RAIO-0518-60220

May 31, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 420 (eRAI No. 9459) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 420 (eRAI No. 9459)," dated April 12, 2018

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's response to the following RAI Question from NRC eRAI No. 9459:

- 03.08.02-18

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Marty Bryan at 541-452-7172 or at mbryan@nuscalepower.com.

Sincerely,

Jennie Wike
Manager, Licensing
NuScale Power, LLC

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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9459

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9459

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Response to Request for Additional Information
Docket No. 52-048

eRAI No.: 9459
Date of RAI Issue: 04/12/2018

NRC Question No.: 03.08.02-18

10 CFR 52.47 requires the design certification applicant to include a description and analysis of the structures, systems, and components with sufficient detail to permit understanding of the system designs. Regulatory Guide 1.216 C.1.k states the details of the analysis and results that should be submitted in report form.

For the CNV Middle Section Model, in Section 3.4 of TR-0917-56119-P, "CNV Ultimate Pressure Integrity," it states that the design was modified to add 7.5 inches of reinforcement around the pressurizer access port opening on the inside surface of the CNV. The report stated that the added reinforcement served to stiffen the CNV shell around the opening and produce less distortion of the access flange, however the addition of the 7.5 inches of reinforcement is not clearly indicated in the drawings of the technical report, nor are there any further details on the reinforcement and its effect on the analysis. Please clearly show the reinforcement on the drawings of the technical report.

It does not appear that the analysis of the CNV Middle Section was re-evaluated to include this 7.5 inches of reinforcement. Please explain why this analysis was not re-evaluated as the reinforcement could produce a different bounding ultimate pressure than is currently indicated in the FSAR.

The RPV support design and RPV lateral support design, which impart stress to the shell of the containment vessel, were both modified since the completion of the containment ultimate pressure analysis. Please include drawings within the technical report that clearly show the differences in design from the one used for the ultimate pressure analysis (for example Figure 3-3) and the current design, to support the statements made that these design changes do not affect the ultimate pressure capacity or buckling results.

NuScale Response:

Figure 3-4 was added to TR-0917-56119, CNV Ultimate Pressure Integrity Technical Report, Section 3, showing the reinforcement around the pressurizer (PZR) access port flanged

opening. The discussion provided in Section 3.4, under Containment Vessel (CNV) Pressure Capacity Models, Item 2, CNV Middle Section Model, was modified to better describe the reinforcement around the pressurizer access opening and to reference the new Figure 3-4.

Justification is currently provided in TR-0917-56119, Section 3.4 why the analysis was not re-evaluated to determine a new bounding pressure. The justification from this section states:

> *... The added reinforcement serves to stiffen the CNV shell around the opening and produce less distortion of the access flange. This additional reinforcement produces a smaller and more uniform deflection of the flange. More deflection of the cover due to a higher pressure is therefore needed to reach the failure criteria specified in Section 3.1. Therefore, the resultant calculated CNV ultimate pressure produces a lower, bounding ultimate pressure from that expected with the added reinforcement.*

Because a lower ultimate pressure is more limiting than a higher pressure, the current TR ultimate pressure bounds the increased ultimate pressure with the added reinforcement. Accordingly, the current design with added reinforcement was not re-analyzed.

Figure 3-5(a) was added to TR-0917-56119, Section 3, to show the current CNV RPV support design. Figure 3-5(b) was added to show the CNV RPV support design analyzed. The discussion provided in Section 3.4, CNV Pressure Capacity Models, Item 2, CNV Middle Section Model, was revised to reference the new figures.

Figure 3-7(a) was added to TR-0917-56119, Section 3, to show the current RPV lateral support design and Figure 3-7(b) was added to show the RPV lateral support design analyzed. The discussion provided in Section 3.4, CNV Pressure Capacity Models, Item 5, Bottom Head Buckling Model, was revised to reference the new figures.

Impact on DCA:

The technical report TR-0916-56119 has been revised as described in the response above and as shown in the markup provided in this response.

