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MFN 06-159 Supplement 1

Docket No. 52-010

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U.S. Nuclear Regulatory Commission
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Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 18 - Related to ESBWR Design Certification Application - Containment Subcompartment Loads - RAI Numbers 6.2-15 S01, 6.2-18 S01, and 6.2-23 S01**

Enclosure 1 contains the GE-Hitachi Nuclear Energy Americas LLC (GEH) response to the subject NRC RAIs originally transmitted via the Reference 1 letter and supplemented by NRC requests for clarification.

If you have any questions or require additional information, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

DO68
NRO

Reference:

1. MFN 06-113, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application*, April 24, 2006

Enclosure:

1. MFN 06-159 Supplement 1 - Response to Portion of NRC Request for Additional Information Letter No. 18 - Related to ESBWR Design Certification Application - Containment Subcompartment Loads - RAI Numbers 6.2-15 S01, 6.2-18 S01, and 6.2-23 S01

cc:	AE Cubbage	USNRC (with enclosures)
	GB Stramback	GEH/San Jose (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	eDRF	0000-0071-5294

Enclosure 1

MFN 06-159 Supplement 1

Response to Portion of NRC Request for

Additional Information Letter No. 18

Related to ESBWR Design Certification Application

Containment Subcompartment Loads

RAI Numbers 6.2-15 S01, 6.2-18 S01, and 6.2-23 S01

NRC RAI 6.2-15 S01:

GE's response to RAI 6.2-15, MFN 06-159, and DCD, Tier 2, Rev. 3, Section 6.2.1.2.1, states that "[a]t least 15% margin above the analytically determined pressure is applied for structural analysis." DCD, Tier 2, Rev. 3, Section 6.2.1.2, notes that a factor of 1.4 is applied to the peak differential pressure calculated for the subcompartment, structure, and the enclosed components.

Please explain this apparent discrepancy.

GEH Response:

See response to RAI 6.2-18 S01, Part A.

DCD Impact:

No DCD changes will be made in response to this RAI.

NRC RAI 6.2-18 S01:

GE's response to RAI 6.2-18, and DCD, Tier 2, Rev. 3, Section 6.2.1.2.3 states that "[t]he mass release rates are determined with Moody's Frictionless Critical Flow Model and Analyzed with TRACG, the peak subcompartment pressure responses were found to be below the design pressure for all postulated pipe break accidents."

A. *Please explain how the statement subcompartment pressure responses were found to be below the design pressure relates to the factor of 1.4" margin stated in Section 6.2.1.2 and the "at least 15% margin" in Section 6.2.1.2.1.*

B. *In GE's response to RAI 6.2-18, GE stated that it did not use computer codes to calculate mass and energy release for containment subcompartment analysis. Please confirm this statement and include it in DCD, Tier 2.*

C. *Please provide the design pressure in DCD, Tier 2.*

GEH Response:

A. A multiplier of 1.2 was applied to the peak pressures calculated for annulus pressurization before being applied to structural analyses. This 1.2 multiplier ensures at least 15% margin above the analytically determined pressures. The last paragraph of DCD Tier 2, Revision 3, Subsection 6.2.1.2 will be rephrased with "a factor of 1.2".

B. No computer program was used to calculate mass and energy releases. A copy of the calculation used is included in the response to RAI 6.2-23 S01, Part C. The mass release rates are based on F. J. Moody, "Maximum Discharge Rate of Liquid Vapor Mixtures from Vessels," Proceedings of the ASME Symposium on Non-Equilibrium Two-Phase Flows, p. 27-36, 1975.

C. The structural integrity of subcompartments is evaluated based on load combination described in DCD Tier 2, Revision 3, Subsection 3.G.1.5.2, instead of a single design pressure. The integrity of the reactor shield wall is discussed in DCD Tier 2, Revision 3, Subsection 3G.1.5.4.2.3.

DCD Impact:

A. In the last paragraph of DCD Tier 2, Subsection 6.2.1.2, "a factor of 1.4" will be replaced with "a factor of 1.2".

B. DCD Tier 2, Subsection 6.2.1.2.3, will be amended to state the following:

> "The mass release rates are determined with Moody's Critical Flow Model for Homogenous Equilibrium Mixture (Reference 6.2-7). The manually determined flows are 9.389 x 104 kg/(sec-m2) and 4.868 x 104 kg/(sec-m2) for FWL and RWCU breaks, respectively."

The added Reference 6.2-7 is:

F. J. Moody, "Maximum Discharge Rate of Liquid Vapor Mixtures from Vessels," Proceedings of the ASME Symposium on Non-Equilibrium Two-Phase Flows, p. 27-36, 1975.

C. The last sentence of DCD Tier 2, Subsection 6.2.1.2.3 will be amended to state the following:

"The subcompartment pressure responses were analyzed with TRACG. The integrity of the reactor shield wall is discussed in Subsection 3G.1.5.4.2.3."

The last paragraph of DCD Tier 2, Subsection 6.2.1.2 will be further amended to state the following:

"During the construction permit stage, a factor of 1.2 is applied to the peak differential pressure calculated for the subcompartment, structure and the enclosed components, for use in the design of the structure and the component supports. At the operating license (OL) stage, the peak calculated differential pressure can be used in structural evaluations. It is expected that the post-OL peak calculated differential pressure would not be substantially different from that of the construction permit stage. However, improvements in the analytical models or changes in the as-built subcompartment may affect the available margin."

NRC RAI 6.2-23 S01:

In RAI 6.2-23 the staff requested for subcompartment nodalization information in accordance with the formats of Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition) Rev. 3, Section 6.2.1.2. In GE's response, MFN 06-159, GE provided nodal data but stated without specifics that it calculated large pipe and vessel support structure volumes and hydraulic diameters and accounted for the additional obstructions by applying a 10% reduction factor in the annulus volume for cells where a specific obstruction is not modeled.

Please provide the following information needed to perform a confirmatory subcompartment analysis of the vessel/shield wall annular volume:

A. The TRACG input for the reactor shield wall subcompartment analysis.

B. The results of a sensitivity analysis on the number and size of the control volumes used in the shield wall subcompartment analysis. This information is needed to verify the appropriateness of the control volume nodalization used in the final reported analysis.

C. A copy of the calculation used to obtain the break mass and energy releases. This information is needed to confirm the appropriateness of the assumptions used in this calculation.

D. Detailed information and/or drawings describing the space between the reactor vessel and shield wall to include the following:

1. The outer diameter of the reactor vessel.

2. A description of the upper and lower heads of the reactor vessel.

3. A description of the shield wall including inner diameter and the volumes surrounding the upper and lower vessel heads.

4. The type and thickness of the reactor vessel insulation, and information on how the insulation is treated in the subcompartment analysis (i.e., whether the insulation is assumed to stay in place or blown away and its affect on the calculated volume and nodalization of the annular volume).

5. A description of the flow obstructions in the reactor vessel/shield wall annular volume: flow area, flow resistance, and flow obstructions providing boundaries for the control volume nodalization.

6. A description of the flow connections (i.e., flow area and flow resistance) between the reactor vessel/shield wall annulus and the upper part of the drywell.

GEH Response:

A. Two TRACG input decks are included as Attachments 1 and 2 of this enclosure:

FW_r2.bdk	for feedwater line (FWL) break
RWCU_r2.bdk	for reactor water clean-up (RWCU) line break

B. The GEH experience with annulus pressurization of previous BWRs has indicated that smaller node sizes around the break location resulted in higher pressures. Based on this, smaller node sizes are applied near the break location. The nodalization of ESBWR annulus pressurization was supplied with the original response to RAI 6.2-23 (MFN 06-159, dated June 5, 2006). The nodes around the postulated breaks, (i.e., Levels 7 through 14) have a dimension of 0.34 m, the smallest size without encroaching the inside diameter of a feedwater line or RWCU line.

