KHNP Response to Issues - DCD Section 3.9.5

Issue #1

As stated in SRP Section 3.9.5, GDC 1 and 10 CFR 50.55a require that reactor internals be designed to quality standards commensurate with the importance of the safety functions performed. Additional information is necessary for the staff to make its findings associated with these regulations and, more specifically, with SRP acceptance criterion 3 in SRP Section 3.9.5 on design criteria and loading conditions.

DCD Tier 2, Section 3.9.5.1 states that the hold down spring is classified as an internal structure. DCD Tier 2, Section 3.9.5 states that core support structures are those structures or parts of structures which are designed to provide direct support or restraint of the core within the reactor vessel. DCD Tier 2, Section 3.9.5.1.2 provides a description of the Upper Guide Structure (UGS) assembly and states that the UGS support barrel consists of a right circular cylinder welder to a ring flange at the upper end and to a circular plate at the lower end. It further states that the flange, which is the supporting member for the entire UGS assembly, seats on its upper side against the reactor vessel head during operation. The lower side of the flange is supported by the hold down ring, which rests on the core support barrel upper flange.

Based on the information provided in the DCD, it is unclear why the hold down ring is classified as an internal structure instead of a core support structure, since it provides direct support of the UGS assembly, which is a core support structure according to DCD Tier 2, Section 3.9.5.1. Therefore, the applicant is requested to provide justification of its current classification or revise the DCD to change the classification.

In addition, the applicant is requested to explain the potential loss of preload of the hold down ring due to stress relaxation during all service and accident conditions and its potential effect on the functional and structural integrity of the core support barrel assembly and the upper guide structure assembly.

Response

The hold down ring provides axial force on the flanges of the UGS assembly and the core support barrel assembly in order to prevent movement of the structures under hydraulic forces. The hold down ring is designed to accommodate the differential thermal expansion between the reactor vessel and the reactor internals in the vessel ledge region. The UGS assembly and core support barrel assembly including hold down ring are supported on the reactor vessel ledge. Therefore, the hold down ring is classified as an internal structure since it is not a major component which provides direct support or restraint of the core within the reactor vessel.

Loss of preload may occur due to loss of deflection of the hold down ring as a result of wear on contact surface and stress relaxation during operation. This loss of preload will decrease an axial load on the core support barrel and UGS flange surface and then induce relative motion between the core support barrel and UGS flanges under service and accident loadings. Considering the loss of preload, the hold down ring is designed to have enough preload to prevent relative motion of reactor internal components. The function of hold down ring is inspected via the CVAP (Comprehensive Vibration Assessment Program) and visual inspection results have showed no relative motion of reactor internal components.

Impact on DCD
There is no impact on the DCD.

Impact on PRA
There is no impact on the PRA.

Impact on Technical Specifications
There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports
There is no impact on any Technical, Topical or Environmental Reports.

Issue #2

GDC 1 and 10 CFR 50.55a require that reactor internals be designed to quality standards commensurate with the importance of the safety functions performed. Item 1 under “Areas of Review” in SRP Section 3.9.5 includes the physical and design arrangements of all reactor internals structures, components, assemblies, and systems, including the positioning and securing of such items within the reactor pressure vessel (RPV), the provision for axial and lateral retention and support of the internals assemblies and components, and the accommodation of dimensional changes due to thermal and other effects. Additional information is needed for the staff to make its finding under this area of review.

DCD Tier 2, Section 3.9.5.1.1 provides a general description of the core support barrel assembly. The core support barrel assembly is supported at its upper end by the upper flange of the core support barrel, which rests on a ledge in the reactor vessel. Alignment is accomplished in the reactor vessel ledge and closure head. The lower flange of the core support barrel supports, secures, and positions the lower support structure and is attached to the lower support structure by means of a welded flexural connection. The lower support structure provides support for the core by means of support beams that transmit the load to the core support barrel lower flange.

Based on the information provided in DCD Tier 2, Section 3.9.5.1.1 and Figure 3.9-9, it is not clear to the staff the configuration and geometry of either the lower flange of the core support barrel or the core support barrel welded flexural connection to the lower support structure. In addition, DCD Tier 2, Section 3.9.5.1.1 states that the core support barrel assembly is supported at its upper flange on the reactor vessel ledge. However, since the core support barrel lower flange is attached to the lower support structure by means of a welded flexural connection, it is unclear to the staff exactly which component(s) support the weight of the core and how much of the core support barrel and the core is supported at the reactor vessel ledge. DCD Tier 2, Section 3.9.5.1.1 also indicates that the lower support structure assembly is the primary component that supports the weight of the core, and Figure 3.9-8 shows that the lower support structure assembly rests on the clevis at the bottom of the reactor vessel. Therefore, the applicant is requested to provide the above clarification in the form of a more detailed description and drawings.

Response

The configuration and geometry of the core support barrel welded flexural connection to the lower support structure are shown in Figure 2-1. The lower flange of the core support barrel is attached to the lower end of the lower support structure cylinder by a welded flexural connection. The inside part in the lower end of the lower support structure cylinder is welded circumferentially to the flexure part in the lower flange top of the core support barrel. The outside part of the lower end of the lower support structure cylinder just slides on the inside surface of the lower flange top of the core support barrel to accommodate the differential thermal expansion between the lower support structure and the core support barrel. As shown in Detail A of Figure 2-1, the bottom portion of the lower support structure cylinder moves on the top surface of the core support barrel lower flange in the radial direction only, but is restricted in the axial direction.

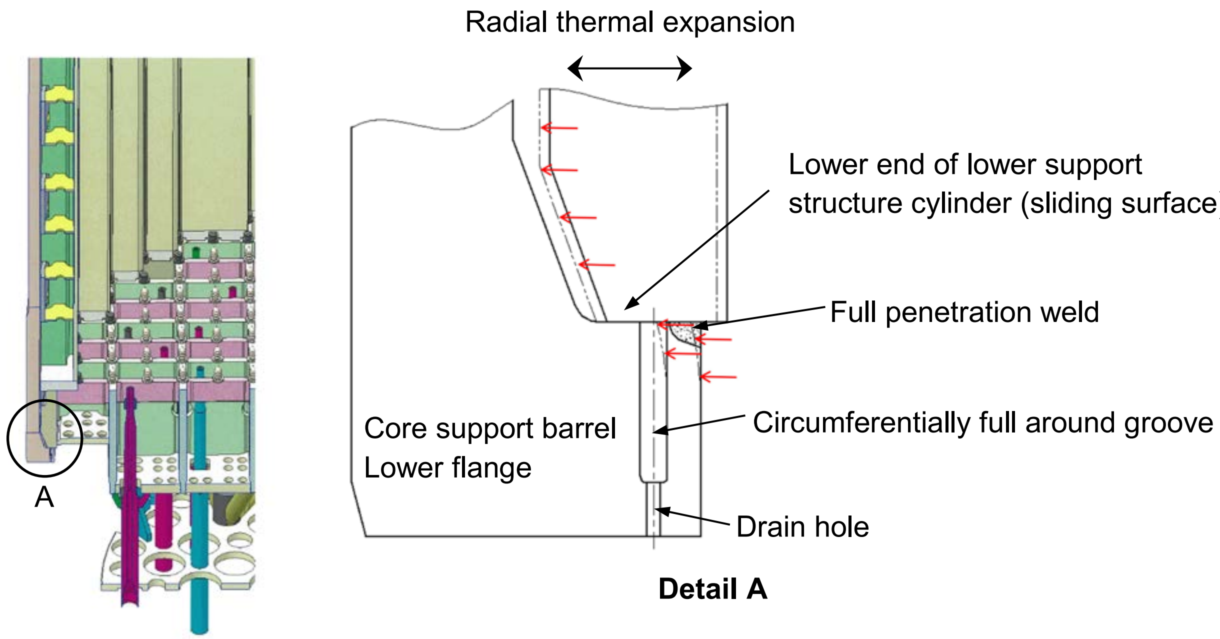

Figure 2-1 Core support barrel lower flange flexure part

The lower support structure assembly does not rest on the clevis at the bottom of the reactor vessel, but on the lower flange of the core support barrel as shown in the above figure. The lower support structure directly supports the weight of the core and then transmits the load to the core support barrel lower flange. Finally, all the loads of the core support barrel assembly and the core are supported at the reactor vessel ledge. The load path is shown in Figure 2-2.

KHNP Response to Issues - DCD Section 3.9.5

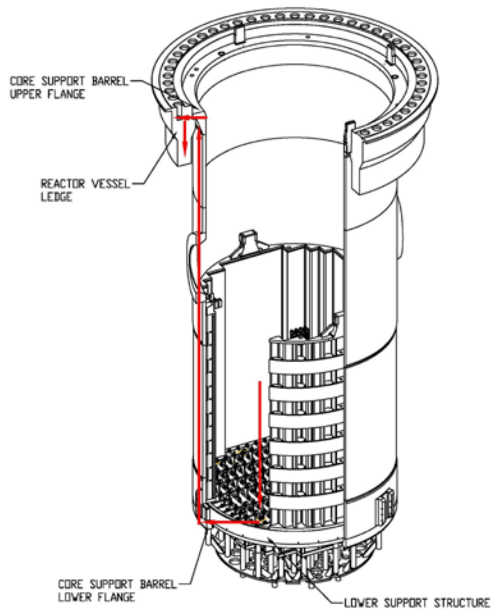

Figure 2-2 Load path of core support barrel assembly

Impact on DCD
There is no impact on the DCD.

