Tier 1 Subsection 2.1.3; Tables 2.1.3-1, 2.1.3-2, 2.1.3-3, and 2.1.3-4; and Figure 2.1.3-3

Reactor System

Tier 2 Tables 1.3-1 and 5.3-5; Subsections 5.3.1.2 and 5.3.4.1; and Figures 5.3-1 and 5.3-6

Reactor Vessel

Description of Change

Correct various tag numbers in the tables and make minor editorial corrections. Provide a precise reference for an ITAAC item in Tier 1 Table 2.1.3-2.

Technical Justification

The changes to GRCA tag numbers are corrections of the tag numbers. The change to Table 2.1.3-2 item 7 is to clarify the first unit testing. The change to Tier 1 Table 2.1.3-2 item 9 is to provide a precise reference for an ITAAC item. The change to vessel diameter is due to progress in detail design and supporting analysis. The changes to the reactor vessel do not have an adverse effect on the neutron fluence at the vessel wall or on the reactor vessel pressure temperature curves. The curves previously calculated are conservative compared to ones calculated using the increased vessel wall thickness and larger vessel diameter. Editorial changes are self-evident.

Regulatory Consequence

These changes have no effect on design function. These changes have no effect on analysis or analysis method. These changes will not affect the FSER conclusions. These corrections represent changes in Tier 1 material. The changes in the ITAAC for internals flow and vibration testing are consistent with the writeup in the FSER.

Change Markup

~~**principal**~~ **Tier 1 Table 2.1.3-1** Revise footnote 1 in Tier 1 Table 2.1.3-1 (on the first two pages) as follows:

1. Fuel assemblies are designed using ASME Section III as a general guide.~~Manufacture standard, but uses ASME Section III guidelines~~

Tier 1 Table 2.1.3-1 Revise the second entry of "Tag No." in Tier 1 Table 2.1.3-1 as follows:

Table 2.1.3-1

Equipment Name	Tag No.	ASME Code Section III Classification	Seismic Cat. I	Class 1E/ Qual. for Harsh Envir.	Safety-Related Display
RV	RXS-MV-01	Yes	Yes	-	-
Reactor Upper Internals Assembly	RXS-MI-01	Yes	Yes	-	-
Reactor Lower Internals Assembly	RXS-MI-02	Yes	Yes	-	-

Revise the second entry (on the second page of the table) in Tier 1 Table 2.1.3-1 as follows:

Table 2.1.3-1 (cont.)

Equipment Name	Tag No.	ASME Code Section III Classification	Seismic Cat. I	Class 1E/ Qual. for Harsh Envir.	Safety-Related Display
Gra~~e~~y Rod Control Assemblies (GRCAs) (16 locations)	RXS-FG-B08/D04/D12/F06/F08/F10/H02/H06/H10/H14/K06/K08/K10/M04/M12/P08~~A07/C03/C11/E05/E07/E09/G01/G05/ G09/G13/J05/J07/J09/L03/L11/N07~~	No(1)	Yes	-	-

Tier 1 Table 2.1.3-2 Revise items 7, 9.c), and 13 in Tier 1 Table 2.1.3-2 as follows:

Table 2.1.3-2 Inspections, Tests, Analysis, and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analysis**	**Acceptance Criteria**
7. The reactor internals will withstand the effects of flow induced vibration.	i) A vibration type test will be conducted on the (first unit) reactor internals representative of AP1000.	i) A report exists and concludes that the ~~prototype~~ (first unit) reactor internals have no observable damage or loose parts as a result of the vibration type test.
	ii) A pre-test inspection, a flow test and a post-test inspection will be conducted on the ~~first~~ as-built reactor internals.	ii) The ~~first~~ as-built reactor internals have no observable damage or loose parts.
9.c) Separation is provided between RXS Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	See Tier 1 Material, Table 3.3-6, item 7.d.~~Section 3.3, Nuclear Island Buildings.~~	See Tier 1 Material, Table 3.3-6, item 7.d. ~~Section 3.3, Nuclear Island Buildings.~~
13. The fuel assemblies and rod control cluster assemblies intended for initial core load and listed in Table 2.1.3-1 have been designed and constructed in accordance with the established~~principal~~ design requirements.	An analysis is performed of the reactor core design.	A report exists and concludes that the fuel assemblies and rod cluster control rod assemblies intended for the initial core load and listed in Table 2.1.3-1 have been designed and constructed in accordance with the principal design requirements.

