U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

5.2.3 REACTOR COOLANT PRESSURE BOUNDARY MATERIALS

REVIEW RESPONSIBILITIES

Primary - Materials and Chemical Engineering Branch ~~(MTEB)~~(EMCB)[1]

Secondary - ~~Chemical Engineering Branch (CMEB)~~None[2]

I. AREAS OF REVIEW

The following areas, which relate to materials of the reactor coolant pressure boundary (RCPB) other than the reactor pressure vessel, which is covered in Standard Review Plan Section 5.3.1, "Reactor Vessel Materials," are reviewed by ~~MTEB and CMEB~~ EMCB[3] as indicated.

1. Material Specifications

   The specifications for pressure-retaining ferritic materials, nonferrous metals and austenitic stainless steels, including weld materials, that are used for each component (e.g., vessels, piping, pumps, and valves) of the reactor coolant pressure boundary, are reviewed by ~~MTEB~~EMCB[4].

   The adequacy and suitability of the ferritic materials, stainless steels, and nonferrous metals specified for the above applications are determined.

2. Compatibility of Materials with the Reactor Coolant

   General corrosion and stress corrosion cracking induced by impurities in the reactor coolant can cause failures of the reactor coolant pressure boundary.

The chemistry of the reactor coolant and the additives (such as inhibitors) whose function is to control corrosion are reviewed by ~~CMEB~~EMCB[5] as part of its primary review responsibility for SRP Sections 5.4.8 and 9.3.4.

~~CMEB~~EMCB[6] reviews the compatibility of the materials of construction employed in the RCPB with the reactor coolant, contaminants, or radiolytic products to which the system is exposed. The extent of the corrosion of ferritic low alloy steels and carbon steels in contact with the reactor coolant is reviewed.

Similarly, a review ~~by MTEB~~ [7]is made of possible uses of austenitic stainless steels in the sensitized condition. The use of austenitic stainless steels in any condition in boiling water reactors (BWR~~'~~s)[8] requires special attention because of the oxygen content of BWR coolant.

3. Fabrication and Processing of Ferritic Materials

~~Items 3.a, 3.b, and 3.c are reviewed by MTEB.~~[9]

a. The fracture toughness properties of ferritic materials used for pressure-retaining components of the reactor coolant pressure boundary are reviewed.

The fracture toughness tests performed on all ferritic materials used for pressure-retaining RCPB components (i.e., vessels, pumps, valves, and piping) are reviewed.

The test procedures used for Charpy V-notch impact and dropweight testing are reviewed.

Fracture toughness of the material is characterized by its reference temperature, RT_{NDT}. This temperature is the higher of the nil ductility temperature (NDT) from the dropweight test or the temperature that is 33.5°C (60°F)[10] below the temperature at which Charpy V-notch impact test data are 68 J (50 ft-lbs)[11] and 0.89 mm (35 mils)[12] lateral expansion.[13]

b. The control of welding in ferritic steels is reviewed.

(1) The quality of welds in low alloy steels can be increased significantly by proper controls. In particular, the propensity for cold cracks or reheat cracks to form in areas under the bead and in heat-affected zones (HAZ) can be minimized by maintaining proper preheat temperatures of the base metal concurrent with controls on other welding variables. The minimum preheat temperature and the maximum interpass temperatures are reviewed.

(2) The quality of electroslag welds in low alloy steel components can be increased by maintaining a weld solidification pattern that possesses a strong intergranular bond in the center of the weld. The welding

variables, which have a significant effect on the weld solidification pattern, must be controlled. The welding variables, solidification patterns, macro etch tests, and Charpy V-notch impact tests of electroslag welds are reviewed. It should be noted that electroslag welds are not normally used in reactor pressure vessel fabrications because of the characteristic low degree of fusion between base metal and such welds. Electroslag welds, where used in the RCPB, are reviewed with respect to regulatory guidance describing acceptable controls for the electroslag weld process.[14]

(3) Experience shows that a welder qualified to weld low-alloy steel or carbon steel components under normal fabricating conditions may not produce acceptable welds if the accessibility to the weld area is restricted. Limited accessibility can occur when component parts are joined in the final assembly or at the plant site, where other adjacent components or structures prevent the welder from assuming an advantageous position during the welding operation. The adequacy of accessibility during the welding of ferritic components is reviewed.

(4) Controls can be exercised to limit the occurrence of underclad cracking in low-alloy steel components clad with stainless steel. Welding processes that generate excessive heating and promote base metal coarsening cause underclad cracking of certain steels. These variables are reviewed.

c. The requirements for nondestructive examination of ferritic wrought seamless tubular products used for ASME Class 1 components of nuclear power plants are specified in Paragraphs NB-2550 through NB-2570, ASME Boiler and Pressure Vessel Code (Reference 21, hereafter "the Code"), Section III, "Rules for Construction of Nuclear Plant Components."[15] The methods of examination specified for nondestructive examination are reviewed.

4. Fabrication and Processing of Austenitic Stainless Steel

Austenitic stainless steels in a variety of product forms (including several stabilized product forms) are used for construction of pressure-retaining components in the reactor coolant pressure boundary. Unstabilized austenitic type stainless steels, which include American Iron and Steel Institute (AISI) Types 304 and 316, are ~~normally~~frequently used.[16] Because these compositions are susceptible to stress corrosion cracking when exposed to certain environmental conditions, process controls must be exercised during all stages of component manufacturing and reactor construction to avoid severe sensitization of the material and to minimize exposure of the stainless steel to contaminants that could lead to stress corrosion cracking.

~~Items 4.a, 4.b, 4.d, and 4.e are reviewed by MTEB; and item 4.c is reviewed I by CMEB. Upon request the CMEB will review corrosion testing data.~~[17]

a. Sensitization is caused by intergranular precipitation of chromium carbide in austenitic stainless steels that are exposed to temperatures in the approximate

range of 430°C to 820°C (800°F to 1500°F)[18]. Precipitation of the chromium carbide at the grain boundaries increases with increasing carbon content and exposure time. Control of the application and processing of stainless steel is needed to eliminate the occurrences of stress corrosion cracking in sensitized stainless steel components of nuclear reactors. Test data and service experience demonstrate that sensitized stainless steel is significantly more susceptible to stress corrosion cracking than nonsensitized (solution heat treated) stainless steel.

The following areas are reviewed: requirements for solution heat treatment of stainless steel; plans to avoid partial or severe sensitization during welding, including information on welding methods, heat input, and interpass temperatures; and a description of the material inspection program that will be used to verify that unstabilized austenitic stainless steels are not susceptible in service to intergranular attack.

Special provisions may apply to the use of austenitic stainless steel in ~~boiling water reactor (~~BWR~~)~~[19] piping because plant operating experience indicates that reactor coolant boundary piping is susceptible to oxygen-assisted stress corrosion cracking.

b. Contamination of austenitic stainless steel with halogens and halogen-bearing compounds (e.g., die lubricants, marking compounds, and masking tape) must be avoided to the maximum degree possible to avoid stress corrosion cracking. Plans for cleaning and protecting the material against contaminants capable of causing stress corrosion cracking during fabrication, shipment, storage, construction, testing, and operation of components and systems are reviewed. Controls for abrasive work (e.g. grinding) on austenitic stainless steel surfaces are also reviewed with respect to potential for material contamination and excessive surface cold-working.[20] Any pickling used in processing austenitic stainless steel components and the restrictions placed on pickling sensitized materials are reviewed. The upper limit on the yield strength of austenitic stainless steel materials is reviewed.

c. Whether sensitized or not, austenitic stainless steel is subject to stress corrosion and must be protected from contaminants that can promote cracking. Thermal insulation is often employed adjacent to, or in direct contact with, stainless steel piping and components. The contaminants present in the thermal insulation may be leached by spilled or leaking liquids and deposited on the stainless steel surfaces. The controls on the use of nonmetallic thermal insulation are reviewed.

d. Austenitic stainless steel is subject to hot cracking (microfissuring) during welding if the weld metal composition or the welding procedure is not properly controlled. Because cracks formed in this manner are small and difficult to detect by nondestructive testing methods, welding procedures, weld metal compositions, and delta ferrite percentages that minimize the possibility of hot cracking must be specified. ~~As a part of achieving this control, Regulatory Guide 1.31, "Control of Ferrite Content in Stainless Steel Weld Metal," contains recommendations for~~

~~process control through the testing of weld test pads. The staff recommendations will provide assurance that the ferrite content will be adequate to prevent microfissuring.~~ The adequacy of the proposed welding procedures, weld metal compositions, testing of weld metals, and delta ferrite content[21] is reviewed.

The assurance of satisfactory electroslag welds for austenitic stainless steel components can be increased by maintaining a weld solidification pattern with a strong intergranular bond in the center of the weld. The welding variables that have a significant effect on the weld solidification pattern must be controlled.

A number of electroslag welding process variables, such as, slag pool depth, electrode feed rate and oscillation, current, voltage, and slag conductivity, have been shown to influence the weld solidification pattern. If the combination of process variables produces a deep pool of molten weld metal, the crystal (dendritic) growth direction from the pool sides will join at an obtuse angle at the center of the weld, and cracks may develop because of the weaker centerline bond between dendrites. A proper combination of process variables promotes a dendritic growth pattern with an acute joining angle, which results in a strong centerline bond. The welding variables, solidification patterns, and macro etch tests used in the electroslag welding of austenitic stainless steel are reviewed.

Experience has shown that a welder qualified to weld stainless steel components under normal fabricating conditions may not produce acceptable welds if the accessibility to the weld area is restricted. Limited accessibility can occur when component parts are joined in the final assembly or at the plant site, where other adjacent components or structures prevent the welder from assuming an advantageous position during the welding operation. The adequacy of accessibility of field erected structures, for welding austenitic stainless steel components, is reviewed.

e. The requirements for nondestructive examination of wrought seamless tubular products used for components of nuclear power plants are specified in Paragraphs NB-2550 through NB-2570[22] of the Code, Section III. Nondestructive examination techniques applied to tubular products used for components of the RCPB, or other safety-related ASME Class 1 systems that are designed for pressure in excess of 1.896 MPa (275 psig)[23] or temperatures in excess of 93°C (200°F)[24], must be capable of detecting unacceptable defects regardless of defect shape, orientation, or location in the product.