Impact on PRA
There is no impact on the PRA.

Impact on Technical Specifications
There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports
There is no impact on any Technical, Topical or Environmental Reports.

Issue #3

GDC 1 and 10 CFR 50.55a require that reactor internals be designed to quality standards commensurate with the importance of the safety functions performed. Item 1 under "Areas of Review" in SRP Section 3.9.5 includes the physical and design arrangements of all reactor internals structures, components, assemblies, and systems, including the positioning and securing of such items within the RPV, the provision for axial and lateral retention and support of the internals assemblies and components, and the accommodation of dimensional changes due to thermal and other effects. Additional information is needed for the staff to make its finding under this area of review.

KHNP Response to Issues - DCD Section 3.9.5

DCD Tier 2, Section 3.9.5.1.1.1 describes the core support barrel as a right circular cylinder including a heavy external ring flange at the top end and an internal ring flange at the lower end. It is unclear to the staff which component is the top ring flange and which component is the lower ring flange in DCD Tier 2, Figure 3.9-9. The applicant is requested to provide a more detailed drawing of the core support barrel that identifies these two ring flanges. In addition, the applicant is requested to describe the function of these two ring flanges and if they support any load during normal and accident conditions.

Response

The configuration related to the top and lower ring flange of the core support barrel is shown in Figure 3-1.

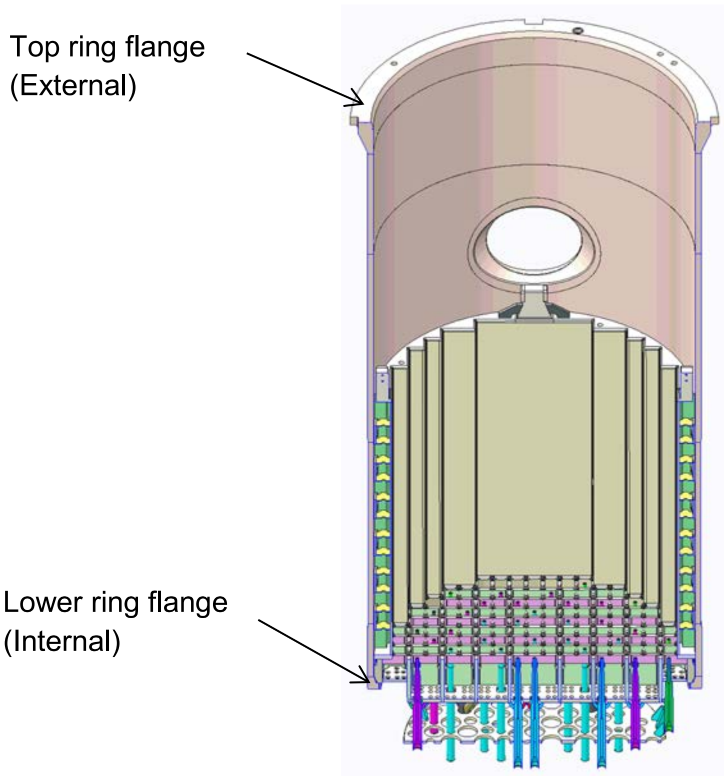

Figure 3-1 Flanges of core support barrel

The core support barrel assembly is supported at its upper end by the top ring flange of the core support barrel, which rests on a ledge in the reactor vessel. The lower ring flange of the core support barrel supports, secures, and positions the lower support structure including the core.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

KHNP Response to Issues - DCD Section 3.9.5

Impact on Technical Specifications
There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports
There is no impact on any Technical, Topical or Environmental Reports.

Issue #4

GDC 1 and 10 CFR 50.55a require that reactor internals be designed to quality standards commensurate with the importance of the safety functions performed. Item 2 under "Areas of Review" in SRP 3.9.5 includes the basis for the design of the reactor internals, loading conditions of normal operation, anticipated operational occurrences, potential adverse flow effects of flow-excited vibrations and acoustic resonances, postulated accidents, and seismic events.

DCD Tier 2, Section 3.9.5.1.1.1 describes that since the weight of the core support barrel is supported at its upper end, it is possible that coolant flow could induce vibrations in the structure. Therefore, amplitude limiting devices, or snubbers, are installed on the outside of the core support barrel near the bottom end. The snubbers consist of six equally spaced lugs around the circumference of the core support barrel and act as a tongue and groove assembly with the mating lugs on the reactor vessel. Minimizing the clearance between the tongue and groove assembly limits the amplitude of vibration. It further describes that the snubbers allow radial and axial expansion of the core support barrel, but restricts lateral movement of the core support barrel. DCD Tier 2, Figure 3.9-10 provides a drawing of the snubber assembly. Additional information on these assemblies is needed for the staff to make its finding under the area of review referenced above. Specifically:

a. The applicant is requested to explain the flow induced vibration effect on the snubbers under both normal and accident conditions.
b. The applicant is requested to clarify if the snubber assembly, either the tongue and groove assembly on the core support barrel, or the mating lug on the reactor vessel, support any weight of the core support barrel and the core.
c. It appears to the staff that there are four snubbers on the core support barrel as shown in DCD Tier 2, Figure 3.9-9, however, DCD Tier 2, Section 3.9.5.1.1.1 states that there are six snubbers. The applicant is requested to clarify this discrepancy.
d. Figure 3.9-10 shows that four pins and four socket head cap screws are used for assembling the shims to the core stabilizing lug on the reactor vessel. However, no description is provided on how the tongue and groove assembly is attached to the core barrel assembly and how the core stabilizing lug is attached to the reactor vessel. Moreover, no description is provided for the pins and socket head cap screws, how these structural fasteners are classified, and the design code used for the design of these structural fasteners. Therefore, the applicant is requested to provide the information stated above.

e. The applicant is requested to clarify if threaded structural fasteners are used in other reactor internals components than those listed in item (d) above.

Response

a. The core support barrel including the snubbers is evaluated for the flow-induced vibration. Pump pulsation and random turbulence loads are used for the response analysis to account for the effect of flow-induced vibration on the core support barrel including the snubbers. DCD Tier 2, Section 3.9.2.3 provides the detail explanation of the response analysis for the APR1400 reactor internal components under normal condition (See Sections 3.2.2 and 3.3.1 of APR1400-Z-M-NR-14009-P* for further information). The reactor internals are inspected to check the flow-induced vibration effect during the hot functional test according to the guidance of NRC RG 1.20. The preoperational flow-induced vibration testing for the reactor internals is described in DCD Tier 2, Section 3.9.2.4.

   The core support barrel including the snubbers is also analyzed for the accident conditions such as earthquake and pipe rupture. The RV motions and asymmetric loads from depressurization due to pipe rupture are applied in the reactor internals analysis under accident conditions. DCD Tier 2, Section 3.9.2.5 provides the detail explanation of the analyses of the reactor internals for earthquake and pipe rupture loads.

   * APR1400-Z-M-NR-14009-P, “Comprehensive Vibration Assessment Program for the Reactor Vessel Internals”, Rev.0, KHNP, Nov. 2014 (Reference 49 of DCD Tier 2, Section 3.9.10)

b. The snubber assembly does not support any weight of the core support barrel and the core. Only radial and axial expansions of the core support barrel are accommodated, but excessive lateral and torsional movement of the core support barrel is restricted by six snubbers.

c. Though it appears that there are four snubbers on the core support barrel as shown in DCD Tier 2, Figure 3.9-9, the core support barrel actually has six snubbers as shown in Figure 4-1. The left figure is a front view of the core support barrel assembly and the right figure is a bottom view of the core support barrel assembly. The left figure presents only three snubbers while another three snubbers are located at the opposite side.