   A sensitivity study was performed to show the impact of the annulus volume. Annulus volumes where no specific obstructions are present were increased by 10%, and the cell volume where the peak pressure occurs was not changed due to presence of obstruction. For a RWCU line break, the peak pressure of the sensitivity cases is reduced to 1.228 MPa, compared to 1.267 MPa of the base case.

C. Pages showing calculations of mass and energy releases are included as Attachment 3 in this enclosure.

D. Following are item-by-item responses:

   1. The outer diameter of the reactor vessel is 7.476 meters.

   2. Descriptions of the reactor vessel, including upper and lower reactor pressure vessel (RPV) heads, are provided in DCD Tier 2, Revision 3, Subsection 5.3.3.2.1.

   3. The geometry of the reactor shield wall (RSW) is shown in the attached Figure (Upper Drywell). The inner diameter of the RSW is 9.292 meters. The thickness is 0.016 meter.

   4. A description of RPV insulation is provided in DCD Tier 2, Revision 3, Subsection 5.3.3.2.2, under the heading "Reactor Vessel Insulation." The insulation is designed to remain in place and resist damage during a safe shutdown earthquake. The reactor insulation is not modeled in the annulus pressurization analysis.

      The effect of blown-away insulation is addressed in a sensitivity study of reduced vent area between the annulus and drywell. A decrease in the RSW to drywell vent flow area (50% reduction) results in practically no change in the peak annulus pressure. Decreasing drywell venting does show a moderate increase in the annulus pressures as the transient progresses, however, since the peak pressure occurs so soon (3 ms) into the transient, the drywell venting does not affect the peak annulus pressures.

   5. The annulus contains various piping and support structures that presents a reduction in volume from the ideal cylinder. Large piping and vessel support structure volumes and hydraulic diameters are calculated to model the obstruction in the annulus nodal volumes. Volumes are minimized for conservatism and simplicity where necessary. For this analysis, the main steam line, feedwater, DPV, and RWCU piping is specifically incorporated. Also, the RPV stabilizer and vessel support structure are incorporated. All other smaller geometries are assumed to be distributed about the annulus. These additional obstructions are accounted for by applying a 10% reduction in the annulus volume for cells where a specific obstruction is not modeled.

6. The geometry of upper drywell head is shown in DCD Tier 2, Revision 3, Figure 3G.1-51. The flow paths between the drywell head and RSW are shown in the attached Figure. The upper drywell head volume is not credited in the annulus pressurization calculation to maximize the annulus pressure.

DCD Impact:

No DCD changes will be made in response to this RAI.

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=ESBWR Annulus Model FW
* This file models the annulus between the RPV and RSW
*               IEOS    NTRACE    IST    NEXTR
OPTIONS          0        0       -1       0
*               DSTEP     TIMET       STDYST    TRANSI    NCOMP    NJUN    IPAK
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*                  EPSO          EPSI          EPSS       IMPCON   OITMAX   IITMAX
MAIN01          1.0000E-04   1.0000E-04   1.0000E-04     1         10        0
*               SITMAX   NTRX   NDMPTR   ICTR   IBORC   IOPTCD     CMULT
MAIN02            10       0      0        0      0        2      1.0000E+02
*               IAIR    ICONTA   NROT   MIXING
MAIN03            1       0        0       1
*
******    COMPONENT LIST CARDS
COMPLIST00   99   01   02
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******    TIME STEP DATA CARDS
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*             DTMIN     DTMAX     TEND   RTWFP  EDINFP   GFINT     DMPINT     SEDINT
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TIMESTEP030   1.0E-08   2.5E-03   0.200  1.0    5.0E-03  5.0E-03   8.0E+03   1.00E+06
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*****                TH
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VSSL9908FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9907FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9906FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9905FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9904FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9903FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9902FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9901FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9918FA-Z0    R09 0.0  0.446 0.446 0.446 0.446 0.446 0.446 0.446 0.446 0.00 E
VSSL9917FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9916FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9915FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9914FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9913FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9912FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9911FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9910FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9909FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9908FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9907FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9906FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9905FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
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VSSL9904FA-Z0     R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9903FA-Z0     R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9902FA-Z0     R09 0.0  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 E
VSSL9901FA-Z0     R09 0.0  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 E
VSSL9918FRICN-R0 F 0.0          E
VSSL9917FRICN-R0 F 0.0          E
VSSL9916FRICN-R0 F 0.0          E
VSSL9915FRICN-R0 F 0.0          E
VSSL9914FRICN-R0 F 0.0          E
VSSL9913FRICN-R0 F 0.0          E
VSSL9912FRICN-R0 F 0.0          E
VSSL9911FRICN-R0 F 0.0          E
VSSL9910FRICN-R0 F 0.0          E
VSSL9909FRICN-R0 F 0.0          E
VSSL9908FRICN-R0 F 0.0          E
VSSL9907FRICN-R0 F 0.0          E
VSSL9906FRICN-R0 F 0.0          E
VSSL9905FRICN-R0 F 0.0          E
VSSL9904FRICN-R0 F 0.0          E
VSSL9903FRICN-R0 F 0.0          E
VSSL9902FRICN-R0 F 0.0          E
VSSL9901FRICN-R0 F 0.0          E
VSSL9918FRICN-T0 F 0.0          E
VSSL9917FRICN-T0 F 0.0          E
VSSL9916FRICN-T0 F 0.0          E
VSSL9915FRICN-T0 F 0.0          E
VSSL9914FRICN-T0 F 0.0          E
VSSL9913FRICN-T0 F 0.0          E
VSSL9912FRICN-T0 F 0.0          E
VSSL9911FRICN-T0 F 0.0          E
VSSL9910FRICN-T0 F 0.0          E
VSSL9909FRICN-T0 F 0.0          E
VSSL9908FRICN-T0 F 0.0          E
VSSL9907FRICN-T0 F 0.0          E
VSSL9906FRICN-T0 F 0.0          E
VSSL9905FRICN-T0 F 0.0          E
VSSL9904FRICN-T0 F 0.0          E
VSSL9903FRICN-T0 F 0.0          E
VSSL9902FRICN-T0 F 0.0          E
VSSL9901FRICN-T0 F 0.0          E
VSSL9918FRICN-Z0 F 0.0          E
VSSL9917FRICN-Z0 F 0.0          E
VSSL9916FRICN-Z0 F 0.0          E
VSSL9915FRICN-Z0 F 0.0          E
VSSL9914FRICN-Z0 F 0.0          E
VSSL9913FRICN-Z0 F 0.0          E
VSSL9912FRICN-Z0 F 0.0          E
VSSL9911FRICN-Z0 F 0.0          E
VSSL9910FRICN-Z0 F 0.0          E
VSSL9909FRICN-Z0 F 0.0          E
VSSL9908FRICN-Z0 F 0.0          E
VSSL9907FRICN-Z0 F 0.0          E
VSSL9906FRICN-Z0 F 0.0          E
VSSL9905FRICN-Z0 F 0.0          E
VSSL9904FRICN-Z0 F 0.0          E
```

VSSL9903FRICN-Z0	F	0.0	E
VSSL9902FRICN-Z0	F	0.0	E
VSSL9901FRICN-Z0	F	0.0	E
VSSL9918FRICP-R0	F	0.0	E
VSSL9917FRICP-R0	F	0.0	E
VSSL9916FRICP-R0	F	0.0	E
VSSL9915FRICP-R0	F	0.0	E
VSSL9914FRICP-R0	F	0.0	E
VSSL9913FRICP-R0	F	0.0	E
VSSL9912FRICP-R0	F	0.0	E
VSSL9911FRICP-R0	F	0.0	E
VSSL9910FRICP-R0	F	0.0	E
VSSL9909FRICP-R0	F	0.0	E
VSSL9908FRICP-R0	F	0.0	E
VSSL9907FRICP-R0	F	0.0	E
VSSL9906FRICP-R0	F	0.0	E
VSSL9905FRICP-R0	F	0.0	E
VSSL9904FRICP-R0	F	0.0	E
VSSL9903FRICP-R0	F	0.0	E
VSSL9902FRICP-R0	F	0.0	E
VSSL9901FRICP-R0	F	0.0	E
VSSL9918FRICP-T0	F	0.0	E
VSSL9917FRICP-T0	F	0.0	E
VSSL9916FRICP-T0	F	0.0	E
VSSL9915FRICP-T0	F	0.0	E
VSSL9914FRICP-T0	F	0.0	E
VSSL9913FRICP-T0	F	0.0	E
VSSL9912FRICP-T0	F	0.0	E
VSSL9911FRICP-T0	F	0.0	E
VSSL9910FRICP-T0	F	0.0	E
VSSL9909FRICP-T0	F	0.0	E
VSSL9908FRICP-T0	F	0.0	E
VSSL9907FRICP-T0	F	0.0	E
VSSL9906FRICP-T0	F	0.0	E
VSSL9905FRICP-T0	F	0.0	E
VSSL9904FRICP-T0	F	0.0	E
VSSL9903FRICP-T0	F	0.0	E
VSSL9902FRICP-T0	F	0.0	E
VSSL9901FRICP-T0	F	0.0	E
VSSL9918FRICP-Z0	F	0.0	E
VSSL9917FRICP-Z0	F	0.0	E
VSSL9916FRICP-Z0	F	0.0	E
VSSL9915FRICP-Z0	F	0.0	E
VSSL9914FRICP-Z0	F	0.0	E
VSSL9913FRICP-Z0	F	0.0	E
VSSL9912FRICP-Z0	F	0.0	E
VSSL9911FRICP-Z0	F	0.0	E
VSSL9910FRICP-Z0	F	0.0	E
VSSL9909FRICP-Z0	F	0.0	E
VSSL9908FRICP-Z0	F	0.0	E
VSSL9907FRICP-Z0	F	0.0	E
VSSL9906FRICP-Z0	F	0.0	E
VSSL9905FRICP-Z0	F	0.0	E
VSSL9904FRICP-Z0	F	0.0	E
VSSL9903FRICP-Z0	F	0.0	E

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VSSL9902FRICP-Z0 F 0.0            E
VSSL9901FRICP-Z0 F 0.0            E
VSSL9918HD-R0    F 1.0            E
VSSL9917HD-R0    F 1.0            E
VSSL9916HD-R0    F 1.0            E
VSSL9915HD-R0    F 1.0            E
VSSL9914HD-R0    F 1.0            E
VSSL9913HD-R0    F 1.0            E
VSSL9912HD-R0    F 1.0            E
VSSL9911HD-R0    F 1.0            E
VSSL9910HD-R0    F 1.0            E
VSSL9909HD-R0    F 1.0            E
VSSL9908HD-R0    F 1.0            E
VSSL9907HD-R0    F 1.0            E
VSSL9906HD-R0    F 1.0            E
VSSL9905HD-R0    F 1.0            E
VSSL9904HD-R0    F 1.0            E
VSSL9903HD-R0    F 1.0            E
VSSL9902HD-R0    F 1.0            E
VSSL9901HD-R0    F 1.0            E
*23456789012345678901234567890123456789*123456789012345678901234567890123456789E
VSSL9918HD-T0    R09 0.0 1.460 1.460 1.460 1.460 1.460 1.460 1.460 1.460 1.816 E
VSSL9917HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9916HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9915HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9914HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9913HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9912HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9911HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9910HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9909HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9908HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9907HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9906HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9905HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9904HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9903HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9902HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9901HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9918HD-Z0    R09 0.0 1.460 1.460 1.460 1.460 1.460 1.460 1.460 1.460 1.816 E
VSSL9917HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9916HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9915HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9914HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9913HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9912HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9911HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9910HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9909HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9908HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9907HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9906HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9905HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9904HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9903HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
```

