## ArevaEPRDCPEm Resource

**From:** Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
**Sent:** Wednesday, July 22, 2009 12:56 PM
**To:** Tesfaye, Getachew
**Cc:** BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); WELLS Russell D (AREVA NP INC)
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 220, FSARCh. 6, Supplement 1
**Attachments:** RAI 220 Supplement 1 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided responses to 2 of the 6 questions of RAI No. 220 on June 4, 2009. The attached file, "RAI 220 Supplement 1 Response US EPR DC.pdf" provides technically correct and complete responses to the remaining 4 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 220 Questions 06.01.01-13, 06.01.01-14, 06.01.01-16, and 06.01.01-18.

The following table indicates the respective pages in the response document, "RAI 220 Supplement 1 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

| Question # | Start Page | End Page |
|---|---|---|
| RAI 220 — 06.01.01-13 | 2 | 2 |
| RAI 220 — 06.01.01-14 | 3 | 4 |
| RAI 220 — 06.01.01-16 | 5 | 6 |
| RAI 220 — 06.01.01-18 | 7 | 7 |

This concludes the formal AREVA NP response to RAI 220 and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

*Ronda Pederson*
ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
**AREVA NP Inc.**
An AREVA and Siemens company
3315 Old Forest Road
Lynchburg, VA 24506-0935
Phone: 434-832-3694
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**From:** Pederson Ronda M (AREVA NP INC)
**Sent:** Thursday, June 04, 2009 3:07 PM
**To:** 'Getachew Tesfaye'
**Cc:** BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); PORTER Thomas (EXT)
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 220, FSARCh. 6

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 220 Response US EPR DC.pdf" provides technically correct and complete responses to 2 of the 6 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 220 Questions 06.01.01-15 and 06.01.01-17.

The following table indicates the respective pages in the response document, "RAI 220 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

| Question # | Start Page | End Page |
|---|---|---|
| RAI 220 — 06.01.01-13 | 2 | 2 |
| RAI 220 — 06.01.01-14 | 3 | 3 |
| RAI 220 — 06.01.01-15 | 4 | 4 |
| RAI 220 — 06.01.01-16 | 5 | 5 |
| RAI 220 — 06.01.01-17 | 6 | 6 |
| RAI 220 — 06.01.01-18 | 7 | 7 |

A complete answer is not provided for 4 of the 6 questions. The schedule for a technically correct and complete response to these questions is provided below.

| Question # | Response Date |
|---|---|
| RAI 220 — 06.01.01-13 | July 24, 2009 |
| RAI 220 — 06.01.01-14 | July 24, 2009 |
| RAI 220 — 06.01.01-16 | July 24, 2009 |
| RAI 220 — 06.01.01-18 | July 24, 2009 |

Sincerely,

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**From:** Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
**Sent:** Tuesday, May 05, 2009 12:33 PM
**To:** ZZ-DL-A-USEPR-DL
**Cc:** Robert Davis; David Terao; Jason Carneal; Joseph Colaccino; ArevaEPRDCPEm Resource
**Subject:** U.S. EPR Design Certification Application RAI No. 220 (2611), FSARCh. 6

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on April 27, 2009, and on May 5, 2009, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

**Hearing Identifier:** AREVA_EPR_DC_RAIs
**Email Number:** 679

**Mail Envelope Properties** (5CEC4184E98FFE49A383961FAD402D310117C331)

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**From:** Pederson Ronda M (AREVA NP INC)

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**Response to**

**Request for Additional Information No. 220, Supplement 1**

**05/05/2009**

**U. S. EPR Standard Design Certification**
**AREVA NP Inc.**
**Docket No. 52-020**
**SRP Section: 06.01.01 - Engineered Safety Features Materials**
**Application Section: 6.1.1**

**QUESTIONS for Component Integrity, Performance, and Testing Branch 1 (AP1000/EPR Projects) (CIB1)**

**Question 06.01.01-13:**

In response to RAI 06.01.01-1, the applicant stated that information on EFWS components is located in U.S. EPR FSAR Tier 2, Section 10.4.9. The applicant also stated that EFWS piping and component pressure retaining parts are constructed of stainless steel. In addition, the applicant suggests that the carbon content of these components will be limited to reduce the potential for stress corrosion cracking. The staff notes that per SRP 10.4.9, the compatibility of EFWS materials is reviewed by the staff under SRP 6.1.1. In order for the staff to find that the EFWS materials meet the acceptance criteria for stainless steels listed in SRP Section 6.1.1, the staff requests that the applicant modify FSAR Section 10.4.9 to specify the maximum carbon content of EFWS stainless steel materials. In addition, the staff requests that the applicant modify FSAR Section 10.4.9 to state the extent to which it complies with the NRC staff guidance in RGs 1.44, 1.31 and 1.37 for the EFWS. Where the applicant deviates from staff guidance in these RGs, the staff requests that the applicant provide justification for the deviation and describe any alternatives and the basis for its alternative approach.