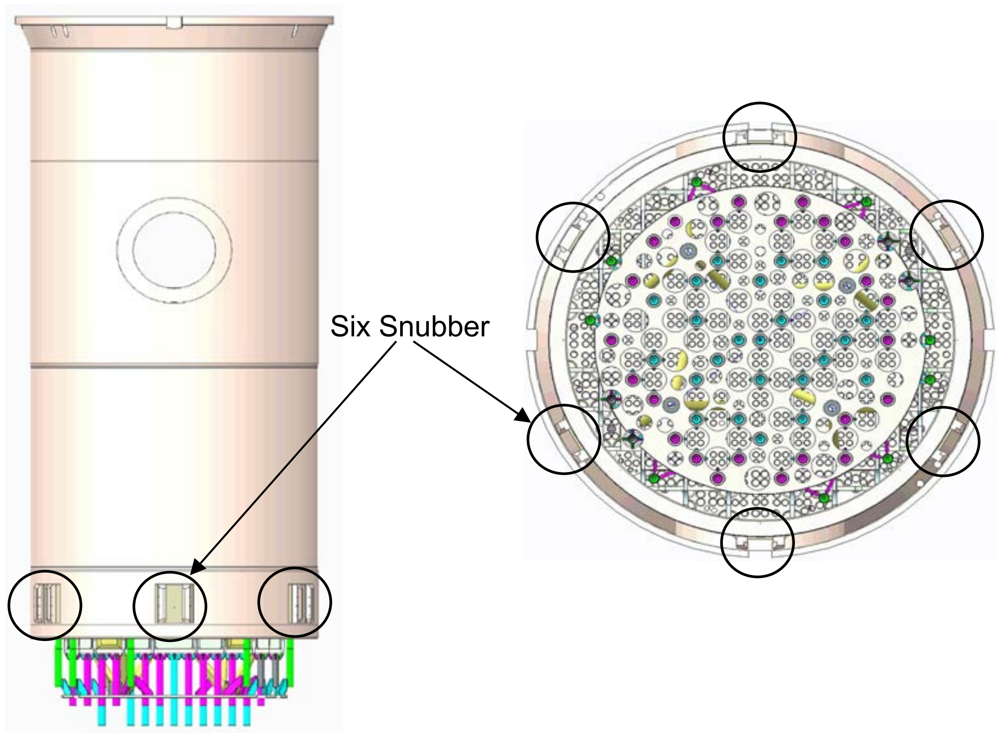

Figure 4-1 Core support barrel snubber

d. A core stabilizing lug is attached to the reactor vessel with a full penetration weld. Two core stabilizing shims are assembled with one core stabilizing lug and four cap screws are used to fasten the shims to the lug. After installing the screws, each socket head cap screw is line drilled and one pin and one plug are inserted. The hole where the pin and plug pass through is welded to fix the screw. All parts of the core stabilizing lug are classified and designed as an ASME Code Class 1 component (NB). Because the core stabilizing lug is attached to the inside wall of the reactor vessel, it is not classified as reactor internals; therefore, the structural fasteners are designed to Section III, Subsection NB of the ASME Code. The snubber lug is attached to the outside wall of the core support barrel by a full penetration weld and is designed in accordance with Section III, Subsection NG of the ASME Code.

e. The fuel locating pins and the socket head cap screws are used as threaded structural fasteners in reactor internal components as shown in the following figure. The fuel locating pins are attached to the top of the lower support structure beams to provide orientation for the lower ends of the fuel assemblies. The fuel locating pins are secured by tack weld to the lock-bar. The socket head cap screws are used to attach the guide lug inserts (shims) to the core shroud guide lug. Four guide lugs, spaced 90 degrees apart, protrude vertically from the top of the core shroud and engage in corresponding slots in the UGS fuel alignment plate to provide proper alignment. The fuel locating pins and socket head cap screws pertaining to the reactor internals are designed in accordance with Section III, Subsection NG of the ASME Code.

KHNP Response to Issues - DCD Section 3.9.5

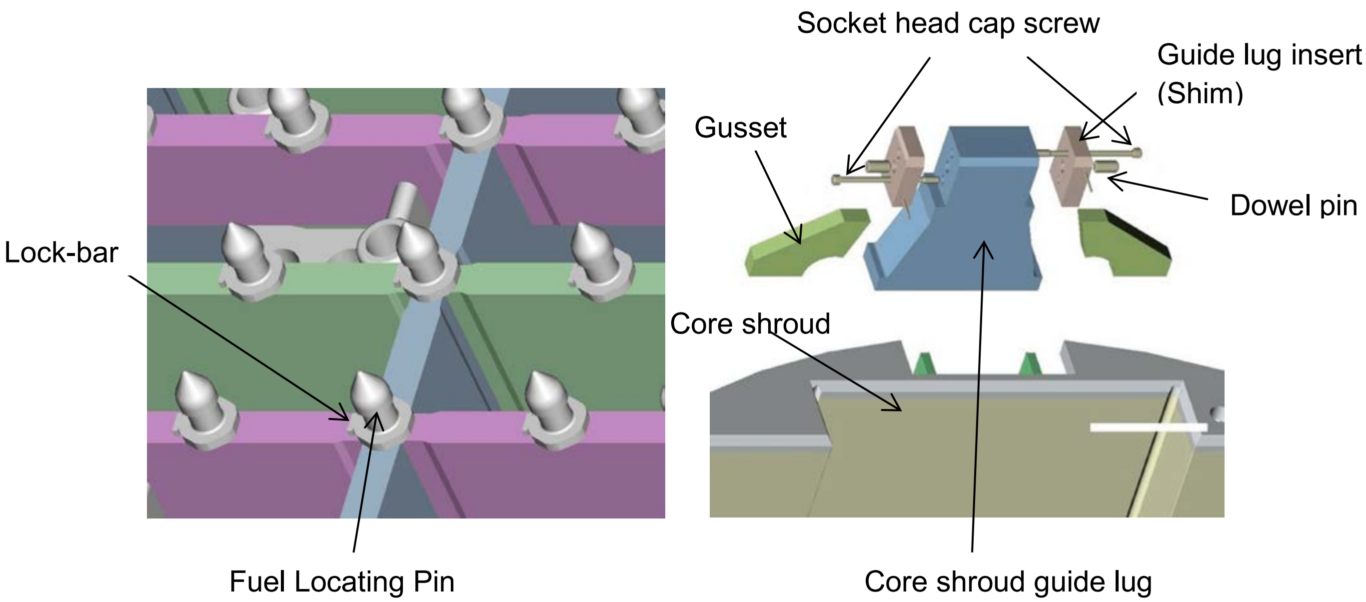

Figure 4-2 Fuel locating pin and socket head cap screw

Impact on DCD
There is no impact on the DCD.

Impact on PRA
There is no impact on the PRA.

Impact on Technical Specifications
There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports
There is no impact on any Technical, Topical or Environmental Reports.

Issue #5

GDC 1 and 10 CFR 50.55a require that reactor internals be designed to quality standards commensurate with the importance of the safety functions performed. Item 1 under “Areas of Review” in SRP 3.9.5 includes the physical and design arrangements of all reactor internals structures, components, assemblies, and systems, including the positioning and securing of such items within the RPV, the provision for axial and lateral retention and support of the internals assemblies and components, and the accommodation of dimensional changes due to thermal and other effects. Additional information is needed for the staff to make its finding under this area of review.

DCD Tier 2, Section 3.9.5.1.1.2 provides a description of the lower support structure and in-core instrumentation (ICI) nozzle assembly. The function of the lower support structure and ICI nozzle assembly is to position and support the fuel assemblies, core shroud and ICI nozzles. The structure is a welded assembly consisting of a short cylinder, support beams, a bottom plate, ICI nozzles and ICI nozzle support plate, as shown in DCD Tier 2, Figure 3.9-11. The upper portion of the lower support structure is a short cylindrical section enclosing an assemblage of grid beams arranged in egg-crate fashion. The outer ends of these beams are welded to the cylinder. Fuel assembly locating pins are attached to the top of the beams.

Because the lower support structure, specifically the short cylindrical section with the welded main support beam, directly supports the fuel assemblies, the applicant is requested to explain the type of welds that are used to weld the main support beams to the short cylindrical section of the lower support structure and how these welds are qualified. In addition, the applicant is requested to describe how the fuel assembly locating pins are attached to the top of the main support beams.

Response

Full penetration weld joints are used to weld the main support beam to the lower support structure cylinder. The welds are qualified by inspection (root and final liquid penetrant examination) per NG-5230.

The fuel locating pins are assembled by a bolted joint at the top surface of the lower support structure beams. The fuel locating pins are secured by a welded lock-bar.

Impact on DCD
There is no impact on the DCD.

Impact on PRA
There is no impact on the PRA.

Impact on Technical Specifications
There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports
There is no impact on any Technical, Topical or Environmental Reports.

KHNP Response to Issues - DCD Section 3.9.5

Issue #6

GDC 1 and 10 CFR 50.55a require that reactor internals be designed to quality standards commensurate with the importance of the safety functions performed. Item 1 under “Areas of Review” in SRP 3.9.5 includes the physical and design arrangements of all reactor internals structures, components, assemblies, and systems, including the positioning and securing of such items within the RPV, the provision for axial and lateral retention and support of the internals assemblies and components, and the accommodation of dimensional changes due to thermal and other effects. Additional information is needed for the staff to make its finding under this area of review.

DCD Tier 2, Section 3.9.5.1.1.2 explains that the bottoms of the main support beams in one direction are welded to an array of plates which contain flow holes to provide proper flow distribution. These plates provide support for the ICI nozzles, support columns, and ICI nozzle support plate.

The applicant is requested to further describe and identify, either with additional drawings or in DCD Tier 2, Figure 3.9-11, the aforementioned array of plates that support the ICI nozzles, support columns, and ICI nozzle support plate. In addition, the applicant is requested to describe the following:

a. The interface between the ICI nozzle to both bottom plate and ICI nozzle support plate
b. The location, number, and function of the support columns, and their interfaces to the bottom plate and ICI nozzle support plate as shown in Figure 3.9-11
c. The function of the gusset as shown in DCD Tier 2, Figure 3.9-11
d. The main support beam configuration (with support from a drawing), as well as how the cross beams are connected to the secondary support beam as shown in DCD Tier 2, Figure 3.9-11

Response

The plates of the lower support structure consist of a bottom plate and a raised bottom plate as shown in DCD Tier 2, Figure 3.9-11. Basically, the plates contain flow holes to provide a uniform flow distribution at the core inlet and the flow is up through the lower support structure plate and then the core. The plates are divided into the various flow hole patterns. The patterns are determined by factors such as the ICI locations, the intersection of the support beams with the bottom plate, and the boundary between raised (peripheral) and bottom (central) portions of the plate. The bottom plate is welded to the lower end of the main support beam and the raised bottom plate is welded to the beams and the lower portions of the lower support structure cylinder.

a. The upper part of the ICI nozzle is welded to the lower support structure bottom plate by gussets(1). The lower part (central) of the ICI nozzle is welded to the hole of ICI nozzle support plate(2) and the lower part (peripheral) of the ICI nozzle is welded to the ICI nozzle support plate by gussets(3) as shown in Figure 6-1.

