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Deletions are shown with the following attributes and color:

~~Strikeout~~, **Blue** RGB(0,0,255).

Deleted text is shown as full text.

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Double Underline, **Redline**, **Red** RGB(255,0,0).

The document was marked with 761 Deletions, 965 Insertions, 0 Moves.

C.I.5: Reactor Coolant and Connecting Systems

Chapter 5 of the ~~final safety analysis report (FSAR)~~ should provide information regarding ~~the reactor coolant system~~the RCS and systems to which it connects. Special consideration should be given to the ~~reactor coolant system~~RCS and pressure-containing appendages out to and including isolation valving, which is the ~~“reactor coolant pressure boundary” (RCPB), as defined in Title 10, Section 50.2(v), of the Code of Federal Regulations [10 CFR 50.2(v)].~~

~~_____ Evaluations, as defined in 10 CFR 50.2(v).~~

~~This section should include evaluations,~~ together with the necessary supporting material, ~~should be included~~ to show that the ~~reactor coolant system~~RCS is adequate to accomplish its intended objective and to maintain its integrity under conditions imposed by all foreseeable reactor behaviors, including both normal and accident conditions. The information should permit an independent determination of the adequacy of the evaluations; that is, assurance that the evaluations included are correct and complete, and all necessary evaluations have been performed. ~~E~~Applicants should reference evaluations included in other chapters that have a bearing on the ~~reactor coolant system should be referenced~~RCS.

C.I.5.1 Summary Description

This section of the FSAR should provide a summary description of the ~~reactor coolant system~~RCS and its various components. This description should indicate the independent and interrelated performance and safety functions of each component; and should include a tabulation of important design and performance characteristics.

C.I.5.1.1 Schematic Flow Diagram

~~P~~This section should provide a schematic flow diagram of the ~~reactor coolant system~~RCS denoting all major components, principal pressures, temperatures, flow rates, and coolant volume under normal steady-state full-power operating conditions.

C.I.5.1.2 Piping and Instrumentation Diagram

~~P~~Applicants should provide a piping and instrumentation diagram of the ~~reactor coolant system~~RCS and connected systems delineating the following three items:

- (1) extent of the systems located within the containment;
- (2) points of separation between the ~~reactor coolant~~RCS (heat transport) ~~system~~ and the secondary (heat utilization or removal) system
- (3) extent of insolubility of any fluid system as provided by the use of isolation valves between the radioactive and non-radioactive sections of the system, isolation valves between the RCPB and connected systems, and passive barriers between the RCPB and other systems.

C.I.5.1.3 Elevation Drawing

~~P~~Applicants should provide an elevation drawing showing principal dimensions of the ~~reactor coolant system~~RCS in relation to the supporting or surrounding concrete structures from

which a measure of the protection afforded by the arrangement and the safety considerations incorporated in the layout can be gained.

C.I.5.2 Integrity of the Reactor Coolant Pressure Boundary

This section of the FSAR should ~~provide a discussion of~~discuss the measures to be employed to ensure and maintain the integrity of the RCPB throughout the plant design lifetime.

C.I.5.2.1 Compliance with Codes and Code Cases

C.I.5.2.1.1 Compliance with 10 CFR 50.55a

~~P~~This section should provide a table showing compliance with the NRC's regulations in 10-CFR-50.55a, "~~Codes and Standards.~~" This table should identify pressure vessel components, piping, pumps, valves, and storage tanks. The applicable component code, ~~and~~ code edition and addenda, ~~and, when required, the component order date~~ of each Class 1 component within the RCPB, as defined in Section III of the ~~American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel~~ Code, may be identified by reference to the table of ~~structures, systems, and components~~SSCs in Section 3.2 of the FSAR or included in this section of the FSAR.

~~In the event there are cases in which~~if conformance to the regulations of 10-CFR 50.55a would result in hardships or unusual difficulties without a compensating increase in the level of safety and quality, applicants should provide a complete description of the circumstances resulting in such cases and the basis for proposed alternative requirements. ~~Describe how~~The description should cover how the proposed alternative requirements will provide an equivalent and acceptable level of safety and quality ~~will be provided by the proposed alternative requirements.~~

C.I.5.2.1.2 Compliance with Applicable Code Cases

~~P~~Applicants should provide a list of ASME Code Cases that will be applied to components within the RCPB. ~~E~~The list should identify each component for which a Code Case has been applied ~~should be identified~~ by Code Case number, revision, and title. ~~G~~Caution isThe agency advised ~~in the use of Code Cases to ensures applicants to ensure~~ that the applicable revision of the Code Case is identified for each component application. ~~Regulatory Guide RG 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III" (latest revision), lists those ASME Code cases related to Section III, Division 1, Code Cases that are generally that are acceptable to the NRC staff. Applicants should indicate the extent of conformance with the recommendations of Regulatory Guide 1.84. If Code Cases the guidance of RG 1.84, including conditions for approval identified in RG 1.84. If applicants use code cases other than those listed are used, they should show that their use will result in as acceptable a level of quality and safety for the component for the component as would be achieved by following the C code C cases that the NRC staff has endorsed has endorsed in Regulatory Guide RG 1.84.~~

C.I.5.2.2 Overpressure Protection

~~P~~This section should provide information, as set forth in the following subsections, to accommodate an evaluation of the systems that protect the RCPB and the secondary side of steam generators from ~~over pressure~~overpressure. These systems include all pressure-

relieving devices (safety and relief valves) for the following:

(1) ~~reactor coolant system~~ four systems:

(1) RCS

(2) primary side of auxiliary or emergency systems connected to the ~~reactor coolant system~~ RCS

(3) any ~~blow-down~~ blowdown or heat dissipation systems connected to the discharge of these pressure-relieving devices

(4) secondary side of steam generators.

C.I.5.2.2.1 Design Bases

P~~This section should~~ provide the design bases on which the functional design of the ~~over pressure~~ overpressure protection was established. A~~It should~~ address ~~over pressure~~ overpressure protection for the RCPB during reactor power operation and low-temperature operation. D~~Applicants should~~ describe compliance with ~~General Design Criterion (GDC) 15~~, as defined in Appendix A to 10 CFR Part 50, as it relates to not exceeding the RCPB design conditions ~~not being exceeded~~ during any condition of normal operation or ~~anticipated operational occurrences~~ AOO, as well as GDC 31, “Fracture Prevention of Reactor Coolant Pressure Boundary,” as it relates to designing the RCPB with sufficient margin to ensure that it behaves in a non-brittle manner and minimizes the probability of rapidly propagating fracture ~~is minimized~~.

C.I.5.2.2.2 Design Evaluation

P~~This section should~~ provide an evaluation of the functional design of the ~~over pressure~~ overpressure protection system. This evaluation should include an analysis of the system's capability to perform its function, describe the analytical model used in the analysis, and discuss the bases for its validity. A~~Also~~ Applicants should also discuss and justify the assumptions used in the analysis, including the plant initial conditions and system parameters. T~~They should~~ list the systems and equipment assumed to operate and describe their performance characteristics. P~~This section should~~ provide studies that show the sensitivity of the system's performance to variations in these conditions, parameters, and characteristics.

D~~Applicants should~~ describe the design of ~~over pressure~~ overpressure protection during low-temperature operations, including the capability to relieve pressure during all ~~over pressure~~ overpressure events during startup and shutdown conditions at low temperatures, particularly ~~at~~ during water-solid conditions. P~~Applicants should~~ provide the analysis that demonstrates how ~~over pressure~~ overpressure protection is achieved, assuming any single active component failure. T~~This section should~~ identify all ~~over pressure~~ overpressure events and, as a subset, identify the events that can be prevented by preventive interlocks or locking out power. D~~Applicants should~~ describe how ~~the over pressure~~ the overpressure protection system is enabled. D~~Describe~~ the alarms and indications associated with the system. D~~Describe~~ and the power source for the system. D~~They should~~ discuss whether any credit is taken for active components to mitigate an ~~over pressure~~ overpressure event and the additional analysis performed that considers s inadvertent system initiation or actuation. If this system uses pressure relief from a low-pressure system, this section should discuss how the low-pressure interlocks will not interfere with the operation of this system.

C.I.5.2.2.3 Piping and Instrumentation Diagrams

PThis section should provide piping and instrumentation diagrams for the over pressure/overpressure protection system showing the number, type, and location of all components, including valves, piping, tanks, instrumentation, and controls. Applicants should identify the connections and interfaces with other systems.

