Request for Additional Information No. 64 (994, 995, 996, 997), Revision 0

9/22/2008

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 05.03.01 - Reactor Vessel Materials
SRP Section: 05.03.02 - Pressure-Temperature Limits, Upper-Shelf Energy, and Pressurized Thermal Shock
SRP Section: 05.03.03 - Reactor Vessel Integrity
Application Section: FSAR Ch. 5
CIB1 Branch

Question 05.03.01-1:

Figure 5.1-2 “RCS Layout” indicates the principal dimensions of RCS components in relation to their surrounding structures. In order for the staff to evaluate reactor pressure vessel (RPV) functionality and ensure standardization of the vessel is achieved, the key RPV dimensions (e.g. thickness, height, width, and location of nozzles) should be provided in the FSAR.

Response to Question 05.03.01-1:

U.S. EPR FSAR Tier 2, Section 5.3.3.1 will be revised to include a statement making reference to a new, Table 5.3-7, for RPV design data. U.S. EPR FSAR Tier 2, Table 5.3-7 will be added and Figure 5.3-4 will be revised to include dimensions for vessel height, diameter, thickness and location of nozzles.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 5.3.3.1 and Figure 5.3-4 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR Tier 2, Table 5.3-7 will be added as described in the response and indicated on the enclosed markup.

Question 05.03.01-2:

The FSAR Section 5.3.1.2 states that the surfaces of the RPV that come into contact with the reactor coolant are clad in stainless steel or Ni-Cr-Fe alloy. However, Section 1.2.3.2.1 states the internal surface of the RPV is covered by stainless steel cladding for corrosion resistance. Clarify the material used for the vessel cladding. Also, provide the thickness of the cladding and describe the process for applying it.

Response to Question 05.03.01-2:

Low alloy steel surfaces of the reactor pressure vessel (RPV) in contact with reactor coolant are clad with either stainless steel or Ni-Cr-Fe alloy. U.S. EPR FSAR Tier 2, Sections 1.2.3.2.1, 5.3.1.1, and 5.3.1.2 will be revised to clarify the use of either stainless steel or Ni-Cr-Fe alloy. U.S. EPR FSAR Tier 2, Table 5.3.7 will be added to include the nominal vessel cladding thickness.

U.S. EPR FSAR Tier 2, Section 5.3.1.2 will also be revised to clarify that all cladding is deposited by weld metal overlay. As stated in U.S. EPR FSAR Tier 2, Section 5.2.3.3.2 (as referenced in Section 5.3.1.4), the welding is conducted utilizing procedures qualified to the rules of ASME Sections III and IX. Specifically, cladding of low alloy steel components with stainless steel is specified to conform to R.G. 1.43. In addition, the low alloy steel materials that require cladding are specified in Section 5.2.3.1 to be produced to a fine grain practice (grain size of 5 or finer) reducing susceptibility to potential underclad cracking.

FSAR Impact:

U.S. EPR FSAR Tier 2, Sections 1.2.3.2.1, 5.3.1.1, and 5.3.1.2 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR Tier 2, Table 5.3-7 will be added as described in the response and indicated on the enclosed markup.

Question 05.03.01-3:

Section 5.3.1.5 of the EPR FSAR states that the vessel fracture toughness data is calculated in accordance with RG 1.99, Revision 2. Use of the procedures in RG 1.99, Revision 2 is only valid for a nominal irradiation temperature of 550 degrees Fahrenheit. Irradiation below 525 degrees Fahrenheit produces greater embrittlement. Confirm in the FSAR that the operating temperature of the EPR RPV will be above 525 degrees Fahrenheit.

Response to Question 05.03.01-3:

Reactor coolant system (RCS) operating temperatures at best estimate conditions are provided in U.S. EPR FSAR Tier 2, Table 5.1-1 and exceed the 525˚F threshold value specified in RG 1.99, Revision 2.

FSAR Impact:

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

Question 05.03.01-4:

Section 5.3.1.6 of the FSAR discusses the RPV material surveillance program based on a 60-year design life. The program will use four specimen capsules. What is the basis for selecting four capsules? While this amount meets minimum requirements of ASTM E185-82, it may be beneficial to have additional capsules when applying for license extension in the future. Discuss the extent to which additional life extension was considered in selecting the number of capsules.