**Response to Question 06.01.01-13:**

U.S. EPR FSAR Tier 2, Section 6.1.1 addresses the conformance of the engineered safety feature (ESF) materials to RG 1.44, RG 1.31, and RG 1.37. U.S. EPR FSAR Tier 2, Section 10.4.9.2.2 will revised to state that the emergency feedwater system (EFWS) materials conform to the requirements and regulatory guidance addressed in U.S. EPR FSAR Tier 2, Section 6.1.1. U.S. EPR FSAR Tier 2, Table 10.4.9-2 will be added to include EFWS materials and the carbon content of EFWS stainless steel materials. U.S. EPR FSAR Tier 2, Section 10.4.9.2.2 and Table 10.4.9-1 will be revised to reference this new table.

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Section 10.4.9.2.2 and Table 10.4.9-1 will be revised as described in the response and indicated on the enclosed markup. U.S. EPR FSAR Tier 2, Table 10.4.9-2 will be added as described in the response and indicated on the enclosed markup.

**Question 06.01.01-14:**

In response to RAI 06.01.01-2, the applicant provided a proposed revision to Table 6.1-1 by letter dated December 19, 2009. In order for the staff to complete its review, the staff requests that the applicant address the following:

1. The applicant's revised Table 6.1-1 indicates that some valves used in ESF systems will be cast austenitic stainless steel (CASS). Given that some of these valves interface with the RCPB, explain how you have addressed the potential for thermal aging embrittlement of all ESF CASS components with service conditions above 482ºF (250ºC) and modify the FSAR accordingly. The staff notes that the applicant's screening process for the determination of CASS susceptibility to thermal aging embrittlement, for components with service conditions above 482ºF (250ºC), should be consistent with the NRC staff position documented in a letter from C. Grimes (USNRC) to D. Walters (Nuclear Energy Institute) dated May 19, 2000 (Agencywide Documents Access and Management System (ADAMS) Accession No.: ML003717179.
2. Ferritic welding filler metals listed in revised Table 6.1-1 list material specifications but do not include classifications for weld materials in the Safety Injection System/Residual Heat Removal System as requested by the staff. If this information is not available, the staff would find the information provided acceptable if the applicant provides a note to Table 6.1-1 that states that "G" classification filler materials are not permitted.
3. The staff requests that the applicant provide a note to Table 6.1-1 that limits the carbon content of austenitic weld filler metal to 0.03 percent maximum to be consistent with the carbon content limit on austenitic stainless steel materials listed in Table 6.1-1.

**Response to Question 06.01.01-14:**

1. The referenced NRC letter has been incorporated into NUREG-1801. As noted in NUREG-1801, Section XI.M12, based on the assessment documented in the referenced NRC letter, screening for susceptibility to thermal aging is not required for pump casings and valve bodies. The existing ASME Section XI inspection requirements, including the alternative requirements of ASME Code Case N-481 for pump casings, are adequate for all pump casings and valve bodies. Furthermore, NUREG-1801, Section XI.M12, states:

   > "The staff's conservative bounding integrity analysis shows that thermally aged CASS valve bodies and pump casings are resistant to failure. For all pump casings and valve bodies greater than nominal pipe size (NPS) 4 in., the existing ASME Section XI inspection requirements, including the alternative requirements of ASME Code Case N-481 for pump casings, are adequate. ASME Section XI, Subsection IWB, requires only surface examination of valve bodies less than NPS 4 in. For valve bodies less than NPS 4 in., the adequacy of inservice inspection (ISI) according to ASME Section XI has been demonstrated by an NRC-performed bounding integrity analysis (Reference letter from Christopher Grimes dated May 19, 2000)."

   Because the ASME Section XI inservice inspection and testing of the reactor coolant pressure boundary (RCPB) is described in U.S. EPR FSAR Tier 2, Section 5.2.4, no additional change to the U.S. EPR FSAR is required.
2. A note will be added to U.S. EPR FSAR Tier 2, Table 6.1-1 to state that the use of electrodes with "G" classification is excluded from the weld filler materials.

3. Note 2 (carbon not exceeding 0.03wt%) will be added to the applicable austenitic stainless steel weld filler materials in U.S. EPR FSAR Tier 2, Table 6.1-1.

Other changes to U.S. EPR FSAR Tier 2, Table 6.1-1, are as follows:

- SA-106 Grade B has been removed from the safety injection system (SIS)/residual heat removal system (RHRS) piping because the carbon steel material is not used in the portion of the SIS/RHRS associated with the engineered safety function (ESF).
- The carbon steel welding materials (SFA 5.17, 5.18, and 5.20) in the SIS/RHRS have been removed as a result of removing the carbon steel base materials.
- SA-508 Grade 3, Class 1 or Class 2 and SA-533 Type B, Class 1 or Class 2 have been added to the low head safety injection heat exchangers tube sheet and channel head (primary side) to allow for clad low alloy steel materials as options for this component, as denoted by Note 6 of U.S. EPR FSAR Tier 2, Table 6.1-1.
- SA-213 Grade TP316 and Grade TP316L have been added as options for the low head safety injection heat exchangers tube (primary side).
- The “L” grades (low carbon) of 308, 309, and 316 materials from SFA 5.4, 5.9, and 5.22 have been added as welding material options for the SIS/RHRS, in-containment refueling water storage tank (IRWST), and extra borating systems (EBS).
- Materials for the annulus ventilation system (AVS) were clarified.

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Table 6.1-1 will be revised as described in the response and indicated on the enclosed markup.