The nondestructive examination procedures used for inspection of tubular products are reviewed.

f. Where cast austenitic stainless steel components are proposed for use in the RCPB, the adequacy of material fracture toughness properties and welding controls to resist thermal aging effects over the design life are reviewed. Since welds on such materials are difficult to inspect using ultrasonic techniques, the inspectability is also reviewed.[25]

~~Inservice inspection requirements for the RCPB are described in SRP Section 5.2.4, "Inservice Inspection and Testing of Reactor Coolant Pressure Boundary."~~[26]

Review Interfaces:

EMCB also performs the following related reviews under the SRP Sections indicated:[27]

1. Evaluates the adequacy of programs for assuring the integrity of bolting and threaded fasteners as part of its primary review responsibility for SRP Section 3.13 (proposed).[28]

2. Determines the acceptability of the reactor coolant chemistry and associated chemistry controls (including additives such as inhibitors) as it relates to corrosion control and compatibility with RCPB materials, as part of its primary review responsibility for SRP Sections 5.4.8 "Reactor Water Cleanup System (BWR)" and 9.3.4 "Chemical and Volume Control System (PWR)."[29]

In addition, the EMCB will coordinate other branches' evaluations that interface with the overall review of the RCPB materials as follows:[30]

1. The Mechanical Engineering Branch (EMEB) determines the adequacy of the design for structural integrity of components and their supports including the adequacy of design fatigue curves for RCPB materials with respect to cumulative reactor service-related environmental and usage factor effects, as part of its primary review responsibility for SRP Section 3.9.3.[31]

2. The Civil Engineering and Geosciences Branch (ECGB) determines the acceptability of inservice inspection requirements specified for the RCPB and the effectiveness of proposed inspection and examination techniques to provide early detection and adequate evaluation of defects in materials and weldments used in the RCPB, as part of its primary review responsibility for SRP Section 5.2.4.[32]

3. The review for Quality Assurance is coordinated and performed by the Quality Assurance and Maintenance Branch (HQMB)[33] as part of its primary review responsibility for Standard Review Plan Sections 17.1, ~~and~~ 17.2, and 17.3[34]. ~~The acceptance criteria necessary for the review and methods of application are contained in the referenced SRP sections.~~

For those areas of review identified above, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP section.[35]

II. ACCEPTANCE CRITERIA

The acceptance criteria for the areas of review described in subsection I of this SRP section describe methods to meet the requirements of the Commission's regulations in 10 CFR Part 50 given below:

~~1~~A.[36] General Design Criteria (GDC) 1 and 30, as they relate to quality standards for design, fabrication, erection and testing;

~~2~~B.[37] GDC 4, as it relates to compatibility of components with environmental conditions;

~~3~~C.[38] GDC 14 and 31, as they relate to extremely low probability of rapidly propagating fracture and gross rupture of the RCPB;

~~4~~D.[39] Appendix B, Criterion XIII,[40] as it relates to onsite material cleaning control;

~~5~~E.[41] Appendix G, as it relates to materials testing and acceptance criteria for fracture toughness of the RCPB; and

~~6~~F.[42] Section 50.55a, as it relates to quality standards ~~and fracture toughness~~applicable to the RCPB[43].

Specific acceptance criteria necessary to meet the relevant requirements of Commission regulations identified above are:

1. Material Specifications

The requirements of GDC 1, GDC 30, and §50.55a regarding quality standards are met for material specifications by compliance with the applicable provisions of the ASME Code and by ~~compliance with the recommendations~~acceptable application of materials Code Cases ~~of~~as described in Regulatory Guide 1.85, "Materials Code Case Acceptability ASME Section III Division 1."[44]

The specifications for permitted materials are those identified in the ASME Code, Section III, Appendix I, or described in detail in the ASME Code, Section II, "Materials" (Reference 21),[45] Parts A, B, and C. Regulatory Guide 1.85~~, "Code Case Acceptability ASME Section III Materials,"~~ describes ~~the~~ acceptable materials Code Cases and guidelines for their application in light-water-cooled nuclear power plants ~~to be~~which may be[46] used in conjunction with the above specifications. ~~(Applicable to materials reviewed in item I.1 by MTEB.)~~[47]

Special requirements for BWR piping materials and materials processing are described in Attachment A to Generic Letter 88-01 (Reference 19). The technical bases for the positions provided in Generic Letter 88-01 and similar recommendations related to minimizing stress corrosion cracking in susceptible piping of BWRs are detailed in NUREG-0313~~, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping."~~ (Reference 18).[48]

2. Compatibility of Materials with the Reactor Coolant

The requirements[49] of GDC 4 relative to compatibility of components with environmental conditions are met by compliance with the applicable provisions of the

ASME Code and by compliance with the ~~recommendations~~positions[50] of Regulatory Guide 1.44, "Control of the Use of Sensitized Stainless Steel."[51]

Ferritic low alloy steels and carbon steels, which are used in many principal pressure-retaining components, are clad with a layer of austenitic stainless steel. If cladding is not used, conservative corrosion allowances must be indicated for all exposed surfaces of carbon and low alloy steels, as indicated in the ASME Code, Section III, NB-~~3120~~3121[52], "Corrosion." ~~(Applicable to materials reviewed by CMEB as specified in item I.2.)~~[53]

Unstabilized austenitic stainless steel of the AISI Type 3XX series used for components of the RCPB must conform to the ~~recommendations~~positions[54] of Regulatory Guide ~~No.~~ 1.44.~~, "Control of the Use of Sensitized Stainless Steel,"~~[55] ~~and the positions of NUREG-0313,~~ Positions related to BWR piping materials,[56] including verification of nonsensitization of the material by an approved test, are described in Attachment A to Generic Letter 88-01. The technical bases for the positions provided in Generic Letter 88-01 and similar recommendations related to minimizing stress corrosion cracking in susceptible piping of BWRs are detailed in NUREG-0313.[57] ~~(Applicable to materials reviewed by MTEB as specified in item I.1.)~~[58]

3. Fabrication and Processing of Ferritic Materials
~~(Applicable to materials reviewed by MTEB as specified in items I.3.a, I.3.b, and I.3.c.)~~[59]

a. The acceptance criteria for fracture toughness are the requirements of Appendix G, "Fracture Toughness Requirements," of 10 CFR Part 50. These criteria satisfy the requirements of GDC 14~~,~~ and GDC 31~~, and §50.55a~~[60] regarding prevention of fracture of the RCPB.

Appendix G requires that the pressure-retaining components of the RCPB that are made of ferritic materials shall meet the requirements for fracture toughness during system hydrostatic tests and any condition of normal operation, including anticipated operational occurrences. With respect to absorbed energy in J (ft-lbs)[61] and lateral expansion as shown by Charpy V-notch (C_v) impact tests, all materials shall meet the acceptance standards of Article NB-2300 of the Code, Section III, and the requirements of Sections IV.A.2 and IV.A.3 of Appendix G, 10 CFR Part 50, as follows:

(1) The special acceptance requirements for fracture toughness of reactor vessels are covered by Standard Review Plan Section 5.3.1, "Reactor Vessel Materials."

(2) Materials for piping (i.e., pipes, tubes, and fittings), pumps, and valves, excluding bolting materials, shall meet the requirements of the Code, Section III, Paragraph NB-2331 or NB-2332 (as applicable based upon thickness), and Appendix G, Paragraph G-3100. The required C_v values for piping, pumps, and valves are specified in Table NB-2332(a)-1 of the Code, Section III.[62]

(3) Materials for bolting for which impact tests are required shall meet the requirements of the Code, Section III, Paragraph NB-2333.

(4) Calibration of instruments and equipment shall meet the requirements of the Code, Section III, Paragraph NB-2360.

b. The acceptance criteria for control of ferritic steel welding are based upon the following regulatory guides and ASME Code provisions to satisfy the quality standards requirements of GDC 1, GDC 30, and §50.55a:

(1) The amount of specified preheat must be in accordance with the requirements of the Code, Section III, Appendix D, Paragraph D-~~1200~~1210[63], supplemented by Regulatory Guide 1.50, "Control of Preheat Temperature for Welding of Low Alloy Steel."[64]

The supplemental acceptance criteria for control of preheat temperature are as follows:

(a) The welding procedure qualification requires that minimum preheat and maximum interpass temperatures be specified and that the welding procedure be qualified at the minimum preheat temperature. For production welds, the preheat temperature should be maintained until a post-weld heat treatment has been performed.

(b) Production welding should be monitored to verify that the limits on preheat and interpass temperatures are maintained. In the event that the above criteria are not met, the weld is subject to rejection.

The preheat controls described in the Westinghouse Topical Report WCAP-8577 (Reference 24)[65] are ~~an~~ acceptable alternate~~i~~ives to compliance with those of Regulatory Guide 1.50. The controls for protection against hydrogen-induced cracking described in Westinghouse Topical Report WCAP-8678 (Reference 25) are acceptable alternatives to those described in Position C.2 of Regulatory Guide 1.50.[66]

(2) The acceptance criteria for electroslag welds are presented in Regulatory Guide 1.34, "Control of Electroslag Weld Properties." These criteria specify acceptable solidification patterns and impact test limits (for qualification of welds in Class 1 and Class 2 components) and the criteria for verifying conformance during production welding.

(3) Regulatory Guide 1.71, "Welder Qualification for Areas of Limited Accessibility," provides the following criteria for requalification of welders: the performance qualification should require testing of the welder when conditions of accessibility to a production weld are less than 30 to 35 cm (12-14 inches) in any direction from the joint; and

requalification is required for different restricted accessibility conditions or when any of the essential variables listed in the Code, Section IX, "Welding and Brazing Qualifications" (Reference 21)[67] are changed.

Qualification of the welder or welding operators for limited accessibility may be waived provided that 100% radiographic and/or ultrasonic examination of the completed welded joint is performed. Examination procedures and acceptance standards should meet the requirements of the ASME Section III of the Code. Records of the examination reports and radiographs should be retained and made part of the Quality Assurance Documentation for the completed weld.

(4) Regulatory Guide 1.43, "Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components," provides criteria to limit the occurrence of underclad cracking in low-alloy steel safety-related components clad with stainless steel. These criteria require that material known to have susceptibility to underclad cracking not be weld clad by high-heat-input welding processes and be qualified for use to demonstrate that underclad cracking is not induced.

c. For nondestructive examination of ferritic steel tubular products, the requirements of GDC 1, GDC 30, and §50.55a regarding quality standards are met by compliance with the applicable provisions of the ASME Code. The acceptance criteria are given in Section III of the Code, Paragraphs NB-2550 through NB-2570.[68]

4. Fabrication and Processing of Austenitic Stainless Steel

a. The requirements[69] of GDC 4 relative to compatibility of components with environmental conditions are met regarding measures to avoid sensitization in austenitic stainless steels. The acceptance criteria for testing, alloy compositions, and heat treatment, to avoid sensitization in austenitic stainless steels, are covered in Regulatory Guide 1.44~~, "Control of the Use of Sensitized Stainless Steel,"~~[70] and additional criteria for BWRs are specified in Attachment A to Generic Letter 88-01 based upon the technical information provided in NUREG-0313. Similar recommendations related to minimizing stress corrosion cracking in susceptible piping of BWRs are described in NUREG-0313.[71]

Regulatory Guide 1.44 also identifies acceptable methods for verification of non-sensitization of austenitic stainless steel materials and qualification of welding processes employed in production including testing using ASTM A-262 Practice A or E (Reference 22) or another method which can be demonstrated to show non-sensitization. Alternative tests that have been previously accepted, based upon the adequacy of justifications presented and circumstances of proposed use, include the use of ASTM A-708 (Reference 23).[72] ~~(Applicable to materials reviewed by MTEB as specified in item I.4.a.)~~[73]

b. The requirements of GDC 4 relative to compatibility of components with environmental conditions are met regarding additional controls to avoid stress corrosion cracking in austenitic stainless steels. These controls consist of acceptance criteria on prevention of contamination, cleaning, and upper limit on yield strength. Additional controls for avoiding stress corrosion cracking are applied to BWRs as described below.[74]

Controls to avoid stress corrosion cracking in austenitic stainless steels are also covered in Regulatory Guide 1.44. This guide provides acceptance criteria on the cleaning and protection of the material against contaminants capable of causing stress corrosion cracking. Acid pickling is to be avoided on fabricated stainless steels. Necessary pickling is to be done only with appropriate controls. Pickling should not be performed upon sensitized stainless steels. ~~(Applicable to materials reviewed by MTEB as specified in item I.4.b.)~~[75]

The quality of water used for final cleaning or flushing of finished surfaces during installation is in accordance with Regulatory Guide 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water Cooled Nuclear Power Plants." Vented tanks with deionized or demineralized water are an acceptable source of water for final cleaning or flushing of finished surfaces. The oxygen content of the water need not be controlled. (Applicable to water specified in Regulatory Guide 1.44 used for final cleaning or flushing of finished stainless steel surfaces~~, and reviewed by CMEB~~[76].)