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VSSL9902HD-Z0     R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9901HD-Z0     R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9918HSA0      F 0.0           E
VSSL9917HSA0      F 0.0           E
VSSL9916HSA0      F 0.0           E
VSSL9915HSA0      F 0.0           E
VSSL9914HSA0      F 0.0           E
VSSL9913HSA0      F 0.0           E
VSSL9912HSA0      F 0.0           E
VSSL9911HSA0      F 0.0           E
VSSL9910HSA0      F 0.0           E
VSSL9909HSA0      F 0.0           E
VSSL9908HSA0      F 0.0           E
VSSL9907HSA0      F 0.0           E
VSSL9906HSA0      F 0.0           E
VSSL9905HSA0      F 0.0           E
VSSL9904HSA0      F 0.0           E
VSSL9903HSA0      F 0.0           E
VSSL9902HSA0      F 0.0           E
VSSL9901HSA0      F 0.0           E
VSSL9918HSM0      F 0.0           E
VSSL9917HSM0      F 0.0           E
VSSL9916HSM0      F 0.0           E
VSSL9915HSM0      F 0.0           E
VSSL9914HSM0      F 0.0           E
VSSL9913HSM0      F 0.0           E
VSSL9912HSM0      F 0.0           E
VSSL9911HSM0      F 0.0           E
VSSL9910HSM0      F 0.0           E
VSSL9909HSM0      F 0.0           E
VSSL9908HSM0      F 0.0           E
VSSL9907HSM0      F 0.0           E
VSSL9906HSM0      F 0.0           E
VSSL9905HSM0      F 0.0           E
VSSL9904HSM0      F 0.0           E
VSSL9903HSM0      F 0.0           E
VSSL9902HSM0      F 0.0           E
VSSL9901HSM0      F 0.0           E
VSSL9918520000    F 400.0         E
VSSL9917520000    F 400.0         E
VSSL9916520000    F 400.0         E
VSSL9915520000    F 400.0         E
VSSL9914520000    F 400.0         E
VSSL9913520000    F 400.0         E
VSSL9912520000    F 400.0         E
VSSL9911520000    F 400.0         E
VSSL9910520000    F 400.0         E
VSSL9909520000    F 400.0         E
VSSL9908520000    F 400.0         E
VSSL9907520000    F 400.0         E
VSSL9906520000    F 400.0         E
VSSL9905520000    F 400.0         E
VSSL9904520000    F 400.0         E
VSSL9903520000    F 400.0         E
VSSL9902520000    F 400.0         E
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VSSL9901520000	F	400.0	E
VSSL9918PA0	F	1.0133E+05	E
VSSL9917PA0	F	1.0133E+05	E
VSSL9916PA0	F	1.0133E+05	E
VSSL9915PA0	F	1.0133E+05	E
VSSL9914PA0	F	1.0133E+05	E
VSSL9913PA0	F	1.0133E+05	E
VSSL9912PA0	F	1.0133E+05	E
VSSL9911PA0	F	1.0133E+05	E
VSSL9910PA0	F	1.0133E+05	E
VSSL9909PA0	F	1.0133E+05	E
VSSL9908PA0	F	1.0133E+05	E
VSSL9907PA0	F	1.0133E+05	E
VSSL9906PA0	F	1.0133E+05	E
VSSL9905PA0	F	1.0133E+05	E
VSSL9904PA0	F	1.0133E+05	E
VSSL9903PA0	F	1.0133E+05	E
VSSL9902PA0	F	1.0133E+05	E
VSSL9901PA0	F	1.0133E+05	E
VSSL9918PN0	F	1.0133E+05	E
VSSL9917PN0	F	1.0133E+05	E
VSSL9916PN0	F	1.0133E+05	E
VSSL9915PN0	F	1.0133E+05	E
VSSL9914PN0	F	1.0133E+05	E
VSSL9913PN0	F	1.0133E+05	E
VSSL9912PN0	F	1.0133E+05	E
VSSL9911PN0	F	1.0133E+05	E
VSSL9910PN0	F	1.0133E+05	E
VSSL9909PN0	F	1.0133E+05	E
VSSL9908PN0	F	1.0133E+05	E
VSSL9907PN0	F	1.0133E+05	E
VSSL9906PN0	F	1.0133E+05	E
VSSL9905PN0	F	1.0133E+05	E
VSSL9904PN0	F	1.0133E+05	E
VSSL9903PN0	F	1.0133E+05	E
VSSL9902PN0	F	1.0133E+05	E
VSSL9901PN0	F	1.0133E+05	E
VSSL9918TLN0	F	280.1	E
VSSL9917TLN0	F	280.1	E
VSSL9916TLN0	F	280.1	E
VSSL9915TLN0	F	280.1	E
VSSL9914TLN0	F	280.1	E
VSSL9913TLN0	F	280.1	E
VSSL9912TLN0	F	280.1	E
VSSL9911TLN0	F	280.1	E
VSSL9910TLN0	F	280.1	E
VSSL9909TLN0	F	280.1	E
VSSL9908TLN0	F	280.1	E
VSSL9907TLN0	F	280.1	E
VSSL9906TLN0	F	280.1	E
VSSL9905TLN0	F	280.1	E
VSSL9904TLN0	F	280.1	E
VSSL9903TLN0	F	280.1	E
VSSL9902TLN0	F	280.1	E
VSSL9901TLN0	F	280.1	E

