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.:	**94-7999**
SRP Section:	**12.03-12.04-Radiation Protection Design Feature**
Application Section:	**12.03**
Date of RAI Issue:	**07/21/2015**

Question No. 12.03-7

REQUIREMENTS

10 CFR 20.1101(b) requires that the licensee use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

10 CFR 20.1406(b) requires that applicants for standard design certifications describe in the application how facility design will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

GUIDANCE

Regulatory Guide 8.8, specifies that components of the primary coolant system and other components in contact with primary coolant should be corrosion resistant and should contain a low cobalt content. In addition, SRP Section 12.3-12.4 references Electric Power Research Institute (EPRI) Report TR-016780, “Utility Requirements Document” as a source of information relevant to ensuring that occupational radiation exposure is ALARA. EPRI TR-016780 and other EPRI documents, including EPRI TR-1003390, provide guidance on cobalt impurity levels. Specifically, EPRI TR-1003390 indicates that cobalt impurity levels in stainless steels should be less than 500 parts per million (ppm) and in Inconels, less than 200 ppm. EPRI TR-016780 indicates that cobalt for component fabricated with stainless steel or nickel base alloy with a large wetted surface area (major piping, clad, etc.) and with operating temperature above 200 degrees Fahrenheit (F) should be restricted to a maximum content of 0.050 weight percentage. In addition, EPRI TR-016780 indicates that components near high neutron flux areas or expected to release significant quantities of corrosion products to the reactor coolant stream, and for components expected to be significant sources of radiation

exposure to plant maintenance personnel cobalt content targets (mean values) lower than 0.05 weight percentage should be specified by the plant designer.

ISSUE

FSAR Section 12.3.1.3, Section b, provides information on corrosion product control. In this section the applicant discusses the use of corrosion resistant material and reducing cobalt content in primary system materials. Some of the information in this section appears inconsistent with the above mentioned guidance and appears somewhat incomplete. Therefore, the staff has the following questions related to corrosion resistance and cobalt content for systems in contact with primary system fluid.

INFORMATION NEEDED

1. While FSAR 12.3.1.3., Section b (including Table 12.3.-1), and FSAR Chapter 5 provides information on corrosion resistance and cobalt control for the primary coolant system, the application is unclear what is being done to limit corrosion and cobalt content in other systems that will be in contact with primary system fluid, such as the chemical and volume control system. Please update FSAR Section 12.3.1.3 (including Table 12.3-1, as appropriate) to provide information describing how the other system in contact with primary system fluid will minimize corrosion and cobalt content.

2. FSAR Section 12.3.1.3, Section b, indicates that the cobalt content for components with a large wetted surface area and an operating temperature of greater than 200 degree F is restricted to maximum of 0.1 weight percentage cobalt. This appears inconsistent with the EPRI TR-016780, which is referenced in the SRP (as discussed above). Please update this information in the FSAR to be consistent with the above mentioned guidance or provide justification for the current values.

3. FSAR Section 12.3.1.3, Section b, also indicates that for components in or near the core or expected to release significant quantities of corrosion products, cobalt content targets (mean value) lower than 0.1 weight percentage are specified. This also appears inconsistent with EPRI TR-016780. Please update the FSAR to ensure that components near high neutron flux areas expected to release significant quantities of corrosion products to the reactor coolant stream, and components expected to be significant source of radiation exposure to plant maintenance personnel are limited in cobalt content (mean value) to lower than 0.05 weight percentage, or justify an alternative approach.

4. FSAR Table 12.3-1 indicates that the cobalt content of finished surfaces for the reactor coolant pump is 0.1 weight percentage maximum value. This is inconsistent with the above mentioned guidance. Please update FSAR Table 12.3-1 to provide a maximum reactor coolant pump cobalt content value consistent with the above mentioned guidance or provide justification for an alternative approach.

5. FSAR Section 12.3.1.1.1 specifies that the average cobalt content of steam generator tube material is less than 0.015 weight percentage. However, no information is provided in FSAR Table 12.3-1 on the average or maximum cobalt content for the steam generator tubes. Please update FSAR Table 12.3-1 to provide this information.

6. Please indicate the material composition (e.g. stainless steel, nickel/chromium based alloy, etc.) of the components currently listed FSAR Table 12.3-1. If the material is not stainless steel (i.e. if the material is a nickel/chromium based alloy or other), please indicate why the cobalt content for the component is acceptable, provided the guidance documents discussed above.

Response

1. For the APR1400, austenitic stainless steel and nickel base alloys (Alloy 690 or equivalent weld materials) of RCS main components such as reactor vessel, pressurizer, reactor coolant pump, reactor coolant pipes, surge line, steam generator, reactor vessel internals are controlled for the limit of cobalt content. Meanwhile, there is no limit in cobalt content for the valves, pumps, pipes or tanks, which belong to other systems such as CVCS. FSAR Table 12.3-1 will be revised to add the information on the cobalt content of the components in other system as follows:

   "The components except where identified in this table – Not Limited"

2. First paragraph of FSAR Section 12.3.1.3 b. 1) will be revised as follows:

   "Cobalt content for components with a large wetted surface area and an operating temperature of greater than 93 ℃ (200 ℉) is restricted to a maximum of 0.05 wt%."

3. Second paragraph of FSAR Section 12.3.1.3 b. 1) will be revised to change the restricted cobalt content as follows:

   "For components in or near the core or components that are expected to release significant quantities of corrosion products, cobalt content (mean value) lower than 0.05 wt% is specified."