The controls for abrasive work on austenitic stainless steel surfaces should, as a minimum, be equivalent to the controls described in Regulatory Guide 1.37 position C.5 to prevent contamination which promotes stress corrosion cracking. Tools which contain materials that could contribute to intergranular or stress-corrosion cracking or which, because of previous usage, may have become contaminated with such materials, should not be used on austenitic stainless steel surfaces.[77]

Laboratory stress corrosion tests and service experience provide the basis for the criterion that cold-worked austenitic stainless steels used in the reactor coolant pressure boundary should have an upper limit on the yield strength of 620 MPa (90,000 psi)[78]. ~~(Applicable to material reviewed by MTEB in item I.4.b.)~~[79]

Additional controls, beyond those described above, are considered necessary to avoid intergranular stress corrosion cracking (IGSCC) in and near welds in BWR austenitic stainless steel piping. The affected piping and the additional controls are described in Attachment A to Generic Letter 88-01 or NUREG-0313. These controls include material and weldment specifications for IGSCC resistant materials, processing techniques, categorization of the IGSCC resistance of installations based upon material properties, treatment history, and post-weld treatments. The technical bases for these controls are described in NUREG-0313.[80]

c. The acceptance criteria for compatibility of austenitic stainless steel with thermal insulation are based on Regulatory Guide 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel,"[81] to satisfy GDC 14 and 31 relative to prevention of failure of the RCPB. The compatibility of austenitic stainless steel materials with thermal insulation is dependent upon the type of insulation. The thermal insulation is acceptable if either reflective metal insulation is employed or a nonmetallic insulation which meets the criteria of Regulatory Guide 1.36~~, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel,"~~[82] is used. The acceptance criteria for nonmetallic insulation for stainless steel are based on the levels of leachable contaminants in the material and are presented in position C.2.b and Figure 1 of the guide.~~ (Applicable to material reviewed by CMEB in item I.4.c.)~~[83]

d. The acceptance criteria for control of welding of austenitic stainless steels are based on NUREG-0313 as described below and on[84] Regulatory Guides 1.31, 1.34, and 1.71, to satisfy the quality standards requirements of GDC 1, GDC 30, and §50.55a.~~ (Item II.4.d is applicable to material reviewed by MTEB as specified in item I.4.d.)~~[85]

The acceptance criteria for delta ferrite in austenitic stainless steel welds are given in Regulatory Guide 1.31, "Control of Ferrite Content in Stainless Steel Weld Metal." These acceptance criteria cover (1) verification of delta ferrite content of filler metals, (2) ferrite measurement, (3) instrumentation, (4) acceptability of test results, and (5) documentation of weld pad verification tests[86]. For the BWR austenitic stainless steel RCPB piping specified in Generic Letter 88-01, the weld metal ferrite content should be controlled as described in the positions of Attachment A to Generic Letter 88-01 or the recommendations of NUREG-0313.[87]

The acceptance criteria for electroslag welds in austenitic stainless steel are given in Regulatory Guide 1.34, "Control of Electroslag Weld Properties." These criteria specify acceptable solidification patterns for qualification of austenitic stainless steel welds and the basis for verifying conformance during production welding.

Regulatory Guide 1.71~~, "Welder Qualification for Areas of Limited Accessibility,"~~[88] provides the following criteria for requalification of welders:

(1) The performance qualification should require testing of the welder when conditions of accessibility to a production weld are less than 30 to 35 cm (12-14 inches) in any direction from the joint.

(2) Requalification is required for different restricted accessibility conditions or when other essential variables listed in the Code, Section IX, are changed. An alternate acceptance criterion is as stated in subsection II.3.b of this SRP section.

e. For nondestructive examination of austenitic stainless steel tubular products, the quality standards requirements of GDC 1, GDC 30, and §50.55a are met by compliance with the applicable provisions of the ASME Code. The acceptance criteria are given in Section III of the Code, Paragraphs NB-2550 through NB-2570.[89] ~~(Item II.4.e. is applicable to material reviewed by MTEB as specified in item I.4.e.)~~[90]

Technical Rationale:[91]

The technical rationale for application of the above acceptance criteria to the RCPB materials is discussed in the following paragraphs:

1. GDC 1 and 10 CFR 50.55a require that structures, systems, and components (SSCs) be designed, fabricated, erected, constructed, tested, and inspected to quality standards commensurate with the importance of the safety function to be performed. 10 CFR 50.55a also incorporates by reference applicable editions and addenda of the ASME Boiler and Pressure Vessel Code. GDC 30 requires that components which are part of the reactor coolant pressure boundary be designed, fabricated, erected, and tested to the highest quality standards practical. The reactor coolant pressure boundary provides a fission product barrier, a confined volume for the inventory of reactor coolant, and flow paths to facilitate core cooling. Application of 10 CFR 50.55a, GDC 1, and GDC 30 to the RCPB materials provides assurance that established standard practices of proven or demonstrated effectiveness are used to achieve a high likelihood that these safety functions will be performed.

2. GDC 4 requires that SSCs important to safety be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operations, maintenance, testing, and postulated accidents, including LOCAs. The RCPB provides a fission product barrier, a confined volume for the inventory of reactor coolant, and flow paths to facilitate core cooling. Application of GDC 4 to the RCPB materials provides assurance that degradation and/or failure of the RCPB resulting from environmental service conditions that could cause substantial reduction in capability to contain reactor coolant inventory, reduction in capability to confine fission products, or interference with core cooling are not likely to occur.

3. GDC 14 requires that the RCPB be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. The RCPB provides a fission product barrier, a confined volume for the inventory of reactor coolant, and flow paths to facilitate core cooling. Application of GDC 14 to the RCPB materials assures that they are selected, fabricated, installed, and tested to provide a low probability of significant degradation and in the extreme, gross failure of the RCPB that could cause substantial reduction in capability to contain reactor coolant inventory, reduction in capability to confine fission products, or interference with core cooling.

4. GDC 31 requires that the RCPB be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions (1) the

boundary behaves in a nonbrittle manner and (2) the probability of rapidly propagating fracture is minimized. The design is required to reflect consideration of service temperatures and other conditions of the boundary material under operating, maintenance, testing, and postulated accident conditions and the uncertainties in determining (1) material properties, (2) the effects of irradiation on material properties, (3) residual, steady state and transient stresses, and (4) size of flaws. The RCPB provides a fission product barrier, a confined volume for the inventory of reactor coolant, and flow paths to facilitate core cooling. Application of GDC 31 to the RCPB materials assures that they are selected to provide sufficient design margin to account for uncertainties associated with flaws and the effects of service and operating conditions, and thereby to provide a minimum probability of material degradation leading to rapid failure. The probability of substantial reduction in capability to contain reactor coolant inventory, reduction in capability to confine fission products, and interference with core cooling is thereby minimized.

5. Appendix G of 10 CFR Part 50 requires that the fracture toughness of RCPB ferritic materials be tested in accordance with the requirements of the ASME Code and that the pressure-retaining components of the RCPB that are made of ferritic materials meet requirements for fracture toughness during system hydrostatic tests and any condition of normal operation, including anticipated operational occurrences. Application of these requirements to the RCPB materials provides a method of satisfying the requirements of GDCs 14 and 31 related to fracture prevention. The rationale for these requirements is as discussed in Items 3 and 4 above.

6. Appendix B of 10 CFR Part 50 requires, in Criterion XIII, that measures be established to control the cleaning of material and equipment to prevent damage or deterioration. The RCPB provides a fission product barrier, a confined volume for the inventory of reactor coolant, and flow paths to facilitate core cooling. Application of cleaning requirements to the RCPB materials provides assurance that contaminants to which they could be exposed will not damage or deteriorate the materials, alter their properties, accelerate effects associated with aging, or increase the susceptibility to failure mechanisms such as stress corrosion cracking. This reduces the likelihood that degradation and/or failure of the RCPB that could cause substantial reduction in capability to contain reactor coolant inventory, reduction in capability to confine fission products, or interference with core cooling.

III. REVIEW PROCEDURES

The reviewer will select and emphasize material from the procedures described below, as may be appropriate for a particular case.

For each area of review described in subsection I of this SRP section, the following review procedures are followed:

1. Material Specifications

The material specifications for each major pressure-retaining component or part used in the RCPB are compared with the acceptable specifications listed in the Code, Sections II and III, acceptable material Code Cases as identified in Regulatory Guide 1.85, staff positions on BWR materials described in Attachment A to Generic Letter 88-01, and/or the recommendations of NUREG-0313,[92] as stated in the acceptance criteria. Exceptions to the material specifications of the Code are clearly identified, and the basis evaluated. The reviewer judges the significance of the exceptions and, taking into account precedents set in earlier cases, determines the acceptability of the proposed exceptions. In those instances where the ~~Materials Engineering Branch~~EMCB[93] takes exception to the use of a specific material or questions certain aspects of a specification, the applicant is advised which material is not acceptable, and for what reason.

Operating experience has indicated that certain nickel-chromium-iron alloys (e.g. Inconel) are susceptible to cracking due to corrosion. Inconel 690 alloy has improved corrosion resistance in comparison to Inconel alloy 600 previously used in RCPB applications. Where nickel-chromium-iron alloys are proposed for use in the RCPB, the reviewer verifies that an acceptable technical basis is either identified (based upon demonstrated satisfactory use in similar applications) or presented by the applicant to support use of the material under the expected environmental conditions (e.g. exposure to the reactor coolant). Particular review emphasis is placed upon the corrosion resistance and stress corrosion cracking resistance properties of the proposed nickel-chromium-iron alloy(s).[94]

Where cast austenitic stainless steels are proposed for use in the RCPB, the reviewer verifies that the material specifications ensure adequate fracture toughness over the design life to support use of the material under the expected environmental conditions (e.g. exposure to the reactor coolant operating temperatures).[95]

2. Compatibility of Materials with the Reactor Coolant

The reviewer verifies that the following information is provided at each respective stage of the review process:

a. At the construction permit stage of review:

(1) A list of the materials of construction of the components of the reactor coolant pressure boundary that are exposed to the reactor coolant, including a description of material compatibility with the coolant, contaminants, and radiolytic products to which the materials may be exposed in service.