KHNP Response to Issues - DCD Section 3.9.5

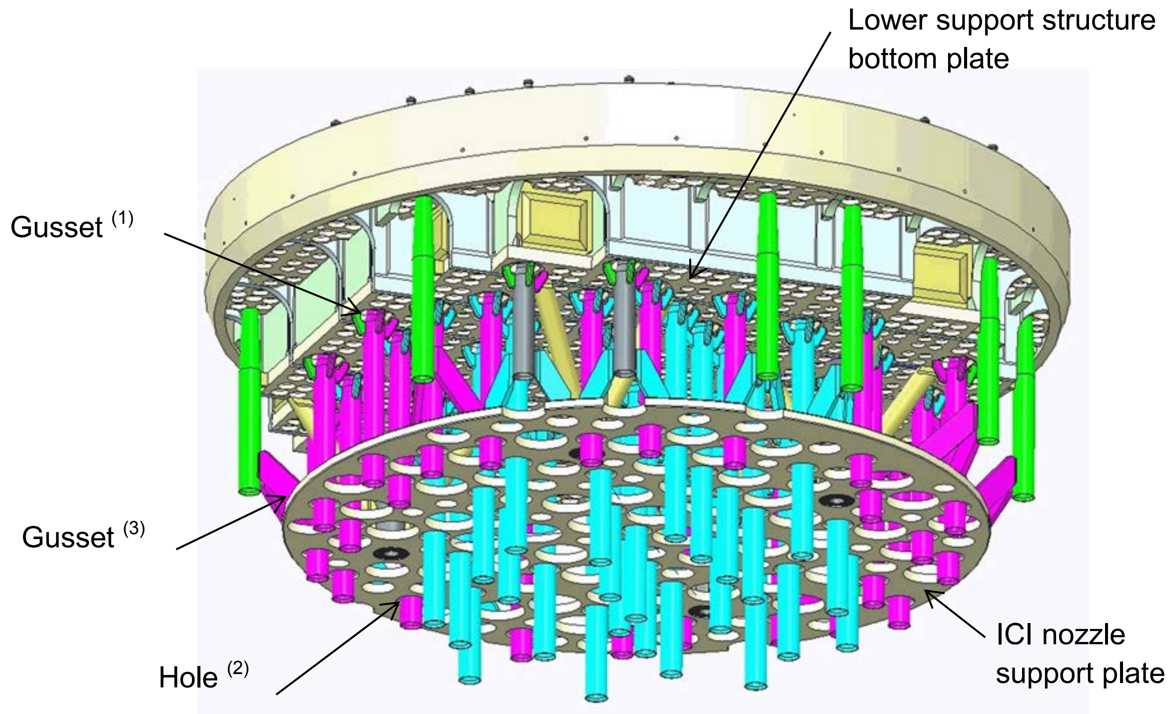

Figure 6-1 Lower support structure/ICI assembly

b. The lower support structure assembly has four support column assemblies to support the bottom plate and the ICI nozzle support plate. One support column assembly consists of one column boss and three support columns. The upper part of the support column is welded to the lower support structure bottom plate and the lower part of support column is welded to the column boss attached to the ICI nozzle support plate as shown in Figure 6-2.

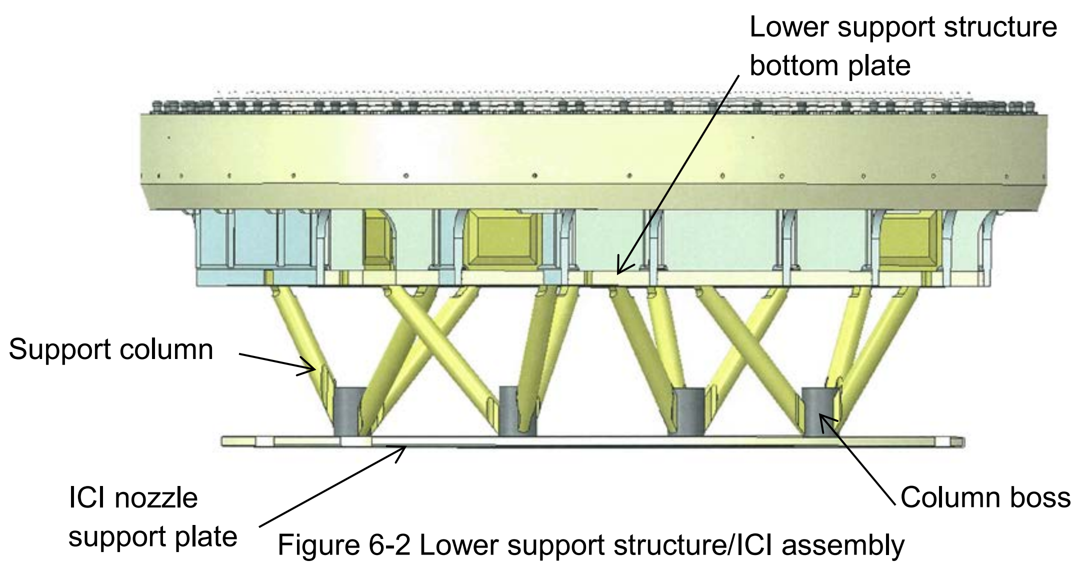

Figure 6-2 Lower support structure/ICI assembly
(ICI Nozzles and gussets are removed for clarity)

c. The function of the gusset is to support the ICI nozzles between the bottom plate and the ICI nozzle support plate.

d. The peripheral portion of main support beam is welded to the inside of the lower support structure cylinder and the lower end of the main support beam is welded to the bottom plate. The main support beam and the secondary support beam are welded to each other at the cross intersection. The cross beams (short support beams) are connected to the secondary support beam and the main support beam by weld as shown in Figure 6-3.

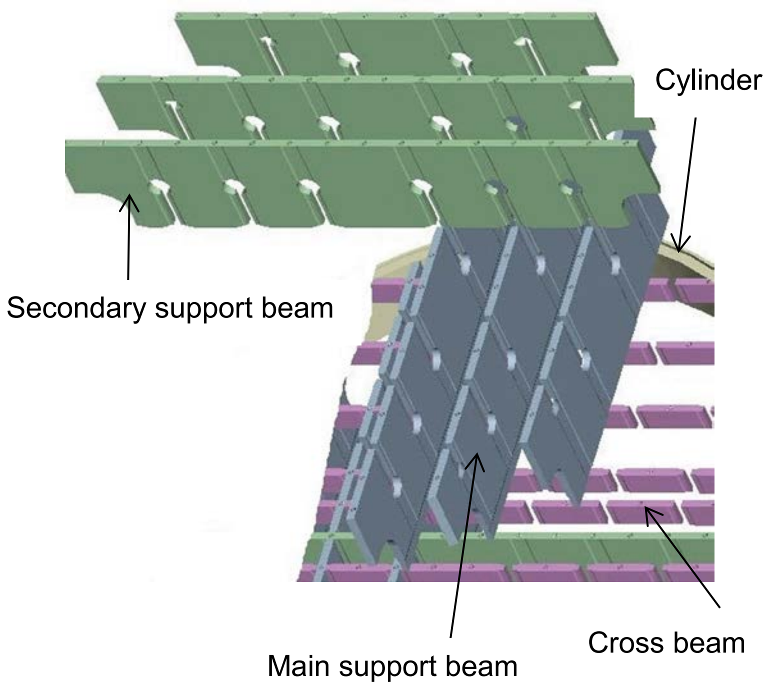

Figure 6-3 Lower support structure beams

The main support beam and the secondary support beam are assembled by cross over at the beam slot location and welded by a full penetration weld along the intersection line as shown in Figure 6-4. The main support beam and the secondary support beam assembly are welded to the lower support structure cylinder by a full penetration weld at the outmost beam side as shown in Figure 6-5. The cross beams are connected to the main support beam and the secondary support beam as shown in Figure 6-6 and welded by a full penetration weld.