Tier 1 Table 2.1.3-3 Revise the second and sixth entries in Tier 1 Table 2.1.3-3 as follows:

Table 2.1.3-3 (cont.)		
Component Name	**Tag No.**	**Component Location**
Reactor Upper Internals Assembly	RXS-MI-01	Containment
Graey Rod Control Assemblies (GRCAs) (16 locations)	RXS-FG-B08/D04/D12/F06/F08/F10/H02/H06/H10/H14/K06/K08/K10/M04/M12/P08~~A07/C03/C11/E05/E07/E09/G01/G05/G09/G13/J05/J07/L03/L11/N07~~	Containment

Tier 1 Table 2.1.3-4 Revise the first two entries in Tier 1 Table 2.1.3-4 as follows:

Table 2.1.3-4
Key Dimensions and Acceptable Variations of the Reactor Vessel and Internals
(Figure 2.1.3.2 and Figure 2.1.3-3)

Description	Dimension or Elevation (inches)	Nominal Value (inches)	Acceptable Variation (inches)
RV inside diameter at beltline (inside cladding)	A	159.7.0	+1.0/-1.0
RV wall thickness at beltline (without cladding)	B	8.48.0	+1.0/-0.12

Tier 1 Figure 2.1.3-3 Revise Tier 1 Figure 2.1.3-3 as shown on the next page.