(2) A list of the materials of construction of the RCPB, and a description of material compatibility with external insulation and with the environment in the event of reactor coolant leakage.

(3) The fabrication and cleaning controls imposed on stainless steel components to minimize contamination with chloride and fluoride ions.

b. At the operating license stage of the review process:

(1) The items listed under subsection III.2.a above, to provide assurance that any changes are noted that may have occurred during the period between the submittal of SARs.

3. Fabrication and Processing of Ferritic Materials

a. The information submitted by the applicant relative to tests for fracture toughness is reviewed for conformance with the acceptance criteria stated in subsection II.3.a. These tests include Charpy V-notch impact and dropweight tests. A description of the tests is reviewed, and the locations of the test specimens and their orientation are verified. Information regarding calibration of instruments and equipment is reviewed for conformance with the acceptance criteria stated in subsection II.3.a.(4) of this SRP section.

In the event that none of the fracture toughness tests has been performed, the preliminary safety analysis report (PSAR) must contain a statement of the applicant's intention to perform this work in accordance with the Code, Section III, Paragraph NB-2300 and Appendix G; and the requirements of 10 CFR Part 50, Appendix G.

The final safety analysis report (FSAR) is reviewed to assure that all the impact tests required by Appendix G to 10 CFR Part 50, as detailed in NB-2300, have been performed.

b. The control of welding in ferritic steels is reviewed as described below:

(1) The information submitted by the applicant regarding the control of preheat temperatures for welding low alloy steel is reviewed for conformance with the acceptance criteria stated in subsection II.3.b.(1) of this SRP section.

(2) The electroslag weld information submitted by the applicant is reviewed for conformance to the acceptance criteria discussed in subsection II.3.b.(2) of this SRP section. The information in the SAR is reviewed to verify that macroetch tests have been made (to assure that an acceptable weld solidification pattern is obtained) and that impact tests specified in Regulatory Guide 1.34 meet the acceptance criteria discussed previously in subsection II.3.b.(2) of this SRP section.

(3) The ASME Code, Section III, requires adherence to the requirements of Section IX~~, "Welding Qualifications."~~ of the Code.[96] One of the requirements is welder qualification for production welds. However, there is a need for supplementing this section of the Code because the assurance of providing satisfactory welds in locations of restricted direct physical and visual accessibility can be increased significantly by qualifying the welder under conditions simulating the space limitations under which the actual welds will be made.

Regulatory Guide 1.71~~, "Welder Qualification for Limited Accessibility,"~~[97] provides the necessary supplement to the Code, Section IX, in this respect. The information submitted by the applicant is reviewed for conformance with acceptance criteria discussed in subsection II.3.b.(3) of this SRP section.

(4) The information submitted by the applicant regarding controls to limit the occurrence of underclad cracking in low alloy steel components when weld cladding with austenitic stainless steel are reviewed for conformance with acceptance criteria given in subsection II.3.b.(4) of this SRP section.

c. The reviewer verifies that acceptable methods specified in the ASME Code, Section III, paragraphs NB-2550 through NB-2570 ~~specifies the ultrasonic acceptable method~~ are proposed by the applicant for examination of ferritic steel tubular products[98].

4. Fabrication and Processing of Austenitic Stainless Steels

a. The information submitted by the applicant in the following areas is reviewed for conformance with the acceptance criteria stated in subsection II.4.a of this SRP section regarding:

(1) The desirable stage in the sequence of processing for solution heat treatment, the rates of cooling, and the quenching media.

(2) Controls to prevent sensitization during welding, as described in Regulatory Guide 1.44.

(3) Controls to verify non-sensitization~~;~~ and to qualify welding processes employed in production, as described in ~~Regulatory Guide 1.44~~ subsection II.4.a of this SRP Section.[99]

(4) For BWRs, additional processing controls, as described in Attachment A to Generic Letter 88-01 (or NUREG-0313)[100].

In the event that information in the above areas is not supplied, sufficient justification for the deviation must be presented.

b. The information submitted by the applicant is reviewed for conformance with the acceptance criteria discussed in subsection II.4.b of this SRP section as follows:

Verification is sought that process controls are exercised during all stages of component manufacture and reactor construction to minimize the exposure of austenitic stainless steels to contaminants that could lead to stress corrosion cracking.

Information is also checked to assure that precautions have been taken to require removal of all cleaning solutions, processing compounds, degreasing agents, and any other foreign material from the surfaces of the component at any stage of processing prior to any elevated temperature treatment and prior to hydrotests. The reviewer verifies that a statement is contained in the SAR that pickling of sensitized austenitic stainless is avoided and that the quality of water used for final cleaning or flushing of finished surfaces during installation is in accordance with acceptance criteria discussed in subsection II.4.b. of this SRP section.

The applicant's description of abrasive work controls for austenitic stainless steel surfaces is reviewed and is verified adequate to minimize the introduction of stress corrosion cracking promoting contaminants and the cold-working of surfaces.[101]

Because excessive cold work in austenitic stainless steel can render this material susceptible to stress corrosion cracking, control must be exerted by the applicant, by placing an upper limit on the yield strength, in accordance with the acceptance criteria discussed in subsection II.4.b of this SRP section. Verification is obtained that the applicant has such a control measure.

For BWRs, particular review emphasis is placed upon verification of conformance to the positions of Generic Letter 88-01 or the recommendations of NUREG-0313 as applicable.[102]

c. The information submitted by the applicant is reviewed to determine the type of insulation used and to determine its compatibility with the austenitic stainless steel used in construction of the component.

There are no compatibility concerns with the use of reflective metal insulation; the chief compatibility concern is with the use of nonmetallic insulation. A review is performed to assure that any such material specified by the applicant is in conformance with the acceptance criteria stated in subsection II.4.c of this SRP section. Verification is obtained that the material has been chemically analyzed by methods equivalent to those prescribed in Regulatory Guide 1.36 and that evidence is obtained that the levels of leachable contaminants are such that stress corrosion of stainless steel will not result from use of the insulation.

d. The information submitted by the applicant regarding control of delta ferrite in austenitic stainless steel welds is reviewed to determine its conformance with the

acceptance criteria stated in subsection II.4.d of this SRP section. The ~~information submitted must state~~ reviewer verifies that appropriate filler metal acceptance tests have been conducted and that a certified materials test report has been received. The~~ information should state, also,~~ reviewer also verifies that the applicant's program ~~for~~ is in[103] compliance with the staff positions in Regulatory Guide 1.31~~, "Control of Ferrite Content in Stainless Steel Weld Metal."~~[104] and the more stringent criteria specified in II.4.d where applicable.[105]

The information submitted by the applicant regarding control of electroslag weld properties for austenitic stainless steel materials is reviewed for conformance with the acceptance criteria discussed in subsection II.4.d of this SRP section.

The review of information on the control of electroslag weld properties in austenitic stainless steels is essentially the same as that discussed previously for ferritic steels. However, because electroslag-welded austenitic stainless steels have very high impact resistance ~~and because the Code, Section III, is not concerned with impact testing of these welds~~[106], the checks are: (1) a macroetch test is used to provide assurance that the solidification pattern is in accordance with the requirement of the acceptance criteria shown in subsection II.4.d of this SRP section, and (2) wrought stainless steel parts are solution heat treated after welding.

The review procedure for information submitted on welder qualification for limited accessibility areas, applicable to austenitic stainless steels, is the same as that for ferritic steels, which has been discussed previously under subsection III.3.b.(3) of this SRP section.

e. The procedures for review of nondestructive examination of tubular products fabricated from austenitic stainless steel are the same as those discussed for similar ferritic products in subsection III.3.c of this SRP section, and the acceptance criteria are as shown in subsection II.4.e of this SRP section.

f. Cast austenitic stainless steel is susceptible to thermal aging at reactor coolant temperatures (Reference 20). The reviewer verifies that the applicant has considered alternative materials to cast stainless steels and has limited use of cast stainless steel in the RCPB to those specific applications where demonstrated to be the best material selection alternative. Where cast material is used, the range of temperatures to which the material will be exposed and the ferrite content of the material receive particular review emphasis. The reviewer verifies that the applicant's proposed material specifications and fabrication controls ensure adequate fracture toughness over the design life of the plant.

Where cast austenitic stainless steel components with welded joints requiring preservice and inservice inspection are proposed, the reviewer confirms the feasibility of required inspections using ultrasonic techniques.[107]

5. General

If the information contained in the safety analysis reports or the plant Technical Specifications does not comply with the appropriate acceptance criteria, or if the information provided is inadequate to establish such compliance, a request for additional information is prepared and transmitted. Such requests identify not only the necessary additional information but also the changes needed in the SAR or the Technical Specifications. Subsequent amendments received in response to these requests are reviewed for compliance with the applicable acceptance criteria.

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.[108]

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient and adequate information has been provided to satisfy the requirements of this standard review plan section and that his evaluation supports conclusions of the following type, to be included in the staff's safety evaluation report:

The staff concludes that the plant design is acceptable and meets the requirements of General Design Criteria 1, 4, 14, 30, and 31 of Appendix A of 10 CFR Part 50; the requirements of Appendices B and G of 10 CFR Part 50; and the requirements of §50.55a of 10 CFR Part 50. This conclusion is based on the staff's review of the SAR.

The materials used for construction of components of the reactor coolant pressure boundary (RCPB) have been identified by specification and found to be in conformance with the requirements of Section III of the ASME Code, ~~and~~ [for BWRs only] in conformance with the ~~requirements~~staff positions of Generic Letter 88-01, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping," which are based upon the technical information and/or recommendations provided in NUREG-0313, Revision 2, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping."[109] Compliance with the above ~~Code~~[110] provisions for material specifications satisfies the quality standards requirements of GDC 1, GDC 30, and §50.55a.

The materials of construction of the RCPB exposed to the reactor coolant have been identified and all of the materials are compatible with the primary coolant water, which is chemically controlled in accordance with appropriate technical specifications. This compatibility has been proven by extensive testing and satisfactory performance. This includes conformance with the ~~recommendations~~positions of Regulatory Guide 1.44, "Control of Sensitized Stainless Steel," and [for BWRs only] conformance with the ~~requirements of NUREG-0313~~staff positions of Generic Letter 88-01 which are based upon the technical information and recommendations provided in NUREG-0313, Revision 2[111]. The cast austenitic stainless steels and nickel-chromium-iron alloys to be

used as RCPB materials have also been demonstrated to be compatible with reactor coolant under the anticipated environmental conditions of RCPB service.[112] General corrosion of all materials, except unclad carbon and low alloy steel, will be negligible. For these materials, conservative corrosion allowances have been provided for all exposed surfaces in accordance with the requirements of the Code, Section III. The above evidence of compatibility with the coolant and compliance with the Code provisions satisfy the requirements of GDC 4 relative to compatibility of components with environmental conditions.