Response to Question 05.03.01-4:

The predicted transition temperature shift is 89°F for circumferential weld #2 per 10CFR50.61 at the RV inside surface at 60 EFPY using the limiting compositions of Cu and Ni contained in the weld and the highest initial RT_{NDT}. The requirements of ASTM E185-82 specify 3 capsules for the RVSP with a predicted transition temperature shift less than 100°F and the third capsule is not required to be tested. Therefore, with four capsules in the RVSP, two capsules could be used for license renewal extension considerations.

In addition to the four original capsules, sufficient material for four more capsules will be archived when the RPV is fabricated. Additional capsules can be fabricated and inserted when capsules are removed. With a lead factor of 1.6 (see response to RAI 64, Question 05.03.01-5 (a)), a new capsule which is inserted when the first one is removed will have a fluence at 60 years of plant operation equivalent to about 80 years of fluence on the RPV.

FSAR Impact:

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

Question 05.03.01-5:

(a) EPR FSAR Section 5.3.1.6 “Material Surveillance” does not discuss locations of capsules or lead factors. Discuss the locations and the associated lead factors of the surveillance capsules in the FSAR.

(b) Section 5.3.1.6 of the FSAR states that a COL applicant will identify the implementation milestones for the material surveillance program (listed as COL Information Item 5.3-1). The FSAR also states that the material surveillance program has been fully described. However, the staff needs additional information (e.g. capsule environment and capsule preparation) to evaluate the adequacy of a fully described surveillance capsule program. RG 1.206 states, “because the material surveillance program is an operational program, as discussed in SECY-05-0197, the [COL] applicant must describe the program and its implementation.” A full description of the material surveillance program should be provided prior to COL issuance. Any information that will not be included in the FSAR should be identified as COL action items.

Response to Question 05.03.01-5:

(a) U.S. EPR FSAR Tier 2, Section 5.3.1.6 will be modified to discuss the locations and the associated lead factors of the surveillance capsules. The discussion also includes specimen guide basket fabrication materials, attachment, and capsule position.

(b) The U.S. EPR FSAR Tier 2, Section 5.3.1.6 constitutes a fully described program as specified by the requirements of RG 1.206 C.I.5.3.1.6 and also requires the COL applicant to identify the implementation milestones for the material surveillance program.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 5.3.1.6 will be revised as described in the response and indicated in the enclosed markups.

Question 05.03.02-1:

FSAR Section 5.3.2 does not discuss how results of the RPV material surveillance capsule program are used in updating pressure-temperature (P/T) limits. In Section 5.3.2, discuss in detail the use of the material surveillance program in updating the P/T limits as applicable. Also, discuss the process of using the integrated surveillance capsule program, if applicable, in recalculating P/T limits.

Response to Question 05.03.02-1:

U.S. EPR FSAR Tier 2, Section 5.3.2.1 will be modified to state that testing of each surveillance capsule will be performed in accordance with 10 CFR 50 Appendix H. The material data will be evaluated using the guidance of RG 1.99. In addition, the P/T limits will be recalculated or the applicable EFPY will be adjusted, as necessary, to ensure that the 1/4T and 3/4T adjusted RT_{NDT} of the RPV based P/T limits is not exceeded. At this time, no integrated surveillance capsule program is proposed.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 5.3.2.1 will be revised as described in the response and indicated on the enclosed markup.

Question 05.03.02-2:

FSAR Section 5.3.2 discusses the development of pressure-temperature limits. Table 5.3-4 provided 1/4T and 3/4T adjusted RT_{NDT} values. However, the FSAR does not provide the projected fluence used in the calculation. Please provide the projected fluence used in the calculation of P-T limits in the FSAR. Also, describe the methodology used in developing the projected fluence values.

Response to Question 05.03.02-2:

Fluence attenuation through the reactor vessel (RV) wall to the 1/4T and 3/4T locations was performed per RG 1.99, Revision 2. FSAR Table 5.3-4 will be modified to show the fluence projections. The fluence attenuation to the 1/4T and 3/4T locations and the adjusted reference temperature (ART) values are calculated per RG 1.99, Revision 2. The fluence projection methodology at the inner wetted surface will be addressed in the response to Question 05.03.02-3.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section Section 5.3.2.1 and Table 5.3-4 will be revised as described in the response and indicated on the enclosed markup.