CNV Pressure Capacity Models:

1. CNV Top Section Model

   - A quarter segment (0 to 90-degree segment) of the total CNV top section was modeled. One slice plane is through the top head centerline along the 90 to 270-degree axis passing through[1]: the CNV Head Manway 18 in. diameter (CNV24); the CRDM Access Opening – 67 in. diameter (CNV25); and the CRDM Power Opening – 18 in. diameter (CNV37). The second slice is through the 0 to 180-degree plane. The blue segment shown in Figure 3-2 shows the segment modeled and actual alignment of openings. The yellow highlighted openings show the penetrations adjusted to align on the cut plane axis.
   - Nozzle penetrations and instrumentation and control openings less than nominal pipe size (NPS) 18 were not modeled.
   - Parent material, cladding and threaded inserts were modeled as separate material properties with shared boundaries. Other bolting components were modeled as separate parts.
   - Fasteners were modeled using minimum minor (thread root) bolt diameters.

2. CNV Middle Section Model

   - A one-eighth slice of the total CNV middle section was modeled. One slice plane is through the centerlines of the SG inspection port (CNV30) and the second plane is through the pressurizer heater access port (CNV31). The blue segment shown in Figure 3-3 shows the segment modeled and actual alignment of openings.

     After the analysis of the CNV ultimate pressure was performed the design was modified to add 7.5 inches of reinforcement around the pressurizer access port opening on the inside surface of the CNV at the vertical top and bottom positions of the opening and transitioning to about 2.1 inches of reinforcement on the horizontal left and right positions of the opening. The location of the additional reinforcement added to the pressurizer access port opening is shown in Figure 3-4~~3~~ below, but is not included in the CNV Ultimate Pressure Capacity middle section model. The added reinforcement serves to stiffen the CNV shell around the opening and produce less distortion of the access flange. This additional reinforcement produces a smaller and more uniform deflection of the flange. More deflection of the

[1] Note: The CNV head manway and CRDM power opening (highlighted in yellow in Figure 3-2) are rotated about the CNV centerline such that they align with the 90-degree axis of the top head. The slight geometric discretization does not impact the results.

cover due to a higher pressure is therefore needed to reach the failure criteria specified in Section 3.1. Therefore, the resultant calculated CNV ultimate pressure produces a lower, bounding ultimate pressure from that expected with the added reinforcement.

- The model segment includes the RPV support on the CNV inside surface. The CNV middle section model was used to evaluate membrane strain due to pressure away from local effects per the guidance of Reference 6.1.1, Section C.1.f.4. The RPV support analyzed applies a load and moment to the wall that reasonably represents the support design.

  The RPV support design has been revised slightly from that modeled in this analysis. The DCA submitted RPV support design is shown in Figure 3-5(a) and the RPV support design modeled in the analysis is shown in Figure 3-5(b). The DCA submitted support design is 2.532 inches below the analyzed support location. The attachment bolt in the DCA submitted design is also moved away from the CNV wall by an additional 4.325 inches. Since this model is used only to evaluate membrane strain due to pressure away from local effects per the guidance of RG 1.216 Section C.1.f.4, the revised RPV support in the DCA submitted design does not affect the CNV Ultimate Pressure Capacity results.

- Parent material, cladding and threaded inserts were modeled as separate material properties with shared boundaries. Other bolting components were modeled as separate parts.

- Fasteners were modeled using minimum minor (thread root) bolt diameters.

3. CNV Bottom Section Model

   - A 1/96 slice of the total CNV bottom section was modeled. The model includes the refueling flanges and a closure bolt. One slice plane is through the centerline of the CNV and passes through the centerline of the closure bolt on the 0-degree axis. The second slice plane passes mid-way between closure studs. The blue segment in Figure 3-6 ~~Figure 3-4~~ shows the segment modeled and alignment with the closure studs.

   - Parent material and cladding were modeled as separate material properties with shared boundaries. Other bolting components were modeled as separate parts.

   - Fasteners were modeled using minimum minor (thread root) bolt diameters.

CNV Head Buckling Models:

4. Top Head Buckling Model

- A full 360-degree CNV top head is modeled. The model includes the CNV Head Manway 18 in. diameter (CNV24) and the CRDM Access opening – 67 in. diameter (CNV25) openings, without covers.
- Nozzle penetrations and small instrumentation and control openings less than NPS 18 were not modeled.
- Parent material and cladding were modeled as separate material properties with shared boundaries.
- Fasteners, including threaded inserts were not included.