**Question 06.01.01-16:**

In RAI 06.01.01-6, the staff requested information related to containment liner and liner penetrations materials. The applicant provided proposed revisions, by letter dated December 19, 2008, to FSAR Section 6.1.1, Table 6.1-1 and Section 3.8. The staff identified the following concerns with the applicant's proposed revisions and requests that the applicant modify the FSAR accordingly.

1. Sheet 1 of revised Table 6.1-1 refers to Sections 3.8.1.6.4 and 3.8.2 for materials used for the reactor building liner and penetrations. However, sheet 7 of proposed Table 6.1-1 lists the materials used for the reactor building liner and penetrations.
2. FSAR Section 3.8.1.6.4 states that welding materials conform to the requirements of ANSI/AWS D1.1 and D1.6 except as modified by ANSI/AISC N690. This statement appears to be inconsistent with other statements in Section 3.8.1.6.4 which reference ASME Code, Section III, Divisions 1 and 2.
3. Proposed revised Table 6.1-1 appropriately lists ASME specifications for liner plate materials. However, the applicant's proposed revision to FSAR Section 3.8.1.6.4 lists ASTM specifications.
4. The applicant listed partial classifications for weld filler material used for the containment liner. The applicant also referenced AWS D1.1 and AWS D1.6. The staff's review of the containment liner system under SRP 6.1.1 includes portions of the containment liner system that are designed and fabricated in accordance with ASME Code Section III. Therefore, the staff requests that the applicant modify the FSAR to clarify where ASME Code jurisdiction ends and where AWS jurisdiction starts. In addition, although the staff notes that the weld filler metal classifications listed by the applicant are not complete, the staff finds that the classifications provided in the proposed table are acceptable as long as the applicant provides a note that prohibits the use of "G" classification electrodes.

**Response to Question 06.01.01-16:**

1. The "Reactor Building Liner and Penetrations" section in U.S. EPR FSAR Tier 2, Table 6.1-1 (Sheet 1 of 6) will be removed because the material information for the Reactor Building (RB) liner and penetrations is provided under the "Reactor Building Liner and Penetration Sleeves" section in U.S. EPR FSAR Tier 2, Table 6.1-1 (Sheet 6 of 6).
2. The statement in U.S. EPR FSAR Tier 2, Section 3.8.1.6.4, "Welding materials conform to the requirements of ANSI/AWS D1.1 or ANSI/AWS D1.6 except as modified by ANSI/AISC N690..." will be replaced with, "Welding materials conform to the requirements of ASME BPV Code, Section II. Welding activities meet the requirements of ASME BPV Code, Sections III and IX." U.S. EPR FSAR Tier 2, Section 3.8.1.2.1 will also be revised to delete the reference to ANSI/AISC N690.
3. U.S. EPR FSAR Tier 2, Section 3.8.1.6.4 will be revised to delete the reference to ASTM A516 and replace it with ASME SA-516 material specification.
4. The references to ANSI/AWS D1.1 and ANSI/AWS D1.6 in U.S. EPR FSAR Tier 2, Table 6.1-1 (Sheet 6 of 6) will be removed. Concerning where the ASME Code jurisdiction stops and AWS jurisdiction begins, the containment liner system is designed and fabricated according to ASME Code Section III and the references to AWS D1.1 and D1.6 will be removed from U.S. EPR FSAR Tier 2, Section 3.8.1.6.8. The use of electrodes with "G"

classification is excluded from the weld filler materials (see the Response to Question 06.01.01-14, Item 2).

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Section 3.8.1.2.1, Section 3.8.1.6.4, and Table 6.1-1 will be revised as described in the response and indicated on the enclosed markup.

**Question 06.01.01-18:**

In response to RAI 06.01.01-11, the applicant provided a proposed revision to Table 2.1.1-7 (ITAAC) by letter dated December 19, 2008. The staff reviewed the applicant's proposed revision and noted that the applicant did not provide specific line items to address fabrication, welding and NDE. The staff requests that the applicant modify Table 2.1.1-7 accordingly.

**Response to Question 06.01.01-18:**

Note that U.S. EPR FSAR Tier 1, Table 2.1.1-7 became U. S. EPR FSAR Tier 1, Table 2.1.1-8 in U.S. EPR FSAR, Revision 1. ITAAC for U.S. EPR FSAR Tier 1, Section 2.1, including the Reactor Containment Building (RCB) and liner plate, were revised in the Response to RAI 132, Supplement 1, Question 14.03.02-11. The ITAAC for the RCB liner plate is in U.S. EPR FSAR Tier 1, Table 2.1.1-8, Item 2.5.

U. S. EPR FSAR Tier 1, Table 2.1.1-8, Item 2.5 will be revised to address fabrication, welding, and non-destructive evaluation (NDE) as follows:

- Fabrication is addressed by item 2.5b.
- Welding is addressed by item 2.5c.
- NDE is addressed by item 2.5e.

**FSAR Impact:**

U. S. EPR FSAR, Tier 1, Table 2.1.1-8, Item 2.5 will be revised as described in the response and indicated on the enclosed markup.