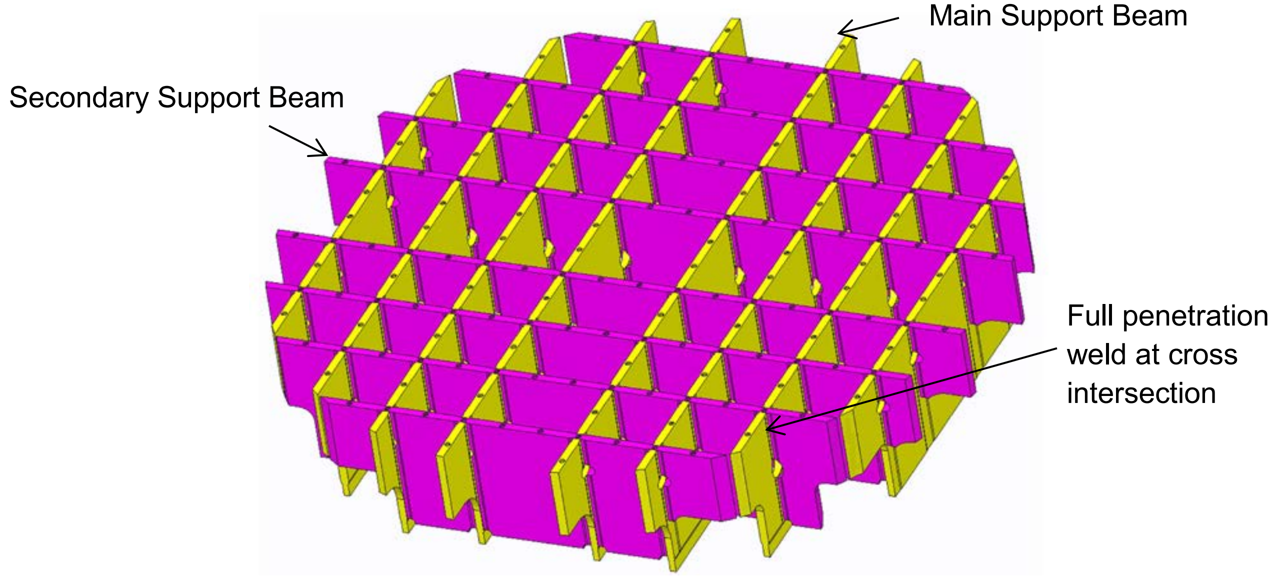

Figure 6-4 Main support beam to secondary support beam weld

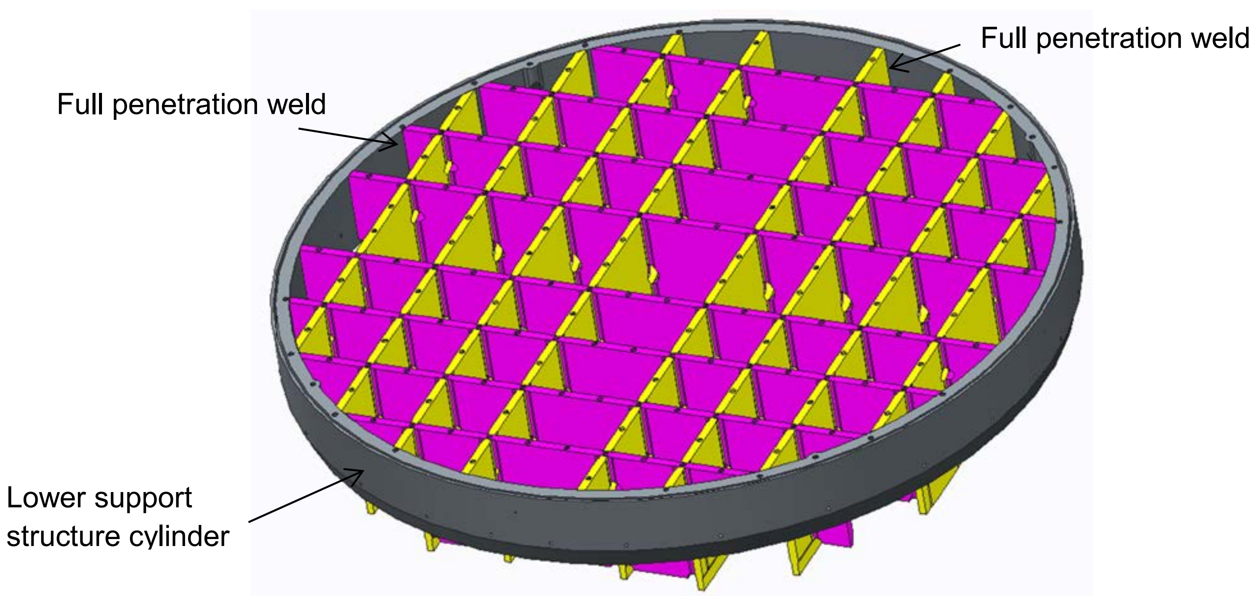

Figure 6-5 Main support beam and secondary support beam to cylinder weld

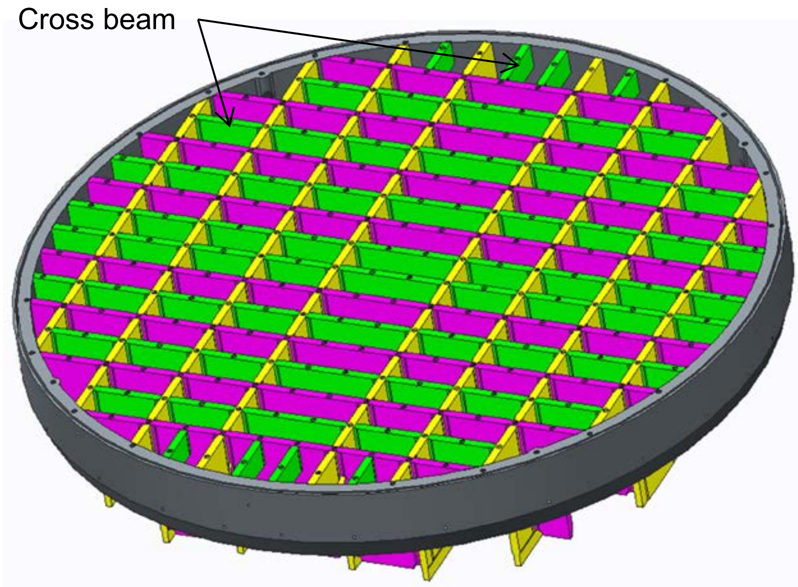

Figure 6-6 Main/secondary support beam and cylinder to cross beam weld

Impact on DCD
There is no impact on the DCD.

Impact on PRA
There is no impact on the PRA.

Impact on Technical Specifications
There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports
There is no impact on any Technical, Topical or Environmental Reports.

Issue #7

GDC 1 and 10 CFR 50.55a require that reactor internals be designed to quality standards commensurate with the importance of the safety functions performed. Item 2 under “Areas of Review” in SRP 3.9.5 includes the basis for the design of the reactor internals, loading conditions of normal operation, anticipated operational occurrences, potential adverse flow effects of flow-excited vibrations and acoustic resonances, postulated accidents, and seismic events. Additional information is needed for the staff to make its finding under this area of review.

DCD Tier 2, Section 3.9.5.1.1.2 describes that the cylinder portion of the lower support structure guides the main coolant flow and limits the core shroud bypass flow by means of holes located near the base of the cylinder. The ICI nozzle support plate provides lateral support of the ICI nozzles. The ICI nozzle support plate is provided with flow holes for requisite flow distribution.

The applicant is requested to describe the effect of flow-induced vibration on the ICI nozzle in both the axial and lateral directions.

Response

The ICI nozzles are evaluated for flow-induced vibration. Vortex shedding, pump pulsation and random turbulence loads are used for the response analysis to account for the effect of flow-induced vibration on the ICI nozzle. DCD Tier 2, Section 3.9.2.3, provides the detailed explanation of the response analysis for the APR1400 reactor internal components under various hydraulic loading conditions (See Sections 3.2.5 and 3.3.5 of APR1400-Z-M-NR-14009-P* for further information). The reactor internals are inspected to check the flow-induced vibration effect during the hot functional test according to the guidance of NRC RG 1.20. The preoperational flow-induced vibration testing for the reactor internals is described in DCD Tier 2, Section 3.9.2.4.

* APR1400-Z-M-NR-14009-P, “Comprehensive Vibration Assessment Program for the Reactor Vessel Internals”, Rev.0, KHNP, Nov. 2014 (Reference 49 of DCD Tier 2, Section 3.9.10)

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical or Environmental Reports.

Issue #8

GDC 1 and 10 CFR 50.55a require that reactor internals be designed to quality standards commensurate with the importance of the safety functions performed. Item 1 under “Areas of Review” in SRP 3.9.5 includes the physical and design arrangements of all reactor internals structures, components, assemblies, and systems, including the positioning and securing of such items within the RPV, the provision for axial and lateral retention and support of the internals assemblies and components, and the accommodation of dimensional changes due to thermal and other effects. Additional information is needed for the staff to make its finding under this area of review.

DCD Tier 2, Section 3.9.5.1.1.3 provides a description of the core shroud. Its function is to provide an envelope for the core and limit the amount of coolant bypass flow. The core shroud consists of a welded vertical assembly of plates designed to channel the coolant through the core. Circumferential rings and top and bottom end plates provide lateral support. The rings are attached to the vertical plates by means of full length welded ribs and horizontal braces. DCD Tier 2, Figure 3.9-12 provides a drawing of the core shroud.

