ArevaEPRDCPEm Resource

From: BRYAN Martin (EXT) [Martin.Bryan.ext@areva.com]
Sent: Tuesday, June 08, 2010 2:25 PM
To: Tesfaye, Getachew
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); HOLM Jerald S (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 343, FSARCh. 4 OPEN ITEM, Supplement 2
Attachments: RAI 343 Supplement 2 Response US EPR DC .pdf

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 343 Supplement 2 Response US EPR DC.pdf" provides technically correct and complete responses to all of the 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 343 Question 04.05-01-7.

The following table indicates the respective pages in the response document, "RAI 343 Supplement 2 Response US EPR DC.pdf" that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 343 — 04.05.01-6	2	2
RAI 343 — 04.05.01-7	3	3

This concludes the formal AREVA NP response to RAI 343, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
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Martin.Bryan.ext@areva.com

From: BRYAN Martin (EXT)
Sent: Friday, April 30, 2010 3:14 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); HOLM Jerald S (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 343, FSARCh. 4 OPEN ITEM, Supplement 1

Getachew,

AREVA NP provided a schedule for responding to RAI 343 in an email on March 1, 2010. This schedule was provided to allow time to allow for a discussion between the NRC and AREVA NP of the final response prior to providing it to the NRC. A discussion of the final response took place on

April 29, 2010. As agreed with the NRC, in order to accommodate further discussions between the NRC and AREVA NP on the final response and allow time for any necessary follow-up, the schedule is being revised as shown below.

AREVA NP's schedule for providing a technically correct and complete response to the two questions in RAI 343 is provided below.

Question #	Response Date
RAI 343-04.05.01-6	June 18, 2010
RAI 343-04.05.01-7	June 18, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
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From: BRYAN Martin (EXT)
Sent: Monday, March 01, 2010 5:44 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); ROMINE Judy (AREVA NP INC); HOLM Jerald S (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 343, FSARCh. 4 OPEN ITEM

AREVA NP's schedule for providing a technically correct and complete response to thetwo questions in RAI 343 is provided below.

Question #	Response Date
RAI 343-04.05.01-6	April 30, 2010
RAI 343-04.05.01-7	April 30, 2010

Martin (Marty) C. Bryan
Licensing Advisory Engineer
AREVA NP Inc.
Tel: (434) 832-3016
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, December 16, 2009 8:49 AM
To: ZZ-DL-A-USEPR-DL

Cc: Davis, Robert; Terao, David; Carneal, Jason; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 343 (4119), FSARCh. 4 OPEN ITEM

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on December 7, 2009, and on December 16, 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 questions in this RAI are OPEN ITEMS in the safety evaluation report for Chapter 4 for Phases 2 and 3 reviews. As such, the schedule we have established for your application assumes technically correct and complete responses prior to the start of Phase 4 review. For any RAI that cannot be answered prior to the start of Phase 4 review, it is expected that a date for receipt of this information will be provided so that the staff can assess how this information will impact the published schedule.

Thanks,

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

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 1511

Mail Envelope Properties (BC417D9255991046A37DD56CF597DB710671029D)

Subject: Response to U.S. EPR Design Certification Application RAI No. 343, FSARCh. 4 OPEN ITEM, Supplement 2
Sent Date: 6/8/2010 2:25:06 PM
Received Date: 6/8/2010 2:25:09 PM
From: BRYAN Martin (EXT)

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MESSAGE	4465	6/8/2010 2:25:09 PM
RAI 343 Supplement 2 Response US EPR DC .pdf		121597

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Priority: Standard
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Sensitivity: Normal
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Response to

Request for Additional Information No. 343, Supplement 2

12/16/2009

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 04.05.01 - Control Rod Drive Structural Materials
Application Section: 4.5.1

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

Question 04.05.01-6:

OPEN ITEM

Figure 05.02.03-12-1 in RAI response 05.02.03-12, dated November 10, 2008, indicates that F347 material will be used to fabricate part of the CRDM pressure housing. However, Table 5.2-2 does not list a forging specification for Grade 347 material. The staff requests that the applicant modify FSAR Table 5.2-2 to list material specifications and grades for all CRDM pressure boundary components.