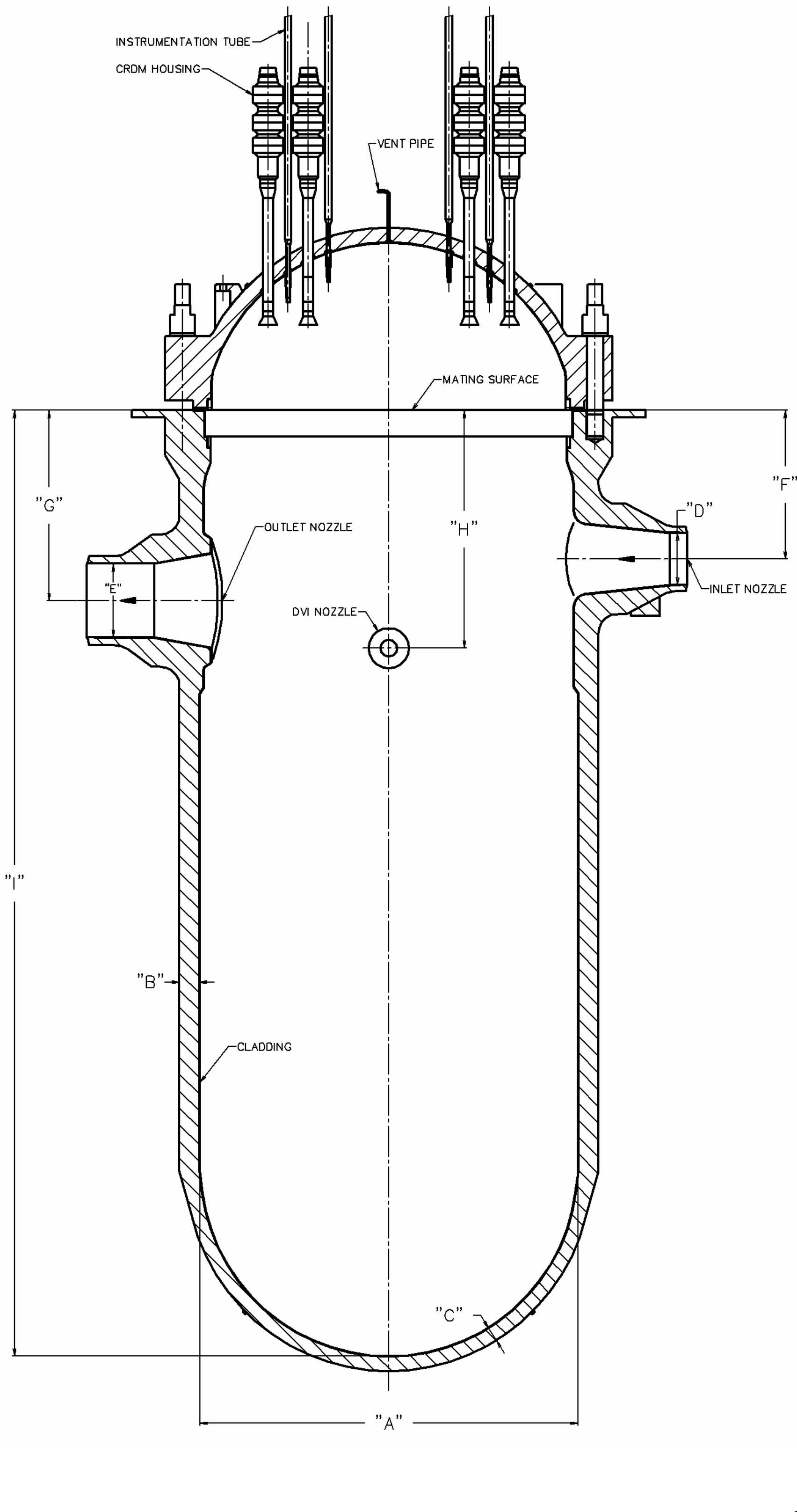

Figure 2.1.3-3
Reactor Vessel Arrangement

Tier 2 Tables 1.3-1 and 5.3-5; Subsections 5.3.1.2 and 5.3.4.1; and Figures 5.3-1 and 5.3-6 Reactor Vessel

Description of Change

Update the description of the reactor vessel to reflect current fabrication techniques and the final design configuration.

Technical Justification

Most of the changes reflect current fabrication practices; for example, a one-piece forged reactor vessel head is the standard replacement head configuration. The increase in vessel inside diameter in the core region by 2 inches helps to decrease the fluence on the vessel. The decrease in the vessel wall thickness near the nozzles makes welding the nozzles easier, and the resulting wall thickness is the same as in the Westinghouse Standard 3XL reactor vessels.

Regulatory Consequence

This change does not have an adverse effect on the design function of the reactor vessel or acceptance criteria for the pressure boundary. The changes in fabrication practices have no regulatory effect. Evaluations have shown that the changes to the reactor vessel dimensions have an insignificant effect on the safety analyses. This change does not require a change in analysis methodology for the steam generator. This change does not affect the conclusions of the FSER. This change is consistent with proposed changes in Tier 1 information.

Change Markup

Table 1.3-1 Revise the vessel inside diameter entry in Table 1.3-1, sheet 2 of 6, as follows:

Table 1.3-1 (Sheet 2 of 6)

AP1000 PLANT COMPARISON WITH SIMILAR FACILITIES

Systems – Components	DCD	AP1000	AP600	Reference 2 Loop
Reactor Vessel	5.3			
Vessel ID		~~157~~ 159 in	157 in	172 in
Construction		forged rings	forged rings	welded plate
Number hot leg nozzles		2	2	2
- ID		31.0 in	31.0 in	42 in
Number cold leg nozzles		4	4	4
- ID		22.0 in	22.0 in	30 in
Number safety injection nozzles		2	2	0

Revise the first, third, and sixth paragraphs of subsection 5.3.1.2 as follows:

5.3.1.2 Safety Description

The reactor vessel consists of a cylindrical section with a transition ring, hemispherical bottom head, and a removable flanged hemispherical upper head (Figure 5.3-1). Key dimensions are shown in Figures 5.3-5 and 5.3-6. The cylindrical section consists of two shells, the upper shell and the lower shell. The upper and lower shells and the lower hemispherical head are fabricated from low alloy steel and clad with austenitic stainless steel. The upper shell forging is welded to the lower shell forging and the lower shell is welded to the transition ring, which is welded to the hemispherical bottom head. The removable flanged hemispherical upper head consists of ~~two sections,~~a single forging, which includes the closure head flange and the closure head dome. The closure head ~~flange and dome are~~is fabricated from a low alloy steel forging ~~and plate respectively,~~ and clad with austenitic stainless steel. Specifics of the processes used in base materials, clad material, and weld materials are discussed in subsection 5.2.3. The removable flanged hemispherical closure head is attached to the vessel (consisting of the upper shell-lower shell-bottom hemispherical head) by studs. Two metal o-rings are used for sealing the two assemblies. Inner and outer monitor tubes are provided through the upper shell to collect any leakage past the o-rings. Details of the head gasket monitoring connections are included in subsection 5.2.5.2.1.