Question 05.03.02-3:

FSAR Section 5.3.2.3 discusses pressurized thermal shock (PTS) and provides the projected RT_{PTS} values for 60 EFPY. However, the FSAR does not provide the applicable projected fluence. Please provide in the FSAR the projected fluence used in the calculation of PTS and describe the methodology used.

Response to Question 05.03.02-3:

A response to this question will be provided by November 20, 2008.

Question 05.03.02-4:

FSAR Section 5.3.2.4 discusses upper-shelf energy (USE). Please describe in the FSAR the method used in projecting USE.

Response to Question 05.03.02-4:

Upper-shelf energy projections were performed per RG 1.99, Revision 2 as stated in U.S. EPR FSAR Tier 2, Section 5.3.1.5. The response to Question 05.03.02-2 provides a table to show the fluence used at the 1/4T location.

FSAR Impact:

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

Question 05.03.02-5:

Section 5.3.2 of the FSAR states that the COL applicant will provide a plant-specific Pressure Temperature Limits Report (PTLR). To enhance the level of standardization in the certification information, it would appear appropriate to provide the PTLR at the design certification stage rather than in each COL application. Discuss your rationale for not including the PTLR in the FSAR. Also, discuss how the adequacy of Technical Specification requirements for pressure-temperature limits can be assured at the design certification stage if generic P-T limits or a PTLR is not provided at the design certification stage.

Response to Question 05.03.02-5:

A response to this question will be provided by November 20, 2008.

Question 05.03.03-1:

Provisions for annealing the RPV provide assurance that fracture toughness properties can be restored to satisfy the fracture toughness requirements of GDC 31, if necessary. Describe in the FSAR the provisions that are in place for the EPR design if thermal annealing of the RPV should be necessary.

Response to Question 05.03.03-1:

Fracture toughness evaluations performed to date for thermal and radiation aging indicate that a thermal annealing of the vessel will not be necessary to maintain the required material properties over the life of plant or even into a license extension. Any instance arising during plant operation that would necessitate this action will be addressed by the licensee in accordance with 10 CFR 50.66.

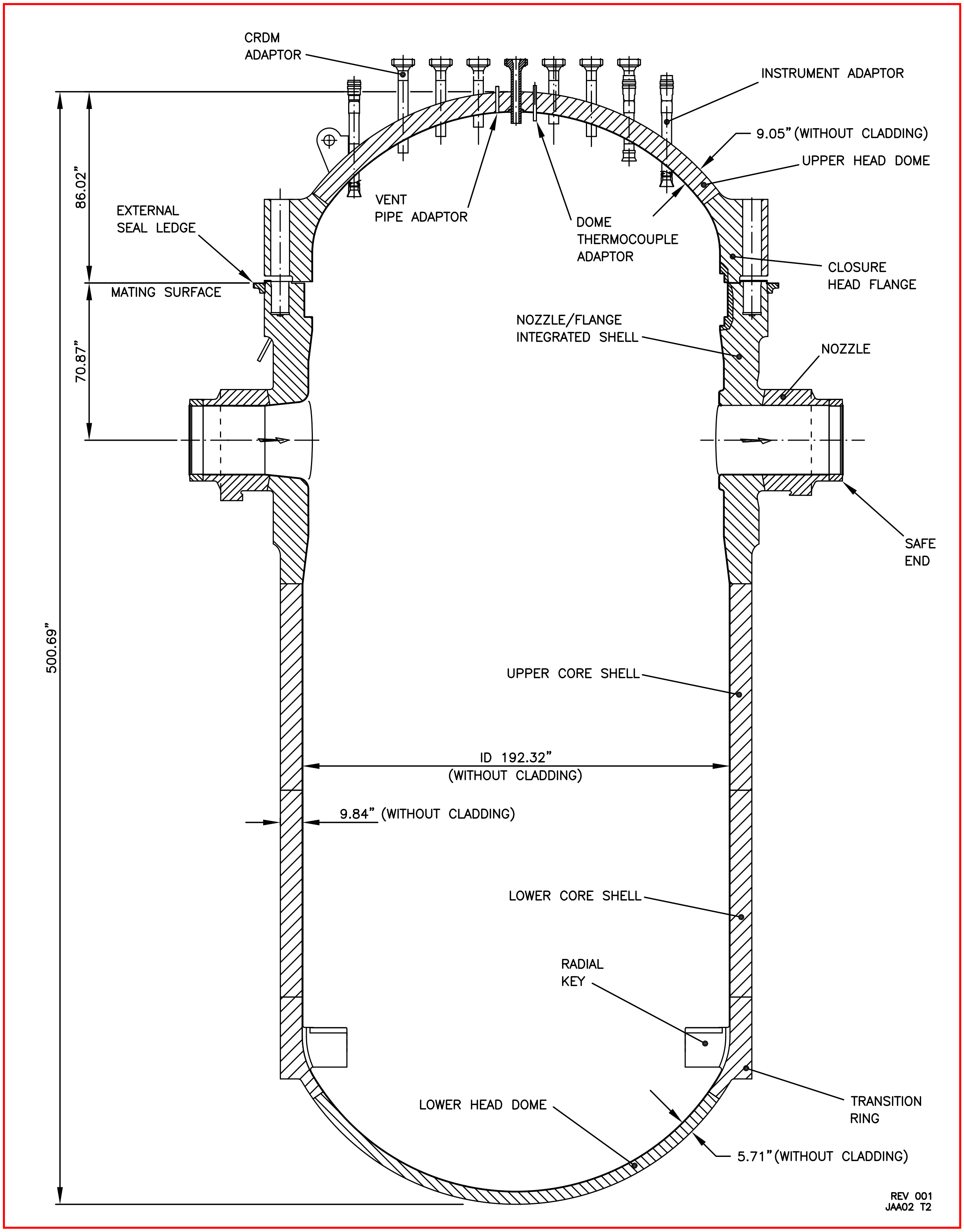
FSAR Impact:

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

U.S. EPR Final Safety Analysis Report Markups

05.03.01-1

Figure 5.3-4—Reactor Pressure Vessel



05.03.01-1

Table 5.3-7—Reactor Pressure Vessel Design Data

Parameter	Value
Design Pressure	2535 psig
Design Temperature	664°F
Vessel Overall Height (in)	500.69
Vessel Inside Diameter (in)	192.32
Vessel Shell Thickness (in)	9.84
Cladding Thickness, Nominal (in)	0.295

5.3.3 Reactor Vessel Integrity

5.3.3.1 Design

05.03.01-1

The RPV and closure head form the enclosure which contains the reactor core. The vessel holds the internals that support the fuel assemblies and that direct the reactor coolant flow through the reactor core. Eight nozzles provide inlet and outlet connections to the four reactor coolant system (RCS) loops. The RPV design data is given in Table 5.3-7—Reactor Pressure Vessel Design Data.

The closure head is attached to the RPV with a stud-nut-washer set. The joint between the RPV and the closure head is sealed by two seals located in concentric, circular recesses on the head flange. The closure head can be removed for refueling and vessel maintenance.

The control rod drive mechanisms (CRDM) are installed on top of the closure head. They are affixed to adaptors welded to the RPV head. Instrumentation adaptors are mounted to the vessel head via welded adapter penetrations to monitor the core temperature and neutron flux.

Section 5.3.1 identifies the regulations with which the RPV design complies, including GDC 1, GDC 14, GDC 30, GDC 31, GDC 32, 10 CFR 50.55a, 10 CFR 50.60 and 10 CFR Part 50, Appendix G. Component classifications are identified in Section 3.2.

radiological release limits in the event of an SSE or other hazard. Isolation of the building is provided if radioactivity is released inside the building. The interaction of the Radioactive Waste Processing Building with Seismic Category I structures is described in ~~Section 3.8.4~~ Section 3.7.2.

Ultimate Heat Sink Structure

Four division-related and independent mechanical draft cooling towers serve as the UHS for the U.S. EPR. Each division has an ESWS Pump Building located with the respective cooling tower structure. The UHS is arranged with two of the four divisions located on opposite sides of the Reactor Building. The UHS is described in Section 9.2.5. The design of the ESWS Pump Buildings is described in Section 3.8.4.

1.2.3.2 Reactor Coolant System

The RCS configuration is a conventional four-loop design. The RPV is located at the center of the Reactor Building and contains the fuel assemblies. The reactor coolant flows from the RPV through the hot leg pipes to the SGs and returns to the RPV via the cold leg pipes, which contain the RCPs. The PZR is connected to one hot leg via a surge line and to two cold legs by spray lines. The RCS is described in further detail in Chapter 5.