VSSL9918TVN0	F		373.1	E
VSSL9917TVN0	F		373.1	E
VSSL9916TVN0	F		373.1	E
VSSL9915TVN0	F		373.1	E
VSSL9914TVN0	F		373.1	E
VSSL9913TVN0	F		373.1	E
VSSL9912TVN0	F		373.1	E
VSSL9911TVN0	F		373.1	E
VSSL9910TVN0	F		373.1	E
VSSL9909TVN0	F		373.1	E
VSSL9908TVN0	F		373.1	E
VSSL9907TVN0	F		373.1	E
VSSL9906TVN0	F		373.1	E
VSSL9905TVN0	F		373.1	E
VSSL9904TVN0	F		373.1	E
VSSL9903TVN0	F		373.1	E
VSSL9902TVN0	F		373.1	E
VSSL9901TVN0	F		373.1	E
VSSL9918VLN-R0	F	0.0		E
VSSL9917VLN-R0	F	0.0		E
VSSL9916VLN-R0	F	0.0		E
VSSL9915VLN-R0	F	0.0		E
VSSL9914VLN-R0	F	0.0		E
VSSL9913VLN-R0	F	0.0		E
VSSL9912VLN-R0	F	0.0		E
VSSL9911VLN-R0	F	0.0		E
VSSL9910VLN-R0	F	0.0		E
VSSL9909VLN-R0	F	0.0		E
VSSL9908VLN-R0	F	0.0		E
VSSL9907VLN-R0	F	0.0		E
VSSL9906VLN-R0	F	0.0		E
VSSL9905VLN-R0	F	0.0		E
VSSL9904VLN-R0	F	0.0		E
VSSL9903VLN-R0	F	0.0		E
VSSL9902VLN-R0	F	0.0		E
VSSL9901VLN-R0	F	0.0		E
VSSL9918VLN-T0	F	0.0		E
VSSL9917VLN-T0	F	0.0		E
VSSL9916VLN-T0	F	0.0		E
VSSL9915VLN-T0	F	0.0		E
VSSL9914VLN-T0	F	0.0		E
VSSL9913VLN-T0	F	0.0		E
VSSL9912VLN-T0	F	0.0		E
VSSL9911VLN-T0	F	0.0		E
VSSL9910VLN-T0	F	0.0		E
VSSL9909VLN-T0	F	0.0		E
VSSL9908VLN-T0	F	0.0		E
VSSL9907VLN-T0	F	0.0		E
VSSL9906VLN-T0	F	0.0		E
VSSL9905VLN-T0	F	0.0		E
VSSL9904VLN-T0	F	0.0		E
VSSL9903VLN-T0	F	0.0		E
VSSL9902VLN-T0	F	0.0		E
VSSL9901VLN-T0	F	0.0		E
VSSL9918VLN-Z0	F	0.0		E

```
VSSL9917VLN-Z0    F 0.0          E
VSSL9916VLN-Z0    F 0.0          E
VSSL9915VLN-Z0    F 0.0          E
VSSL9914VLN-Z0    F 0.0          E
VSSL9913VLN-Z0    F 0.0          E
VSSL9912VLN-Z0    F 0.0          E
VSSL9911VLN-Z0    F 0.0          E
VSSL9910VLN-Z0    F 0.0          E
VSSL9909VLN-Z0    F 0.0          E
VSSL9908VLN-Z0    F 0.0          E
VSSL9907VLN-Z0    F 0.0          E
VSSL9906VLN-Z0    F 0.0          E
VSSL9905VLN-Z0    F 0.0          E
VSSL9904VLN-Z0    F 0.0          E
VSSL9903VLN-Z0    F 0.0          E
VSSL9902VLN-Z0    F 0.0          E
VSSL9901VLN-Z0    F 0.0          E
*234567890123456789012345678901234567890*1234567890123456789012345678901234567890E
VSSL9918VOL0      R09 1.0 526.8 526.8 526.8 526.8 526.8 526.8 526.8 526.8  1.0  E
VSSL9917VOL0      R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9916VOL0      R09 1.0 0.900 0.900 0.900 0.477 0.900 0.962 0.900 0.869  0.90 E
VSSL9915VOL0      R09 1.0 0.315 0.315 0.900 0.900 0.900 0.692 0.692 0.588  0.90 E
VSSL9914VOL0      R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9913VOL0      R09 1.0 0.404 0.900 0.900 0.900 0.900 0.894 0.894 0.947  0.90 E
VSSL9912VOL0      R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9911VOL0      R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9910VOL0      R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9909VOL0      R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9908VOL0      R09 1.0 0.404 0.900 0.900 0.900 0.900 0.900 0.900 0.947  0.90 E
VSSL9907VOL0      R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9906VOL0      R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9905VOL0      R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9904VOL0      R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9903VOL0      R09 1.0 0.034 0.034 0.034 0.900 0.900 0.438 0.438 0.207  0.90 E
VSSL9902VOL0      R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9901VOL0      R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9918VVN-R0    F 0.0          E
VSSL9917VVN-R0    F 0.0          E
VSSL9916VVN-R0    F 0.0          E
VSSL9915VVN-R0    F 0.0          E
VSSL9914VVN-R0    F 0.0          E
VSSL9913VVN-R0    F 0.0          E
VSSL9912VVN-R0    F 0.0          E
VSSL9911VVN-R0    F 0.0          E
VSSL9910VVN-R0    F 0.0          E
VSSL9909VVN-R0    F 0.0          E
VSSL9908VVN-R0    F 0.0          E
VSSL9907VVN-R0    F 0.0          E
VSSL9906VVN-R0    F 0.0          E
VSSL9905VVN-R0    F 0.0          E
VSSL9904VVN-R0    F 0.0          E
VSSL9903VVN-R0    F 0.0          E
VSSL9902VVN-R0    F 0.0          E
VSSL9901VVN-R0    F 0.0          E
VSSL9918VVN-T0    F 0.0          E
```

```
VSSL9917VVN-T0    F 0.0              E
VSSL9916VVN-T0    F 0.0              E
VSSL9915VVN-T0    F 0.0              E
VSSL9914VVN-T0    F 0.0              E
VSSL9913VVN-T0    F 0.0              E
VSSL9912VVN-T0    F 0.0              E
VSSL9911VVN-T0    F 0.0              E
VSSL9910VVN-T0    F 0.0              E
VSSL9909VVN-T0    F 0.0              E
VSSL9908VVN-T0    F 0.0              E
VSSL9907VVN-T0    F 0.0              E
VSSL9906VVN-T0    F 0.0              E
VSSL9905VVN-T0    F 0.0              E
VSSL9904VVN-T0    F 0.0              E
VSSL9903VVN-T0    F 0.0              E
VSSL9902VVN-T0    F 0.0              E
VSSL9901VVN-T0    F 0.0              E
VSSL9918VVN-Z0    F 0.0              E
VSSL9917VVN-Z0    F 0.0              E
VSSL9916VVN-Z0    F 0.0              E
VSSL9915VVN-Z0    F 0.0              E
VSSL9914VVN-Z0    F 0.0              E
VSSL9913VVN-Z0    F 0.0              E
VSSL9912VVN-Z0    F 0.0              E
VSSL9911VVN-Z0    F 0.0              E
VSSL9910VVN-Z0    F 0.0              E
VSSL9909VVN-Z0    F 0.0              E
VSSL9908VVN-Z0    F 0.0              E
VSSL9907VVN-Z0    F 0.0              E
VSSL9906VVN-Z0    F 0.0              E
VSSL9905VVN-Z0    F 0.0              E
VSSL9904VVN-Z0    F 0.0              E
VSSL9903VVN-Z0    F 0.0              E
VSSL9902VVN-Z0    F 0.0              E
VSSL9901VVN-Z0    F 0.0              E
*
*****          PIPE
*
PIPE02000    2     "FW BREAK AND VESSEL"
*            NCELLS    NODES     JUN1      JUN2       MAT
PIPE02010     1          0         1         2         0
PIPE02DX0              0.355              E
PIPE02VOL0             0.0166             E
PIPE02TL0              488.75             E
PIPE02TV0              488.75             E
PIPE02P0               7.305E+06          E
PIPE02PA0              0.0                E
PIPE02ALP              0.0                E
PIPE02FRICN0    0.0         1.0           E
PIPE02FRICP0    0.0         0.0           E
PIPE02FA0       0.0468      0.0468        E
PIPE02VL0       0.0         0.0           E
PIPE02VV0       0.0         0.0           E
PIPE02ICHOKE0   0           0             E
*
```

```
*****          FILL
*
FILL01000     1   "FW PIPE VELOCITY BOUNDARY"
*             JUN1    IFTY    IFTR    NFTX
FILL01010       1       0       0       4
*             DXIN    VOLIN    ALPIN   VIN    TIN     PIN      BORCIN
FILL01011     0.355   0.0166   0.0     55.2   488.75 7.305E+06  0
*
.END OF INPUTS
```

```
=ESBWR Annulus Model RWCU
* This file models the annulus between the RPV and RSW
*               IEOS   NTRACE   IST   NEXTR
OPTIONS           0        0    -1       0
*               DSTEP     TIMET       STDYST   TRANSI   NCOMP   NJUN   IPAK
MAIN00            0     0.0000E+00     0         1        3       2      1
*                  EPSO         EPSI         EPSS      IMPCON   OITMAX   IITMAX
MAIN01          1.0000E-04   1.0000E-04   1.0000E-04     1        10        0
*               SITMAX   NTRX   NDMPTR   ICTR   IBORC   IOPTCD     CMULT
MAIN02            10       0      0        0      0       2      1.0000E+02
*               IAIR   ICONTA   NROT   MIXING
MAIN03            1       0       0       1
*
******    COMPONENT LIST CARDS
COMPLIST00   99   01   02
*
******    TIME STEP DATA CARDS
*
*23456789012345678901234567890123456789*123456789012345678901234567890123456789E
*             DTMIN     DTMAX     TEND  RTWFP  EDINFP   GFINT    DMPINT    SEDINT
TIMESTEP010   1.0E-08   1.0E-04   0.004  1.0   5.0E-04  5.0E-04  8.0E+03  1.00E+06
TIMESTEP020   1.0E-08   1.0E-03   0.018  1.0   2.0E-03  2.0E-03  8.0E+03  1.00E+06
TIMESTEP030   1.0E-08   2.5E-03   0.200  1.0   5.0E-03  5.0E-03  8.0E+03  1.00E+06
*
******    VSSL HEADER CARD
VSSL9900000    99 "3D Annulus"
*             VSSL SIMPLE PARAMETER CARD
*                            NASX         NRSX         NTSX         NCSR
VSSL9900010                   18           2            9            1
*                   IDCU   IDCL   IDCR   ICRU   ICRL   ICRR
VSSL9900011           0      0      0      0      0      0
*                            ROHS         CPHS          CHS          EMHS
VSSL9900012         2.35000E+03  8.82000E+02  1.62780E+00  7.00000E-01
*                            ISDU         ISDL         ISDR
VSSL9900013                   0            0            0
*                           CZSDL        CRSDV
VSSL9900014         1.00000E+26  1.00000E+26
*                     NODESD      DHOUTL      DHOUTV      DTOUTL      DTOUTV
VSSL9900015              0          0.0         0.0         0.0         0.0
*****               Z
VSSL9900110   2.362      5.377      7.637      9.897
VSSL9900111  12.157     14.417     14.757     15.097
VSSL9900112  15.437     15.777     16.117     16.457
VSSL9900113  16.797     17.137     19.005     20.874
VSSL9900114  21.892     31.892   E
*****               RAD
VSSL9900120   3.738      4.646      E
*****               TH
VSSL9900130  0.0698     0.1396     0.2094     0.3491
VSSL9900131  0.7854     1.5708     2.3562     3.1416
VSSL9900132  6.2832  E
* This set of source cards is commented out, because it is overlaid below:
*                     ISRL   ISRC   ISRF          JUNS          ZJN
*SSL9900140             13     10     -3            2           0.5
VSSL9900140              8     10     -3            2           0.5
```

```
*****           Level VSSL99LVNNNN0 Data
VSSL9918ALPN0     R09 0.0 R09 1.0 E
VSSL9917ALPN0     R09 0.0 R09 1.0 E
VSSL9916ALPN0     R09 0.0 R09 1.0 E
VSSL9915ALPN0     R09 0.0 R09 1.0 E
VSSL9914ALPN0     R09 0.0 R09 1.0 E
VSSL9913ALPN0     R09 0.0 R09 1.0 E
VSSL9912ALPN0     R09 0.0 R09 1.0 E
VSSL9911ALPN0     R09 0.0 R09 1.0 E
VSSL9910ALPN0     R09 0.0 R09 1.0 E
VSSL9909ALPN0     R09 0.0 R09 1.0 E
VSSL9908ALPN0     R09 0.0 R09 1.0 E
VSSL9907ALPN0     R09 0.0 R09 1.0 E
VSSL9906ALPN0     R09 0.0 R09 1.0 E
VSSL9905ALPN0     R09 0.0 R09 1.0 E
VSSL9904ALPN0     R09 0.0 R09 1.0 E
VSSL9903ALPN0     R09 0.0 R09 1.0 E
VSSL9902ALPN0     R09 0.0 R09 1.0 E
VSSL9901ALPN0     R09 0.0 R09 1.0 E
VSSL9918DSA0      F 0.0           E
VSSL9917DSA0      F 0.0           E
VSSL9916DSA0      F 0.0           E
VSSL9915DSA0      F 0.0           E
VSSL9914DSA0      F 0.0           E
VSSL9913DSA0      F 0.0           E
VSSL9912DSA0      F 0.0           E
VSSL9911DSA0      F 0.0           E
VSSL9910DSA0      F 0.0           E
VSSL9909DSA0      F 0.0           E
VSSL9908DSA0      F 0.0           E
VSSL9907DSA0      F 0.0           E
VSSL9906DSA0      F 0.0           E
VSSL9905DSA0      F 0.0           E
VSSL9904DSA0      F 0.0           E
VSSL9903DSA0      F 0.0           E
VSSL9902DSA0      F 0.0           E
VSSL9901DSA0      F 0.0           E
VSSL9918DSAZ0     F 0.0           E
VSSL9917DSAZ0     F 0.0           E
VSSL9916DSAZ0     F 0.0           E
VSSL9915DSAZ0     F 0.0           E
VSSL9914DSAZ0     F 0.0           E
VSSL9913DSAZ0     F 0.0           E
VSSL9912DSAZ0     F 0.0           E
VSSL9911DSAZ0     F 0.0           E
VSSL9910DSAZ0     F 0.0           E
VSSL9909DSAZ0     F 0.0           E
VSSL9908DSAZ0     F 0.0           E
VSSL9907DSAZ0     F 0.0           E
VSSL9906DSAZ0     F 0.0           E
VSSL9905DSAZ0     F 0.0           E
VSSL9904DSAZ0     F 0.0           E
VSSL9903DSAZ0     F 0.0           E
VSSL9902DSAZ0     F 0.0           E
VSSL9901DSAZ0     F 0.0           E
```