C.1.5.2.2.4 Equipment and Component Description

DThis section should describe the equipment and components of the over pressure/overpressure protection system, including schematic drawings of the safety and relief valves and a discussion of how the valves operate. IdentifyIt should identify the significant design parameters for each component, including the design, throat area, capacity, and set points of the valves and the diameter, length, and routing of piping. Applicants should list the design parameters (e.g., pressure and temperature) for each component; and specify the number and type of operating cycles; as well as the environmental conditions (e.g., temperature and pressure) for which each component is designed.

C.1.5.2.2.5 Mounting of Pressure-Relief Devices

DThis section should describe the design and installation details of the mounting of the pressure-relief devices within the RCPB and the secondary side of steam generators. Applicants should specify the design bases for the assumed loads (i.e., thrust, bending, and torsion) imposed on the valves, nozzles, and connected piping in the event that all valves discharge. They should describe how these loads can be accommodated; and include a listing of these loads and resulting stresses. Applicants may cross-reference material contained in Section 3.9.3.3 of the FSAR may be cross-referenced.

C.1.5.2.2.6 Applicable Codes and Classification

This section should identify the applicable industry codes and classifications applied to the system.

C.1.5.2.2.7 Material Specification

Applicants should identify the material specifications for each component.

C.1.5.2.2.8 Process Instrumentation

Applicants should identify all process instrumentation.

C.1.5.2.2.9 System Reliability

Applicants should discuss system reliability and the consequences of equipment/component failures.

C.1.5.2.2.10 Testing and Inspection

This section should identify the tests and inspections to be performed (1) prior to/before operation and during startup to demonstratethat demonstrate the functional performance and (2) as inservice surveillance to ensure continued reliability. Applicants should describe

specific testing of the low-temperature ~~over pressure~~overpressure protection system, particularly operability testing, exclusive of relief valves, ~~prior to~~before each shutdown.

C.I.5.2.3 Reactor Coolant Pressure Boundary Materials

C.I.5.2.3.1 Material Specifications

P~~This section should~~ provide a list of specifications for the principal ferritic materials, austenitic stainless steels, and nonferrous metals, ~~(including bolting and weld materials,)~~ to be used in fabricating and assembling each component (e.g., vessels, piping, pumps, and valves) that is part of the RCPB, excluding the ~~reactor pressure vessel~~RPV. ~~Identify~~It should identify the grade or type and final metallurgical condition of the material placed in service. “Metallurgical condition” is a technical term used to describe the microstructure of the materials. Based on its phase diagram, the microstructure of a material can vary in accordance with the heat treatments applied to the materials. Different microstructures of a material will possess different mechanical properties. One example is the heat treatment of the austenitic stainless steel in a certain temperature range will create a sensitized microstructure, which is characterized by chromium depletion along the grain boundary. Austenitic stainless steel with sensitized microstructure is susceptible to IGSCC. Materials engineers with metallurgy background should be able to provide the requested information.

If the as-procured, as-built grade, type and final metallurgical condition of the materials are unavailable at the time of the COL application, representative or bounding data and information may be submitted for staff review as part of the COL application. The COL applicant should submit the as-procured, as-built grade, type and final metallurgical condition of the materials to the staff at a pre-determined time agreed upon by the both parties. The applicant may need to work with the NRC staff during the review to arrive at an appropriate method (e.g., ITAAC, license condition, FSAR update) to ensure that the as-built plant is consistent with the design reviewed during the licensing process.

C.I.5.2.3.2 Compatibility with Reactor Coolant

P~~Applicants should~~ provide the following four pieces of information relative to the compatibility of the materials of construction and the external insulation of the RCPB with the reactor coolant:

- (1) ~~Pressurized-water reactor (Regarding PWR)~~ coolant chemistry (PWRs only). ~~D~~ applicants should describe the chemistry ~~of the~~of the reactor coolant and the additives (such as corrosion inhibitors). ~~D~~They should describe water chemistry, including maximum allowable content of chloride, fluoride, sulfate, and oxygen, ~~as well as~~as well as the permissible content of hydrogen and soluble poisons. ~~D~~They should discuss methods ~~to control~~to control water chemistry, including pH, and others details of the coolant chemistry program to indicate whether coolant chemistry will be maintained at a level comparable to the guidelines in the latest version in the Electric Power Research Institute (EPRI) report series, “PWR Water Chemistry Guidelines.” ~~D~~Applicants should discuss the industry-recommended methodologies that will be used to monitor water chemistry, and provide appropriate references.
- (2) ~~Boiling-water reactor (Regarding BWR)~~ coolant chemistry (BWRs only). ~~D~~ applicants should describe the chemistry of the reactor coolant and the methods for maintaining coolant chemistry. P~~They should~~ provide sufficient information about allowable range

and maximum allowable chloride, fluoride, and sulfate contents, maximum allowable conductivity, pH range, location of conductivity meters, performance monitoring, and other details of the coolant chemistry program to indicate whether the facility can maintain coolant chemistry ~~will be maintained~~ at a level comparable to the recommendations in Regulatory Guide 1.56, "Maintenance of Water Purity in Boiling-Water Reactors." Discuss guidelines in the latest version in the EPRI report series, "BWR Water Chemistry Guidelines." Applicants should discuss the industry-recommended methodologies that will be used to monitor water chemistry; and provide appropriate references.

- (3) ~~Regarding the~~ compatibility of construction materials with reactor coolant. ~~P~~ Applicants should provide a list of the materials of construction exposed to reactor coolant and a description of material compatibility with the coolant, contaminants, and radiolytic products to which the materials may be exposed. If ~~non-metallic~~ nonmetallic materials are exposed to reactor coolant, applicants should include a description of the compatibility of these materials with the coolant.
- (4) ~~Regarding the~~ compatibility of construction materials with external insulation and reactor coolant. ~~P~~ Applicants should provide a list of the materials of construction of the RCPB and a description of their compatibility with external insulation and the environment, especially in the event of coolant leakage. ~~P~~ Applicants should provide sufficient information about the selection, procurement, testing, storage, and installation of any nonmetallic thermal insulation for austenitic stainless steel to indicate whether the concentrations of chloride, fluoride, sodium, and silicate in thermal insulation will be within the ranges recommended in Regulatory Guide RG 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel." ~~P~~ They should provide information on the ~~leach~~ leachable contaminants in insulation on ~~non-austenitic~~ piping.

C.I.5.2.3.3 *Fabrication and Processing of Ferritic Materials*

P Applicants should provide the following three types of information relative to fabrication and processing of ferritic materials used for components of the RCPB:

- (1) ~~Fracture toughness. In regard to~~ Regarding fracture toughness of the ferritic materials, including bolting materials for components (e.g., vessels, piping, pumps, and valves) of the RCPB, applicants should indicate how compliance with the test and acceptance requirements guidelines of Appendix G to 10 CFR Part 50 and with Section Article NB-2300 and Appendix G to Section III of the ASME Code is achieved. ~~S~~ Applicants should submit the fracture toughness data in tabular form, including information regarding the calibration of instruments and equipment (FSAR).
- (2) ~~Control of welding. Provide~~ Provide

If the actual, as procured fracture toughness data is unavailable at the time of the COL application, representative or bounding data and information may be submitted for staff review as part of the COL application. The COL applicant should submit the actual, as procured fracture toughness data to the staff at a pre-determined time agreed upon by the both parties. The applicant may need to work with the NRC staff during the review to arrive at an appropriate method (e.g., ITAAC, license condition, FSAR update) to ensure that the as-built plant is consistent with the design reviewed during the licensing process.