1.2.3.2.1 Reactor Pressure Vessel

05.03.01-2

The RPV is the main component of the RCS. The vessel is cylindrical, with a welded hemispherical bottom and a removable flanged hemispherical upper head with gasket. The RPV is made of low-alloy steel, with the internal surface covered by stainless steel or Ni-Cr-Fe alloy cladding for corrosion resistance. This unit is designed to provide the volume required to contain the reactor core, the control rods, the heavy reflector, and the supporting and flow-directing internals. The RPV nozzles are the fixed point of the RCS.

The RPV has four inlet nozzles and four outlet nozzles located in a horizontal plane just below the reactor vessel flange but above the top of the core. Coolant from the cold legs enters the vessel through the inlet nozzles and flows down through the annulus formed by the space between the core barrel and the reactor vessel inner wall. At the bottom of the vessel, the coolant is deflected to pass up through the core to the outlet nozzles. Heated reactor coolant leaves the RPV through four outlet nozzles, flowing into the hot legs and toward the SGs.

The cylindrical shell of the RPV consists of two sections, an upper and a lower part. To minimize the number of large welds, which require frequent in-service inspections, the upper part of the RPV is machined from a single forging and fabricated with eight nozzles. Because the nozzles are welded to an axis-symmetric ledge machined out from the forged flange shell, most of the reinforcement needed for the nozzle design is

5.3 Reactor Vessel

The reactor pressure vessel (RPV) and closure head form what is the enclosure that contains the reactor core. The RPV holds the internals that support the fuel assemblies and that direct the reactor coolant flow through the reactor core. Eight nozzles provide inlet and outlet connections to the four reactor coolant system (RCS) loops. The general design of the RPV is described in Section 5.3.3.1.

5.3.1 Reactor Vessel Materials

The RPV is part of the reactor coolant pressure boundary (RCPB) and is designed and constructed to meet the requirements for ASME Boiler and Pressure Vessel Code Section III (ASME Section III, Reference 1), Class 1 components, in accordance with 10 CFR 50.55(a). The RPV materials are selected, designed and constructed to minimize the probability of significant degradation or rapidly propagating fractures in the RPV (GDC 1, GDC 14 and GDC 30).

As addressed in Section 5.3.3.1, the RPV provides support for internal reactor components and is designed to accommodate the effects of environmental conditions associated with normal operations, maintenance, testing, postulated accidents and anticipated operational occurrences (AOO) as defined by GDC 4. Section 3.9 identifies the design transients for which the RPV is designed.

The RPV meets the fracture toughness requirements of 10 CFR Part 50, Appendix G and those associated with ASME Section III, Class 1 components (10 CFR 50.60). The ferritic materials provide sufficient margin to account for uncertainties associated with flaws and the effects of service and operating conditions, while allowing the vessel to behave in a non-brittle manner and minimizing the probability of rapidly propagating fracture (GDC 31).

An RPV material surveillance program monitors the RPV beltline materials for changes in fracture toughness resulting from exposure to neutron irradiation and the thermal environment (GDC 32). The program complies with 10 CFR Part 50, Appendix H, as described in Section 5.3.1.6 (10 CFR 50.60).

Material cleaning control for the RPV conforms to RG 1.37 and meets the quality assurance requirements of 10 CFR Part 50, Appendix B, Criterion XIII.

5.3.1.1 Material Specifications

05.03.01-2

The RPV is made of low-alloy steel due to its mechanical and physical properties, toughness, availability in the required sizes and thicknesses, satisfactory prior service in neutron fields, fabricability, and weldability. The low-alloy steel is also compatible with the stainless steel and Ni-Cr-Fe alloy cladding used for corrosion resistance. The austenitic stainless steels and non-ferrous materials used for RPV appurtenances are used for their corrosion resistance, acceptable mechanical properties, and fabricability. The RPV surfaces normally in contact with the reactor coolant are either austenitic stainless steel or Ni-Cr-Fe alloy. A listing of material specifications for the RPV and its appurtenances is provided in Table 5.3-1—Reactor Pressure Vessel Material Specifications andTable 5.3-2—Reactor Pressure Vessel Weld Material Specifications. The RPV materials meet the requirements of the ASME Section III and comply with fracture toughness requirements of 10 CFR Part 50, Appendix G as addressed in Section 5.3.1.5.