VSSL9900DSAZ0	F 0.0	E
VSSL9918DSHLX0	F 400.0	E
VSSL9917DSHLX0	F 400.0	E
VSSL9916DSHLX0	F 400.0	E
VSSL9915DSHLX0	F 400.0	E
VSSL9914DSHLX0	F 400.0	E
VSSL9913DSHLX0	F 400.0	E
VSSL9912DSHLX0	F 400.0	E
VSSL9911DSHLX0	F 400.0	E
VSSL9910DSHLX0	F 400.0	E
VSSL9909DSHLX0	F 400.0	E
VSSL9908DSHLX0	F 400.0	E
VSSL9907DSHLX0	F 400.0	E
VSSL9906DSHLX0	F 400.0	E
VSSL9905DSHLX0	F 400.0	E
VSSL9904DSHLX0	F 400.0	E
VSSL9903DSHLX0	F 400.0	E
VSSL9902DSHLX0	F 400.0	E
VSSL9901DSHLX0	F 400.0	E
VSSL9918DSHVX0	F 400.0	E
VSSL9917DSHVX0	F 400.0	E
VSSL9916DSHVX0	F 400.0	E
VSSL9915DSHVX0	F 400.0	E
VSSL9914DSHVX0	F 400.0	E
VSSL9913DSHVX0	F 400.0	E
VSSL9912DSHVX0	F 400.0	E
VSSL9911DSHVX0	F 400.0	E
VSSL9910DSHVX0	F 400.0	E
VSSL9909DSHVX0	F 400.0	E
VSSL9908DSHVX0	F 400.0	E
VSSL9907DSHVX0	F 400.0	E
VSSL9906DSHVX0	F 400.0	E
VSSL9905DSHVX0	F 400.0	E
VSSL9904DSHVX0	F 400.0	E
VSSL9903DSHVX0	F 400.0	E
VSSL9902DSHVX0	F 400.0	E
VSSL9901DSHVX0	F 400.0	E
VSSL9918DSTH0	F 0.0	E
VSSL9917DSTH0	F 0.0	E
VSSL9916DSTH0	F 0.0	E
VSSL9915DSTH0	F 0.0	E
VSSL9914DSTH0	F 0.0	E
VSSL9913DSTH0	F 0.0	E
VSSL9912DSTH0	F 0.0	E
VSSL9911DSTH0	F 0.0	E
VSSL9910DSTH0	F 0.0	E
VSSL9909DSTH0	F 0.0	E
VSSL9908DSTH0	F 0.0	E
VSSL9907DSTH0	F 0.0	E
VSSL9906DSTH0	F 0.0	E
VSSL9905DSTH0	F 0.0	E
VSSL9904DSTH0	F 0.0	E
VSSL9903DSTH0	F 0.0	E
VSSL9902DSTH0	F 0.0	E
VSSL9901DSTH0	F 0.0	E