The materials of construction for the RCPB are compatible with the thermal insulation used in these areas and are in conformance with the recommendations of Regulatory Guide 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steels." Conformance with the above recommendations satisfy the requirements of GDC 14 and GDC 31 relative to prevention of failure of the RCPB.

The ferritic steel tubular products and the tubular products fabricated from austenitic stainless steel have been found to be acceptable by nondestructive examinations in accordance with the provisions of the ASME Code, Section III. Compliance with these Code requirements satisfies the quality standards requirements of GDC 1, GDC 30 and §50.55a.

The fracture toughness tests required by the ASME Code, augmented by Appendix G, 10 CFR Part 50, provide reasonable assurance that adequate safety margins against nonductile behavior or rapidly propagating fracture can be established for all pressure retaining components of the reactor coolant pressure boundary. The use of Appendix G of the ASME Code, Section III, and the results of fracture toughness tests performed in accordance with the Code and NRC regulations in establishing safe operating procedures, provides adequate safety margins during operating, testing, maintenance, and postulated accident conditions. Compliance with these Code provisions and NRC regulations satisfies the requirements of GDC 14 and GDC 31~~ and §50.55a~~[113] regarding prevention of fracture of the reactor coolant pressure boundary.

The controls imposed on welding preheat temperatures for welding ferritic steels are in conformance with the recommendations of Regulatory Guide 1.50, "Control of Preheat Temperature for Welding Low Alloy Steels~~.~~," or vendor topical reports which the staff has previously accepted as alternatives.[114] These controls provide reasonable assurance that cracking of components made from low alloy steels will not occur during fabrication and minimize the possibility of subsequent cracking due to residual stresses being retained in the weldment. These control satisfy the quality standards requirements of GDC 1, GDC 30, and §50.55a.

The controls imposed on electroslag welding of ferritic steels are in accordance with the recommendations of Regulatory Guide 1.34, "Control of Electroslag Weld Properties," and provide assurance that welds fabricated by the process will have high integrity and will have a sufficient degree of toughness to furnish adequate safety margins during operating, testing, maintenance, and postulated accident conditions. Conformance with

the recommendations of Regulatory Guide 1.34 also satisfies the quality standards requirements of GDC 1, GDC 30, and §50.55a.

The controls imposed on welding ferritic steels under conditions of limited accessibility are in accordance with the recommendations of Regulatory Guide 1.71, "Welder Qualification for Areas of Limited Accessibility," and provide assurance that proper requalification of welders will be required in accordance with the welding conditions. These controls also satisfy the quality standards requirements of GDC 1, GDC 50, and §50.55a. The controls imposed on weld cladding of low-alloy steel components by austenitic stainless steel are in accordance with the recommendations of Regulatory Guide 1.43, "Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components." These controls provide assurance that practices that could result in underclad cracking will be restricted. The controls also satisfy the quality standards requirements of GDC 1, GDC 30, and §50.55a.

The controls to avoid stress corrosion cracking in reactor coolant pressure boundary components constructed of austenitic stainless steels limit yield strength of cold-worked austenitic stainless steels to 620 MPa (90,000 psi)[115] maximum and conform to the recommendations of Regulatory Guides 1.44, "Control of the Use of Sensitized Stainless Steel," [for BWRs only] the positions of Generic Letter 88-01 or NUREG-0313, Revision 2 recommendations,[116] and 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water Cooled Nuclear Plants." The controls followed in accordance with these recommendations, during material selection, fabrication, examination, and protection, in order to prevent excessive yield strength, sensitization, and contamination, provide reasonable assurance that the RCPB components of austenitic stainless steels will be in a metallurgical condition that minimizes susceptibility to stress corrosion cracking during service. These controls meet the requirements of GDC 4 relative to compatibility of components with environmental conditions and the requirements of GDC 14 relative to prevention of leakage and failure of the RCPB.

The controls imposed during welding of austenitic stainless steels in the RCPB are in accordance with the recommendations of Regulatory Guide 1.31, "Control of Ferrite Content in Stainless Steel Weld Metal;"; [for BWRs only] the positions of Generic Letter 88-01 and/or the recommendations of NUREG-0313, Revision 2; Regulatory Guide 1.34;;[117] and Regulatory Guide 1.71. These controls provide reasonable assurance that welded components of austenitic stainless steel will not develop microfissures during welding and will have high structural integrity. These controls meet the quality standards requirements of GDC 1, GDC 30, and §50.55a and satisfy the requirements of GDC 14 relative to prevention of leakage and failure of the RCPB.

The fabrication controls for cast austenitic stainless steel components, in conjunction with acceptable base material and weld metal specifications, provide for welded joint inspectability and adequate fracture toughness to resist thermal aging for the design life. These controls therefore satisfy the applicable requirements of GDC 1, GDC 4, GDC 14, GDC 30, and §50.55a.[118]

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP Section.[119]

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[120] Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section.[121]

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced ~~r~~Regulatory ~~g~~Guides ~~and NUREG~~.[122] Acceptable repairs and upgrades are described in the referenced Generic Letter for previously accepted materials and welds which do not meet NUREG-0313, Revision 2 recommendations related to material specifications and post weld treatments for stress corrosion cracking resistant piping installations. NUREG-0313, Revision 2, recommendations for stress corrosion cracking resistant installations will be used by the staff for evaluation of susceptible piping in new BWR applications.[123]

VI. REFERENCES[124]

~~3~~1.[125] 10 CFR Part 50, Section 50.55a, "Codes and Standards. "[126]

~~1~~2. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Plants~~:~~," ~~(~~Criterion 1, "Quality Standards and Records."~~;~~

3. 10 CFR Part 50, Appendix A, Criterion 4, "Environmental and ~~Missile~~Dynamic Effects Design Bases."[127]~~;~~

4. 10 CFR Part 50, Appendix A, Criterion 14, "Reactor Coolant Pressure Boundary."~~;~~

5. 10 CFR Part 50, Appendix A, Criterion 30, "Quality of Reactor Coolant Pressure Boundary."~~; and~~

6. 10 CFR Part 50, Appendix A, Criterion 31, "Fracture Prevention of Reactor Coolant Pressure Boundary."~~)~~

7. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"; Criterion XIII, "Handling, Storage and Shipping."[128]

~~2~~8. 10 CFR Part 50, Appendix G, "Fracture Toughness Requirements."

~~5. ASTM, A-262, Practice E, "Copper-Copper Sulfate-Sulfuric Acid Test for Detecting Susceptibility to Intergranular Attack in Stainless Steels," Annual Book of ASTM Standards, American Society for Testing and Materials.~~[129]

~~6. ASTM E 23, "Notched Bar Impact Testing of Metallic Materials," Annual Book of ASTM Standards, American Society for Testing and Materials.~~

~~7. ASTM E-208, "Standard Method for Conducting Dropweight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels," Annual Book of ASTM Standards, American Society for Testing and Materials.~~[130]

~~8~~9. Regulatory Guide 1.31, "Control of Ferrite Content in Stainless Steel Weld Metal."

~~9~~10. Regulatory Guide 1.34, "Control of Electroslag Weld Properties."

1~~0~~1. Regulatory Guide 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel."

1~~0~~2. Regulatory Guide 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water Cooled Nuclear Power Plants."

1~~2~~3. Regulatory Guide 1.43, "Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components."[131]

1~~3~~4. Regulatory Guide 1.44, "Control of the Use of Sensitized Stainless Steel."

1~~4~~5. Regulatory Guide 1.50, "Control of Preheat Temperature for Welding of Low-Alloy Steel."

1~~5~~6. Regulatory Guide 1.71, "Welder Qualification for Areas of Limited Accessibility."

1~~6~~7. Regulatory Guide 1.85, ~~"Code Case Acceptability ASME Section III Materials."~~"Materials Code Case Acceptability ASME Section III Division 1."[132]

1~~7~~8. NUREG-0313~~,~~; Revision 2; "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping~~.~~"; Hazelton, W.S., Koo, W.H.; Division of Engineering and Systems Technology; January, 1988. (Revision 0 of t~~T~~his document replace~~s~~d Branch Technical Position MTEB 5-7, "Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping~~.~~," which was a part of previous revisions of this SRP Section)[133]

19. NRC Letter to All Licensees of Boiling Water Reactors (BWRs), and Holders of Construction Permits for BWRs, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping (Generic Letter No. 88-01)," January 25, 1988.[134]

20. NUREG/CR-4513 (ANL-90/42), "Estimation of Fracture Toughness of Cast Stainless Steels During Thermal Aging in LWR Systems," Chopra, O. K., prepared by Argonne National Laboratory for the U.S. Nuclear Regulatory Commission, June 1991.[135]

~~4~~21. ASME Boiler and Pressure Vessel Code, Section II, "Materials," Parts A, B, and C~~;~~; Section III, "Rules for Construction of Nuclear Plant Components"; and Section IX, "Welding and Brazing Qualifications"; American Society of Mechanical Engineers.[136]

22. ASTM, A-262-1970[137], "Detecting Susceptibility to Intergranular Attack in Stainless Steels"; Practice A "Oxalic Acid Etch Test for Classification of Etch Structures of Stainless Steels"; Practice E, "Copper-Copper Sulfate-Sulfuric Acid Test for Detecting Susceptibility to Intergranular Attack in Stainless Steels"; Annual Book of ASTM Standards, American Society for Testing and Materials.[138139]

23. ASTM A-708-1974[140], "Detection of Susceptibility to Intergranular Corrosion in Severely Sensitized Austenitic Stainless Steel," 1979 Annual Book of ASTM Standards, American Society for Testing and Materials.[141]

~~18~~24. WCAP-8577, "The Application of Preheat Temperatures After Welding Pressure Vessel Steels," Westinghouse Electric Corporation Topical Report, (Sept~~.~~ember[142] 1975, Approved by Letter J.F. Stolz to C. Eicheldinger, June 18, 1976).