# U.S. EPR Final Safety Analysis Report Markups

**Table 2.1.1-8—Reactor Building ITAAC (~~5~~ 6 Sheets)**

| | Commitment Wording | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|---|
| | missiles and earthquake). | | |
| 2.5 | The RCB, including liner plate, maintains its pressure boundary integrity at the design pressure.<br>06.01.01-18 | a. Inspections will be performed for the existence of ASME Code Section III Design Report(s) for the RCB liner plate.~~An analysis of the RCB liner plate will be performed per ASME Code Section III design requirements.~~<br>b. Inspections will be performed to verify the existence of RCB liner plate analyses which reconcile as-fabricated deviations to the ASME Code Design Report as required by ASME Code Section III.~~Inspections will be conducted on the RCB liner plate to verify installation as specified on the liner plate construction drawings.~~<br>c. Inspections of pressure boundary welds will be performed to verify that welding on the RCB liner plate is performed in accordance with ASME Code Section III requirements.~~A Structural Integrity Test of the RCB, including the liner plate, will be performed~~. | a. ASME Code Section III Design Report(s) (NCA-3550) exist for the RCB liner plate.~~ASME Code Section III stress reports exist and conclude that the RCB liner plate meets ASME Code Section III design requirements.~~<br>b. ASME Code Date Reports (NCA-8000) exist and conclude that Reconciliation (NCA-3554) of the as-fabricated RCB liner plate with the Design Report (NCA-3550) has occurred.~~The RCB liner plate has been installed as specified on the liner plate construction drawings.~~<br>c. ASME Code Section III Data Reports exist and concludes that pressure boundary welding has been performed on the RCB liner plate in accordance with ASME Code Section III.~~The RCB, including the liner plate, maintains its integrity at the design pressure of at least 62 psig.~~ |

**Table 2.1.1-8—Reactor Building ITAAC (~~5~~ 6 Sheets)**

| | Commitment Wording | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|---|
| | 06.01.01-18 | d. A Structural Integrity Test of the RCB, including the liner plate, will be performed.<br>e. Pre-service inspections on the RCB liner plate have been performed in accordance with ASME Code Section III. | d. The RCB, including the liner plate, maintains its integrity at the design pressure of at least 62 psig.<br>e. ASME Code Section III Data Reports exist and conclude that pre-service NDE performed on the RCB liner plate meets ASME Section III requirements. |
| 2.6 | The RCB is a post-tensioned, pre-stressed concrete structure. | Inspection of the RCB will be performed. | The RCB contains post-tensioning tendons for pre-stressing the concrete structure. |

- ACI SP-2 (99), Manual of Concrete Inspection (Reference 13).

06.01.01-16

- ~~ANSI/AISC N690-1994 (R2004), Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities, including Supplement 2 (Reference 14).~~
- ~~ANSI/AWS D1.1/D1.1M-2006, Structural Welding Code – Steel (Reference 18).~~
- ANSI/AWS D1.4-2005, Structural Welding Code - Reinforcing Steel (Reference 19).
- ~~ANSI/AWS D1.6 – 1999, Structural Welding Code – Stainless Steel (Reference 20).~~
- ASME BPV Code - 2004 Edition.
  - Section II - Material Specifications.
  - Section III, Division 2 - Code for Concrete Reactor Vessels and Containments.
  - Section V - Nondestructive Examination.
  - Section VIII - Pressure Vessels.
  - Section IX - Welding and Brazing Qualifications.
  - Section XI – Rules for Inservice Inspection of Nuclear Power Plant Components.
- Acceptable ASME BPV Code cases per RG 1.84, Revision 33, August 2005.
- ASME NOG-1-04, Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder) (Reference 21).

### 3.8.1.2.2 Standards and Specifications

Industry standards (e.g., those published by the ASTM) are used to specify material properties, testing procedures, fabrication, and construction methods. Section 3.8.1.6 lists the applicable standards used.

Structural specifications cover the areas related to the design of the RCB. These specifications emphasize the important points of the industry standards for the RCB and reduce the options that would otherwise be permitted by the industry standards. These specifications cover the following areas:

- Concrete material properties.
- Mixing, placing, and curing of concrete.
- Reinforcing steel and splices.

### 3.8.1.6.3 Tendon System Materials

*Tendons*

The post-tensioning tendon system consists of load-carrying and non-load-carrying components. The load-carrying components include the post-tensioning wires that make up the tendons, and anchorage components composed of bearing plates, anchor heads, wedges, and shims. Non-load-carrying components include the tendon sheathing (including sheaths, conduits, trumpet assemblies, couplers, vent and drain nipples, and other appurtenances) and corrosion prevention materials.

Materials used for the RCB post-tensioning system (including post-tensioning steel, anchorage components, and non-load-carrying and accessory components) meet the requirements of Subarticle CC-2400 of the ASME BPV Code, Section III, Division 2.

The Freyssinet C-range post-tensioning system has the following properties:

- ASTM A416 (Reference 36), Grade 270, low-relaxation tendon material.
- Tendon ultimate strength $F_{pu} = 270$ ksi
- Tendon minimum yield strength $F_{py} = (0.9)(270) = 243$ ksi
- Modulus of elasticity of tendon material $E_{ps} = 28{,}000$ ksi
- Number of strands per tendon $N_{strands} = 55$
- Total area of each tendon $A_p = 12.76$ in$^2$

The materials used for the anchorage components are compatible with the tendon system. Tendon raceways consist of corrugated steel ducts and rigid metal conduit. These components are non-structural and are sealed to prevent the intrusion of concrete during construction.