The shell forgings of the RPV beltline are restricted to the maximum composition limits shown in Table 5.3-3—Maximum Limits for RPV and Appurtenances Material Composition. The phosphorous, nickel, and copper content is limited to reduce sensitivity to radiation embrittlement of the vessel. The weld filler metals used in the beltline region of the RPV are restricted to the limits shown in Table 5.3-3.

Stainless steel normally in contact with the reactor coolant has a maximum cobalt content of 0.05 wt percent. Stainless steel base and weld filler materials have a limited carbon content not exceeding 0.03 wt percent and are supplied in accordance with RG 1.44. Stainless steel base and weld filler metal in contact with the reactor coolant has a limited sulfur content, as shown in Table 5.3-3.

The Ni-Cr-Fe Alloy 600 base metal and Alloy 82/182 weld filler metal are not used in Ni-Cr-Fe applications. Alloy 690 base metal and Alloy 52/52M/152 weld filler metal are used in Ni-Cr-Fe applications. The Ni-Cr-Fe base metal in contact with the reactor coolant has a limited sulfur content not exceeding 0.02 percent.

5.3.1.2 Special Processes Used for Manufacturing and Fabrication

05.03.01-2

The RPV is a vertically mounted cylindrical vessel consisting of forged shells, heads, and nozzles joined by circumferential welds. The surfaces of the RPV low alloy steel that come into contact with the reactor coolant are clad in stainless steel or Ni-Cr-Fe alloy using weld metal overlay. The design of the RPV is addressed in Section 5.3.3.

The RPV is fabricated in accordance with ASME Section III, NB-4000 and RPV materials comply with the requirements of ASME Section III, NB-2000.

5.3.1.3 Special Methods for Nondestructive Examination

The non-destructive examination (NDE) of the RPV and its appurtenances is conducted in accordance with ASME Section III requirements. Full penetration weld preparations for pressure retaining materials are examined in accordance with ASME Section III, NB-5130, prior to welding.

The cladding on the sealing surfaces and load-bearing surfaces of the RPV flange and the closure head flange are ultrasonically examined for the complete volume for both

05.03.02-2

Table 5.3-4—~~End of Life RTNDT, RTPTS, and Upper Shelf Energy Projections~~60 EFPY RPV Fluence, Upper Shelf Energy, ART, and RT_{NDT} Projections

Material	Inner Wetted Surface Peak Fluence (n/cm^2) E<1MeV	1/4T Peak Fluence (n/cm^2) E<1MeV	3/4T Peak Fluence (n/cm^2) E<1MeV	Initial CV USE (ft-lbs)	Predicted EOL CV USE[1] (ft-lbs)	Initial RTNDT (°F)	1/4T Adjusted RTNDT[1] (°F)	3/4T Adjusted RTNDT[1] (°F)	RTPTS[1] (°F)	Screening Criteria (°F)
Nozzle shell	2.1E+17	1.1E+17	3.4E+16	75	66	-4	8.0	1.2	14.0	270
Upper core shell	1.4E+19	7.3E+18	2.2E+18	75	64	-4	63.4	40.2	70.3	270
Lower core shell	1.4E+19	7.3E+18	2.2E+18	75	64	-4	63.4	40.2	70.3	270
Transition ring	4.4E+18	2.3E+18	7.1E+17	75	66	-4	57.8	32.0	69.4	270
Weld #1	2.1E+17	1.1E+17	3.4E+16	75	66	-4	15.4	4.2	24.8	300
Weld #2	1.4E+19	7.2E+18	2.2E+18	75	61	-4	126.5	93.4	141.1	300
Weld #3	4.4E+18	2.3E+18	7.1E_17	75	64	-4	95.4	53.8	115.3	300

Notes:

1. These values are conservatively estimated at 60 EFPY.

05.03.01-5

~~The capsules are located in guide baskets bolted to the outside of the core barrel and positioned directly opposite the center portion of the core, as shown in Figure 5.3-3—Major Weld Locations on the RPV. The specimen guide baskets are fabricated of ASME SA-240 Type 304LN steel. A plug in the RPV upper internals provides the ability to remove the capsules when the vessel closure head is removed.~~

The specimen capsules are confined in rigid specimen guide baskets. The specimen guide baskets are attached with austenitic stainless steel bolts to the outside of the core barrel in the down-comer region at the mid elevation of the core, as shown in Figure 5.3-3—Major Weld Locations on the Reactor Pressure Vessel. The specimen guide baskets are fabricated from ASME SA-240 Type 304 steel carbon <0.03% and are located at 7 and 187 degrees from the main axis of the vessel. Each of the two guide baskets provides two capsule irradiation positions, one on either side of the 7 and 187 degree locations, for a total of four capsule irradiation locations. A plug in the RPV upper internals provides the ability to remove the capsules when the vessel closure head is removed.