VSSL9918DSTHZ0	F	0.0	E
VSSL9917DSTHZ0	F	0.0	E
VSSL9916DSTHZ0	F	0.0	E
VSSL9915DSTHZ0	F	0.0	E
VSSL9914DSTHZ0	F	0.0	E
VSSL9913DSTHZ0	F	0.0	E
VSSL9912DSTHZ0	F	0.0	E
VSSL9911DSTHZ0	F	0.0	E
VSSL9910DSTHZ0	F	0.0	E
VSSL9909DSTHZ0	F	0.0	E
VSSL9908DSTHZ0	F	0.0	E
VSSL9907DSTHZ0	F	0.0	E
VSSL9906DSTHZ0	F	0.0	E
VSSL9905DSTHZ0	F	0.0	E
VSSL9904DSTHZ0	F	0.0	E
VSSL9903DSTHZ0	F	0.0	E
VSSL9902DSTHZ0	F	0.0	E
VSSL9901DSTHZ0	F	0.0	E
VSSL9900DSTHZ0	F	400.0	E
VSSL9918DSTLX0	F	400.0	E
VSSL9917DSTLX0	F	400.0	E
VSSL9916DSTLX0	F	400.0	E
VSSL9915DSTLX0	F	400.0	E
VSSL9914DSTLX0	F	400.0	E
VSSL9913DSTLX0	F	400.0	E
VSSL9912DSTLX0	F	400.0	E
VSSL9911DSTLX0	F	400.0	E
VSSL9910DSTLX0	F	400.0	E
VSSL9909DSTLX0	F	400.0	E
VSSL9908DSTLX0	F	400.0	E
VSSL9907DSTLX0	F	400.0	E
VSSL9906DSTLX0	F	400.0	E
VSSL9905DSTLX0	F	400.0	E
VSSL9904DSTLX0	F	400.0	E
VSSL9903DSTLX0	F	400.0	E
VSSL9902DSTLX0	F	400.0	E
VSSL9901DSTLX0	F	400.0	E
VSSL9918DSTVX0	F	400.0	E
VSSL9917DSTVX0	F	400.0	E
VSSL9916DSTVX0	F	400.0	E
VSSL9915DSTVX0	F	400.0	E
VSSL9914DSTVX0	F	400.0	E
VSSL9913DSTVX0	F	400.0	E
VSSL9912DSTVX0	F	400.0	E
VSSL9911DSTVX0	F	400.0	E
VSSL9910DSTVX0	F	400.0	E
VSSL9909DSTVX0	F	400.0	E
VSSL9908DSTVX0	F	400.0	E
VSSL9907DSTVX0	F	400.0	E
VSSL9906DSTVX0	F	400.0	E
VSSL9905DSTVX0	F	400.0	E
VSSL9904DSTVX0	F	400.0	E
VSSL9903DSTVX0	F	400.0	E
VSSL9902DSTVX0	F	400.0	E
VSSL9901DSTVX0	F	400.0	E