- (2) Applicants should provide the following information relative to the control of welding of ferritic materials used for components of the RCPB:
- (a) They should include sufficient information regarding the avoidance of cold cracking during welding of low-alloy steel components of the RCPB to indicate whether the degree of weld integrity and quality will be comparable to that obtainable by following the recommendations of Regulatory Guide RG 1.50, “Control of Preheat Temperature for Welding of Low-Alloy Steel,” and Regulatory Guide RG 1.43, “Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components.” Applicants should provide details on proposed minimum preheat temperature and maximum interpass temperature during procedure qualification and production welding. They should provide information on the moisture control for low-hydrogen, covered-arc-welding electrodes.
 - (b) Applicants should provide sufficient information for electroslag welds in the low-alloy steel components of the RCPB to indicate whether the degree of weld integrity and quality will be comparable to that obtainable by following the recommendations of Regulatory Guide 1 of RG 1.34, “Control of Electroslag Weld Properties.” They should provide details on the control of welding variables and the metallurgical tests required during procedure qualification and production welding.
 - (c) In regard to welding and weld repair during fabrication and assembly of ferritic steel components of the RCPB, applicants should provide sufficient details for on welder qualification for weld areas of limited accessibility, requalification, and monitoring of production welding for adherence to welding qualification requirements to indicate whether the degree of weld integrity and quality will be comparable to that obtainable by following the recommendations of Regulatory Guide of RG 1.71, “Welder Qualification for Areas of Limited Accessibility.”
 - (d) Applicants should describe the controls to limit the occurrence of underclad cracking in low-alloy steel components clad with stainless steel.
- (3) ~~Nondestructive examination.~~ Applicants should provide sufficient information on nondestructive examination about the program for NDE of ferritic steel tubular products (pipe, tubing, flanges, and fittings) for components of the RCPB to indicate whether detection of unacceptable defects (regardless of defect shape, orientation, or location in the product) will be in conformance are consistent with the requirements of the ASME Code.

~~G.1.5.2.3.4~~ =

If data, test results, or other information are unavailable at the time of the COL application, representative or bounding data and information may be submitted for staff review as part of the COL application. The COL applicant should submit the data, test results, or other information that was not available at the time of COL application to the staff at a pre-determined time agreed upon by the both parties. The applicant may need to work with the NRC staff during the review to arrive at an appropriate method (e.g., ITAAC, license condition, FSAR update) to ensure that the as-built plant is consistent with the design reviewed during the licensing process.

G.1.5.2.3.4 Fabrication and Processing of Austenitic Stainless Steels

PApplicants should provide the following three types of information relative to fabrication and processing of austenitic stainless steels for components of the RCPB:

(1) ~~Avoidance of stress-corrosion cracking.~~ PApplicants should provide the following information relative to avoidance of stress-corrosion cracking of austenitic stainless steels for components of the RCPB during all stages of component manufacture and reactor construction:

(a) SApplicants should include sufficient details about the avoidance of sensitization during fabrication and assembly of austenitic stainless steel components of the RCPB to indicate whether the degree of freedom from sensitization will be comparable to that obtainable by following the recommendations of Regulatory Guide RG 1.44, "Control of the Use of Sensitized Stainless Steel." ~~D~~They should describe provisions in material selection and processing to minimize susceptibility to ~~intergranular stress corrosion cracking (IGSCC)~~ consistent with the recommendations in Generic Letter ~~88-01~~, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping," dated January 25, 1988, and ~~Revision 2 of~~ NUREG-0313, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping."

(b) SApplicants should provide sufficient details about the process controls to minimize exposure to contaminants capable of causing stress-corrosion cracking of austenitic stainless steel components of the RCPB to show whether process controls will provide, during all stages of component manufacture and reactor construction, a degree of surface cleanliness comparable to that obtainable by following the recommendations of Regulatory Guide RG 1.44 and Regulatory Guide RG 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants." ~~D~~Applicants should describe the controls for abrasive work on austenitic stainless steel surfaces. †They should identify any pickling used in processing austenitic stainless steel components and describe the restrictions placed on pickling of sensitized materials. †Applicants should also identify the upper yield strength limit of the austenitic stainless steel materials used. ==

~~(c) Cold-worked~~

If the actual, as-procured yield strength of the austenitic stainless steels. Provide steel materials is unavailable at the time of the COL application, representative or bounding data and information may be submitted for staff review as part of the COL application. The COL applicant should submit the actual, as-procured yield strength of the austenitic stainless steel materials to the staff at a pre-determined time agreed upon by the both parties. The applicant may need to work with the NRC staff during the review to agree on an appropriate method (e.g., ITAAC, license condition, FSAR update) to ensure that the as-built plant is consistent with the design reviewed during the licensing process.

(c) Applicants should provide assurance that cold-worked austenitic stainless steels will have a maximum ~~0.2%~~2-percent offset yield strength ~~of 620 MPa~~of 620 megapascal (90,000 psi) to reduce the probability of stress-corrosion cracking in RCPB applications. †Applicants should identify augmented ~~inservice inspection~~ISI to ensure the structural integrity of the components during service. In general, cold-worked austenitic stainless steels should not be used

for RCPB applications, ~~but may~~but they may be used when ~~there is~~ no proven alternative is available. If such materials are used, applicants should describe the service experience and laboratory testing in the simulated environment to which the components will be exposed. ~~They should~~ describe the controlled, measured, and documented fabrication process for cold-worked components.

- (2) ~~Control of welding.~~ Applicants should provide the following information relative to the control of welding of austenitic stainless steels for components of the RCPB:
 - (a) Applicants should provide sufficient information on electroslag welds in austenitic stainless steel components of the RCPB to indicate whether the degree of weld integrity and quality will be comparable to that obtainable by following the recommendations of Regulatory Guide RG 1.34 and including. The information should include the control of welding variables and the metallurgical tests required during procedure qualification and production welding.
 - (b) In regard to welding and weld repair during fabrication and assembly of austenitic stainless steel components of the RCPB, applicants should provide sufficient details about welder qualification for areas of limited accessibility, requalification, and monitoring of production welding for adherence to welding qualification requirements to indicate whether the degree of weld integrity and quality will be comparable to that obtainable by following the recommendations of Regulatory Guide RG 1.71.
- (3) ~~Nondestructive examination.~~ Applicants should provide sufficient information about the program ~~for nondestructive examination~~for NDE of austenitic stainless steel tubular products (pipe, tubing, flanges, and fittings) for components of the RCPB to indicate whether detection of unacceptable defects (regardless of defect shape, orientation, or location in the product) ~~will be in conformance~~are consistent with the ASME Code.

C.I.5.2.3.5– Prevention of Primary Water Stress-Corrosion Cracking (PWSCC) for Nickel-Base Alloys (PWRs only)

This section should provide the following two pieces of information relative to fabrication and processing of nickel-based alloys for components of the RCPB:

- (1) Applicants should identify the nickel-based alloy components of the RCPB and discuss the prevention ~~of primary water stress corrosion cracking (PWSCC).~~ Identify the inservice inspections performed to demonstrate the nickel-based alloy materials are not susceptible to PWSCC, and of PWSCC. Applicants should describe test results that demonstrate the nickel-based alloy materials are not susceptible to PWSCC, and identify the ISI that will be performed to confirm that PWSCC is not occurring in the materials.
- (2) For nickel-chromium-iron alloys used as RCPB materials, applicants should provide the technical basis for use either by identification (based upon demonstrated satisfactory use in similar applications) or presentation of information to support use of the material under the expected environmental conditions (e.g., exposure to reactor coolant). Operating experience has indicated that certain nickel-chromium-iron alloys (e.g., Alloy 600 and Alloy 182/82) are susceptible to PWSCC. Alloy 690 has improved resistance to stress-corrosion cracking in comparison to Alloy 600 and Alloy 182/82 previously used in reactor plants.

C.I.5.2.3.6 Threaded Fasteners

PThis section should provide a summary description of the program for ensuring the integrity of bolting and threaded fasteners and their adequacy. RApplicants should reference FSAR Section 3.13, as appropriate.