It is unclear to the staff based on this figure how the circumferential rings are attached to the vertical plates by means of full length welded ribs and horizontal braces. Therefore, the applicant is requested to describe how the circumferential rings are attached to the vertical plates. In addition, DCD Tier 2, Section 3.9.5.1.1.3 does not describe how the core shroud vertical plates are attached to each other. Therefore, the applicant is requested to provide this description. If structural fasteners are used, the applicant is requested to provide description on how these fasteners are designed and qualified under the intended operating life of the plant.

Response

The upper and lower portions of the circumferential rings are attached to the cutout of the rib by weld as shown in in Figure 8-1. The ribs are attached to the vertical plates by means of a full length weld axially.

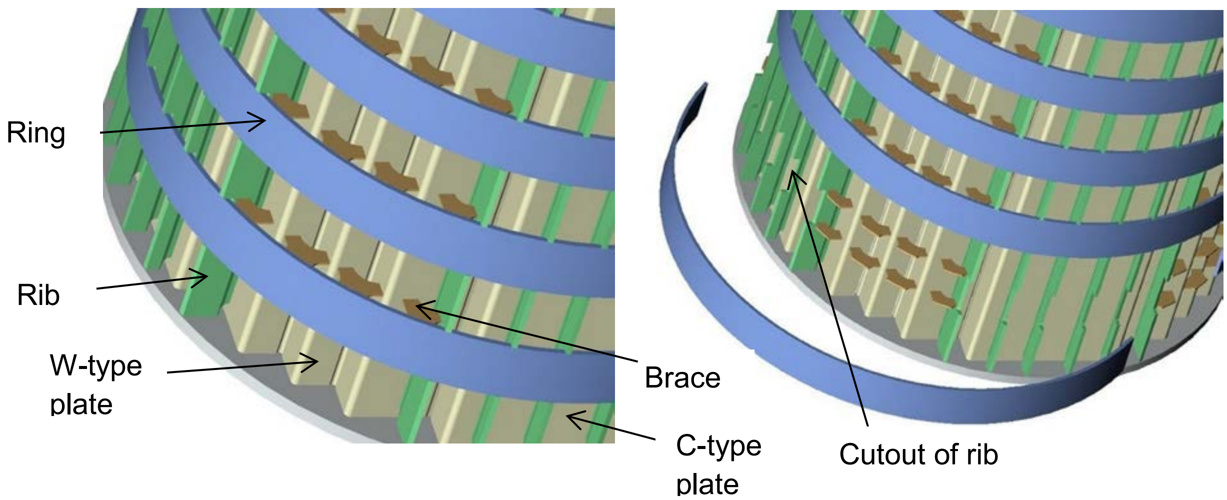

Figure 8-1 Core Shroud Assembly

The core shroud vertical plates consist of four W-type plates and four C-type plates as shown in Figure 8-2. The W and C-type plates are welded on the bottom and top flanges. The W and C-type plates are then attached to each other by means of a full length weld axially. There are no structural fasteners used to attach the core shroud vertical plates.

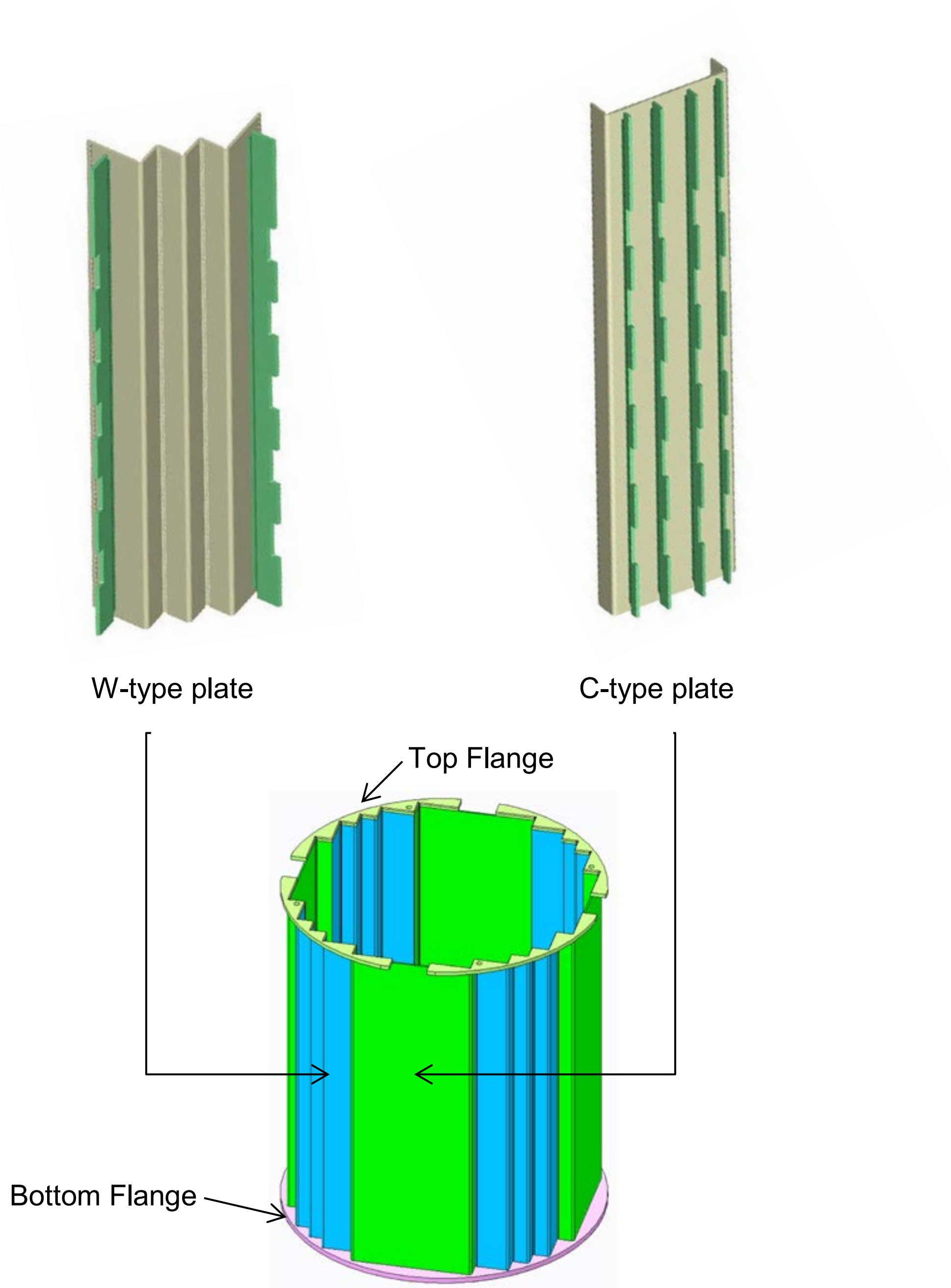

Figure 8-2 Core Shroud Plate

Impact on DCD
There is no impact on the DCD.

Impact on PRA
There is no impact on the PRA.

Impact on Technical Specifications
There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports
There is no impact on any Technical, Topical or Environmental Reports.

Issue #9

GDC 1 and 10 CFR 50.55a require that reactor internals be designed to quality standards commensurate with the importance of the safety functions performed. Item 1 under "Areas of Review" in SRP 3.9.5 includes the physical and design arrangements of all reactor internals structures, components, assemblies, and systems, including the positioning and securing of such items within the RPV, the provision for axial and lateral retention and support of the internals assemblies and components, and the accommodation of dimensional changes due to thermal and other effects. Additional information is needed for the staff to make its finding under this area of review.

DCD Tier 2, Section 3.9.5.1.2 provides a description and function of the UGS assembly. The UGS assembly consists of two subassemblies, the UGS barrel assembly and the inner barrel assembly (IBA). The IBA sits on top of the UGS barrel assembly as shown in DCD Figure 3.9-13. The UGS barrel assembly consists of UGS support barrel, fuel alignment plate, UGS support plate and control element guide tubes. The fuel alignment plate is positioned below the UGS support plate by cylindrical control element guide tubes. These guide tubes are attached to the UGS support plate and the fuel alignment plate by rolling the tubes into the holes in the plates. The function of the alignment plate is to align the lower ends of the control element guide tubes, which in turn locate the upper ends of the fuel assemblies. The control element guide tubes bear the upward force on the fuel assembly hold down devices. This upward force is transmitted from the fuel alignment plate through the control element guide tubes to the UGS barrel support plate.

Based on the information provided in the DCD, the staff does not consider the description of the UGS barrel assembly and its subassemblies to be sufficient. Specifically, the applicant is requested to provide additional or revised drawings of the UGS barrel assembly that show the interface between the UGS support plate and control element guide tubes, and the interface between the control element guide tubes and the fuel alignment plate. Additional, to assist the staff's review, the applicant is requested to provide a cross-sectional drawing of the control element guide tubes. The applicant is also requested to describe the following:

a. The interface between the UGS support plate and control element guide tubes, and the interface between the control element guide tubes and the fuel alignment plate. Specifically, how are the control element guide tubes rolled in the holes of the UGS support plate and fuel alignment plate?
b. What loads, during both normal operation and accident conditions, do the control element guide tubes experience?

c. How is the structural integrity of the control element guide tubes maintained throughout its design life under both normal and accident conditions?
d. How do the control element assembly and its corresponding drive shaft move in and out of the control element guide tubes into the inner barrel assembly? What is the position of the control element assembly relative to the inner barrel assembly and control element guide tubes when at its fully withdrawn position?