25. WCAP-8678, "Effect of Preheat and Post Weld Heat Treat on Hydrogen-Induced Cracking in Pressure Vessel Steels," Westinghouse Electric Corporation Topical Report, September 1975.[143]

~~BRANCH TECHNICAL POSITION MTEB 5-7~~

~~MATERIAL SELECTION AND PROCESSING~~
~~GUIDELINES FOR BWR COOLANT PRESSURE BOUNDARY PIPING~~

~~(BTP MTEB 5-7 has been superseded by NUREG 0313).~~[144]

SRP Draft Section 5.2.3
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	Current PRB names and abbreviations	Editorial change made to reflect the current SRP Section 5.2.3 PRB abbreviation for the Materials and Chemical Engineering Branch.
2.	Current PRB names, review assignments, and abbreviations	Editorial change made to reflect that no PRB is currently assigned secondary review responsibility for SRP Section 5.2.3.
3.	Current PRB names and abbreviations	Editorial change made to reflect the current SRP Section 5.2.3 PRB abbreviation for the Materials and Chemical Engineering Branch.
4.	Current PRB names and abbreviations	Editorial change made to reflect the current SRP Section 5.2.3 PRB abbreviation for the Materials and Chemical Engineering Branch.
5.	Current PRB names and abbreviations	Editorial change made to reflect the current SRP Section 5.2.3 PRB abbreviation for the Materials and Chemical Engineering Branch.
6.	Current PRB names and abbreviations	Editorial change made to reflect the current SRP Section 5.2.3 PRB abbreviation for the Materials and Chemical Engineering Branch.
7.	Editorial	Since there is no longer a secondary review branch for SRP Section 5.2.3, itemized identification of the PRB review responsibilities was removed.
8.	Editorial	Deleted apostrophe to improve punctuation.
9.	Editorial	Since there is no longer a secondary review branch for SRP Section 5.2.3, itemized identification of the PRB review responsibilities was removed.
10.	SRP-UDP format item, NRC Metrication Policy implementation	Added the SI Equivalent of 60°F (temperature difference) and reformatted in SI units to be consistent with NRC Metrication Policy. See enclosed conversion documentation.
11.	SRP-UDP format item, NRC Metrication Policy implementation	Added the SI Equivalent of 50 ft-lbs and reformatted in SI units to be consistent with NRC Metrication Policy. See enclosed conversion documentation.
12.	SRP-UDP format item, NRC Metrication Policy implementation	Added the SI Equivalent of 35 mils and reformatted in SI units to be consistent with NRC Metrication Policy. See enclosed conversion documentation.
13.	Analyst Note	The analyst notes that this information appears consistent with ASME Code, Section III, paragraph NB-2331. No change (e.g. to cite NB-2331 as the source of this information) is proposed.

Item	Source	Description
14.	Editorial	In response to PRB comments, clarification was added in the Areas of Review with respect to regulatory guidance for the control of electroslag weld processes and the limited applicability of electroslag welds to RPV fabrication.
15.	SRP-UDP format item, reformat reference citations	Added identification by reference number for the first citation of the ASME Code as required by SRP-UDP format guidance. Note that since subsection VI, Reference 20 identifies several major sections of the ASME Code, the convention followed is to identify the first citation of a major Section (e.g. Section II) by its reference number.
16.	Editorial	In response to a PRB comment, added clarification that stabilized stainless steels are also used as RCPB materials.
17.	Editorial	Since there is no longer a secondary review branch for SRP Section 5.2.3, itemized identification of branch review responsibilities was removed.
18.	SRP-UDP format item, NRC Metrication Policy implementation	Added the SI Equivalent of the 800°F to 1500°F temperature range and reformatted in SI units to be consistent with NRC Metrication Policy. See enclosed conversion documentation.
19.	Editorial	Revised to use a previously defined abbreviation.
20.	**Integrated Impact 807**	Added grinding as an Area of Review based upon RG 1.37 position C.5 related to grinding, and staff review of the issue as described in the CE System 80+ FSER.
21.	**Integrated Impact 800**	The Integrated Impact recommends revision of the SRP to incorporate staff positions more restrictive than RG 1.31. Since modification of the existing discussion of RG 1.31 to reflect this new information in the Areas of Review was problematic, the existing discussion of RG 1.31 was deleted from the Areas of Review and the discussion was summarized as is customary for Areas of Review.
22.	Editorial	Revised for consistency with information presented in I.3.c., which appears to be correct for the 1992 edition of the Code.
23.	SRP-UDP format item, NRC Metrication Policy implementation	Added the SI Equivalent of 275 psig and reformatted in SI units to be consistent with NRC Metrication Policy. See enclosed conversion documentation.
24.	SRP-UDP format item, NRC Metrication Policy implementation	Added the SI Equivalent of 200°F and reformatted in SI units to be consistent with NRC Metrication Policy. See enclosed conversion documentation.

Item	Source	Description
25.	**Integrated Impact 852**	Added an Areas of Review discussion specific to review of proposed use of cast austenitic stainless steel in the RCPB.
26.	Editorial	This information was deleted as unnecessary based upon the added review interface to SRP Section 5.2.4 below.
27.	SRP-UDP format item	Added Review Interface subsection of Areas of Review using numbered paragraphs to be consistent with SRP-UDP required format so that reviews performed by the SRP Section 5.2.3 PRB in other SRP Sections which are relevant to the overall review of RCPB materials are detailed in their own subsection.
28.	SRP-UDP Integration of Bolting Issues, Potential Impacts 1006, 1841, and 21671	Added a review interface reflecting reviews of bolting and threaded fastener programs under new SRP Section 3.13.
29.	Editorial, Potential Impacts 24339 and 24346	Developed Review Interface from an existing interface (see I.2) to SRP Sections 5.4.8 and 9.3.4 based upon staff reviews of water chemistry as discussed in Section 5.2.3 of the CE System 80+ and ABWR FSERs.
30.	Editorial	Added sentence consistent with SRP-UDP format, to introduce Review Interfaces with other branches.
31.	Potential Impact 24341	The consistency check for PI 24341 suggests that a review interface with SRP Section 3.9.3 be considered, since the staff discussed issues associated with environmental and usage factor effects upon the fatigue resistance of materials in conjunction with reviews of RCPB materials, in the CE System 80+ FSER.
32.	Editorial, Potential Impact 23366, PRB Comments	Developed Review Interface with SRP Section 5.2.4 in place of an existing citation of SRP Section 5.2.4 as relevant to the review of RCPB materials in existing Areas of Review, subsection I.4. The PRB for SRP 5.2.4 has changed to ECGB.In the CE System 80+ FSER, the staff expressed concerns regarding the inspectability (using ultrasonic techniques) of cast austenitic stainless steel as proposed by the applicant. The staff indicated that a material that is difficult to inspect may not be able to conform to 10 CFR 50.55a(g). SRP Section 5.2.4 provides reviews determining compliance with the requirements of 10 CFR 50.55a related to inspections and examinations of the RCPB. A Review Interface was thus added to reflect that the overall review of materials includes review of their inspectability.

Item	Source	Description
33.	Current PRB names and abbreviations	Editorial change made to reflect the current SRP Sections 17.1 and 17.2 PRB name and abbreviation for the Quality Assurance and Maintenance Branch.
34.	Editorial	Revised to reflect issuance of SRP Section 17.3 which provides review of Quality Assurance Program Descriptions. SRP Section 17.3 was issued subsequent to Rev. 2 of SRP Section 5.2.3 and appears relevant to the materials quality assurance review interface discussed in Rev. 2 of SRP Section 5.2.3.
35.	Editorial	Revised to reflect standard SRP-UDP discussion of the criteria and reviews detailed in other SRP Sections in Areas of Review, Review Interfaces.
36.	Editorial	Renumbered/relettered to improve clarity. For example, there were two subsections which could be referenced as II.1 under the existing numbering scheme.
37.	Editorial	Renumbered/relettered to improve clarity. For example, there were two subsections which could be referenced as II.1 under the existing numbering scheme.
38.	Editorial	Renumbered/relettered to improve clarity. For example, there were two subsections which could be referenced as II.1 under the existing numbering scheme.
39.	Editorial	Renumbered/relettered to improve clarity. For example, there were two subsections which could be referenced as II.1 under the existing numbering scheme.
40.	Reference Verification, Editorial	Added more precise location of the applicable requirements for clarity.
41.	Editorial	Renumbered/relettered to improve clarity. For example, there were two subsections which could be referenced as II.1 under the existing numbering scheme.
42.	Editorial	Renumbered/relettered to improve clarity. For example, there were two subsections which could be referenced as II.1 under the existing numbering scheme.
43.	Reference Verification, Editorial	The current requirements of 10 CFR 50.55a do not explicitly address fracture toughness. Discussion of 10 CFR 50.55a in conjunction with fracture toughness was thus deleted. Fracture toughness is addressed by 10 CFR 50 Appendix G.

Item	Source	Description
44.	Editorial	Revised to improve the accuracy of the information presented and updated the title.
45.	SRP-UDP format item, reformat reference citations	Added identification by reference number for the first citation of Section II of the ASME Code.
46.	Editorial	Revised to improve the accuracy and clarity of the information presented.
47.	Editorial	Since the applicability of this criteria is clear as presented and since there is no secondary review branch currently responsible for this SRP Section, the applicability statement and the itemized identification of branch review responsibilities were removed.
48.	**Integrated Impact 805**	Added citation of Generic Letter 88-01 as the source document for staff positions related to IGSCC for BWR austenitic stainless steel and associated weldments. Also added identification of references for initial citations, as required by SRP-UDP format guidance.Revised to reflect current SRP-UDP approach for implementation of evolutionary plant issues in the SRP.
49.	Editorial	Added plural to provide grammar improvement.
50.	Reference Verification, Editorial	Regulatory Guide 1.44 provides information clearly delineated therein as "regulatory positions." Language was thus revised to be consistent with the language used within the Regulatory Guide.
51.	SRP-UDP format item, reformat reference citations	Added title for the first citation of the Reg. Guide in an effort to establish a consistent practice throughout the SRP Section with respect to citation of reference documents. In Rev. 2 of this SRP Section, titles of several referenced documents were stated in conjunction with the first citation. In some cases, the title was repeated for some subsequent citations.
52.	Reference Verification, Editorial	Updated to reflect the correct paragraph number based upon the 1992 edition of the Code.
53.	Editorial	Since the applicability of this criteria is clear as presented and since there is no secondary review branch currently responsible for this SRP Section, the applicability statement and the itemized identification of branch review responsibilities were removed.
54.	Reference Verification, Editorial	Regulatory Guide 1.44 provides information clearly delineated therein as "regulatory positions." Language was thus revised to be consistent with the language used within the Regulatory Guide.