*Grouting of Tendons*

Cement grout for the grouted tendon system in the RCB is selected based on the testing and material requirements of the ASME BPV Code, Section III, Division 2, as amended by RG 1.136, which endorses the Regulatory Positions of RG 1.107, Qualifications for Cement Grouting for Prestressing Tendons in Containment Structures.

### 3.8.1.6.4 Liner Plate System and Penetration Sleeve Materials

06.01.01-16

The 0.25 inch thick liner plate is ~~ASTM A516~~SA-516, Grade 55, 60, 65 or 70 material, which conforms to Subarticle CC-2500 of the ASME BPV Code, Section III, Division 2

(GDC 16). Thickened liner plates are used at penetrations, brackets, and embedded assemblies.

Penetration assemblies and appurtenances that are either not backed by concrete or are embedded in concrete and surrounded by a compressible material to provide local flexibility conform to the material requirements of Subsection NE of the ASME BPV Code, Section III, Division 1 (GDC 16). Penetration sleeve materials are listed in Table 6.1-1.

06.01.01-16

Welding materials conform to the requirements of ASME BPV Code, Section II. Welding activities meet the requirements of ASME BPV Code, Sections III and IX.~~ANSI/AWS D1.1 or ANSI/AWS D1.6 except as modified by ANSI/AISC N690, Sections Q1.17.1 and Q1.17.2.1. The compatibility of filler metal with base metal is specified in Table 3.1 of ANSI/AWS D1.1.~~

Materials used for the carbon steel liner plate, carbon steel and low alloy steel attachments, and appurtenances subject to ASME BPV Code Division 2 requirements, meet the fracture toughness requirements of Subsection CC-2520 of the ASME BPV Code, Section III, Division 2.

Materials used in ASME Division 1 attachments and appurtenances meet the fracture toughness requirements of Subsection 2300 of the ASME BPV Code, Section III, Division 1.

#### 3.8.1.6.5 Steel Embedments

Steel embedment materials conform to the requirements of Subsection CC-2000 of the ASME BPV Code, Section III, Division 2.

#### 3.8.1.6.6 Corrosion Retarding Compounds

Corrosion retarding compounds used for the RCB are described in Section 6.1.2.

#### 3.8.1.6.7 Quality Control

In addition to the quality control measures addressed in Section 3.8.1.6, refer to Chapter 17 for a description of the quality assurance program for the U.S. EPR (GDC 1).

#### 3.8.1.6.8 Special Construction Techniques

Special techniques are not used for construction of the RCB. Modular construction methods are used to the extent practical for prefabricating portions of the containment liner, equipment hatch, airlocks, penetrations, reinforcing steel, tendon conduits, and concrete formwork. Such methods have been used extensively in the construction industry. Rigging is pre-engineered for heavy lifts of modular sections. Permanent

**Table 6.1-1—Pressure-Retaining Material Specifications for Engineered Safety Features**
**Sheet 1 of 6**

06.01.01-16

| Component | Material |
|---|---|
| ~~**Reactor Building Liner and Penetrations**~~ | |
| ~~All~~ | ~~Refer to Sections 3.8.1.6.4 and 3.8.2~~ |
| **Safety Injection System/Residual Heat Removal System** | |
| Piping | SA-312 Grade TP304L [1, 2, 4]<br>SA-312 Grade TP316LN [1, 2, 4]<br>06.01.01-14 ~~SA-106 Grade B~~ |
| Fittings | SA-403 Grade WP304L Class S [1, 2]<br>SA-403 Grade WP316LN [1]<br>SA-182 Grade F304L [1]<br>~~SA-182 Grade F316L [1]~~<br>SA-182 Grade F316LN [1] |
| Valves | SA-182 Grade F304 [1, 2]<br>SA-182 Grade F304L [1]<br>SA-182 Grade F316 [1, 2]<br>SA-182 Grade F316L [1]<br>SA-351 Grade CF3<br>SA-351 Grade CF3A<br>SA-351 Grade CF3M<br>SA-479 Type 304 [1, 2]<br>SA-479 Type 304L [1]<br>SA-479 Type 316 [1, 2]<br>SA-479 Type 316L [1] |
| Accumulators | SA-182 Grade F304 [1, 2]<br>SA-182 Grade F304L [1]<br>SA-240 Type 304 [1, 2]<br>SA-240 Type 304L [1]<br>SA-336 Grade F304 [1, 2]<br>SA-336 Grade F304L [1, 2]<br>SA-479 Type 304 [1, 2]<br>SA-479 Type 304L [1] |

