the 1 inch diameter line does not correspond to any items contained in Table 10.3.2-4 (wherein the Main Feed Isolation Values are listed).

Supplement Table 10.3.2-4 with information on the ASME Class 2 portion of the CF FW Chemical Injection Line.

10.03.06-14

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 1 and 30; and 10 CFR Part 50.55a contain provisions regarding quality standards for material specifications that are met by compliance with the applicable provisions of the ASME Boiler and Pressure Vessel Code (ASME Code) and by acceptable application of materials Code Cases as described in Regulatory Guide (RG) 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III." Specifications for permitted materials are identified in the ASME Code, Section III, Appendix I, or described in detail in the ASME Code, Section II.

In Table 10.3.2-3 the applicant states that the fittings, valves, and flanges within the "pipe chase to AF pump turbine steam isolation valve" system are ASME Section III, Class 2.

In Table 3.2-1, Sheet 3 of 86, the applicant states that the "Steam admission/exhaust/preheating lines and valves" are ASME Section III, Class 3 piping and components.

The staff believes that both tables describe the same components but do not have consistent codes of construction. Revise Table 10.3.2-3 and/or Table 3.2-1 to correct or clarify the code classes of the piping and components.

10.03.06-15

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 4 requires that structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents. Additionally, structures, systems, and components shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

In Section 10.4.9.2.5, "Design Features for Minimization of Contamination," relates to Auxiliary Feedwater (AF) system which connects to the feedwater system downstream of the Main Feed Isolation Valves and upstream of the Steam Generators. In the paragraph titled "Reduction of Cross-Contamination, Decontamination, and Waste Generation" the applicant states "Auxiliary feedwater piping is required to be fabricated of stainless steel material…"

The connection between the two systems will result in a dis-similar metal joint. Provide information on how this connection will be made: describe the type of connection (e.g. welding), any joint preparation that will be made (e.g. buttering), necessary process controls (e.g. Code Cases, compliance to Regulatory Guides), and overall configuration of the joint.

10.03.06-16

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 4 requires that structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents. Additionally, structures, systems, and components shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

In Section 10.3.6 the applicant states the following:

e. "… the entire portion of the MSS piping is made of carbon steel with a 0.889 mm (0.035 in) additional margin in design"

A similar statement is made for the feedwater piping.

Later the applicant states:

> "The specified wall thickness (prior to fabrication) is a standardized wall thickness stipulated in ASME B36.10M. [The wall thickness] is determined to exceed the required design wall thickness with consideration of minus tolerances … during fabrication."

The staff seeks further information: Does the "design thickness" discussed in relation to ASME B36.10M the analytical design thickness plus the additional margin for wear (e.g. design thickness = analytical thickness + wear margin, and: ASME B36.10 thickness > design thickness)?

10.03.06-17

Title 10 of the Code of Federal Regulations (10 CFR) Part 50.65 requires monitoring of the condition and operation of Structures, Systems, and Components (SSCs) to ensure that they are capable of maintaining their intended function. The functions are established from design goals which are based on operating experience. The requirements of 10 CFR 50.65 are applicable to non-safety systems "whose failure could cause a reactor scram or actuation of a safety-related system;" a main steam-line or feed-line break would result in an Engineered Safety Feature (ESF) actuation. Generic Letter (GL) 89-08. "Erosion/Corrosion-Induced Pipe Wall Thinning," defined a Flow Accelerated Corrosion (FAC) program that would meet the requirements of 10 CFR 50.65 for secondary, non-safety related systems. GL 89-08 states that a FAC program meeting all the requirements of EPRI NSAC-202L-R2 would be meet the produce reasonable assurance that adequate protection could be achieved.

In FSAR Section 10.3.6.3, on page 10.3-27, the applicant states:

> The following piping portions with potential for FAC are generally based on NSAC-202L-R3 (Reference 17) and NUREG-1344 (Reference 18) attached to GL 89-08 (References 19).
>
> a. For other safety/non-safety carbon steel piping with relatively mild FAC degradation identified in NUREG-1344 attached to GL 89-08, NSAC-202L-R3, and through experience, the average thinning rates of 2.54 × 10-6 mm/hr (0.1 × 10-6 in/hr) in steam system and 4.35 × 10-6 mm/hr (0.17 × 10-6 in/hr) in the water system are given based on the actual measurement records from Korea standard nuclear plants. The additional thickness of 0.889 mm (0.035 in) for the portion of steam system piping, and 1.524 mm (0.06 in) for the portion of water system piping in design are applied in consideration of the 40 years of design life.

The staff has compared the wear rates of the APR-1400 to extended and stretch power uprates for four operating PWRs of Combustion Engineering or Westinghouse designs. The wear rates on feedwater and steam systems for these operating plants are between 2x and 6x the wear rates of the APR-1400 design. The licensees provided multiple data points for the wear rates and the large majority of the wear rates (80% of the data points or more) were larger than the APR-1400 wear rates.

The staff understands that data from the power uprates of US operating plants may represent the bounding thinning rates of components in a system and the wear rates in the APR-1400 FSAR is an average rate. However, operating experience demonstrates that secondary piping systems fail locally rather than globally. The staff questions the accuracy of "a 40 year design life" of the secondary piping system.

Provide the staff with additional information on the wear rates. The data should include: location of measurements, type of component (pipe, elbow, orifice, etc.), measured wear, CHECWORKS wear rate, and any additional information that would be helpful in validating the discrepancy between the Korean Standard Nuclear Plant wear rates and those that have been seen in the US.


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