5. Bottom Head Buckling Model

   - A full, 360-degree CNV bottom head was modeled. There are no penetrations in the CNV bottom head. The CNV support skirt on the outside of the bottom head was included in the model.
   - The design of the reactor pressure vessel (RPV) lateral support located on the dome of the bottom head has subsequently been revised. The pin and retainer modeled in the analysis had the pin located on the bottom, inside surface of the CNV, and the retainer on the bottom, outside surface of the RPV. After completion of the analysis the design was modified to the ~~current~~DCA submitted design with the pin located on the RPV and the retainer on the CNV. Figure 3-7(a) shows the DCA submitted design of the RPV lateral support and Figure 3-7(b) shows the RPV lateral support design modeled for the analysis. Since the RPV lateral support is located at the center of the dome and remote from the knuckle, it provides no additional support to the knuckle. Therefore, this design change has no impact on the buckling of the knuckle due to internal pressure.

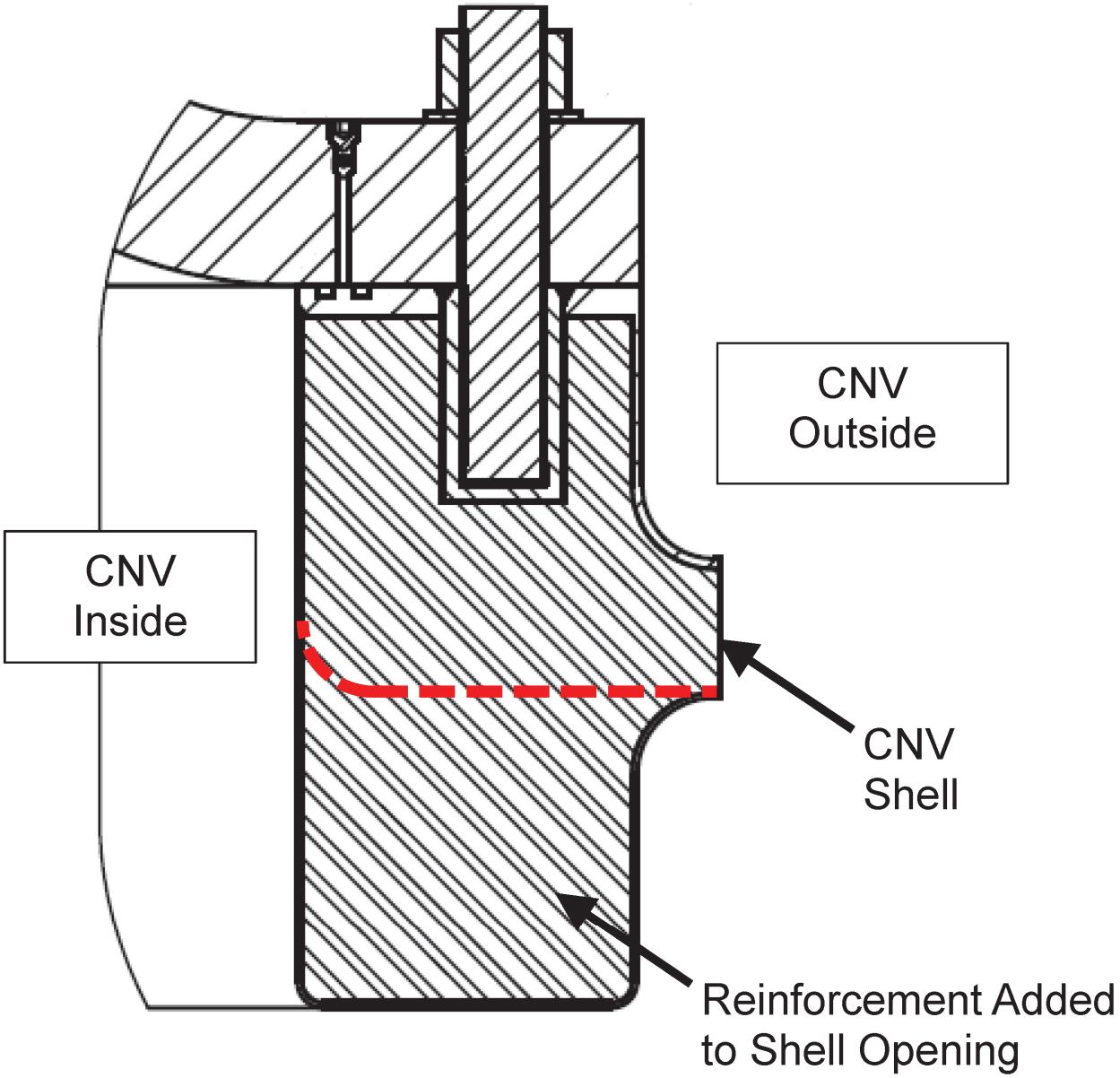
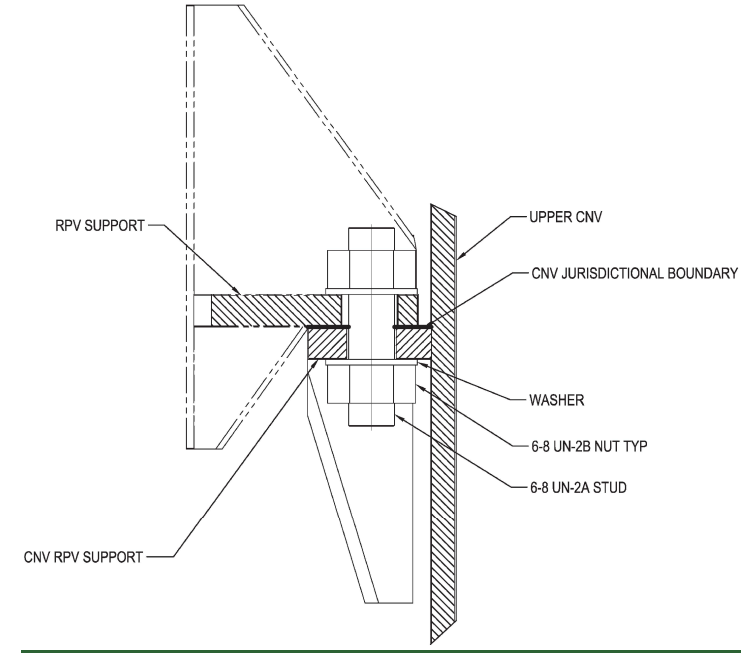
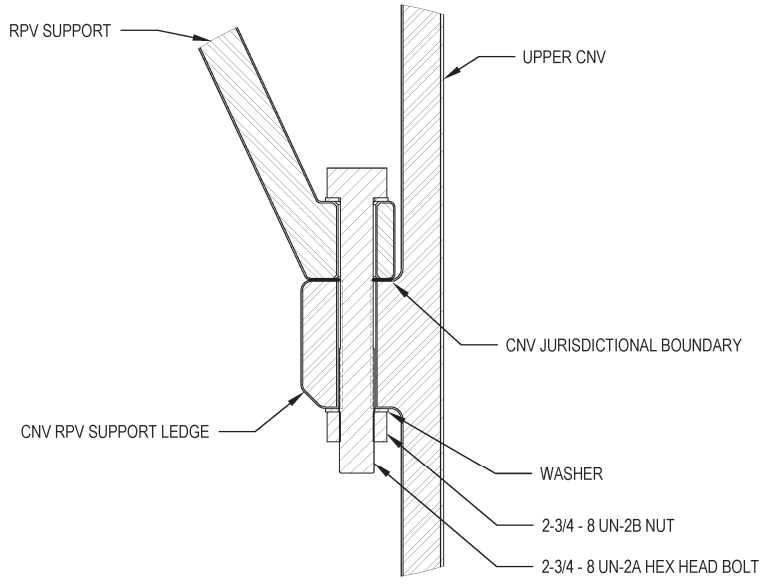