**Table 6.1-1—Pressure-Retaining Material Specifications for Engineered Safety Features**
**Sheet 2 of 6**

| Component | Material |
|---|---|
| Low Head Safety Injection Heat Exchangers Tube Sheet, and Channel Head (primary side) | SA-182 Grade F304 [1, 2]<br>SA-182 Grade F304L [1]<br>SA-182 Grade F316 [1, 2]<br>SA-182 Grade F316L [1]<br>SA-240 Type 304 [1, 2]<br>SA-240 Type 304L [1]<br>SA-240 Type 316 [1, 2]<br>SA-240 Type 316L [1]<br>SA-336 Grade F304 [1, 2]<br>SA-336 Grade F304L [1, 2]<br>SA-336 Grade F316 [1, 2]<br>SA-336 Grade F316L [1, 2]<br>SA-479 Type 304 [1, 2]<br>SA-479 Type 304L [1]<br>SA-479 Type 316 [1, 2]<br>SA-479 Type 316L [1]<br>SA-508 Grade 3 Class 1 or Class 2 [6]<br>SA-533 Type B Class 1 or Class 2 [3, 6] |
| Low Head Safety Injection Heat Exchangers Tube (primary side) | SA-213 Grade TP304 [1, 2]<br>SA-213 Grade TP304L [1, 2]<br>SA-213 Grade TP316 [1, 2]<br>SA-213 Grade TP316L [1, 2] |
| Low Head Safety Injection Heat Exchangers Shell (secondary side) | SA-508 Grade 3 Class 1 or Class 2<br>SA-533 Type B Class 1 or Class 2 [3] |
| Low Head Safety Injection Pump | SA-351 Grade CF3<br>SA-182 Grade F304 [1, 2]<br>SA-182 Grade F304L [1]<br>SA-336 Grade F304 [1, 2]<br>SA-336 Grade F304L [1, 2]<br>SA-564 Type 630 [3]<br>SA-194 Grade 6 [3]<br>SA-240 Type 304 [1, 2]<br>SA-240 Type 304L [1]<br>SA-240 Type 316 [1, 2]<br>SA-240 Type 316L [1]<br>SA-193 Grade B8 [1]<br>SA-193 Grade B8M [1]<br>SA-194 Grade 8 [1]<br>SA-194 Grade 8M [1] |

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**Table 6.1-1—Pressure-Retaining Material Specifications for Engineered Safety Features**
**Sheet 3 of 6**

| Component | Material |
|---|---|
| Medium Head Safety Injection Pump | SA-182 Grade F304 [1, 2]<br>SA-182 Grade F304L [1]<br>SA-336 Grade F304 [1, 2]<br>SA-336 Grade F304L [1, 2]<br>SA-453 Grade 660<br>SA-564 Type 630 [3]<br>SA-194 Grade 6 [3]<br>SA-240 Type 304 [1, 2]<br>SA-240 Type 304L [1]<br>SA-240 Type 316 [1, 2]<br>SA-240 Type 316L [1]<br>SA-193 Grade B8 [1]<br>SA-193 Grade B8M [1]<br>SA-194 Grade 8 [1]<br>SA-194 Grade 8M [1] |
| Welding material<br>• Ferritic | SFA 5.5[5], ~~5.17, 5.18, 5.20,~~ 5.23[5], 5.28[5], and 5.29[5] |
| • Austenitic Stainless Steel<br>06.01.01-14 | SFA 5.4 E308[2], E309[2], E316[2], E308L[2], E309L[2], E316L[2]<br>SFA 5.9 ER308[2], ER309[2], ER316[2], ER308L, ER309L, ER316L<br>SFA 5.22 E308[2], E309[2], E316[2], E308L[2], E309L[2], E316L[2] |
| • NiCrFe | SFA 5.11 ENiCrFe-7<br>SFA5.14 ERNiCrFe-7, ERNiCrFe-7A |
| **In-Containment Refueling Water Storage Tank System** | |
| Liner | SA-182 Grade F304 [1, 2]<br>SA-182 Grade F304L [1]<br>SA-182 Grade F316 [1, 2]<br>SA-182 Grade F316L [1]<br>SA-240 Type 304 [1, 2]<br>SA-240 Type 304L [1]<br>SA-240 Type 316 [1, 2]<br>SA-240 Type 316L [1]<br>SA-479 Type 304 [1, 2]<br>SA-479 Type 304L [1]<br>SA-479 Type 316 [1, 2]<br>SA-479 Type 316L [1] |
| Process piping | SA-312 Grade TP304L [1, 2, 4] |

**Table 6.1-1—Pressure-Retaining Material Specifications for Engineered Safety Features**
**Sheet 4 of 6**

| Component | Material |
|---|---|
| Fittings | SA-403 Grade WP304L Class S [1, 2]<br>SA-182 Grade F304L [1] |
| Valves | SA-182 Grade F304 [1, 2]<br>SA-182 Grade F304L [1]<br>SA-182 Grade F316 [1, 2]<br>SA-182 Grade F316L [1]<br>SA-351 Grade CF3<br>SA-351 Grade CF3A<br>SA-351 Grade CF3M<br>SA-479 Type 304 [1, 2]<br>SA-479 Type 304L [1]<br>SA-479 Type 316 [1, 2]<br>SA-479 Type 316L [1] |
| Welding material (Austenitic Stainless Steel) 06.01.01-14 | SFA 5.4 E308[2], E309[2], E316[2], E308L[2], E309L[2], E316L[2]<br>SFA 5.9 ER308[2], ER309[2], ER316[2], ER308L, ER309L, ER316L<br>SFA 5.22 E308[2], E309[2], E316[2], E308L[2], E309L[2], E316L[2] |
| **Extra Borating System** | |
| Tanks | SA-182 Grade F304 [1, 2]<br>SA-182 Grade F304L [1]<br>SA-182 Grade F316 [1, 2]<br>SA-182 Grade F316L [1]<br>SA-240 Type 304 [1, 2]<br>SA-240 Type 304L [1]<br>SA-240 Type 316 [1, 2]<br>SA-240 Type 316L [1]<br>SA-479 Type 304 [1, 2]<br>SA-479 Type 304L [1]<br>SA-479 Type 316 [1, 2]<br>SA-479 Type 316L [1] |
| Process piping | SA-312 Grade TP304L [1, 2, 4] |
| Fittings | SA-403 Grade WP304L Class S [1, 2]<br>SA-182 Grade F304L [1] |