C.I.5.2.4 Inservice Inspection and Testing of the Reactor Coolant Pressure Boundary

C.I.5.2.4.1 Inservice Inspection and Testing Program

DThis section should discuss the inservice inspectionISI and testing program for the NRC Quality Group A components of the RCPB (ASME Boiler and Pressure Vessel Code, Section III, Code Class- 1 components) that complies with the requirementsguidelines of 10 CFR-50.55a. PIt should provide sufficient detail to show that the inservice inspectionISI program meets the requirements of Section XI of the ASME Code. Because the inservice inspectionISI program is an operational program, as discussed in SECY-05-0197, applicants should describe the program and its implementation must be described with sufficient scope and level of detail to enable the staff to make a reasonable assurance finding regarding its acceptability. PTherefore, applicants should provide descriptive information on the following:

- (3) System boundary, subject to inspection. DIn particular, they should discuss components (other than steam generator tubes) and associated supports to include all pressure vessels, piping, pumps, valves, and bolting:
- (4) Accessibility. Describe covering the following eight areas:
 - (1) Regarding accessibility, applicants should describe provisions for access to components and identify any remote access equipment needed to perform inspections.
 - (5) E
 - (2) Regarding examination categories and methods. D, applicants should discuss the methods, techniques, and procedures used to meet ASME Code requirements. For performing ultrasonic testing (UT) not covered by ASME Appendix VIII to Section XI; Appendix VIII of the ASME Code, the applicant should address the issues/concerns identified in Regulatory GuideRG 1.150, "Ultrasonic Testing of Reactor Vessel Welds During Pre-service and Inservice Examinations" Examinations," to ensure that the UTultrasonic testing methods, techniques, and procedures; used for ASME Code examinations; are consistent with those recommended in the subject regulatory guide.
 - (3) Regarding inspection intervals. D, applicants should discuss program scheduling in compliancecomparison with the ASME Code.
 - (4) Evaluation of examination results. DApplicants should discuss provisions for evaluating examination results, including evaluation methods for detected flaws and repair procedures for components that reveal defects.
 - (5) System pressure tests. ProvideApplicants should provide descriptive information on system pressure tests and correlated technical specificationTS requirements.

- (6) Applicants should identify any components that are exempted from the ASME Code Section XI examination requirements.
- (7) ~~Code exemptions. Identify any exemptions from Code requirements.~~
- (10) ~~Relief requests. Discuss~~ Applicants should discuss any requests for relief from ASME Code requirements that are impractical as a result of limitations of component design, geometry, or materials of construction.
- (8) ~~Code cases. Identify Code Cases that have been invoked.~~

~~It is acceptable to submit a general description of the programs as long as it “fully describes” the programs, as defined in SECY-05-0197, and references~~ Applicants should identify ASME Code cases that are invoked.

Because the ISI and IST programs are operational programs, the programs and their implementation milestones should be fully described and reference any applicable standards regarding the ISI and IST programs. ~~When detail information for the ISI and IST programs, as required in this section, is not available at the time of submitting the application, the COL applicant should make a commitment in the application that such information will be provided at a later date (at least one year prior to fuel load) for NRC review.~~ Fully described should be understood to mean that the program is clearly and sufficiently described in terms of the scope and level of detail to allow for a reasonable assurance finding of acceptability.

C.I.5.2.4.2 ~~Pre-Service~~ Inspection and Testing Program

~~This section should describe the pre-service examination program that meets the requirements/guidelines of Sub-a Article NB-5280 of Section III, Division I, of the ASME Code. Because the pre-service inspection program is and preservice testing programs are operational program, as discussed in SECY-05-0197 programs, the programs and its/their implementation must be described with sufficient milestones should be fully described and reference any applicable standards. Fully described should be understood to mean that the program is clearly and sufficiently described in terms of the scope and level of detail to allow for the staff to make a reasonable assurance finding on-its/of acceptability.~~

C.I.5.2.5 Reactor Coolant Pressure Boundary Leakage Detection

~~Applicants should describe in this section the RCPB leakage detection systems in sufficient detail to demonstrate the extent to which the recommendations of Regulatory Guide RG 1.45, “Reactor Coolant Pressure Boundary Leakage Detection Systems,” and Regulatory Guide RG 1.29, “Seismic Design Classification,” have been followed.~~

~~Specifically, the applicant should provide information that will permit comparison with the regulatory positions of the ese guides, giving a detailed description of the systems employed, their sensitivity and response time, and the reliance placed on their proper functioning. This section should also identify the limiting leakage conditions that will be included in the technical specifications TS.~~

~~In addition, this section should identify the leakage detection systems that are designed to meet the sensitivity and response guidelines of Regulatory Guide RG 1.45 and that will be included in the Technical Specifications. TS. Applicants should describe these systems and those that are used for alarm as an indirect indication of leakage, and provide the design criteria. They should describe how signals from the various leakage detection systems~~

are correlated to provide information to plant operators regarding leakage location and quantitative leakage flow rate.

Applicants should demonstrate that the system is capable of separately monitoring and collecting leakage from both identifiable and unidentifiable sources. They should describe the floor drain system to demonstrate that leakage will flow to the sump or tank where it is collected; and identify all potential inter-system leakage paths and the instrumentation used in each path. Applicants should demonstrate adequate monitoring capability to ensure that the limits of inter-system leakage assumed in the accident analyses are not exceeded. For radioactivity monitoring leakage detection, they should describe the primary coolant radioactivity concentration assumption being used to analyze the sensitivity of the leak detection systems.

This section should describe the provisions to test and calibrate all leakage detection systems; and provide and justify the frequency of testing and calibration. The applicant should describe the periodic testing of the floor drainage system that will check for blockage and ensure operability.

C.I.5.3 Reactor Vessels

C.I.5.3.1 Reactor Vessel Materials

This section of the FSAR should contain pertinent data in sufficient detail to provide assurance that the materials (including weld materials), fabrication methods, and inspection techniques used for the reactor vessel and applicable attachments and appurtenances conform to all applicable regulations. The FSAR should also describe the specifications and criteria to be applied; and should demonstrate that the requirements have been met.

C.I.5.3.1.1 - Material Specifications

This section should list all materials in the reactor vessel, applicable attachments, and appurtenances; and provide the material specifications, making appropriate references to the applicable sections in Chapter 53 of the FSAR. If any materials other than those listed in Appendix I to Section III of the ASME Code are used, applicants should provide the data called for under identified in Appendix IV to Section III of the ASME Code for approval of the new material. This section should reference information regarding material specifications provided in other documents or sections of the FSAR. It should be referenced in this section. Address mechanical and physical properties of these materials should be addressed. and describe the effects of radiation on these materials, where applicable; should be described.

C.I.5.3.1.2 Special Processes Used for Manufacturing and Fabrication

This section should describe the manufacture of the product forms and methods used to fabricate the vessel or any of its applicable attachments and appurtenances. Applicants should discuss any special or unusual processes used; and show that they will not compromise the integrity of the reactor vessel.

C.I.5.3.1.3 Special Methods for Nondestructive Examination

This section should describe in detail all special procedures for detecting surface and internal discontinuities, with emphasis on procedures that differ from those in Section III of the ASME Code. Applicants should pay particular attention to calibration methods,

instrumentation, method of application, sensitivity, reliability, reproducibility, and acceptance standards.

C.I.5.3.1.4 Special Controls for Ferritic and Austenitic Stainless Steels

Making appropriate references to the applicable sections in Chapter 53 of the FSAR, applicants should describe controls on welding, composition, heat treatments, and similar processes covered by regulatory guides to verify that these recommendations or equivalent controls are employed. The description should include controls for abrasive work (e.g., grinding) on austenitic stainless steel. Applicants should address the following guidance should be addressed:

- Regulatory GuideRG 1.34, “Control of Electroslag Weld Properties”
- Regulatory GuideRG 1.37, “Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants”
- Regulatory GuideRG 1.43, “Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components”Steel Components
- Regulatory GuideRG 1.44, “Control of the Use of Sensitized Stainless Steel”
- Regulatory GuideRG 1.50, “Control of Preheat Temperature for Welding of Low-Alloy Steel”
- Regulatory GuideRG 1.71, “Welder Qualification for Areas of Limited Accessibility”
- Regulatory GuideRG 1.99, “Radiation Embrittlement of Reactor Vessel Materials”
- Regulatory GuideRG 1.190, “Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence”
- NUREG-0313, “Technical Report on Material Selection and Processing Guidelines for BWRfor BWR Coolant Pressure Boundary Piping,”Revision 2Piping”

C.I.5.3.1.5 Fracture Toughness

This section should describe the fracture testing and acceptance criteria specified for materials of the reactor vessel and appurtenances thereto. In particular, it should describe how the toughness requirements of Appendix G to 10 CFR Part 50 will be met. Applicants should specify the maximum nil-ductility reference temperature (RT_{NDT}) to which the ferritic materials of the reactor vessel will be fabricated. They should identify ITAAC which that will be completed to verify that these ferritic reactor vessel materials meet these specifications.