The specimen capsules are fabricated from a corrosion resistant material. The specimens are placed in the capsules with spacers to promote heat transfer to the surrounding coolant and backfilled with an inert gas to protect against specimen oxidation. The projected capsule lead factors are as follows and are the same for all irradiation locations:

- Ferritic/clad interface - 1.6.
- 1/4T RV location - 2.9.

The RPV material samples experience higher neutron fluence than the RPV because of their closer proximity to the reactor core. Thus, changes in the material properties of the samples will precede changes in the RPV material properties. Periodically, these capsules are withdrawn and the material samples are tested to measure the mechanical property changes. Data from the tested material samples are used to predict the material property changes to the RPV. The specimen evaluations include pre-irradiation and post-irradiation testing of Charpy V-notch, tensile and 1/2t (thickness) compact tension (CT) fracture mechanics specimens.

The materials selected for the reactor vessel surveillance program are those that are adjacent to the active height of the core. Using the maximum initial nil-ductility reference temperature (RT_{NDT}) values, maximum nickel and copper contents allowed in the RPV and a 60 effective full power year (EFPY) fluence, the limiting RPV beltline material for the U.S. EPR is predicted to be Weld #2, as shown in Figure 5.3-3. This prediction was made in accordance with 10 CFR 50.61. Based on the predictions of the most susceptible materials and on the requirements of ASTM E-185-82 and

05.03.02-1

Testing of each surveillance capsule will be performed in accordance with 10 CFR 50, Appendix H. The material data will be evaluated using the guidance of RG 1.99. The P/T limits will be recalculated or the applicable EFPY will be adjusted, as necessary, to confirm that the 1/4T and 3/4T adjusted RT_{NDT} of the RPV based P/T limits is not exceeded. The initial RT_{NDT}, final predicted RT_{NDT} or adjusted reference temperature (ART), and the copper and nickel contents for materials in the RPV beltline are provided in Table 5.3-3 and Table 5.3-4. The fluence attenuation to the 1/4T and 3/4T locations and the ART values are calculated per RG 1.99, Revision 2.

Generic heatup and cooldown curves are provided in Figure 5.3-1—Reactor Coolant System Heatup Pressure-Temperature Curve and Figure 5.3-2—Reactor Coolant System Cooldown Pressure-Temperature Curve. A COL applicant that references the U.S. EPR design certification will provide a plant-specific pressure and temperature limits report (PTLR), consistent with an approved methodology.

5.3.2.2 Operating Procedures

Plant operating procedures provide reasonable assurance that the P-T limits identified in Section 5.3.2.1 will not be exceeded during conditions of normal operation, AOOs and system hydrostatic tests. The transient conditions considered in the design of the RPV, as presented in Section 3.9.1.1, are representative of the operating conditions considered to occur during plant operation. The selected transients form a conservative basis for evaluation of the RCS and do not result in pressure-temperature changes that exceed the heatup and cooldown rate limits used in the development of the Pressure-Temperature Limit curves of Section 5.3.2.1

5.3.2.3 Pressurized Thermal Shock

The RPV design provides protection against unstable crack growth under faulted conditions. A safety injection actuation following an emergency or faulted event produces relatively high thermal stresses in regions of the RPV contacting the cooler water from the safety injection system. Consideration is given to these areas, including the beltline region and the RPV nozzles, which provide reasonable assurance of RPV integrity under these postulated transients.

An analysis was performed to determine the RPV pressurized thermal shock reference temperatures (RT_{PTS}) applicable to 60 EFPY. The RT_{PTS} values were conservatively calculated for various RPV materials over 60 EFPY with the most limiting core design. These values, calculated in accordance with 10 CFR 50.61 and presented in Table 5.3-4, do not exceed the screening criteria.