Response to Question 04.05.01-6:

Three parts were inadvertently marked with the label “F347” in Figure 05.02.03-12-1 (i.e., Parts 1, 3, and 5) of the response to RAI 88, Question 05.02.03-12. The label “F347” should not have contained the letter F. These parts are fabricated from ASME material specification SA-479 Grade 347, which is already listed in U.S. EPR FSAR Tier 2, Table 5.2-2.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 04.05.01-7:

OPEN ITEM

The staff requested, in RAI 88 Question 05.02.03-1, that the applicant delete SA-479 UNS S41500 from Table 5.2-2 for use in the CRDM pressure housing, provide an alternative material or take the appropriate steps to have SA-479 UNS S41500 included in Table 2A by ASME Code, Section III. The applicant responded, by letter dated November 10, 2008, and stated that it has submitted a request to ASME Code to extend the properties currently provided in Section II Part D for SA-182 Grade F6NM (UNS S41500) to SA-479 (UNS S41500) material. The applicant stated that it expects the Code Case to be issued in the near future. The staff requests that the applicant notify the NRC staff when ASME Code has approved the code case requested by the applicant.

Response to Question 04.05.01-7:

- The request to extend the properties currently provided in Section II Part D for SA-182/182M Grade F6NM to SA-479/479M UNS S41500 was approved October 12, 2009 by ASME as Code Case N-785.
- The basis for approval of this code case is that the chemical composition, material properties, and heat treatment requirements for SA-182/182M Grade F6NM and SA-479/479M UNS S41500 are virtually identical. As this code case has not yet been added to RG 1.84, U.S. EPR FSAR Tier 2, Section 5.2.3.1 will be revised to specifically address acceptability of this code case for use.
- The appropriate control rod drive mechanism (CRDM) materials listed in U.S. EPR FSAR Tier 2, Table 5.2-2 for "Control Rod Drive Mechanism" and in U.S. EPR FSAR Tier 2, Section 4.5.1.1 and Section 4.5.1.3 will be modified to reflect this code case. This code case will also be added to U.S. EPR FSAR Tier 2, Table 5.2-1.
- Code cases listed in U.S. EPR FSAR Tier 2, Table 5.2-1 include those applicable to ASME Section XI and the ASME OM Code. U.S. EPR FSAR Tier 2, Section 5.2.1.2 will be revised to clarify that code cases used in the U.S. EPR design certification are listed in Table 5.2-1, not just code cases applicable to ASME Section III.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 4.5.1.1, Section 4.5.1.3, Section 5.2.1.2, Section 5.2.3.1, Table 5.2-1, and Table 5.2-2 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

4.5 REACTOR MATERIALS

4.5.1 Control Rod Drive System Structural Materials

GDC 1 and 10 CFR 50.55(a) establish the requirements regarding structures, systems, and components (SSC) important to safety being designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. The specifications and design requirements of the materials selected for the control rod drive mechanism (CRDM) are described in Sections 3.9.4, 4.5, and 5.2.3.

GDC 14 establishes requirements regarding the reactor coolant pressure boundary being designed, fabricated, erected, and tested to have extremely low probability of abnormal leakage, rapidly propagating failure, or gross rupture. The pressure boundary of the CRDM is designed in accordance with ASME Code and the materials are selected based on compatibility with their environment as described in Sections 3.9.4, 4.5, and 5.2.3.

GDC 26 establishes the requirements regarding control rods being capable of reliable control of reactivity changes to prevent exceeding fuel design limits under conditions of normal operation, including anticipated operational occurrences. The CRDM material selection and fabrication support reliable rod movement for reactivity control, which is addressed in Sections 3.9.4, 4.5, and 5.2.3.

4.5.1.1 Materials Specifications

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Parts exposed to reactor coolant are made of corrosion resistant materials. The CRDM pressure boundary materials exposed to reactor coolant include Type 347 stabilized austenitic stainless steel and ASME SA-479 UNS S41500 (Code Case N-785)/SA-182 Grade F6NM ~~(UNS S41500)~~ martensitic stainless steel. The CRDM pressure boundary bolting-studs materials not exposed to reactor coolant include Alloy A-286 austenitic stainless steel bolting studs as well as martensitic stainless steel nuts. These materials are listed in Table 5.2-2.

The CRDM pressure boundary materials and pressure boundary weld filler material, which includes Type 347 austenitic stainless steel and alloy 52/52M/152 nickel base alloys, meet the ASME Boiler and Pressure Vessel Code, Section III, Subsection NB (Reference 1). No Alloy 600 base metal or Alloy 82/182 weld metals are used in the CRDM pressure boundary in accordance with GDC 1 and 10 CFR 50.55(a).