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VSSL9918DSTLZB0  F 400.0          E
VSSL9900DSTLZB0  F 400.0          E
VSSL9918DSTVZB0  F 400.0          E
VSSL9900DSTVZB0  F 400.0          E
VSSL9918FA-R0    F 0.0            E
VSSL9917FA-R0    F 0.0            E
VSSL9916FA-R0    F 0.0            E
VSSL9915FA-R0    F 0.0            E
VSSL9914FA-R0    F 0.0            E
VSSL9913FA-R0    F 0.0            E
VSSL9912FA-R0    F 0.0            E
VSSL9911FA-R0    F 0.0            E
VSSL9910FA-R0    F 0.0            E
VSSL9909FA-R0    F 0.0            E
VSSL9908FA-R0    R09 0.0 0.0656   R08  0.0 E
VSSL9907FA-R0    F 0.0            E
VSSL9906FA-R0    F 0.0            E
VSSL9905FA-R0    F 0.0            E
VSSL9904FA-R0    F 0.0            E
VSSL9903FA-R0    F 0.0            E
VSSL9902FA-R0    F 0.0            E
VSSL9901FA-R0    F 0.0            E
*234567890123456789012345678901234567 89*1234567890123456789012345678901234567 89E
VSSL9918FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9917FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9916FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9915FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9914FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9913FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9912FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9911FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9910FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9909FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9908FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9907FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9906FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9905FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9904FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9903FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9902FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9901FA-T0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00  0.00 E
VSSL9918FA-Z0    R09 0.0  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 E
VSSL9917FA-Z0    R09 0.0  0.446 0.446 0.446 0.446 0.446 0.446 0.446 0.446 0.00 E
VSSL9916FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9915FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9914FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9913FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9912FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9911FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9910FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9909FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9908FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9907FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9906FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9905FA-Z0    R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
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VSSL9904FA-Z0     R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9903FA-Z0     R09 0.0  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00 E
VSSL9902FA-Z0     R09 0.0  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 E
VSSL9901FA-Z0     R09 0.0  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 E
VSSL9918FRICN-R0 F 0.0          E
VSSL9917FRICN-R0 F 0.0          E
VSSL9916FRICN-R0 F 0.0          E
VSSL9915FRICN-R0 F 0.0          E
VSSL9914FRICN-R0 F 0.0          E
VSSL9913FRICN-R0 F 0.0          E
VSSL9912FRICN-R0 F 0.0          E
VSSL9911FRICN-R0 F 0.0          E
VSSL9910FRICN-R0 F 0.0          E
VSSL9909FRICN-R0 F 0.0          E
VSSL9908FRICN-R0 F 0.0          E
VSSL9907FRICN-R0 F 0.0          E
VSSL9906FRICN-R0 F 0.0          E
VSSL9905FRICN-R0 F 0.0          E
VSSL9904FRICN-R0 F 0.0          E
VSSL9903FRICN-R0 F 0.0          E
VSSL9902FRICN-R0 F 0.0          E
VSSL9901FRICN-R0 F 0.0          E
VSSL9918FRICN-T0 F 0.0          E
VSSL9917FRICN-T0 F 0.0          E
VSSL9916FRICN-T0 F 0.0          E
VSSL9915FRICN-T0 F 0.0          E
VSSL9914FRICN-T0 F 0.0          E
VSSL9913FRICN-T0 F 0.0          E
VSSL9912FRICN-T0 F 0.0          E
VSSL9911FRICN-T0 F 0.0          E
VSSL9910FRICN-T0 F 0.0          E
VSSL9909FRICN-T0 F 0.0          E
VSSL9908FRICN-T0 F 0.0          E
VSSL9907FRICN-T0 F 0.0          E
VSSL9906FRICN-T0 F 0.0          E
VSSL9905FRICN-T0 F 0.0          E
VSSL9904FRICN-T0 F 0.0          E
VSSL9903FRICN-T0 F 0.0          E
VSSL9902FRICN-T0 F 0.0          E
VSSL9901FRICN-T0 F 0.0          E
VSSL9918FRICN-Z0 F 0.0          E
VSSL9917FRICN-Z0 F 0.0          E
VSSL9916FRICN-Z0 F 0.0          E
VSSL9915FRICN-Z0 F 0.0          E
VSSL9914FRICN-Z0 F 0.0          E
VSSL9913FRICN-Z0 F 0.0          E
VSSL9912FRICN-Z0 F 0.0          E
VSSL9911FRICN-Z0 F 0.0          E
VSSL9910FRICN-Z0 F 0.0          E
VSSL9909FRICN-Z0 F 0.0          E
VSSL9908FRICN-Z0 F 0.0          E
VSSL9907FRICN-Z0 F 0.0          E
VSSL9906FRICN-Z0 F 0.0          E
VSSL9905FRICN-Z0 F 0.0          E
VSSL9904FRICN-Z0 F 0.0          E
```

VSSL9903FRICN-Z0	F	0.0	E
VSSL9902FRICN-Z0	F	0.0	E
VSSL9901FRICN-Z0	F	0.0	E
VSSL9918FRICP-R0	F	0.0	E
VSSL9917FRICP-R0	F	0.0	E
VSSL9916FRICP-R0	F	0.0	E
VSSL9915FRICP-R0	F	0.0	E
VSSL9914FRICP-R0	F	0.0	E
VSSL9913FRICP-R0	F	0.0	E
VSSL9912FRICP-R0	F	0.0	E
VSSL9911FRICP-R0	F	0.0	E
VSSL9910FRICP-R0	F	0.0	E
VSSL9909FRICP-R0	F	0.0	E
VSSL9908FRICP-R0	F	0.0	E
VSSL9907FRICP-R0	F	0.0	E
VSSL9906FRICP-R0	F	0.0	E
VSSL9905FRICP-R0	F	0.0	E
VSSL9904FRICP-R0	F	0.0	E
VSSL9903FRICP-R0	F	0.0	E
VSSL9902FRICP-R0	F	0.0	E
VSSL9901FRICP-R0	F	0.0	E
VSSL9918FRICP-T0	F	0.0	E
VSSL9917FRICP-T0	F	0.0	E
VSSL9916FRICP-T0	F	0.0	E
VSSL9915FRICP-T0	F	0.0	E
VSSL9914FRICP-T0	F	0.0	E
VSSL9913FRICP-T0	F	0.0	E
VSSL9912FRICP-T0	F	0.0	E
VSSL9911FRICP-T0	F	0.0	E
VSSL9910FRICP-T0	F	0.0	E
VSSL9909FRICP-T0	F	0.0	E
VSSL9908FRICP-T0	F	0.0	E
VSSL9907FRICP-T0	F	0.0	E
VSSL9906FRICP-T0	F	0.0	E
VSSL9905FRICP-T0	F	0.0	E
VSSL9904FRICP-T0	F	0.0	E
VSSL9903FRICP-T0	F	0.0	E
VSSL9902FRICP-T0	F	0.0	E
VSSL9901FRICP-T0	F	0.0	E
VSSL9918FRICP-Z0	F	0.0	E
VSSL9917FRICP-Z0	F	0.0	E
VSSL9916FRICP-Z0	F	0.0	E
VSSL9915FRICP-Z0	F	0.0	E
VSSL9914FRICP-Z0	F	0.0	E
VSSL9913FRICP-Z0	F	0.0	E
VSSL9912FRICP-Z0	F	0.0	E
VSSL9911FRICP-Z0	F	0.0	E
VSSL9910FRICP-Z0	F	0.0	E
VSSL9909FRICP-Z0	F	0.0	E
VSSL9908FRICP-Z0	F	0.0	E
VSSL9907FRICP-Z0	F	0.0	E
VSSL9906FRICP-Z0	F	0.0	E
VSSL9905FRICP-Z0	F	0.0	E
VSSL9904FRICP-Z0	F	0.0	E
VSSL9903FRICP-Z0	F	0.0	E

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VSSL9902FRICP-Z0 F 0.0             E
VSSL9901FRICP-Z0 F 0.0             E
VSSL9918HD-R0    F 1.0             E
VSSL9917HD-R0    F 1.0             E
VSSL9916HD-R0    F 1.0             E
VSSL9915HD-R0    F 1.0             E
VSSL9914HD-R0    F 1.0             E
VSSL9913HD-R0    F 1.0             E
VSSL9912HD-R0    F 1.0             E
VSSL9911HD-R0    F 1.0             E
VSSL9910HD-R0    F 1.0             E
VSSL9909HD-R0    F 1.0             E
VSSL9908HD-R0    F 1.0             E
VSSL9907HD-R0    F 1.0             E
VSSL9906HD-R0    F 1.0             E
VSSL9905HD-R0    F 1.0             E
VSSL9904HD-R0    F 1.0             E
VSSL9903HD-R0    F 1.0             E
VSSL9902HD-R0    F 1.0             E
VSSL9901HD-R0    F 1.0             E
*23456789012345678901234567890123456789*123456789012345678901234567890123456789E
VSSL9918HD-T0    R09 0.0 1.460 1.460 1.460 1.460 1.460 1.460 1.460 1.460 1.816 E
VSSL9917HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9916HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9915HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9914HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9913HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9912HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9911HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9910HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9909HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9908HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9907HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9906HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9905HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9904HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9903HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9902HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9901HD-T0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9918HD-Z0    R09 0.0 1.460 1.460 1.460 1.460 1.460 1.460 1.460 1.460 1.816 E
VSSL9917HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9916HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9915HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9914HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9913HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9912HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9911HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9910HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9909HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9908HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9907HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9906HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9905HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9904HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9903HD-Z0    R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
```