Item	Source	Description
55.	Editorial	Corrected style for this citation of Regulatory Guide 1.44 by deleting "No." and relocating the title to an earlier citation.
56.	**Integrated Impact 805**	Added citation of Generic Letter 88-01 as the source document for staff positions related to IGSCC for BWR austenitic stainless steel and associated weldments. Although the purpose of Generic Letter 88-01 was to request information from BWR licensees and permit holders, staff positions are provided in this letter, including positions related to reactor water chemistry, whose technical bases are detailed in NUREG-0313, Rev. 2. In the ABWR FSER, the staff accepted the applicant's commitments to conform to the criteria of NUREG-0313, Rev. 2. Since a previous revision of NUREG-0313 was already cited throughout the Acceptance Criteria subsection as specific criteria, citation of Generic Letter 88-01 was added in locations where NUREG-0313 was already cited. Although this citation was not explicitly limited to BWRs in SRP Section 5.2.3 Rev. 2, it is clear, from evaluation findings related to materials compatibility with the reactor coolant, that the intent was to limit application of NUREG-0313 to BWRs.Revised to reflect current SRP-UDP approach for implementation of evolutionary plant issues in the SRP.
57.	Editorial	Provided reference to Integrated Impact 846 changes related to addition of alternate criteria for testing to verify non-sensitization.
58.	Editorial	Since the applicability of this criteria is clear as presented and since there is no secondary review branch currently responsible for this SRP Section, the applicability statement and the itemized identification of branch review responsibilities were removed.
59.	Editorial	Since the applicability of this criteria is clear as presented and since there is no secondary review branch currently responsible for this SRP Section, the applicability statement and the itemized identification of branch review responsibilities were removed.
60.	Reference Verification, Editorial	The current requirements of 10 CFR 50.55a do not explicitly address fracture toughness. Discussion of 10 CFR 50.55a in conjunction with fracture toughness was thus deleted.
61.	SRP-UDP format item, NRC Metrication Policy implementation	Added the SI Equivalent unit for ft-lbs and reformatted in SI units to be consistent with NRC Metrication Policy.
62.	Reference Verification, Editorial	Updated reference citations to reflect the 1992 edition of the Code.

Item	Source	Description
63.	Reference Verification, Editorial	Updated reference citations to reflect the 1992 edition of the Code.
64.	Reference Verification, Editorial	Corrected title of Regulatory Guide 1.50.
65.	SRP-UDP format item, reformat reference citations	Identified the Westinghouse report by reference number per SRP-UDP format requirements for first citation of references.
66.	**Integrated Impact 845**	Added citation of WCAP-8678 as an acceptable alternative to RG 1.50 welding preheat temperature controls related to hydrogen-induced cracking. In the CE System 80+ FSER, the applicant cited this Topical Report as a basis for an exception to RG 1.50 position C.2. The staff evaluated and accepted this report. Also made editorial changes including identification of the Westinghouse report by reference number per SRP-UDP format requirements for first citation of references.
67.	SRP-UDP format item, reformat reference citations	Added title (relocated from a later citation in III.3.b(3)) and identification by reference number for the first citation of Section IX of the ASME Code.
68.	Reference Verification, Editorial	The Areas of Review (I.3.c) cites paragraphs NB-2550 through NB-2570 for nondestructive examination requirements for tubular products (the Code also identifies applicability to fittings). This information appears consistent with the 1980 (in effect at the time of SRP Section 5.2.3, Rev. 2) and 1992 editions of the Code. Specific criterion 3.c is thus revised to cite paragraphs NB-2550 through NB-2570.
69.	Editorial	Added plural for grammar improvement.
70.	Editorial	Removed title of Regulatory Guide 1.44 since it is specified in an earlier citation.
71.	**Integrated Impacts 799 and 805**	Citation of Generic Letter 88-01 as providing sensitization control criteria for BWRs which is more stringent than RG 1.44 is added. Since RG 1.44 and NUREG-0313 are cited in the Acceptance Criteria, as specific criteria in this regard, citation of Generic Letter 88-01 was added in the specific criteria.Revised to reflect current SRP-UDP approach for implementation of evolutionary plant issues in the SRP.

Item	Source	Description
72.	**Integrated Impact 846**	Added identification of ASTM A-708 as a previously accepted alternative to the RG 1.44-endorsed ASTM A-262 Practices A or E for verification of non-sensitization of austenitic stainless steels (including post welding verifications of qualification welds for qualification of welding processes). Also added/provided identification by reference number for the first citation of these ASTM references per SRP-UDP format guidance.
73.	Editorial	Since the applicability of this criteria is clear as presented and since there is no secondary review branch currently responsible for this SRP Section, the applicability statement and the itemized identification of branch review responsibilities were removed.
74.	**Integrated Impacts 799 and 805**	To support the subsequent citation of NUREG-0313 and Generic Letter 88-01 for staff positions related to prevention of IGSCC in BWR RCPB piping, this introduction was added to the discussion of issues covered in specific criterion 4.b.
75.	Editorial	Since the applicability of this criteria is clear as presented and since there is no secondary review branch currently responsible for this SRP Section, the applicability statement and the itemized identification of branch review responsibilities were removed.
76.	Editorial	Since there is no secondary review branch currently responsible for this SRP Section, the itemized identification of branch review responsibilities were removed.
77.	**Integrated Impact 807**	Added specific criteria for abrasive work on stainless steel surfaces based upon RG 1.37 position C.5 related to grinding, and staff review of the issue as described in the CE System 80+ FSER.
78.	SRP-UDP format item, NRC Metrication Policy implementation	Added the SI Equivalent of 90,000 psi and reformatted in SI units to be consistent with NRC Metrication Policy.
79.	Editorial	Since the applicability of this criteria is clear as presented and since there is no secondary review branch currently responsible for this SRP Section, the applicability statement and the itemized identification of branch review responsibilities were removed.

Item	Source	Description
80.	**Integrated Impacts 799 and 805**	Citation of NUREG-0313 and Generic Letter 88-01 as providing IGSCC prevention control criteria more comprehensive and stringent than RG 1.44 were added. Since RG 1.44 is cited in the Acceptance Criteria, as specific criteria in this regard, citation of NUREG-0313 and Generic Letter 88-01 (including a description of issues covered in these documents) were added in the specific criteria.Revised to reflect current SRP-UDP approach for implementation of evolutionary plant issues in the SRP.
81.	Editorial	Relocated title to the first citation of Regulatory Guide 1.36.
82.	Editorial	Relocated title to the first citation of Regulatory Guide 1.36.
83.	Editorial	Since the applicability of this criteria is clear as presented and since there is no secondary review branch currently responsible for this SRP Section, the applicability statement and the itemized identification of branch review responsibilities were removed.
84.	**Integrated Impact 800**	To support the subsequent citation of NUREG-0313 for staff recommendations related to welding of austenitic stainless steels, this citation is added to the introduction of issues covered in specific criterion 4.d.
85.	Editorial	Since there is no longer a secondary review branch for SRP Section 5.2.3, identification of the PRB, which appears to have been specified for clarity in distinguishing who reviews the subject materials, was removed as unnecessary.
86.	Editorial	Added plural to improve grammar.
87.	**Integrated Impact 800**	Added weld metal ferrite content criteria more stringent than Regulatory Guide 1.31 limits based on Generic Letter 88-01 staff positions and the recommendations of NUREG-0313, Rev. 2. Review Procedures have also been added in III.4.d which verify weld metal ferrite content limits more stringent than Regulatory Guide 1.31 based on the above documents. The proposed change has been modified to reflect incorporation of a PRB comment.Revised to reflect current SRP-UDP approach for implementation of evolutionary plant issues in the SRP.
88.	Editorial	Deleted title since the title is presented previously, in conjunction with the first citation.

Item	Source	Description
89.	Reference Verification, Editorial	The Areas of Review (I.3.c) cites paragraphs NB-2550 through NB-2570 for nondestructive examination requirements for tubular products (the Code also identifies applicability to fittings). This information appears consistent with the 1980 (in effect at the time of SRP Section 5.2.3, Rev. 2) and 1992 (current) editions of the Code. Specific criterion 4.e is thus revised to cite paragraphs NB-2550 through NB-2570.
90.	Editorial	Since there is no longer a secondary review branch for SRP Section 5.2.3, identification of the PRB, which appears to have been specified for clarity in distinguishing who reviews the subject materials, was removed as unnecessary.
91.	SRP-UDP format item.	Technical Rationale were developed and added for the following Acceptance Criteria: GDCs 1, 4, 14, 30, and 31; 10 CFR 50 Appendices B and G; and 10 CFR 50.55a. The SRP-UDP program requires that Technical Rationale be developed for the Acceptance Criteria.
92.	Editorial, **Integrated Impact 805**	Clarified that the review also covers proposed use of material code cases previously accepted by the staff (those identified in RG 1.85) and staff positions on BWR materials specified in Generic Letter 88-01 or NUREG-0313 (for evolutionary BWRs), as detailed in subsection II, specific criterion 1.
93.	Current PRB names and abbreviations	Editorial change made to reflect the current SRP Section 5.2.3 PRB abbreviation for the Materials and Chemical Engineering Branch.
94.	**Integrated Impact 808**	Added Review Procedures for review of nickel-chromium-iron alloys proposed as RCPB materials.
95.	**Integrated Impact 852**	Added Review Procedures for review of cast austenitic stainless steels proposed as RCPB materials.
96.	Editorial	Deleted the title (since provided in first citation of Section IX) and clarified that Section IX refers to the Code.
97.	Editorial	Deleted title since the title is presented previously, in conjunction with the first citation.

Item	Source	Description
98.	Reference Verification, Editorial	The Acceptance Criteria (specific criterion II.3.c) has been revised to cite paragraphs NB-2550 through NB-2570 for nondestructive examination requirements for tubular products (the Code also identifies applicability to fittings). This information is stated in SRP Section 5.2.3, Rev. 2 Areas of Review I.3.c and appears consistent with the 1980 (in effect at the time of SRP Section 5.2.3, Rev. 2) and 1992 editions of the Code. The Review Procedure is thus revised based upon verification of the reference information and revision of II.3.c. Also revised language to reflect a Review Procedure.
99.	**Integrated Impact 846**	Modified review procedures to alert the reviewer to an acceptable alternative to RG 1.44 endorsed ASTM A-262 Practices A or E for verification of non-sensitization of austenitic stainless steels (including post welding verifications for qualification of welding processes).
100.	**Integrated Impacts 799, 800, and 805**	Revised based upon previous implementation of recommendations of Integrated Impacts 799, 800, and 805 in subsection II, specific criteria.Revised to reflect current SRP-UDP approach for implementation of evolutionary plant issues in the SRP.
101.	**Integrated Impact 807**	Added Review Procedures for review of abrasive work controls for stainless steel surfaces.
102.	**Integrated Impacts 799 and 805**	Citation of Generic Letter 88-01 was added to focus review emphasis in the Review Procedures.
103.	Editorial	Revised language to reflect a review procedure rather than an information content expectation similar to the style appropriate for RG 1.70 guidance.
104.	Editorial	Deleted title since the title is provided in an earlier citation of this reference document.
105.	**Integrated Impact 800**	Revised Review Procedure to reflect more stringent criteria than provided in RG 1.31 for weld metal ferrite content.
106.	Reference Verification, Editorial	It could not be verified with certainty that the latest version of the ASME Code, Section III is not concerned with impact testing of electroslag stainless steel welds. This representation was deleted to assure that no incorrect or outdated information is presented in the SRP.
107.	**Integrated Impact 852**	Added Review Procedures to address thermal aging and inspectability issues associated with use of cast austenitic stainless steel in the RCPB.