Figure 3-4 Reinforcement Added to PZR Access Opening



(a) DCA Submitted Design



(b) Design Analyzed

Figure 3-5 CNV RPV Support Geometry

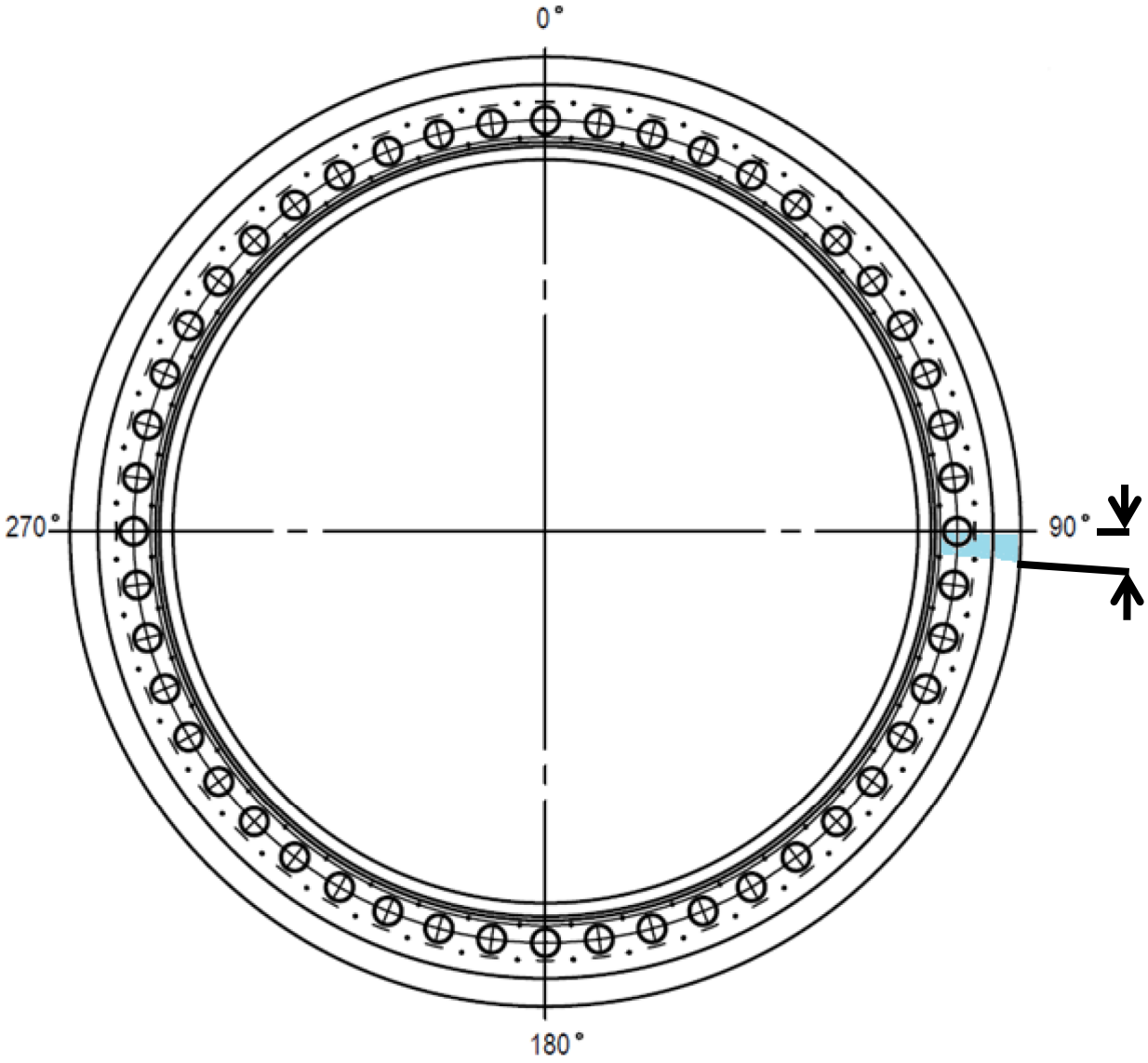
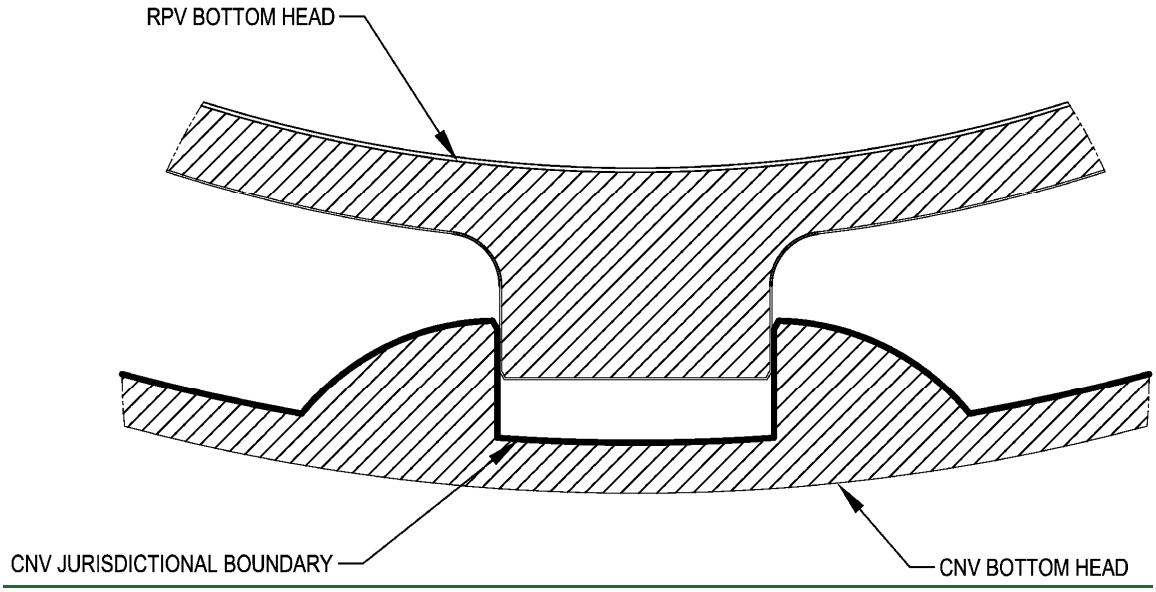