Four core support pads are ~~welded to~~located on the bottom hemispherical head just below the ~~bottom hemispherical head~~transition ring-to-lower shell circumferential weld. The core support pads function as a clevis. At assembly, as the lower internals are lowered into the vessel, the keys at the bottom of the lower internals engage the clevis in the axial direction. With this design, the internals are provided with a lateral support at the furthest extremity and may be viewed as a beam supported at the top and bottom.

There are 69 penetrations in the removable flanged hemispherical head (closure head) that are used to provide access for the control rod drive mechanisms. Each control rod drive mechanism is positioned in its opening and welded to the closure head penetration. In addition there are 42 penetrations in the closure head used to provide access for in-core and core exit instrumentation. A tube is inserted into each of the 42 penetrations and is welded ~~to the closure head penetration~~into place.

Revise the first five paragraphs of subsection 5.3.4.1 as follows:

5.3.4.1 Design

The reactor vessel is the high pressure containment boundary used to support and enclose the reactor core. It provides flow direction with the reactor internals through the core and maintains a volume of coolant around the core. The vessel is cylindrical, with a transition ring, hemispherical bottom head, and removable flanged hemispherical upper head. The vessel is fabricated by welding together the lower head, the transition ring, the lower shell and the upper shell. The upper shell contains the penetrations from the inlet and outlet nozzles and direct vessel injection nozzles. The closure head is fabricated with a head dome and bolting flange. The upper head has penetrations for the control rod drive mechanisms, the incore instrumentation, head vent, and support lugs for the integrated head package.

The reactor vessel (including closure head) is approximately 40 feet long and has an inner diameter at the core region of ~~157~~ 159 inches. The total weight of the vessel (including closure head and CRDMs) is approximately 417 tons. Surfaces which can become wetted during operation and refueling are clad to a nominal 0.22 inches of thickness with stainless steel welded overlay which includes the upper shell top surface but not the stud holes. The AP1000 reactor vessel's design objective is to withstand the design environment of 2500 psi and 650°F for 60 years. The major factor affecting vessel life is radiation degradation of the lower shell.

As a safety precaution, there are no penetrations below the top of the core. This eliminates the possibility of a loss of coolant accident by leakage from the reactor vessel which could allow the core to be uncovered. The core is positioned as low as possible in the vessel to limit reflood time in an accident. The main radial support system of the lower end of the reactor internals is accomplished by key and keyway joints to the vessel wall. At equally spaced points around the circumference, a clevis block is ~~welded to~~located on the reactor vessel inner diameter. A permanent cavity liner seal ring is attached to the top of the vessel shell for welding to the refueling cavity liner. To decrease outage time during refueling, access to the stud holes is provided to allow stud hole plugging with the head in place. ~~The flange is designed to interface properly with a multiple stud tensioner device.~~ By the use of a ring forging with an integral flange, the number of welds is minimized to decrease inservice inspection time.

The lower head has an approximate 6.5 feet inner spherical radius. The lower radial supports are ~~attached to~~located on the head at the elevation of the lower internals lower core support plate. The ~~lower head~~transition ring is welded to the lower shell course with the weld located outside the high~~er~~ fluence active core region. The lower shell is a ring forging about eight inches thick with an inner diameter of ~~157~~ 159 inches. The length of the shell is greater than 168 inches to place the upper shell weld outside of the active fuel region. The upper shell is a large ring forging. Included in this forging are four 22-inch inner diameter inlet nozzles, two 31-inch inner diameter outlet nozzles and two 6.81-inch inner diameter direct vessel injection nozzles (8-inch schedule 160 pipe connections). These nozzles are forged into the ring or are fabricated by "set in" construction. The inlet and outlet nozzles are offset axially in different planes by 17.5 inches. The injection nozzles are 100 inches down from the main flange and the outlet nozzles are 80 inches down and the inlet nozzles are 62.5 inches below the mating surface.

The closure head has a 77.5-inch inner spherical radius and a 188.0-inch O.D. outer flange. Cladding is extended across the bottom of the flange for refueling purposes. Forty-five, seven-inch diameter studs attach the head to the lower vessel and two metal o-rings are used for sealing. The upper head has sixty-nine 4-inch outer diameter penetrations for the control rod drive mechanism housings and forty-two~~, 1.5-inch O.D.~~ penetrations for the incore instrumentation tubes.