4. FSAR Table 12.3-1 will be revised to change the cobalt content limitation of reactor coolant pump cladding as follows:

   "Reactor Coolant Pump Cladding – 0.05 w/o (max)"

5. FSAR Table 12.3-1 will be revised to update cobalt content of Steam Generator Tube as follows:

   "Steam Generator Tube – 0.015 w/o (mean value)"

6. FSAR Table 12.3-1 will be revised to identify the materials of the components listed in FSAR Table 12.3-1 as follows:

   "Reactor Vessel Assembly Cladding[1)]
   Reactor Coolant Pipe Cladding[1)]
   Pressurizer Assembly Cladding[1)]

Steam Generator Cladding[1)]
Reactor Coolant Pump Cladding[1)]
Core Support Barrel Assembly[2)]
Lower Support Structure Assembly[2)]
Instrument Nozzle Assembly[2)]
Upper Guide Structure Assembly[2)]
Inner Barrel Assembly[2)]
Core Shroud Assembly[2)]
Surge Line[4)]
Control Element Driving Mechanisms including RV CEDM nozzles[2,3)]
Steam Generator Tube[3)]

1) Austenitic Stainless Steel Type 308, or Type 309, or Ni based Alloy(Alloy 690 equivalent weld material)
2) Austenitic Stainless Steel Type 304
3) Alloy 690TT
4) Austenitic Stainless Steel Type 347
5) Small quantity of cobalt base alloy (Stellite or Haynes alloy) as bar, casting, or hardfacing is used for the CEDMs, RVIs, pumps, or valves."

Impact on DCD

Table 12.3-1 will be revised as indicated on the Attachment 1.
DCD Section 12.3.1.3 will be revised as indicated on the Attachment 2.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on Technical Specification.

Impact on Technical/Topical/Environmental Reports

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

Table 12.3-1

Cobalt Contents of Finished Surface for Primary System Materials

Component	Cobalt Content
Reactor Vessel Assembly Cladding	0.05 w/o (max)
Reactor Coolant Pipe	0.05 w/o (max)
Pressurizer Assembly Cladding	0.05 w/o (max)
Steam Generator Cladding	0.05 w/o (max)
Reactor Coolant Pump	0.1 w/o (max)
Core Support Barrel Assembly	0.05 w/o (max)
Lower Support Structure Assembly	0.05 w/o (max)
Instrument Nozzle Assembly	0.05 w/o (max)
Upper Guide Structure Assembly	0.05 w/o (max)
Inner Barrel Assembly	0.05 w/o (max)
Core Shroud Assembly	0.05 w/o (max)

Replace
Table 12.3-1 will be replaced with following pages (Attachment 1 (2/2)).

APR1400 DCD TIER 2

Table 12.3-1

Cobalt Contents of Finished Surface for Primary System Materials

Component	Cobalt Content
Reactor Vessel Assembly Cladding[1)]	0.05 w/o (max)
Reactor Coolant Pipe Cladding[1)]	0.05 w/o (max)
Pressurizer Assembly Cladding[1)]	0.05 w/o (max)
Steam Generator Cladding[1)]	0.05 w/o (max)
Reactor Coolant Pump Cladding[1)]	0.05 w/o (max)
Core Support Barrel Assembly[2)]	0.05 w/o (max)
Lower Support Structure Assembly[2)]	0.05 w/o (max)
Instrument Nozzle Assembly[2)]	0.05 w/o (max)
Upper Guide Structure Assembly[2)]	0.05 w/o (max)
Inner Barrel Assembly[2)]	0.05 w/o (max)
Core Shroud Assembly[2)]	0.05 w/o (max)
Surge Line[4)]	0.05 w/o (max)
Control Element Driving Mechanisms including RV CEDM nozzles [2, 3)]	0.05 w/o (max)
Steam Generator Tube[3)]	0.015 w/o (mean value)
The components except where identified in this table	Not Limited

1) Austenitic Stainless Steel Type 308, or Type 309, or Ni based Alloy(Alloy 690 equivalent weld material)
2) Austenitic Stainless Steel Type 304
3) Alloy 690TT
4) Austenitic Stainless Steel Type 347
5) Small quantity of cobalt base alloy (Stellite or Haynes alloy) as bar, casting, or hardfacing is used for the CEDMs, RVIs, pumps, or valves.

12.3.1.3 Source Term Control

Source term control is an important aspect of the APR1400 design. The following design features reduce the doses received by plant personnel from operations, maintenance, and inspection activities:

a. Fuel performance

The APR1400 design features provide reasonable assurance of low primary system source terms, not only because of the extended fuel cycle, but also because of minimized fuel clad leakage based on extremely low fuel clad defects.

b. Corrosion product control

The APR1400 design includes design features that reduce corrosion product production in the primary system.

1) Primary system materials

The APR1400 design specifies that primary system components are to be fabricated from materials with low corrosion rates and low cobalt impurities (target of 0.02 wt% or less) except where no proven alternative exists. This approach is consistent with NRC RG 8.8, Position 2.e.

Cobalt content for comp a large wetted surface area and an operating temperature of greater than 93 °C (200 °F) is restricted to a maximum of 0.1 wt%. For components in or near the core or components that are expected to release significant quantities of corrosion products, cobalt content targets (mean values) lower than 0.1 wt% are specified.

Change "0.05"

delete "target"

Change "value"

Change "is"

The cobalt content for primary system materials are presented in Table 12.3-1.

The presence of antimony in RCP bearings has presented a problem with hot particles in the current generation of nuclear plants. In the APR1400 design, RCP bearings are designed to minimize the amount of antimony.