Item	Source	Description
108.	SRP-UDP Format Item, Implement 10 CFR 52 Related Changes	To address design certification reviews a new paragraph was added to the end of the Evaluation Findings. This paragraph addresses design certification specific items including ITAAC, DAC, site interface requirements, and combined license action items.
109.	**Integrated Impact 805**	Evaluation Findings with respect to Generic Letter 88-01 (as it relates to NUREG-0313, Rev. 2) were added since Generic Letter 88-01 was added as specific criteria for material specifications.Revised to reflect current SRP-UDP approach for implementation of evolutionary plant issues in the SRP.
110.	Editorial	Revised to reflect that all bases for accepting materials may not be included in the Code (e.g. NUREG-0313, Rev. 2 recommendations).
111.	**Integrated Impacts 799 and 805**	Evaluation Findings with respect to Generic Letter 88-01 were added since Generic Letter 88-01 was added as specific criteria for compatibility of materials with reactor coolant. Also modified wording of findings with respect to NUREG-0313 to indicate that recommendations are applicable to evolutionary BWRs.Revised to reflect current SRP-UDP approach for implementation of evolutionary plant issues in the SRP.
112.	**Integrated Impacts 808 and 852**	Added findings related to added Review Procedures for review of material specifications for cast austenitic stainless steels and nickel-chromium-iron alloys. These findings were also added to address PRB comments.
113.	Reference Verification, Editorial	The current requirements of 10 CFR 50.55a do not explicitly address fracture toughness. Discussion of 10 CFR 50.55a in conjunction with fracture toughness was thus deleted. Also added citation of GDC 14 in conjunction with this finding, consistent with subsection II, specific criterion 3.a.
114.	**Integrated Impact 845**	Revised to reflect that acceptance may be based upon the WCAP reports identified in specific criterion 3.b(1).
115.	SRP-UDP format item, NRC Metrication Policy implementation	Added the SI Equivalent of 90,000 psi and reformatted in SI units to be consistent with NRC Metrication Policy. See enclosed conversion documentation.
116.	**Integrated Impacts 799 and 805**	Evaluation Findings with respect to Generic Letter 88-01 and NUREG-0313 were added since these documents provide specific criteria for avoiding IGSCC in BWR austenitic stainless steel piping.Revised to reflect current SRP-UDP approach for implementation of evolutionary plant issues in the SRP.

Item	Source	Description
117.	**Integrated Impact 800**	Findings were added to address weld metal ferrite limits based upon Generic Letter 88-01 and/or NUREG-0313, Rev. 2.Revised to reflect current SRP-UDP approach for implementation of evolutionary plant issues in the SRP.
118.	**Integrated Impact 852**	Added findings related to added Review Procedures for review of the use of cast austenitic stainless steels as RCPB materials. These findings were also added to address PRB comments.
119.	SRP-UDP Format Item, implementation of 10 CFR 52	Provided standard change to Evaluation Findings to address design certification reviews.
120.	SRP-UDP Format Item	Added boiler-plate statement indicating the applicability of the SRP to 10 CFR 52 license applications.
121.	SRP-UDP Format Item	Added boiler-plate statement describing the applicability of the SRP to existing and new applications.
122.	Editorial	Deleted "and NUREG" since no implementation schedule is explicitly provided in NUREG-0313, Rev. 2. Neither is an implementation schedule specified in Generic Letter 88-01 with respect to material selection.
123.	**Integrated Impacts 799 and 805**	Added implementation discussion of previously accepted BWR materials and welds which would not conform to current Generic Letter 88-01 positions (e.g. tighter material specifications, different post weld treatments than originally applied, etc.) for assuring IGSCC resistant installations.Revised to reflect current SRP-UDP approach for implementation of evolutionary plant issues in the SRP.
124.	Reference Verification, Editorial	Reorganized and rearranged references (including renumbering) to reflect current SRP-UDP format for the References subsection.
125.	SRP-UDP Format Item, Reformat References	Reordered and renumbered references in accordance with SRP-UDP guidance.
126.	Reference Verification, Editorial	Added title for 10 CFR 50.55.a.
127.	Reference Verification, Editorial	Updated to reflect the current title of GDC 4.
128.	SRP-UDP format item	Added reference to 10 CFR 50, Appendix B since it is cited as Acceptance Criterion II.4.
129.	Editorial	Incorporated information from former reference 5 into new reference for ASTM A-262.
130.	SRP-UDP format item	Deleted ASTM E 23 and E 208 as references since they are not directly cited in this SRP Section.

Item	Source	Description
131.	Reference Verification, Editorial	Revised to reflect the correct title of Regulatory Guide 1.43.
132.	Reference Verification, Editorial	Updated to reflect current title of RG 1.85.
133.	Editorial, **Integrated Impacts 799, 800, and 805**	Since these Integrated Impacts involve changes related to or based upon NUREG-0313, Rev. 2 and/or Generic Letter 88-01, the reference listing was updated to reflect NUREG-0313, Rev. 2 and to clarify the history of replacement of former BTP MTEB 5-7.
134.	**Integrated Impacts 799, 800, and 805**	Generic Letter 88-01 was added as a reference.
135.	**Integrated Impact 852**	Added NUREG/CR reference which provides background information on the thermal aging issue for cast materials.
136.	Reference Verification, SRP-UDP format item	Added titles for major Code sections identified for this reference.
137.	**Integrated Impact 1382**	Revised the reference for ASTM A262 to cite the version of the standard considered applicable to the existing SRP citation.
138.	**Integrated Impact 846**	Since changes to the SRP reflect acceptability of ASTM A-708 to the staff as an alternative to Practices A or E of ASTM A-262, added reference to ASTM A-262 Practice A and combined with information from former reference 5.
139.	**Integrated Impact 804** SRP-UDP standards citation update	Consideration should be given to updating the citation of ASTM A-262 pending the review and approval of the associated standard comparison.
140.	**Integrated Impact 1383**	Revised the reference for ASTM A708 to cite the version of the standard considered applicable to the SRP citation.
141.	**Integrated Impact 846**	Since changes to the SRP reflect acceptability of ASTM A-708 to the staff as an alternative to Practices A or E of ASTM A-262, added reference to ASTM A-708.
142.	Editorial	Revised listing of WCAP-8577 for consistency with added reference for WCAP-8678.
143.	**Integrated Impact 845**	Added reference to WCAP-8678.
144.	Editorial	Deleted as redundant to information stated in conjunction with subsection VI, reference to NUREG-0313.

Integrated Impact No.	Issue	SRP Subsections Affected
657	Consider citing the latest versions of ASTM E 23 and ASTM E 208 in the SRP.	No changes in this proposed draft revision.
693	Evaluate the latest version of ASTM A-262 for regulatory endorsement (in Regulatory Guide 1.44).	No changes in this proposed draft revision.
694	Evaluate the latest version of the ASME Code, Section IX for regulatory endorsement (in Regulatory Guide 1.50).	No changes in this proposed draft revision.
695	Evaluate the latest version of the ASME Code, Section IX for regulatory endorsement (in Regulatory Guide 1.71).	No changes in this proposed draft revision.
696	Evaluate the latest version of the ASME Code, Section IX for regulatory endorsement (in Regulatory Guide 1.34).	No changes in this proposed draft revision.
745	Evaluate the latest versions of ASTM C692 and ASTM D512 for regulatory endorsement (in Regulatory Guide 1.36).	No changes in this proposed draft revision.
799	Revise the SRP to address staff positions, based upon NUREG-0313, Rev. 2 and Generic Letter 88-01, which are more restrictive than RG 1.44.	Acceptance Criteria (specific criteria) subsections II.2, II.4.a, and II.4.b; Review Procedures subsections III.4.a(4), and III.4.b; Evaluation Findings subsection IV; Implementation subsection V; and References subsection VI, references 18 and 19.
800	Revise the SRP to address staff positions for stainless steel weld metal which are more restrictive than RG 1.31.	Areas of Review subsection I.4.d; Acceptance Criteria (specific criteria) subsection II.4.d; Review Procedures subsection III.4.d; Evaluation Findings subsection IV; and References subsection VI, references 18 and 19.
801	Revise the SRP to include review of safety-related threaded fasteners/bolting.	No changes in this proposed draft revision.
802	Revise the SRP to cite ANSI/ASME NQA-2 in addition to Regulatory Guide 1.37 for cleanliness controls. Also consider revising Regulatory Guide 1.37 to cite ANSI/ASME NQA-2.	No changes in this proposed draft revision.
803	Revise the SRP to address staff positions supplementing EPRI Evolutionary Plant Utilities Requirements Document (URD) requirements for control of impurities/contaminants to which the RCPB materials could be exposed.	No changes in this proposed draft revision.

Integrated Impact No.	Issue	SRP Subsections Affected
804	Revise the SRP to cite the latest version of ASTM A-262. Also evaluate the latest version of ASTM A-262 for regulatory endorsement (in Regulatory Guides 1.37 and 1.44).	No changes in this proposed draft revision.
805	Revise the SRP to address staff positions related to avoiding IGSCC in BWR austenitic stainless steel piping, based upon NUREG-0313, Rev. 2 and Generic Letter 88-01.	Acceptance Criteria (specific criteria) subsections II.1, II.2, II.4.a, and II.4.b; Review Procedures subsections III.1, III.4.a(4), and III.4.b; Evaluation Findings subsection IV; Implementation subsection V; and References subsection VI, references 18 and 19.
806	Evaluate the latest versions of AWS A4.2 and AWS A5.4 for regulatory endorsement (in Regulatory Guide 1.31).	No changes in this proposed draft revision.
807	Revise the SRP to address staff positions related to abrasive work (e.g. grinding) on austenitic stainless steel which are more restrictive than RG 1.37.	Areas of Review subsection I.4.b; Acceptance Criteria (specific criteria) subsection II.4.b; and Review Procedures subsection III.4.b.
808	Add Review Procedures for review of the acceptability of nickel-chromium-iron alloys as RCPB materials.	Review Procedures subsection III.1; and Evaluation Findings subsection IV.
845	Revise the SRP to identify further acceptable alternatives to compliance with RG 1.50 welding preheat temperature controls.	Acceptance Criteria (specific criteria) subsection II.3.b(1) and Evaluation Findings subsection IV; and References subsection VI, reference 24.
846	Revise the SRP to identify acceptable alternatives to compliance with RG 1.44 controls to verify non-sensitization of austenitic stainless steel materials and weldments (e.g. following welding as a welding process qualification technique).	Acceptance Criteria (specific criteria) subsection II.4.a; Review Procedures subsection III.4.a(3); and References subsection VI, references 21 and 22.
852	Revise the SRP to add review of the acceptability of cast austenitic stainless steel materials to verify adequate fracture toughness for the design life to resist thermal aging and to verify the feasibility of inspections of welds in cast components.	Areas of Review subsections I.4.f; Review Procedures subsections III.1 and III.4.f; Evaluation Findings subsection IV; and References subsection VI reference 25.
1382	Update the non-date-specific citation of ASTM A262 to cite the 1970 version.	References, subsection VI, Item 22.
1383	Update the non-date-specific citation of ASTM A708 to cite the 1974 version.	References, subsection VI, Item 23.