Response

a. The control element guide tubes (Figure 9-1) are attached to the top of the UGS support plate and the bottom of fuel alignment plate by a full around weld after tube rolling. The tube rolling for the control element guide tube and the UGS support plate (or fuel alignment plate) is performed by a hydraulically operated rolling machine. The section view of the CEA guide tube interface area is shown in Figure 9-2 and the insert tube interface area is shown in Figure 9-3. The inner barrel assembly is inserted into the upper guide structure and welded at the flange by a flexure weld as shown in Figure 9-4. The CEA shroud consists of the shroud tube and web plate. Four web plates are full penetration welded axially on the outside surface of the shroud tube and equally spaced circumferentially as shown in Section B-B of Figure 9-4.

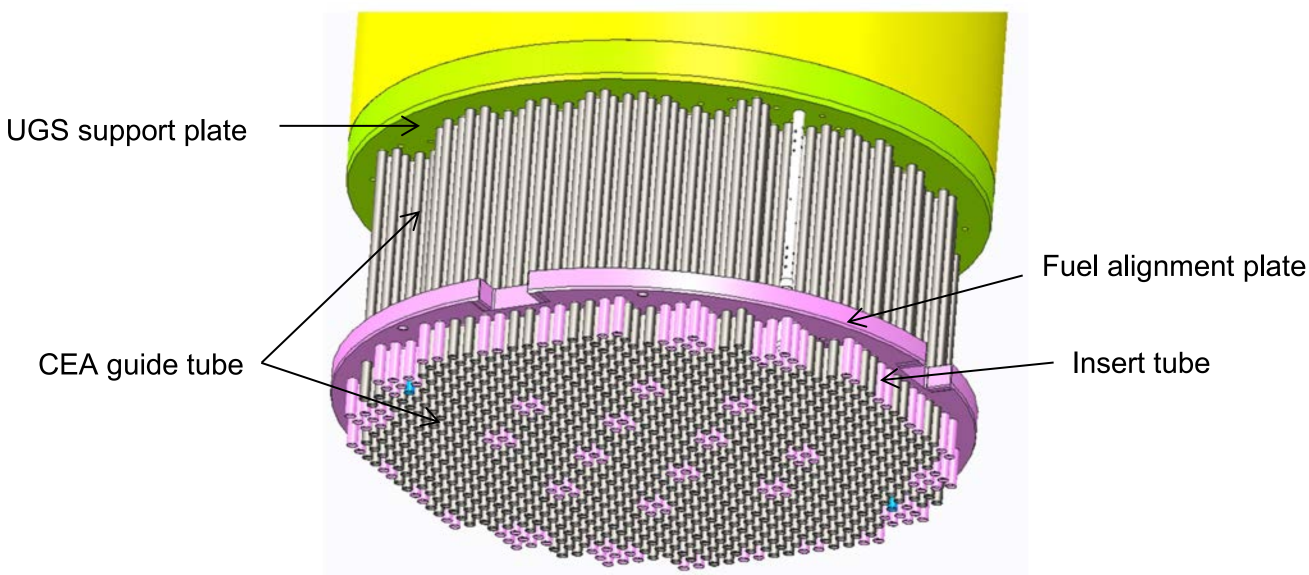

Figure 9-1 CEA guide tube assembly

KHNP Response to Issues - DCD Section 3.9.5

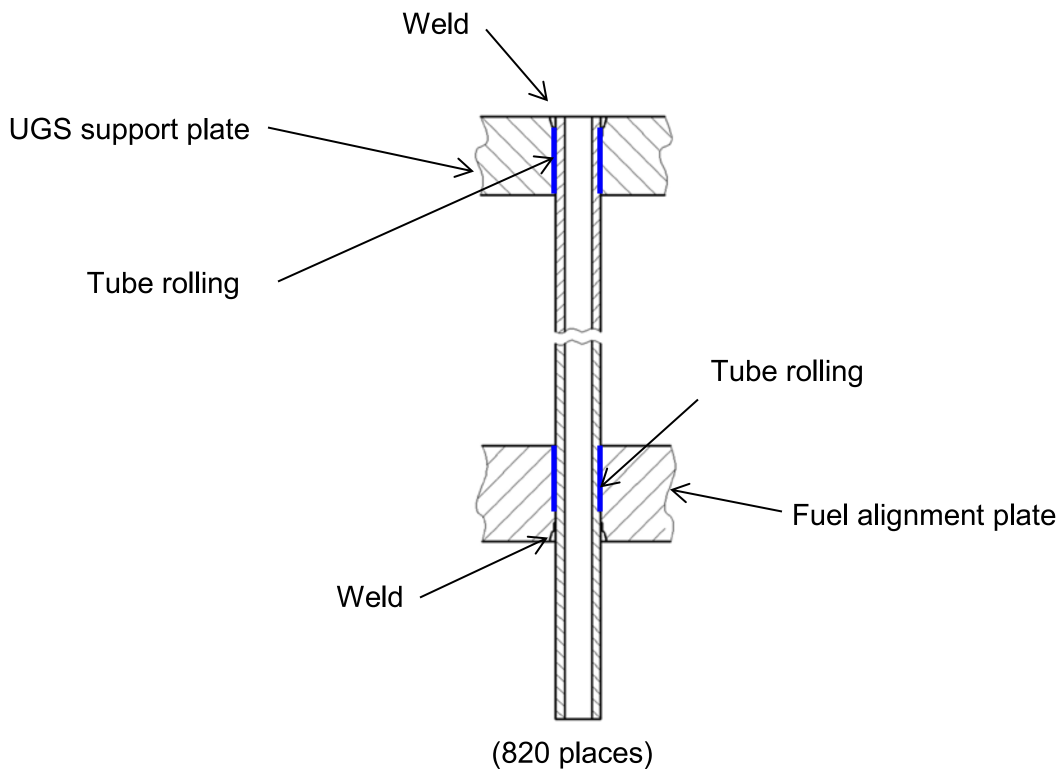

Figure 9-2 CEA guide tube to UGS support plate and fuel alignment plate interface