C.I.5.3.1.6 Material Surveillance

This section should describe the material surveillance program in sufficient detail to provide assurance that the program meets the requirements of Appendix H to 10 CFR Part 50. Describe Appendix H, “Reactor Vessel Material Surveillance Program Requirements,” to 10 CFR Part 50. It should describe the method for calculating neutron fluence for the reactor vessel beltline and the surveillance capsules. Because the material surveillance program is an operational program, as discussed in SECY-05-0197SECY-05-0197, the program and its implementation must be described with sufficient scope and levelmilestones should be fully described and reference any applicable standards. Fully described should be understood to mean that the program is clearly and sufficiently described in terms of the scope and level of detail to enable the NRC staff to makeallow for a reasonable assurance finding regarding on

~~its acceptability~~of acceptability. In particular, applicants should address the following six topics:

- (1) basis for selection of material in the program
- (2) number and type of specimens in each capsule
- (3) number of capsules and proposed withdrawal schedule comply comparable with American Society for Testing and Materials (ASTM) Standard E-185, "Surveillance Tests on Structural Materials in Nuclear Reactors," Annual Book of ASTM Standards, Part 30, American Society for Testing and Materialsas referenced to in 10 CFR Part 50, Appendix H
- (4) neutron flux and fluence calculations for vessel wall and surveillance specimens and conformance with the guidance of Regulatory GuideRG 1.190
- (5) expected effects of radiation on vessel wall materials and basis for estimation
- (6) location of capsules, method of attachment, and provisions to ensure that capsules will be retained in position throughout the vessel lifetime.

C.I.5.3.1.7 Reactor Vessel Fasteners

~~∅~~This section should describe the materials and design for the stud bolts, washers, nuts, and other fasteners for the reactor vessel closure. ~~include~~It should include sufficient detail regarding materials property requirements, nondestructive evaluation ~~procedures~~techniques, lubricants or surface treatments, ~~and protection~~and protection provisions to show ~~that~~ the specifications of SRP-3.13, "Threaded Fasteners" Appendix I to Section III of the ASME Code, providing the data called for under Appendix IV to Section III of the ASME Code and the recommendations of Regulatory GuideRG 1.65, "Materials and Inspections for Reactor Vessel Closure Studs," or equivalent measures, ~~are followed~~are followed. ~~In~~The FSAR; should describe the mechanical property and fracture toughness tests ~~which~~that will be performed to demonstrate that the materials from which these fasteners are fabricated conform to these recommendations or their equivalent. ~~Applicants should~~ identify any ITAAC ~~which~~that will be completed to verify that the materials from which these fasteners are constructed met these specifications.

C.I.5.3.2 Pressure-Temperature Limits, Pressurized Thermal Shock, and Charpy Upper-Shelf Energy Data and Analyses

This section of the FSAR should describe the bases for setting operational limits on pressure and temperature for the RCPB during any condition of normal operation, including ~~anticipated operational occurrences~~AOO, and hydrostatic tests. In addition, this discussion should provide detailed assurance that Appendices G and H to 10 CFR Part 50 and 10 CFR Part 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events," (PWRs only) will be complied with throughout the life of the plant.

C.I.5.3.2.1 Limit Curves

~~∅~~This section should describe how the applicant will develop pressure-temperature limit curves for (1) pre-service system hydrostatic tests; (2) inservice leak and hydrostatic tests; (3) normal operation, including ~~heat-up~~heatup and ~~cool-down~~cooldown, and (4) reactor core operation ~~will be developed~~.

If procedures or criteria other than those recommended in the ASME ~~Boiler and~~

Pressure Vessel Code are used, applicants should show that equivalent safety margins are provided. This section should describe the bases used to determine these limits and provide typical curves with temperatures relative to the RT_{NDT} of the limiting material (as defined in paragraph Article NB-2331 of Section III of the ASME Code).

Based on material properties, including such as initial nil-ductility reference temperature, RT_{NDT} and material chemical composition, etc., to which reactor vessel ferritic materials will be procured, applicants should demonstrate how pressure-temperature limits which that meet the requirements of 10 CFR Part 50, Appendix G, G to 10 CFR Part 50 can be met for the licensed life of the facility. Applicants should describe the bases used for the prediction, and indicate the extent to which the recommendations of Regulatory Guide RG 1.99 are followed.

This section should describe procedures that will be used to update these limits during while in service. A and address radiation effects and the extent to which the recommendations of Regulatory Guide RG 1.190 are followed.

C.1.5.3.2.2 Operating Procedures

This section should describe how the applicant will develop operating procedures, which that will ensure that the pressure-temperature limits in Section 5.3.2.1 of the FSAR will not be exceeded during any condition of normal operation, including anticipated operational occurrences AOO, and system hydrostatic tests, will be developed. The FSAR should include a commitment that plant operating procedures will ensure that the pressure-temperature limits identified in Section 5.3.2.1 of the FSAR will not be exceeded during any foreseeable upset condition.

C.1.5.3.2.3 Pressurized Thermal Shock (PWRs only)

This section should discuss pressurized thermal shock (PTS). Using limiting material properties to which the ferritic reactor vessel materials will be procured, applicants should provide the calculational methods and assumptions and compare the projected values of the PTS reference temperature (RT_{PTS}) for reactor vessel beltline materials with the screening criteria in 10 CFR 50.61. If RT_{PTS} values are projected to exceed the PTS screening criterion before the expiration date of the operating license, applicants should provide safety analyses to support reactor operation.

C.1.5.3.2.4 Upper-Shelf Energy

Applicants should specify minimum Charpy upper-shelf energy values to which ferritic materials of the reactor vessel will be procured. They should identify the ITAAC which that will be completed to verify that these ferritic reactor vessel materials meet or exceed these specifications. Applicants should provide projected Charpy upper-shelf energy values at the expiration date of the operating license based on the methodology in Regulatory Guide RG 1.99 and demonstrate that beltline materials will satisfy the requirement of Appendix G (paragraph IV.A.1.a) to 10 CFR Part 50.

C.I.5.3.3 Reactor Vessel Integrity

This section of the FSAR should provide a summary of all information related to the integrity of the reactor vessel. ~~Summarize, including~~ the major considerations in achieving reactor vessel safety, ~~and describe~~ and a description of the factors contributing to the vessel's integrity. ~~Also identify the reactor vessel designer and manufacturer, and describe their~~ The COL applicant may identify a specific manufacturer, if one has been chosen, and provide a description of its experience.

C.I.5.3.3.1 Design

~~Provide a~~ This section should brief ~~description of~~ describe the reactor vessel design, preferably with a schematic, including materials, construction features, fabrication methods, and inspections. S Applicants should s summarize applicable design codes and bases. ~~R and~~ r reference other sections of the FSAR as appropriate.

C.I.5.3.3.2 Materials of Construction

~~Identify~~

Applicants should identify the reactor vessel materials, including weld materials, and describe any special requirements ~~to improve their properties or quality~~. E They should e emphasize the reasons for selection; and provide assurance of suitability.

C.I.5.3.3.3 Fabrication Methods

~~Identify~~

This section should identify the reactor vessel fabrication methods, including forming, welding, cladding, and machining. D Applicants should d describe the service history of vessels constructed using these methods and the vessel supplier's experience with the procedures.

C.I.5.3.3.4 Inspection Requirements

~~Summarize~~

This section should summarize the inspection test methods and requirements, paying particular attention to the level of initial integrity. D Applicants should d describe any methods that are in addition to the ~~minimum requirements~~ guidelines established in Section III of the ASME Code.

C.I.5.3.3.5 Shipment and Installation

~~Summarize~~

This section should summarize the means used to protect the vessel so that its as-manufactured integrity will be maintained during shipment and site installation. R Applicants should r should r reference other FSAR sections as appropriate.

C.I.5.3.3.6 Operating Conditions

S This section should s summarize the operational limits that will be specified to ensure vessel safety. P Applicants should p provide a basis for concluding that vessel integrity will be maintained during the most severe postulated transients and PTS events at PWRs. ~~Reference,~~ r referencing other FSAR sections as appropriate.

C.I.5.3.3.7 Inservice Surveillance

S This section should s summarize the ~~inservice inspection~~ ISI and material surveillance

programs; and explain their adequacy relative to the requirements guidelines of Appendix H to 10 CFR Part 50 and Section XI of the ASME Code. Applicants should reference Sections C.1.5.2.4 and C.1.5.3.1.6 as appropriate.