Materials used in the CRDM internals are selected based on a proven AREVA design with 30 years of operating experience. CRDM internals are non-pressure boundary and non-structural components, thus the CRDM internals material specifications are not required to be ASME materials. CRDM internals material specifications are typically per European standards and are listed in Table 4.5-1—Control Rod Drive

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austenitic stainless steel used in these applications is ASME SA-479 UNS S41500 (Code Case N-785)/SA-182 Grade F6NM (UNS S41500). This material is martensitic stainless steel and is delivered in the quenched and tempered condition. The material is tempered between 1050°F and 1120°F as required by the ASME material specifications.

Materials other than austenitic stainless steel used in the non-pressure boundary components of the CRDM include martensitic stainless steel, cobalt-chromium alloy, nickel-base materials, and cobalt base material. The materials not used in pressure boundary applications are selected based on a proven German design with 30 years of operating experience. Materials are selected for their compatibility with the reactor coolant, as described in ASME articles NB-2160 and NB-3120 (Reference 1).

The martensitic stainless steel base metal used in the non-pressure boundary components is delivered in the quenched and tempered condition; tempering is performed at a temperature to between 1256°F and 1436°F.

The cobalt-chromium alloy is delivered in the solution annealed condition.

The nickel-base alloy used is a precipitation hardenable alloy which is extremely resistant to chemical corrosion and oxidation. It is supplied in the solution annealed (followed by quenching) and thermally aged condition for optimum resistance to stress corrosion cracking.

The cobalt alloy is only used in a very small portion of the CRDM where an alternate material will not perform satisfactorily. It has a very low susceptibility to corrosion.

The sliding surfaces of the latch unit are hard chromium plated. This material is only used in a very small portion of the CRDM where an alternate material will not perform satisfactorily.

4.5.1.4 Cleaning and Cleanliness Control

Cleanliness of the CRDMs is controlled during manufacture and installation per the requirements of ASME NQA-1-1994 (Reference 3) and RG 1.37 as addressed in Section 5.2.3.

4.5.2 Reactor Internals and Core Support Materials

GDC 1 and 10 CFR 50.55(a) establish the requirements regarding SSC important to safety being designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. The specifications and design requirements of the materials selected for the reactor internals and core support structures are described in Sections 3.9.5, 4.5, and 5.2.3.

5.2 Integrity of the Reactor Coolant Pressure Boundary

This section describes the measures employed to provide and maintain the integrity of the reactor coolant pressure boundary (RCPB) for the plant design lifetime. Consistent with the definition in 10 CFR 50.2, the U.S. EPR RCPB includes all pressure-containing components, such as pressure vessels, piping, pumps, and valves which are part of the reactor coolant system (RCS) or connected to the RCS, up to and including these:

- The outermost containment isolation valve in system piping which penetrates primary reactor containment.
- The second of two valves normally closed during normal reactor operation in system piping which does not penetrate primary reactor containment.
- The RCS safety and relief valves.

Section 3.9 presents the design transients, loading combinations, stress limits, and evaluation methods used in the design analyses of RCPB components and supports to demonstrate that RCPB integrity is maintained.

5.2.1 Compliance with Codes and Code Cases

5.2.1.1 Compliance with 10 CFR 50.55a

The RCPB components are designed and fabricated as Class 1 components in accordance with Section III of the ASME Boiler and Pressure Vessel Code (Reference 1), except for components that meet the exclusion requirements of 10 CFR 50.55a(c) which are designed and fabricated as Class 2 components. The RCPB component classification complies with the requirements of GDC 1 and 10 CFR 50.55a. Table 3.2.2-1—Classification Summary lists the RCPB components, including pressure vessels, piping, pumps, and valves, along with the applicable component codes. Other safety-related plant components are classified in accordance with RG 1.26, as specified in Section 3.2.

The code of record for the design of the U.S. EPR is the 2004 edition of the ASME Boiler and Pressure Vessel Code (no addenda).

The application of Section XI of the 2004 edition of the ASME Boiler and Pressure Vessel Code to the U. S. EPR is described in Section 5.2.4 and Section 6.6 The application of the ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code) (Reference 2) is described in Section 3.9.6.

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5.2.1.2 Compliance with Applicable Code Cases

ASME Section III Code Cases acceptable for use ~~in the U.S. EPR design~~, subject to the limitations specified in 10 CFR 50.55a, are listed in RG 1.84. Code Cases pertaining to

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ASME Section III, Division 2 are addressed in Section 3.8. ~~Table 5.2-1—ASME Code Cases lists the specific Code Cases used in the U.S. EPR design. A COL applicant that references the U.S. EPR design certification will identify additional ASME Code Cases to be used. Code Cases pertaining to ASME Code Section III, Division 2 are addressed in Section 3.8.~~ASME Section XI Code Cases acceptable for use for preservice inspection and inservice inspection (ISI), subject to the limitations specified in 10 CFR 50.55a, are listed in RG 1.147 and described in Section 5.2.4 and Section 6.6. ASME OM Code Cases acceptable for use for preservice testing and inservice testing (IST), subject to the limitations specified in 10 CFR 50.55a, are listed in RG 1.192 and described in Section 3.9.6.