**Table 6.1-1—Pressure-Retaining Material Specifications for Engineered Safety Features**
**Sheet 5 of 6**

| Component | Material |
|---|---|
| Valves | SA-182 Grade F304 [1, 2]<br>SA-182 Grade F304L [1]<br>SA-182 Grade F316 [1, 2]<br>SA-182 Grade F316L [1]<br>SA-351 Grade CF3<br>SA-351 Grade CF3A<br>SA-351 Grade CF3M<br>SA-479 Type 304 [1, 2]<br>SA-479 Type 304L [1]<br>SA-479 Type 316 [1, 2]<br>SA-479 Type 316L [1] |
| Pumps | SA-182 Grade F304 [1, 2]<br>SA-182 Grade F304L [1]<br>SA-336 Grade F304 [1, 2]<br>SA-336 Grade F304L [1, 2]<br>SA-453 Grade 660<br>SA-193 Grade B6<br>SA-194 Grade 6 [3] |
| Welding material (Austenitic Stainless Steel)<br>06.01.01-14 | SFA 5.4 E308[2], E309[2], E316[2], E308L[2], E309L[2], E316L[2]<br>SFA 5.9 ER308[2], ER309[2], ER316[2], ER308L, ER309L, ER316L<br>SFA 5.22 E308[2], E309[2], E316[2], E308L[2], E309L[2], E316L[2] |

**Table 6.1-1—Pressure-Retaining Material Specifications for Engineered Safety Features**
**Sheet 6 of 6**

| Component | Material |
|---|---|
| **Annulus Ventilation System** | |
| ~~Ducts (accident trains)~~Nuclear grade filtration housing (not in annulus) | ASTM A-240 Type 304 [1, 2] |
| Ducts, structural steel supports (inside the annulus) ~~(normal operation trains)~~ | ASTM A-36<br>~~ASTM A-653~~ |
| Ducts (inside the annulus) stainless steel sheet | ASTM A-167<br>ASTM A-480 |
| **Main control room air conditioning system** | |
| All | Refer to Section 9.4.1 |
| **Reactor Building Liner and Penetration Sleeves** | |
| Liner Plate | Carbon Steel SA-516 Grades 55, 60, 65 or 70 (ASME Section III, Division 2, Subsection CC) |
| Penetration Sleeves<br>• Pipe Material | • Carbon Steel SA-333 Grade 6, SA-106 Grades A, B or C<br>• Austenitic Stainless Steel SA-312 Grades TP304 or TP 304L<br>(ASME Section III, Division 1, Subsection NE) |
| • Plate Material | • Carbon Steel SA-516, Gr. 55, 60, 65 or 70, and SA-537 Class 1 or 2<br>(ASME Section III, Division 1, Subsection NE) |
| Welding Material<br>• Carbon Steel | • E70XX (~~AWS D1.1,~~ SFA-5.1)<br>• ER70S-X[5] or E70C-XC (~~AWS D1.1,~~ SFA-5.18)[5]<br>• E7XT-X (~~AWS D1.1,~~ SFA-5.20)[5] |
| • Low Alloy Steel | • E80XX-X (~~AWS D1.1,~~ SFA-5.5)[5]<br>• ER80S-XXX[5] or E80C-XXX (~~AWS D1.1,~~ SFA-5.28)[5]<br>• E8XTX-X[5] (~~AWS D1.1,~~ SFA-5.29)[5] |
| • Stainless Steel | • E308L-XX, E309L-XX or E316L-XX (~~AWS D1.6,~~ SFA-5.4)<br>• ER308L, ER309L or ER316L (~~AWS D1.6,~~ SFA-5.9)<br>• E308LTX-X[5], E309LTX-X[5] or E316LTX-X (~~AWS D1.6,~~ SFA-5.22)[5] |

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**Notes:**

1. Solution annealed and rapidly cooled.
2. Carbon not exceeding 0.03 wt%.
3. Quenched and tempered.
4. Piping ~~should be~~is seamless.
5. Electrodes with "G" classification are excluded.
6. Clad with austenitic stainless steel on primary side.

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Makeup to the storage pools can also be provided by hose from the fire water system or other available water sources.

The EFWS has the capability to perform its required safety-related functions following design basis transients or accidents assuming a single active failure in one EFW train and with a pump out of service for preventive maintenance in a second train. The system capacity is sufficient to remove decay heat and provide feedwater for cooldown of the RCS following a reactor trip from full power.

The EFWS design flow requirement provides 400 gpm (at 122°F) to a minimum of two SGs following a main feedwater line break when pumping against the main steam relief train (MSRT) setpoint pressure. This requirement is met assuming a single active failure and an EFW pump out for maintenance.

All four EFWS trains are powered from separate emergency buses, each backed by an emergency diesel generator (EDG), with trains 1 and 4 also capable of being powered from the diverse station blackout diesel generators (SBODG).