Table 5.3-5 Revise the 8th, 9th, and 12th entries in Table 5.3-5 as follows:

Table 5.3-5 **REACTOR VESSEL DESIGN PARAMETERS**	
(approximate values)	
Outside diameter at shell (in.)	~~173~~176
Inside diameter at shell (in.)	~~157~~159
Clad thickness, ~~minimum~~ nominal (in.)	0.22

Figures 5.3-1 and 5.3-6 Revise Figures 5.3-1 and 5.3-6 as shown on the following pages.

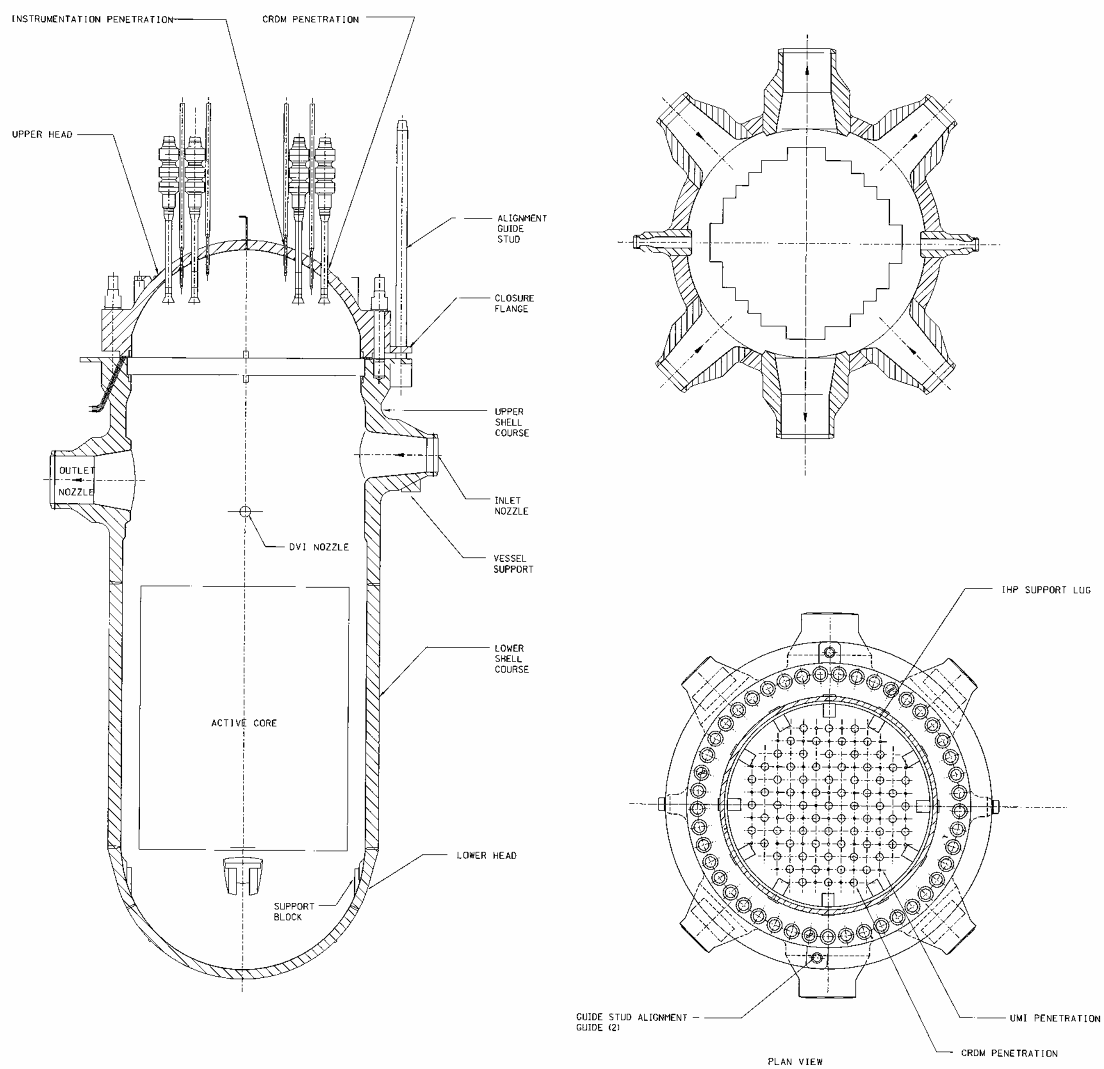

Figure 5.3-1

Reactor Vessel

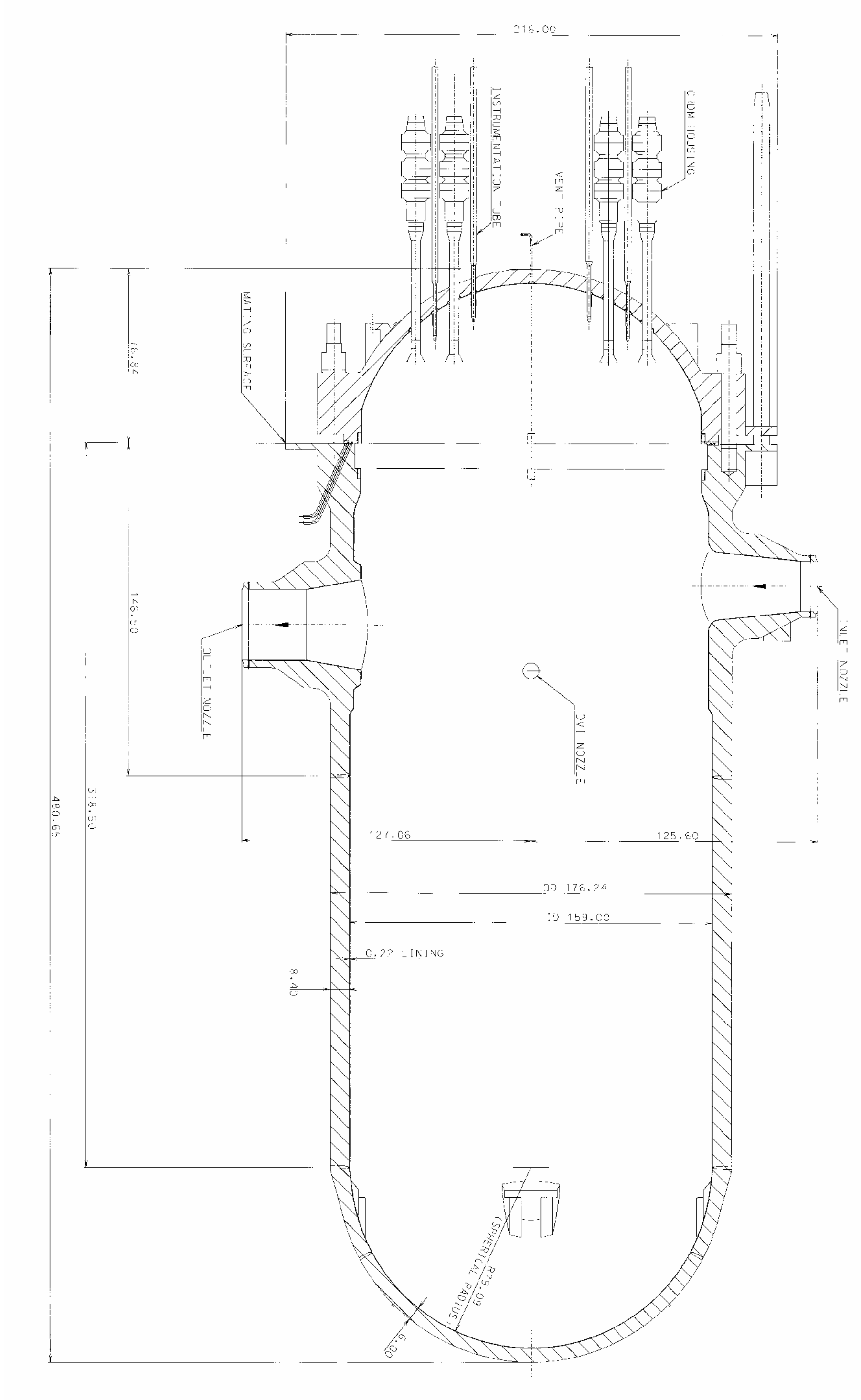

Figure 5.3-6

Reactor Vessel Key Dimensions, Side View