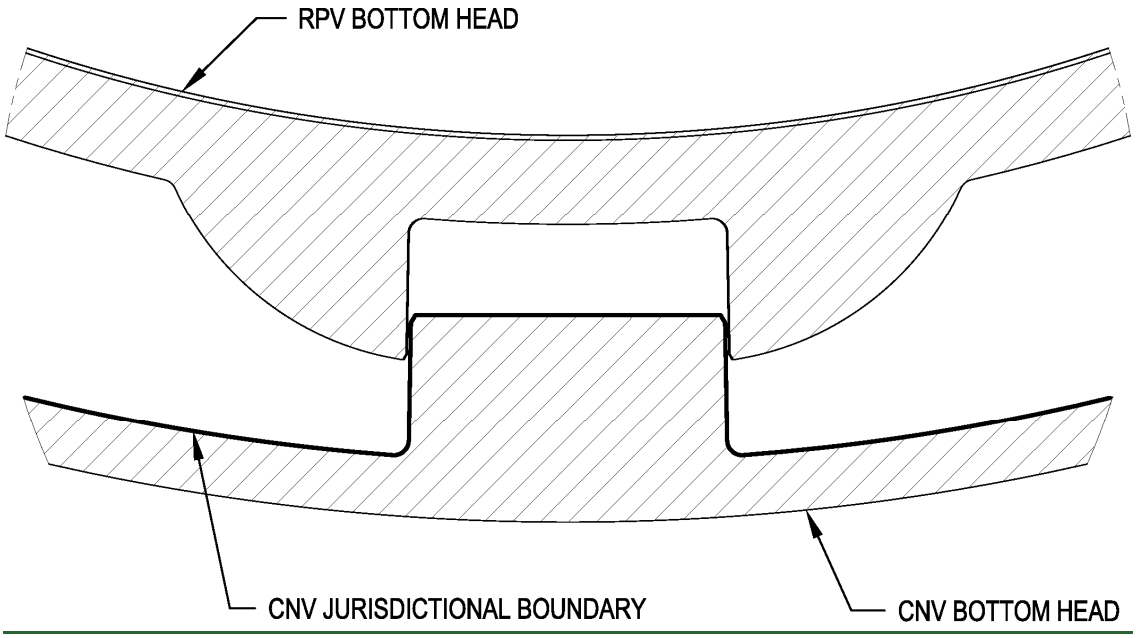


Figure 3-6~~4~~ CNV bottom section model alignment



(a) DCA Submitted Design



(b) Design Analyzed

Figure 3-7 RPV Lateral Support Geometry