Table 5.2-1—ASME Code Cases lists the specific Code Cases used in the U.S. EPR design. A COL applicant that references the U.S. EPR design certification will identify additional ASME Code Cases to be used.

5.2.2 Overpressure Protection

Pressurizer safety relief valves (PSRV) protect the RCPB from overpressure during power operation and during low temperature operation. Auxiliary and emergency systems connected to the RCS are not utilized for RCPB overpressure protection.

Main steam safety valves (MSSV) and main steam relief trains protect the secondary side of the steam generators from overpressure. Secondary side overpressure protection is addressed in Section 10.3.

5.2.2.1 Design Bases

Component design bases for the PSRVs and the secondary side overpressure protection devices are addressed in Section 5.4.13 and Section 10.3, respectively.

The PSRVs are part of the RCPB and are designed to meet the requirements for ASME Section III, Class 1 components (GDC 1, GDC 30, 10 CFR 50.55a). Component classifications are presented in Section 3.2.

The opening set pressures and capacity of the PSRVs are sufficient to limit the RCS pressure to less than 110 percent of the RCPB design pressure during any condition of normal operation, including anticipated operational occurrences (AOO) (GDC 15). The bounding design transient for RCPB overpressure is a turbine trip at full power. This transient bounds all upset, emergency and faulted conditions identified in Section 3.9.1.

The PSRVs maintain the RCS pressure below brittle fracture limits when the RCPB is stressed under operating, maintenance, testing, and postulated accident conditions, including low temperature operation, so that the RCPB behaves in a non-brittle manner and the probability of rapidly propagating fracture is minimized (GDC 31).

NiCrFe Alloy 600 base metal or Alloys 82/182 weld metal is not used in RCPB applications. NiCrFe Alloy 690 base metal has controlled chemistry, mechanical properties, and thermo-mechanical processing requirements that produce an optimum microstructure for resistance to intergranular corrosion. Alloy 690 is solution annealed and thermally treated to optimize the resistance to intergranular corrosion.

Alloy 690 and its weld filler metals (Alloy 52/52M/152) in contact with RCS primary coolant have limited cobalt content not exceeding 0.05 wt%. Alloy 690 in contact with RCS primary coolant has limited sulfur content not exceeding 0.02 wt%.

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Code Case N-785 has been applied to CRDM materials as shown in Table 5.2-2. This code case was approved by the ASME Boiler and Pressure Vessel Standards Committee on October 12, 2009. The basis for approval of this case is derived from the fact that the chemical composition, material properties, and heat treatment requirements for SA-182/182M Grade F6NM and SA-479/479M (UNS S41500) are virtually identical.

5.2.3.2 Compatibility with Reactor Coolant

5.2.3.2.1 Reactor Coolant Chemistry

The RCS water chemistry is controlled to minimize negative impacts of chemistry on materials integrity, fuel rod corrosion, fuel design performance, and radiation fields, and is routinely analyzed for verification. The water chemistry parameters are based on industry knowledge and industry experience as summarized in the EPRI PWR Primary Water Chemistry Guidelines (Reference 3).

The chemical and volume control system (CVCS) provides the primary means for maintaining the required volume of water in the RCS and for the addition of chemicals. The design of the CVCS allows for the addition of chemicals to the RCS to control pH, scavenge oxygen, control radiolysis reactions, and maintain corrosion product particulates within a specified range. Table 5.2-3—Reactor Coolant Water Chemistry - Control Parameters shows the control values for the reactor coolant chemistry parameters and impurity limitations during power operation. These criteria conform to the recommendations of RG 1.44 and the EPRI PWR Primary Water Chemistry Guidelines report.

Enriched boric acid (EBA) is added to the RCS as a soluble neutron poison for core reactivity control. Lithium hydroxide enriched in lithium 7 is used as a pH control agent to maintain a slightly basic pH at operating conditions. This chemical is chosen for its compatibility with the materials and water chemistry of borated water/stainless steel/zirconium/nickel-base alloy systems. Lithium-7 is also produced in solution from the neutron irradiation of the dissolved boron in the coolant.