C.1.5.3.3.8 Threaded Fasteners

Summarize

This section should summarize the programs for ensuring the integrity of bolting and threaded fasteners and their adequacy. Applicants should reference FSAR Section C.1.3.13 as appropriate.

C.1.5.4 Reactor Coolant System Component and Subsystem Design

This section of the FSAR should provide information regarding performance requirements and design features to ensure overall safety of the various components and subsystems within or allied with the reactor coolant system RCS. Because these components and subsystems differ for various types and designs of reactors, the components and subsystems are not assigned specific subsection numbers. The FSAR should contain a separate subsection (numbered 5.4.1 through 5.4.x) for each principal component or subsystem. Each subsection should present the design bases, description, evaluation, and necessary tests and inspections for the component or subsystem, including radiological considerations from the viewpoints of how radiation affects operation and ~~the viewpoint of~~ how radiation levels affect the operators and capabilities of operation and maintenance. Applicants should describe the appropriate details regarding the mechanical design ~~should be described in~~ FSAR Sections C.1.3.7, C.1.3.9, and C.1.5.2.

The following subsections identify components and subsystems that should be discussed; and the corresponding information that should be provided. As appropriate to the specific reactor type and design, certain subsections are “not not applicable”, and additional subsections are necessary to address other components and subsystems (e.g., core makeup tanks, automatic depressurization system valves, passive residual heat removal (RHR) heat exchanger, isolation condenser system, gravity-driven cooling system, passive containment cooling system).

C.1.5.4.1 Reactor Coolant Pumps

Applicants should provide the reactor coolant pump RCP design bases, description, evaluations, and tests and inspections. They should discuss the provisions taken to preclude rotor over speeding overspeeding of the reactor coolant pumps RCP in the event of a design-basis loss-of-coolant accident (LOCA).

C.1.5.4.1.1 Pump Flywheel Integrity (PWRs only)

Applicants should provide explicit information to demonstrate how the reactor coolant pump (RCP) flywheel design complies with the design criteria of GDC 1, “Quality Standards and Records,” and GDC 4, “Environmental and Dynamic Effects Design Bases,” GDC 1 and GDC 4 as specified in Appendix A to 10 CFR Part 50. Applicants should discuss the extent to which the recommendations of Regulatory Guide RG 1.14, “Reactor Coolant Pump RCP Flywheel Integrity,” are followed with respect to the design, testing, analysis, Pre-service preservice inspection, and in-service inspection ISI of the RCP flywheels. They should identify any particular exceptions or alternatives to the regulatory positions and criteria in Regulatory Guide 1 RG 1.14 and, if applicable, discuss and justify how a particular exception or

alternative will provide an acceptable level of quality and safety and will ensure continued compliance with GDC 4.

C.I.5.4.2 Steam Generators (PWRs only)

PApplicants should provide estimates of design limits for radioactivity levels in the secondary side of the steam generators during normal operation, and They should discuss the bases for those estimates. Discuss and the potential effects of tube ruptures.

PApplicants should provide the steam generator design criteria to prevent unacceptable tube damage from flow-induced vibration from FIV and cavitation. Reference, referencing the information provided in Section C.I.3 FSAR Section 3.9.3. Include and including the following two specific pieces of information:

- (1) design conditions and transients that will be specified in the design of the steam generator tubes and the operating condition category selected (i.e.g., upset, emergency, or faulted) that defines the allowable stress intensity limits to be used and the justification for this selection
- (2) extent of tube-wall thinning that could be tolerated without exceeding the allowable stress intensity limits defined above under the postulated condition of a design-basis pipe break in the RCPB or a break in the secondary piping during reactor operation.

C.I.5.4.2.1 Steam Generator Materials

DApplicants should discuss the design of the steam generator, including: (1) the selection, processing, testing, and inspection (during fabrication/processing) of the materials used to fabricate the steam generator; (2) fracture toughness of the ferritic materials used in the steam generator; (3) design design provisions for limiting the susceptibility of the steam generator to degradation and/or corrosion; (4) fracture toughness of the ferritic materials used in the steam generator; (5) compatibility of materials with the primary (reactor) and secondary coolant; and (6) the provisions provisions for accessing the secondary side of the steam generator for maintenance and cleaning.

Address Applicants should address the following six considerations:

- (1) Selection and Fabrication of Materials. Making appropriate references to FSAR Section C.I.5.2.3, applicants should provide information on the selection and fabrication of materials for components of the steam generators, including tubing, tube sheet tubesheet, channel head casting or plate, tube sheet tubesheet and channel head cladding, forged nozzles, shell pressure plates, access plates (manway and handhole), tube supports, feeding, bolting, and threaded fasteners. They should list the Ccode Ccases used in material selection. P and p provide technical justification for any Ccode Ccases not listed in Regulatory Guide RG 1.84.
- (2) PApplicants should provide information on the fracture toughness properties of ferritic materials, making appropriate references to FSAR Section C.I.5.2.3. Provide sufficient The information on materials on materials for Class 1 components should be sufficient to show compliance with how the requirements of Article guidelines of Article NB-2300 and Appendix G to Section III of the ASME Code can be verified. For Class 2 materials, applicants should provide sufficient information to show compliance with how the requirements of Article guidelines of Article NC-2300 of Section III of the ASME

Code will be verified. ~~A~~ They should address welding qualification, fabrication, and inspection during manufacture and assembly as discussed in ~~conformance with the requirements~~ of Sections III and IX of the ASME Code.

- (3) ~~Steam Generator Design.~~ Applicants should provide information on those aspects of design that may affect the performance of steam generator materials. ~~The information should~~ describe methods used to avoid extensive crevice areas where the tubes pass through the ~~tube sheet~~ tubesheet and tubing supports. ~~It should~~ describe the corrosion allowance for steam generator materials. ~~Applicants should~~ identify the method used to fasten tubes to the ~~tube sheet~~ tubesheet and show that ~~compare~~ it meets the requirements guidelines of Sections III and IX of the ASME Code. ~~Include, including the extent of tube expansion and the methods of expansion used.~~ Applicants should describe the heat treatment of the steam generator tube material and the design of the support structures.
- ~~(4) Compatibility of Steam Generator Tubing with the Primary and Secondary Coolant.~~ Provide (4) Applicants should provide information on the fabrication and processing of austenitic stainless steel materials (if used in pressure boundary applications), as discussed in Section C.I.5.2.3.4 of this guide.
- (5) Applicants should provide information on the compatibility of steam generator tubing with both the primary and secondary coolant. ~~They should~~ describe the methods used in monitoring and maintaining the chemistry of the primary and secondary coolant within the specified ranges.
- ~~(5) Accessing the Secondary Side of the Steam Generator. Describe~~
- (6) Applicants should describe the design provisions for removing surface deposits, sludge, loose parts (foreign objects), and excessive corrosion products from the secondary side of the steam generator.

C.I.5.4.2.2 Steam Generator Program

~~Applicants should~~ describe provisions in the design of the primary and secondary side of the steam generator that permit implementation of a steam generator tube integrity program. ~~They should~~ describe the elements of the steam generator tube integrity program:

~~Address, addressing~~ the following three considerations:

- (1) ~~Regarding steam G generator D design.~~ Applicants should describe the design provisions for permitting access to both the primary and secondary side of the steam generator. ~~They should~~ discuss the extent to which each tube is accessible for periodic inspection, testing, and repair (including plugging and stabilizing) using currently available methods and techniques (which are capable of finding the forms of degradation that may affect the tube throughout its service life). Applicants should discuss the extent to which secondary-side internals that can affect tube integrity may be accessed. The application should describe design provisions for inspecting ~~for~~ and removing loose parts (foreign objects) from the steam generator. ~~Describe design provisions~~ as well as for limiting the introduction of loose parts into the steam generator.
- (2) ~~Steam Generator Program.~~ Applicants should describe the elements of the steam generator program and the extent to which they are consistent with the steam generator

program requirements provided in ~~R~~the latest revision ~~3.4~~ of the Standard Technical Specifications ~~(STS)~~. ~~They should~~ discuss the method for determining tube repair criteria. ~~and~~ describe the scope and extent of the pre-service inspection of the steam generator tubes.