### 10.4.9.2.2 Component Description

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The EFWS safety-related piping and components are designed and constructed in accordance with Quality Group C and Seismic Class I requirements, except for the containment isolation boundary piping and valves that are Quality Group B. The classification of components is described in Section 3.2. The EFWS piping and component pressure retaining parts are constructed of austenitic stainless steel. The EFWS materials conform to the requirements and regulatory guidance in Section 6.1.1. EFWS component data information is provided in Table 10.4.9-1—Emergency Feedwater System Component Data and material specifications are provided in Table 10.4.9-2—Emergency Feedwater System Material Specifications.

#### 10.4.9.2.2.1 EFW Pumps

The four EFW pumps are centrifugal multistage barrel-type design. The pump casings have top-mounted suction and discharge flanges. The pump and motor are horizontally mounted on a common base plate. The pump and motor bearings are oil lubricated and the thrust bearings are air cooled. The pumps utilize a single cartridge-type mechanical seal that does not require external seal water.

The pump bearing temperatures are monitored by sensors located on the outer ring of the rolling elements. Pump vibration is monitored by vibration sensors located on the bearing housings.

The EFW pumps are driven directly by ac motors utilizing flexible couplings. The motor bearings and winding temperatures are monitored, as is motor bearing vibration.

**Table 10.4.9-1—Emergency Feedwater System Component Data**

| | | |
|---|---|---|
| **Emergency Feedwater Storage Pools** | | |
| Quantity | | 4 |
| Type | | Protected reinforced concrete structure |
| Liner | | Austenitic stainless steel |
| ≈ Available Volume | | 110,000 gal – Pools 1 and 4 |
| | | 95,600 gal – Pools 2 and 3 |
| Design Code | | ACI 349 |
| Seismic Design | | Seismic Category I |
| **Emergency Feedwater Pumps** | | |
| **Pump** | Quantity | 4 |
| | Type | Horizontal centrifugal, multistage |
| | Design Flow (@ 122°F) | 400 gpm |
| | TDH | 3570 ft |
| | NPSH Required | 14 ft |
| | NPSH Available | 39 ft |
| | Material 06.01.01-13 | ~~Austenitic stainless steel~~See Table 10.4.9-2 |
| | Design Code | ASME Section III, Class 3 |
| | Seismic Design | Seismic Category I |
| | | |
| **Motor** | Horsepower | 650 HP |
| | Power Supply | 6.9 kV, 60 Hz, 3 phase, Class 1E |
| | Design Code | NEMA |
| | Seismic Design | Seismic Category I |
| | Classification | 1E |

Table 10.4.9-2—Emergency Feedwater Material Specifications
Sheet 1 of 2

| Component | Material |
|---|---|
| Tanks (liner) | SA-182 Grade F304[1, 2] |
| | SA-182 Grade F304L[1] |
| | SA-182 Grade F316[1, 2] |
| | SA-182 Grade F316L[1] |
| | SA-240 Type 304[1, 2] |
| | SA-240 Type 304L[1] |
| | SA-240 Type 316[1, 2] |
| | SA-240 Type 316L[1] |
| | SA-479 Type 304[1, 2] |
| | SA-479 Type 304L[1,] |
| | SA-479 Type 316[1, 2] |
| | SA-479 Type 316L[1] |
| Process Piping | SA-312 Grade TP304L[1, 2,4] |
| Fittings | SA-182 Grade F304L[1] |
| | SA-403 Grade WP304L Class S[1, 2] |
| Valves | SA-182 Grade F304[1, 2] |
| | SA-182 Grade F304L[1] |
| | SA-182 Grade F316[1,2] |
| | SA-182 Grade F316L[1] |
| | SA-351 Grade CF3 |
| | SA-351 Grade CF3A |
| | SA-351 Grade CF3M |
| | SA-479 Type 304[1, 2] |
| | SA-479 Type 304L[1] |
| | SA-479 Type 316[1, 2] |
| | SA-479 Type 316L[1] |

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Table 10.4.9-2—Emergency Feedwater Material Specifications
Sheet 2 of 2

| Component | Material |
|---|---|
| Pump | SA-182 Grade F304[1, 2] |
| | SA-182 Grade F304L[1] |
| | SA-182 Grade F316[1, 2] |
| | SA-182 Grade F316L[1] |
| | SA-336 Grade F304[1, 2] |
| | SA-336 Grade F304L[1, 2] |
| | SA-336 Grade F316[1, 2] |
| | SA-336 Grade F316L[1, 2] |
| | SA-194 Grade 6 [3] |
| | SA-564 Type 630[3] |
| | SA-240 Type 304[1, 2] |
| | SA-240 Type 304L[1] |
| | SA-240 Type 316[1, 2] |
| | SA-240 Type 316L[1] |
| | SA-193 Grade B8[1] |
| | SA-194 Grade 8[1] |
| Austenitic stainless steel welding material | SFA 5.4 E308[2], E309[2], E316[2] |
| | SFA 5.4 E308L[2], E309L[2], E316L[2] |
| | SFA 5.9 ER308[2], ER309[2], ER316[2] |
| | SFA 5.9 ER308L, ER309L, ER316L |
| | SFA 5.22 E308[2], E309[2], E316[2] |
| | SFA 5.22 E308L[2], E309L[2], E316L[2] |

**Notes:**

1. Solution annealed and rapidly cooled.
2. Carbon not exceeding 0.03wt%.
3. Quenched and tempered.
4. Piping is seamless.

Next File

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