In addition to degasification during startup, two chemicals are added to the reactor coolant to control oxygen: (1) hydrazine during startup operations below 250°F; and

Table 5.2-1—ASME Code Cases

Code Case Number	Title
N-60-5	Material for Core Support Structures Section III, Division 1
N-71-18	Additional Materials for Subsection NF, Class 1, 2, 3, and MC Supports Fabricated by Welding, Section III, Division 1
N-284-1 [1]	Metal Containment Shell Buckling Design Methods, Section III, Division 1, Class MC
N-319-3	Alternate Procedure for Evaluation of Stresses in Butt Welding Elbows in Class 1 Piping, Section III, Division 1
N-729-1	Alternative Examination Requirements for PWR Reactor Vessel Upper Heads with Nozzles Having Pressure-Retaining, Partial-Penetration Welds
N-785 [3]	Use of SA-479/SA-479M, UNS S41500 for Class 1, Welded Construction Section III, Division 1
OMN-1, Revision 0 [2]	Alternative Rules for Preservice and Inservice Testing of Active Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants
OMN-13, Revision 0 [2]	Requirements for Extending Snubber Inservice Visual Examination Interval at LWR Power Plants

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NOTES:

1. See Section 3.8 for use.
2. See Section 3.9.6 for use.
3. See Section 5.2.3.1 for use.

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Table 5.2-2—Material Specifications for RCPB Components
Sheet 4 of 5

Component	Material
Latch housing 04.05.01-7	ASME SA-479 UNS S41500 (Code Case N-785)/SA-182 Grade F6NM (see Note 1) ~~(UNS S41500)~~
Seamless tube	ASME SA-312 Grade TP347 (Seamless) (see Note 3)
Bolt	ASME SA-453 Grade 660 (see Note 7)
Nut	ASME SA-437 Grade B4C (see Note 1)
Welding filler material	SFA 5.4 E347 SFA 5.9 ER347 SFA 5.14 ERNiCrFe-7 SFA 5.14 ERNiCrFe-7A
RCPB Valves~~Pressurizer Safety Relief Valves~~	
Bodies~~A vendor for the PSRV has not been chosen for the U.S. EPR~~	SA-182 Grade F304 (see Notes 3 & 4), Grade F304L (see Note 3), Grade F304LN (see Note 3), Grade F316 (see Notes 3 & 4), Grade F316L (see Note 3), Grade F316LN (see Note 3)
	SA-351 Grade CF3, Grade CF3A, Grade CF3M, Grade CF8 (see Note 4), Grade CF8A (see Note 4), Grade CF8M (see Note 4 & 10)
Bonnets	SA-182 Grade F304 (see Notes 3 & 4), Grade F304L (see Note 3), Grade F304LN (see Note 3), Grade F316 (see Notes 3 & 4), Grade F316L (see Note 3), Grade F316LN (see Note 3)
	SA-351 Grade CF3, Grade CF3A, Grade CF3M, Grade CF8 (see Note 4), Grade CF8A (see Note 4), Grade CF8M (see Note 4 & 10)
	SA-240 Type 304 (see Notes 3 & 4), Type 304L (see Note 3), Type 304LN (see Note 3), Type 316 (see Notes 3 & 4), Type 316L (see Note 3), 316LN (see Note 3)
Discs	SA-182 Grade F304 (see Notes 3 & 4), Grade F304L (see Note 3), Grade F304LN (see Note 3), Grade F316 (see Notes 3 & 4), Grade F316L (see Note 3), Grade F316LN (see Note 3)
	SA-351 Grade CF3, Grade CF3A, Grade CF3M, Grade CF8 (see Note 4), Grade CF8A (see Note 4), Grade CF8M (see Note 4 & 10)
	SA-479 Type 304 (see Notes 3 & 4), Type 304L (see Note 3), Type 304LN (see Note 3), Type 316 (see Notes 3 & 4), Type 316L (see Note 3), 316LN (see Note 3), XM-19 (see Note 3)
	SA-564 Type 630 (Conditions H1075, H1100, H1150)
	SB-637 UNS N07718 (see Note 8)
Stems	SA-479 Type 304 (see Notes 3 & 4), Type 304L (see Note 3), Type 304LN (see Note 3), Type 316 (see Notes 3 & 4), Type 316L (see Note 3), Type 316LN (see Note 3), Type XM-19 (see Notes 3 & 9)
	SA-564 Type 630
	SB-637 UNS N07718 (see Note 8)