- (3) ~~Technical Specifications~~. ~~Applicants should~~ describe the steam generator tube inspection and reporting requirements to be adopted into the ~~Technical Specifications~~TS (including the limiting conditions for operation (LCO), surveillance requirements, and primary-to-secondary leakage limits). ~~They should~~ discuss the extent to which ~~there are~~ any potential conflicts (i.e., differences) exist between the ~~Technical Specifications~~TS and Article IWB-2000 of Section XI of the ASME Code ~~f~~ (refer to 10 CFR 50.55a(b)(2)(iii)~~f~~).

C.I.5.4.3 Reactor Coolant Piping

Applicants should provide an overall description of the reactor coolant piping system with detailed information on the criteria, methods, and materials; and include appropriate references to FSAR Chapter 3 and Sections ~~C.1.3 and C.1.5.2.3~~. The description should include the design, fabrication, and operation provisions to control those factors that contribute to stress-corrosion cracking.

C.I.5.4.4 [Reserved]

C.I.5.4.5 [Reserved]

C.I.5.4.6 Reactor Core Isolation Cooling System (BWRs only)

~~—The proposed pre-operational test program should be discussed. The discussion should verify test objectives, methods of testing, and test acceptance criteria. [Note: For the design of the Economic Simplified Boiling Water Reactor (ESBWR), this subsection may address the isolation condenser system, in lieu of the reactor core isolation cooling system, and include analogous detailed information and reference to Section C.1.6.3, “Emergency Core Cooling System,” as appropriate.]~~

~~C.I.5.4.6.1 Design Bases~~

~~—Provide~~

C.I.5.4.6.1 Design Bases

Applicants should provide a summary of the reactor core isolation cooling (RCIC) system. ~~The summary should~~ discuss the RCIC system design bases and criteria for both the steam side and pump side and include the following four considerations:

- (4) ~~(1)~~ compliance with respect to GDCs ~~4, 5, 29, 33, 34, and 54~~
- (5) ~~:~~ GDC 5, “Sharing of Structures, Systems, and Components,” GDC 29, “Protection Against Anticipated Operational Occurrences,” GDC 33, “Reactor Coolant Makeup,” GDC 34, “Residual Heat Removal,” and GDC 54, “Systems Penetrating Containment”
- (2) reliability and operability requirements, including the bases for manual operations ~~required~~needed to operate the system
- (6) ~~—~~

- (3) design for operation following a ~~loss of offsite power~~LOOP event and compliance with 10 CFR 50.63, “Loss of All Alternating Current Power,” regarding station blackout (SBO) events by conformance with Regulatory Guide 1.155, “Station Blackout”
- (4) design bases for protecting the RCIC system from physical damage, including the bases for the RCIC system support structure and protection against incidents that could jointly fail the RCIC and high-pressure core spray (HPCS)systems.

C.I.5.4.6.2 System Design

~~(1) Piping and Instrumentation Diagrams. Provide~~

Applicants should provide the following five pieces of information about RCIC system design:

- (1) Applicants should provide a description of the RCIC system, including piping and instrumentation diagrams showing all components, piping, points where connecting systems and subsystems tie together, and instrumentation and controls (I&C) associated with subsystem and component actuation. They should provide a complete description of component interlocks; as well as a diagram showing temperatures, pressures, and flow rates for RCIC operation.
- (2) Applicants should provide equipment and component descriptions. Describe that cover each component of the system. The descriptions should identify the significant design parameters for each component. S, state the design pressure and temperature of components for various portions of the system, and explain the bases for their selection.
- (3) ~~Applicable Codes and Classifications. Identify~~ Applicants should identify the applicable industry codes and classifications for the system design.
- (4) Applicants should discuss system reliability considerations. Discuss, including provisions incorporated in the design to ensure that the system will operate when needed and will deliver the required flow rates.
- (5) ~~Manual Actions. Applicants should discuss~~ all manual actions required by that an operator in order must take for the RCIC system to operate properly, assuming all components are operable. The discussion should identify any actions that are required to must be taken from outside the control room. Applicants should repeat this discussion for the most limiting single failure in the combined RCIC and HPSCS and high-pressure core spray system.

C.I.5.4.6.3 Performance Evaluation

Applicants should provide an evaluation of the ability of the RCIC system to perform its function. They should describe the analytical methods used; and clearly state all assumptions.

C.I.5.4.7 Residual Heat Removal System

~~The proposed pre-operational test program should be discussed. The discussion should verify test objectives, methods of testing, and test acceptance criteria.~~

C.I.5.4.7.1 Design Bases

Provide

C.I.5.4.7.1 Design Bases

Applicants should provide a summary description of the residual heat removal (RHR) system. The description should discuss the design bases, including the following 10 considerations:

- (1) Applicants should discuss design bases with respect to GDCs 2, GDC 4, GDC 5, GDC 19, "Control Room," and GDC 34.
- (2) Applicants should discuss functional design bases, including the time required to reduce the reactor coolant system (RCS) temperature to approximately 100 °C (212 °F); and to a temperature that would permit refueling. They should present the design-basis times for the case where the entire RHR system is operable, as well as the case with the most limiting single failure in the RHR system.
- (3) Applicants should discuss the design bases for the isolation of the RHR system from the RCS. The discussion should cover the isolation design bases, including any interlocks that are provided. Discuss, and the design bases regarding prevention of RHR pump damage in the event of closure of the isolation valves.
- (4) Applicants should discuss the design bases of the RHR system for the prevention of an interfacing systems loss-of-coolant accident (LSLOCA) LOCA.
- (5) Applicants should discuss the design bases for the pressure relief capacity of the RHR system. The discussion should include the design bases and considerations for limiting transients, equipment malfunctions, and possible operator errors during plant startup and cool-down/cool-down when the RHR system is not isolated from the RCS.
- (6) Applicants should discuss the design bases for reliability and operability requirements. They should describe the design bases regarding the manual actions required to operate the system with emphasis on any operations that cannot be performed from the control room in the event of a single failure. Describe The description should cover protection against single failure in terms of piping arrangement and layout, selection of valve types and locations, redundancy of various system components, redundancy of power supplies, and redundancy of instrumentation. Describe It should also include protection against valve motor flooding and spurious single failures.
- (7) Applicants should discuss the design bases established to protect the RHR system from physical damage. Discuss the The discussion should cover the design bases for the RHR system support structure and for protection against incidents and accidents that could render redundant components inoperative (e.g., fires, pipe whip, internally generated missiles, loss-of-coolant accident/LOCA loads, seismic events).
- (8) Applicants should discuss the design bases of the RHR system for shutdown and mid-loop operations.
- (9) Applicants should discuss the design bases of the RHR system relief valves for low-temperature over pressure/overpressure protection, if applicable.
- (10) For passive core cooling system PWR designs with the passive residual heat removal heat exchanger (PRHRHX) and the Since PWR designs might include active RHR systems s designated as a non-safety-related/nonsafety-related systems s for defense in-

depth defense-in-depth functions, applicants should provide an evaluation in accordance with the process of “regulatory treatment of non-safety systems” RTNSS to determine necessary regulatory oversight for the active RHR system.

C.I.5.4.7.2 System Design

~~(11) — Schematic Piping and Instrumentation Diagrams. Provide~~

Applicants should provide the following six pieces of information about RHR system design:

(1) Applicants should provide a description of the RHR system, including schematic piping and instrumentation diagrams showing all components, piping, points where connecting systems and subsystems tie together, and instrumentation and controls I&C associated with subsystem and component actuation. ~~Provide a~~ The description of should cover component interlocks. ~~P~~ Applicants should provide a mode diagram showing temperatures, pressures, and flow rates for each mode of RHR operation (~~for example, in a BWR e.g.,~~ the RCIC condensing mode).

~~(12) — Equipment and Component Descriptions. Describe in a BWR).~~

(2) Applicants should provide equipment and component descriptions that cover each component of the system. ~~†~~ The descriptions should identify the significant design parameters for each component. ~~S,~~ state the design pressure and temperature of components for various portions of the system, and explain the bases for their selection. ~~P~~ Applicants should provide pump characteristic curves and pump power requirements. ~~S~~ This information should specify the available and required net positive suction head for the RHR pumps. ~~D~~ Applicants should describe heat exchanger characteristics, including design flow rates, inlet and outlet temperatures for the cooling fluid and for the fluid being cooled, the overall heat transfer coefficient, and the heat transfer area. ~~†~~ They should identify each component of the RHR system that is also a portion of some other system ~~{~~ (e.g., the emergency core cooling system (ECCS)).