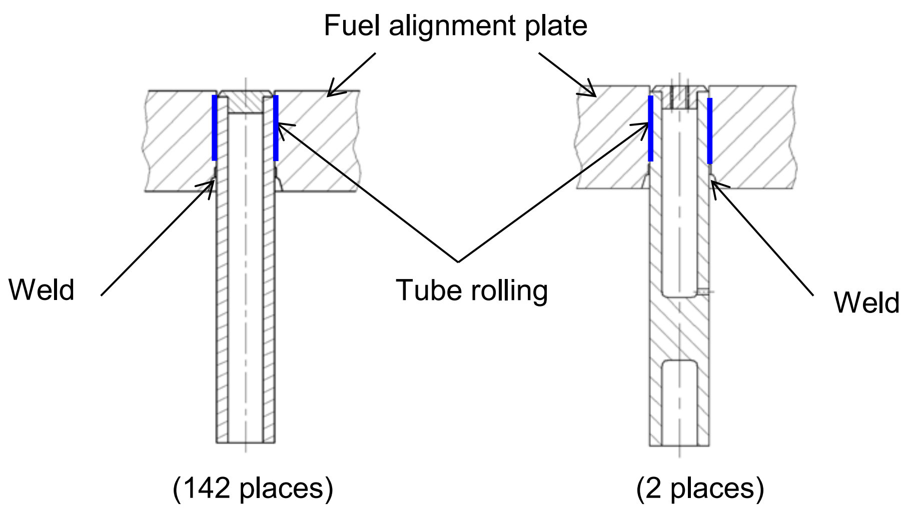

Figure 9-3 Insert tube to fuel alignment plate interface

KHNP Response to Issues - DCD Section 3.9.5

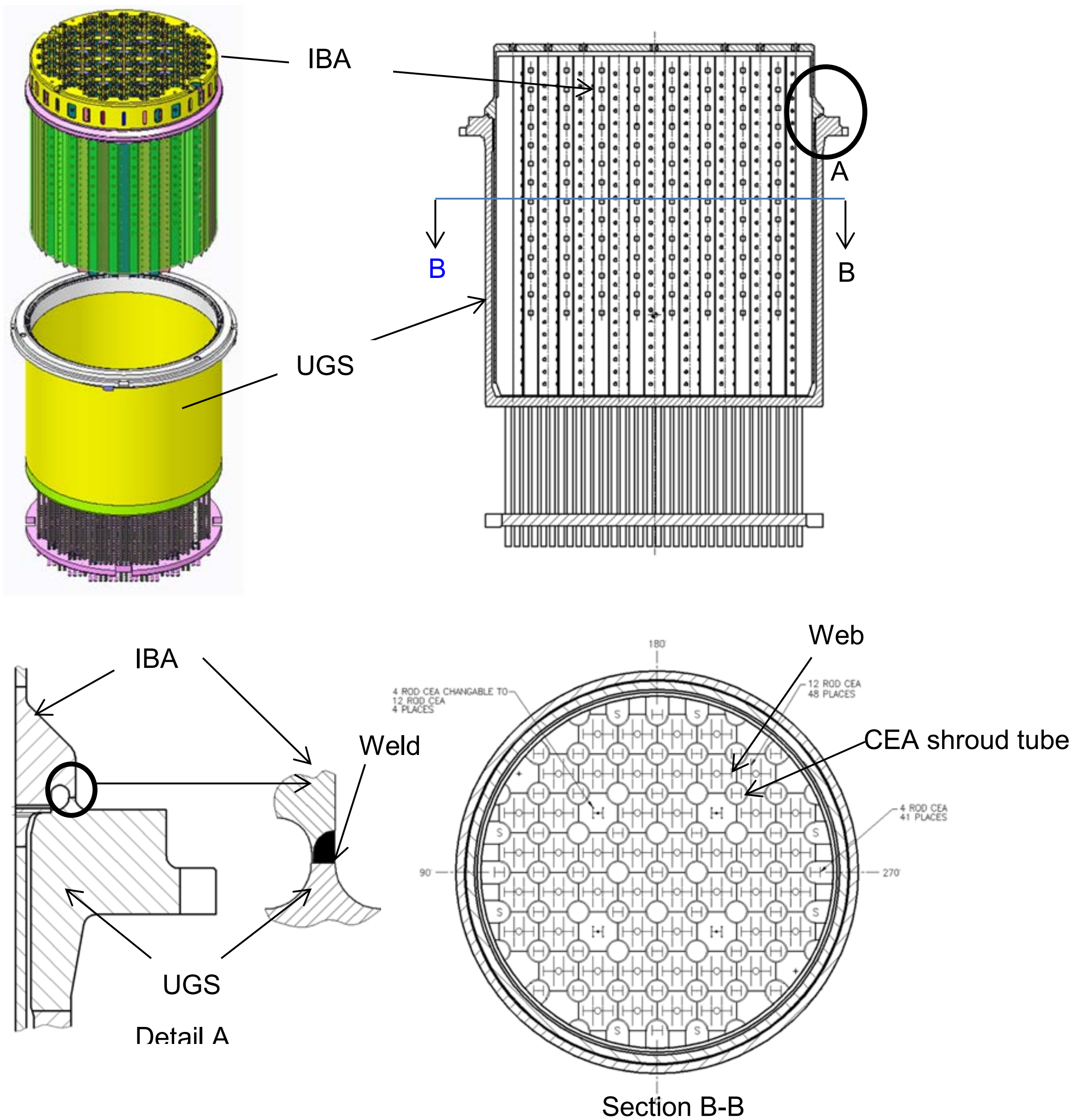

Figure 9-4 UGS assembly

KHNP Response to Issues - DCD Section 3.9.5

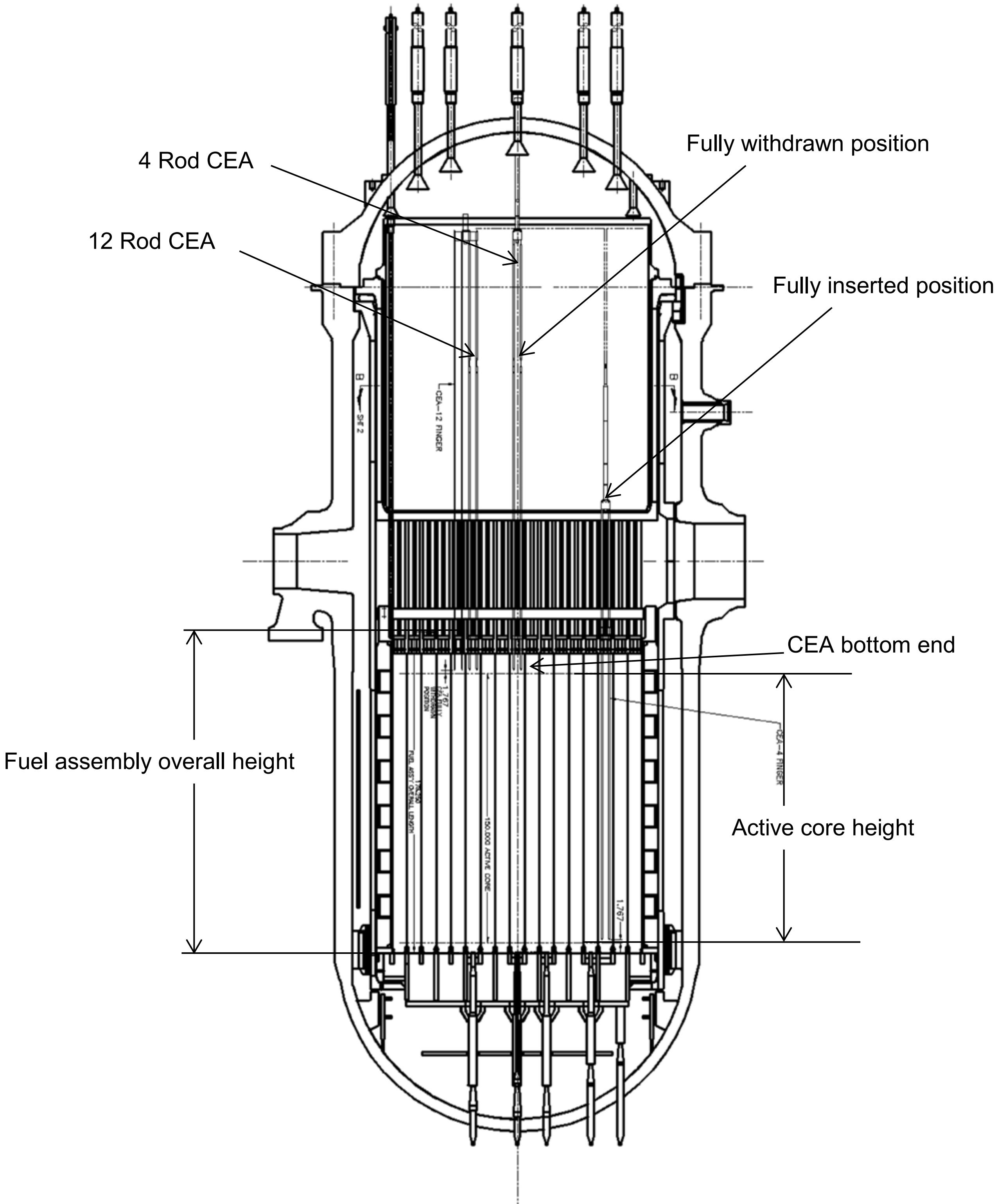

Figure 9-5 CEA position

b. The control element guide tubes experience the loads related to mechanical static loads, thermal loads, hydraulic static loads, hydraulic dynamic loads (pump pulsation and random turbulence), IRWST, SSE, DBPB and BLPB ((MS/FWPB) or LOCA) loads during normal operation and accident conditions.

c. The control element guide tubes are evaluated for Level A, B, C, D conditions in accordance with ASME Section III NG Code. The fatigue evaluation for the control element guide tubes is performed for 60 years of design life and in-service inspection is performed every 10 years. Additionally, the control element guide tubes are inspected via CVAP and the visual inspection results have showed no abnormal condition. Therefore, the structural integrity of the control element guide tubes can be maintained throughout 60 years under both normal and accident conditions.

d. The control element assembly and its corresponding drive shaft move in and out of the control element guide tubes into the inner barrel assembly by CEDM latch driving, magnetic jack type, described in DCD Tier 2, Section 3.9.4 (CEDM). The lower end of the control element assembly is positioned near the top of the active core within the fuel assembly when the CEA's are in the fully withdrawn position as shown in Figure 9-5. In this position, the four and twelve rods of the CEA are inside of the CEA shroud of the inner barrel assembly as shown in Section B-B of Figure 9-4.

Impact on DCD
There is no impact on the DCD.

Impact on PRA
There is no impact on the PRA.

Impact on Technical Specifications
There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports
There is no impact on any Technical, Topical or Environmental Reports.

KHNP Response to Issues - DCD Section 3.9.5

Issue #10
GDC 1 and 10 CFR 50.55a require that reactor internals be designed to quality standards commensurate with the importance of the safety functions performed. Item 1 under "Areas of Review" in SRP 3.9.5 includes the physical and design arrangements of all reactor internals structures, components, assemblies, and systems, including the positioning and securing of such items within the RPV, the provision for axial and lateral retention and support of the internals assemblies and components, and the accommodation of dimensional changes due to thermal and other effects. Additional information is needed for the staff to make its finding under this area of review.

DCD Tier 2, Figure 3.9-8 provides an overview of the reactor internals arrangement. A surveillance capsule assembly is shown in the figure, but no description is provided in DCD Tier 2 Section 3.9.5. The applicant is requested to provide information for the surveillance capsule assembly, including the quantity and location of these assemblies and the means by which the surveillance capsule assembly is attached.

Response
The surveillance capsule assembly is not classified as reactor internals, but as the reactor vessel since it is attached to the inside wall of the reactor vessel. Therefore, the information of the surveillance capsule assembly was provided in DCD Tier 2, Section 5.3.1.6 (Material Surveillance), Tables 5.3-1 through 7 and Figures 5.3-1 through 6.

Impact on DCD
There is no impact on the DCD.

Impact on PRA
There is no impact on the PRA.

Impact on Technical Specifications
There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports
There is no impact on any Technical, Topical or Environmental Reports.