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.:	**489-8615**
SRP Section:	**10.03.06 – Steam and Feedwater System Materials**
Application Section:	**10.3.6**
Date of RAI Issue:	**05/24/2016**

Question No. 10.03.06-23

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." In response to RAI 314-8378, Question 10.03.06-17 the applicant provided CHECWORKS data for components

In response to RAI 314-8378, Question 10.03.06-17 the applicant provided CHECWORKS data for components within the steam and feedwater systems. The staff concludes that several components in the steam and feedwater system are expected to deplete of the 0.06 or 0.035 inch corrosion margin prior to the conclusion of the 40 year license period.

The CHECWORKS data also states that the components are expected to be operable for 40 years. This information suggests that additional margin designed into thickness on the feedwater and steam piping. This additional margin is used to justify structural integrity when the corrosion thickness is depleted.

1) Confirm that a component with wear exceeding the corrosion allowance would meet still meet the requirements of ASME Code, Section III or ASME B31.1.

2) State where this additional thickness (above the ASME Code, Section III or ASME B31.1 requirements) comes from

3) If additional margin is used to justify structural integrity once the corrosion thickness is depleted, than the additional margin is element of a methodology to meet the requirements of GL 89-08 (which requires a FAC program which prevents unexpected failure).

   a. Update the FSAR to state that procured piping thickness will include additional thickness beyond the corrosion thickness which is used to prevent FAC failure.

   b. Update the FSAR to state where this thickness comes from.

Response

1) Wall thinning occurs during plant operation due to erosion/corrosion or FAC. Analytical evaluations are performed to determine if component wear is exceeding the minimum required wall thickness. The evaluation is based on the ASME Code Case N-597, ASME Sec. III NB, NC, ND-3650 for safety related piping, and ASME B31.1 104.8 for non-safety related piping. If the component does not meet the code requirement, it will be repaired or replaced.

2) The equation for minimum wall thickness involves the additional thickness above the ASME Sec. III NB, NC, ND-3640 for safety related piping, and ASME B31.1 104.1 for non-safety related piping. The additional thickness A specified in ASME Sec. III NC-3641 is as follows:

   A = an additional thickness, in. (mm):

   (a) to compensate for material removed or wall thinning due to threading or grooving, required to make a mechanical joint. The values of A listed in Table NC-3641.1(a)-1 are minimum values for material removed in threading.

   (b) to provide for mechanical strength of the pipe. Small diameter, thin wall pipe or tubing is susceptible to mechanical damage due to erection, operation, and maintenance procedures. Accordingly, appropriate means must be employed to protect such piping against these types of loads if they are not considered as Design Loads. Increased wall thickness is one way of contributing to resistance against mechanical damage.

   (c) to provide for corrosion or erosion. Since corrosion and erosion vary widely from installation to installation, it is the responsibility of designers to determine the proper amounts which must be added for either or both of these conditions.

3) FSAR will be revised.

Impact on DCD

DCD Tier 2, Subsections 10.3.6.3 will be revised.

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.

d. Condensate piping from the deaerator inlet control valves to the deaerator is made of chrome-moly materials. Other condensate piping is made of carbon steel with a 1.524 mm (0.06 in) additional margin in the design.

e. As shown in Table 10.3.2-2 and Table 10.3.2-3, the entire portion of MSS piping is made of carbon steel with a 0.889 mm (0.035 in) additional margin in design.

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

g. Most feedwater heater drain piping is made of carbon steel with 1.524 mm (0.06 in) additional margin in design. FAC-susceptible portions such as downstream components of control valves are made of high-content chrome-moly materials.

For safety/non-safety carbon steel piping with relatively mild potential for FAC degradation, the required design wall thickness is based on piping design pressure, design temperature, and allowable stress in accordance with ASME Section III NC/ND-3640 or ASME B31.1 Paragraph 104. The specified wall thickness (prior to fabrication) is a standardized wall thickness stipulated in ASME B36.10M (Reference 20). It is determined to exceed the required design wall thickness with consideration of minus tolerances of the thicknesses by the appropriate amount to account for the expected wall thickness loss during fabrication. The piping layout includes a consideration of several features for the various piping systems to minimize the incidence of FAC and erosion/corrosion in piping as follows:

a. Elimination of high-turbulence points wherever possible (e.g., increasing the pipe length downstream of flow orifice, control valve)

b. Application of a suitable flow orifice to minimize cavitation possibilities (e.g., using the multi-plate orifice and multi-hole orifice)

c. Application of long-radius elbows

d. Application of smooth transition at shop or field welds

e. Selection of pipe diameter to have velocities within industry-recommended values

h. Additional thickness beyond the corrosion allowance is included on steam and feedwater system piping based on the additional thickness (A) of ASME code Section III for safety related piping and ASME B31.1 for non-safety related piping.