~~(13) — C~~

(3) Regarding control—S, applicants should state the RHR system relief valve capacity and settings; and ~~state~~ the method of collecting fluids discharged through the relief valve. ~~D~~ Applicants should describe provisions with respect to the control circuits for motor-operated isolation valves in the RHR system, including consideration of inadvertent actuation. ~~†~~ The description should include discussions of the controls and interlocks for these valves (e.g., intent of Institute of Electrical and Electronics Engineers (IEEE Std.) Standard 279-1971, “Criteria for Protection Systems for Nuclear Power Generating Stations”), considerations for automatic valve closure (e.g., RCS pressure exceeds design pressure of residual heat removal RHR system), valve position indications, and valve interlocks and alarms.

~~(14) — Applicable Codes and Classifications. Identify~~

(4) Applicants should identify the applicable industry codes and classifications for the system design.

~~(15) — System R~~

(5) Applicants should discuss system reliability ~~C~~considerations. ~~Discuss, including~~ provisions incorporated in the design to ensure that the system will operate when needed and will deliver the required flow rates (e.g., redundancy and separation of components and power sources).

~~(16) Manual Actions. D~~

(6) Applicants should discuss all manual actions ~~required to be taken by that~~ an operator ~~in order~~must take for the RHR system to operate properly with all components assumed to be operable. ~~†The discussion should identify any actions that are required to~~must be taken from outside the control room. ~~R~~Applicants should repeat this discussion for the most limiting single failure in the RHR system.

C.I.5.4.7.3 Performance Evaluation

~~P~~Applicants should provide an evaluation of the ability of the RHR system to reduce the temperature of reactor coolant at a rate consistent with the design basis (see Section C.I.5.4.7.1 of this guide).

~~D~~Applicants should describe the analytical methods used and clearly state all assumptions. P~~They should provide curves showing the reactor coolant temperature as a function of time for the~~two following cases:

- (1) ~~A~~All RHR system components are operable:
- (2) ~~†~~The most limiting single failure has occurred in the RHR system.

C.I.5.4.8 Reactor Water Cleanup System (BWRs only)

C.I.5.4.8.1 Design Bases

~~P~~Applicants should provide the design objectives and design criteria for the reactor water cleanup system (RWCS), in terms of (1) maintaining reactor water purity within the guidelines of Regulatory Guide 1.56, "Maintenance of Water Purity in Boiling-Water Reactors" the latest version in the EPRI report series, "BWR Water Chemistry Guidelines," (2) providing system isolation capabilities to maintain the integrity of the RCPB, and (3) precluding liquid poison removal when the poison is required for reactor shutdown. D~~Applicants should describe how~~they will implement the applicable requirements of 10 CFR Part 50 ~~will be implemented, and indicate~~by indicating the extent to which the recommendations of Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," and Regulatory Guide 1.29, "Seismic Design Classification," of RG 1.26 will be followed.

C.I.5.4.8.2 System Description

~~D~~Applicants should describe each component and its capacity. Indicate, indicating the processing routes and the expected and design flow rates. ~~Describe~~The description should cover the ~~instrumentation and controls~~I&C to (1) ~~isolate~~isolate the system to maintain the RCPB, (2) isolate the system in the event the liquid poison system is needed for reactor shutdown, and (3) monitor, control, and annunciate abnormal conditions concerning the system temperature and differential pressure across filter/demineralizer units and resin strainers. ~~†~~Applicants should indicate the means to be used for "holding"~~holding~~ filter/demineralizer beds

intact if system flow is reduced or lost. They should describe control features to prevent inadvertent opening of the filter/demineralizer backwash valves during normal operation. They should describe the resin transfer system and indicate the provisions to ensure that transfers are complete and that crud traps in transfer lines are eliminated. For systems using other than filter/demineralizer units, applicants should provide appropriate information. They should indicate the routing and termination points of system vents. Applicants should provide piping and instrumentation diagrams indicating system interconnections and seismic and quality group interfaces.

C.I.5.4.8.3 Performance Evaluation

Applicants should provide the design bases for the system capacity; and discuss the system's capability to maintain acceptable reactor water purity for normal operation, including anticipated operational occurrences AOO (e.g., reactor startup, shutdown refusing, condensate demineralizer breakthrough, and equipment downtime). They should indicate any reliance on other plant systems to meet the design objectives (e.g., liquid radwaste system). Applicants should present the design criteria for components and piping in terms of temperature, pressure, flow, or volume capacity. They should provide the seismic design and quality group classifications for components and piping. Applicants should discuss the capability of the non-regenerative heat exchanger to reduce the process temperature to a level low enough to be compatible with the cleanup demineralizer resins in the event that there is no flow return to the reactor system.

C.I.5.4.9 [Reserved]

C.I.5.4.10 [Reserved]

C.I.5.4.11 Pressurizer Relief Tank (PWRs only)

C.I.5.4.11.1 Design Bases

Applicants should describe the design bases for the pressurizer relief tank system, including provisions for compliance with GDC 2 (meeting comparing with the guidelines of Regulatory Guide RG 1.29, "Seismic Design Criteria") and GDC 4. Describe The description should cover the maximum step load and the consequent steam volume that the pressurizer relief tank must absorb; as well as the maximum heat input that the volume of water in the tank must absorb under any normal conditions or anticipated operational occurrences AOO. Include It should include information for (1) relief valve discharge to the tank; and (2) combined relief and safety valves discharge to the tank.

C.I.5.4.11.2 System Description

Applicants should provide a description of the system, including the tank, the piping connections from the tank to the loop seals of the pressurizer relief and safety valves, the relief tank spray system and associated piping, the nitrogen supply piping, and the piping from the tank to the cover gas analyzer and the reactor coolant drain tank. They should provide a piping and instrumentation diagram and a drawing of the pressurizer relief tank.

C.I.5.4.11.3 Performance Evaluation

Applicants should demonstrate that the system, including the tank, is designed to

handle the maximum heat load; and that the tank design pressure and temperature are adequate. They should present the results of a failure modes and effects analysis to demonstrate that the auxiliary systems serving the tank can meet the single-failure criterion without compromising safe plant shutdown. Applicants should identify the tank rupture disk and relief valve capacities; and show that their relief capacity is at least equal to the combined capacity of the pressurizer relief and safety valves.

C.I.5.4.11.4 Instrumentation

Applicants should discuss the instrumentation and controls for the pressurizer relief tank and associated piping.

C.I.5.4.12 Reactor Coolant System High Point Vents

C.I.5.4.12.1 Design Bases

Applicants should provide a summary of the reactor coolant system RCS high point vents system; and discuss the design bases and criteria. The summary should describe compliance with the provisions of 10 CFR 50.34(f)(2)(vi), 50.44, 50.46, 50.49, and 50.55a, and GDCs 1, 14, 17, 19, 30, 34, and 36; 10 CFR 50.44, "Combustible Gas Control for Nuclear Power Reactors," 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Nuclear Power Reactors," 10 CFR 50.49, 10 CFR 50.55a, GDC 1, GDC 14, "Reactor Coolant Pressure Boundary," GDC 17, "Electric Power Systems," GDC 19, GDC 30, "Quality of Reactor Coolant Pressure Boundary," GDC 34, and GDC 36, "Inspection of Emergency Core Cooling System."

C.I.5.4.12.2 System Design

Applicants should provide a description of the vent system, including its location, size, discharge capacity, functions, and discharge area(s) areas. They should provide piping and instrumentation diagrams showing all components, piping, and instrumentation and controls I&C. They should describe electrical power supplied from emergency buses. Describe and operability from the control room and system instrumentation. Applicants should identify information available to the operator for initiating and terminating system operation.

C.I.5.4.12.3 Performance Evaluation

Applicants should provide an evaluation of the vent system's capability to remove non-condensable gases from the primary coolant system with a minimal probability of inadvertent or spurious actuation. Evaluate The evaluation should cover vent system operation, including procedures that address (1) when venting is/is not needed, (2) the method to determine the size of a non-condensable bubble, (3) initial conditions for venting, (4) requisite instrumentation, and (5) operator actions.

C.I.5.4.13 [Reserved]

C.I.5.4.14 [Reserved]