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VSSL9902HD-Z0     R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9901HD-Z0     R09 0.0 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 1.816 E
VSSL9918HSA0      F 0.0        E
VSSL9917HSA0      F 0.0        E
VSSL9916HSA0      F 0.0        E
VSSL9915HSA0      F 0.0        E
VSSL9914HSA0      F 0.0        E
VSSL9913HSA0      F 0.0        E
VSSL9912HSA0      F 0.0        E
VSSL9911HSA0      F 0.0        E
VSSL9910HSA0      F 0.0        E
VSSL9909HSA0      F 0.0        E
VSSL9908HSA0      F 0.0        E
VSSL9907HSA0      F 0.0        E
VSSL9906HSA0      F 0.0        E
VSSL9905HSA0      F 0.0        E
VSSL9904HSA0      F 0.0        E
VSSL9903HSA0      F 0.0        E
VSSL9902HSA0      F 0.0        E
VSSL9901HSA0      F 0.0        E
VSSL9918HSM0      F 0.0        E
VSSL9917HSM0      F 0.0        E
VSSL9916HSM0      F 0.0        E
VSSL9915HSM0      F 0.0        E
VSSL9914HSM0      F 0.0        E
VSSL9913HSM0      F 0.0        E
VSSL9912HSM0      F 0.0        E
VSSL9911HSM0      F 0.0        E
VSSL9910HSM0      F 0.0        E
VSSL9909HSM0      F 0.0        E
VSSL9908HSM0      F 0.0        E
VSSL9907HSM0      F 0.0        E
VSSL9906HSM0      F 0.0        E
VSSL9905HSM0      F 0.0        E
VSSL9904HSM0      F 0.0        E
VSSL9903HSM0      F 0.0        E
VSSL9902HSM0      F 0.0        E
VSSL9901HSM0      F 0.0        E
VSSL9918520000    F 400.0      E
VSSL9917520000    F 400.0      E
VSSL9916520000    F 400.0      E
VSSL9915520000    F 400.0      E
VSSL9914520000    F 400.0      E
VSSL9913520000    F 400.0      E
VSSL9912520000    F 400.0      E
VSSL9911520000    F 400.0      E
VSSL9910520000    F 400.0      E
VSSL9909520000    F 400.0      E
VSSL9908520000    F 400.0      E
VSSL9907520000    F 400.0      E
VSSL9906520000    F 400.0      E
VSSL9905520000    F 400.0      E
VSSL9904520000    F 400.0      E
VSSL9903520000    F 400.0      E
VSSL9902520000    F 400.0      E
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VSSL9901520000	F	400.0	E
VSSL9918PA0	F	1.0133E+05	E
VSSL9917PA0	F	1.0133E+05	E
VSSL9916PA0	F	1.0133E+05	E
VSSL9915PA0	F	1.0133E+05	E
VSSL9914PA0	F	1.0133E+05	E
VSSL9913PA0	F	1.0133E+05	E
VSSL9912PA0	F	1.0133E+05	E
VSSL9911PA0	F	1.0133E+05	E
VSSL9910PA0	F	1.0133E+05	E
VSSL9909PA0	F	1.0133E+05	E
VSSL9908PA0	F	1.0133E+05	E
VSSL9907PA0	F	1.0133E+05	E
VSSL9906PA0	F	1.0133E+05	E
VSSL9905PA0	F	1.0133E+05	E
VSSL9904PA0	F	1.0133E+05	E
VSSL9903PA0	F	1.0133E+05	E
VSSL9902PA0	F	1.0133E+05	E
VSSL9901PA0	F	1.0133E+05	E
VSSL9918PN0	F	1.0133E+05	E
VSSL9917PN0	F	1.0133E+05	E
VSSL9916PN0	F	1.0133E+05	E
VSSL9915PN0	F	1.0133E+05	E
VSSL9914PN0	F	1.0133E+05	E
VSSL9913PN0	F	1.0133E+05	E
VSSL9912PN0	F	1.0133E+05	E
VSSL9911PN0	F	1.0133E+05	E
VSSL9910PN0	F	1.0133E+05	E
VSSL9909PN0	F	1.0133E+05	E
VSSL9908PN0	F	1.0133E+05	E
VSSL9907PN0	F	1.0133E+05	E
VSSL9906PN0	F	1.0133E+05	E
VSSL9905PN0	F	1.0133E+05	E
VSSL9904PN0	F	1.0133E+05	E
VSSL9903PN0	F	1.0133E+05	E
VSSL9902PN0	F	1.0133E+05	E
VSSL9901PN0	F	1.0133E+05	E
VSSL9918TLN0	F	280.1	E
VSSL9917TLN0	F	280.1	E
VSSL9916TLN0	F	280.1	E
VSSL9915TLN0	F	280.1	E
VSSL9914TLN0	F	280.1	E
VSSL9913TLN0	F	280.1	E
VSSL9912TLN0	F	280.1	E
VSSL9911TLN0	F	280.1	E
VSSL9910TLN0	F	280.1	E
VSSL9909TLN0	F	280.1	E
VSSL9908TLN0	F	280.1	E
VSSL9907TLN0	F	280.1	E
VSSL9906TLN0	F	280.1	E
VSSL9905TLN0	F	280.1	E
VSSL9904TLN0	F	280.1	E
VSSL9903TLN0	F	280.1	E
VSSL9902TLN0	F	280.1	E
VSSL9901TLN0	F	280.1	E

VSSL9918TVN0	F		373.1	E
VSSL9917TVN0	F		373.1	E
VSSL9916TVN0	F		373.1	E
VSSL9915TVN0	F		373.1	E
VSSL9914TVN0	F		373.1	E
VSSL9913TVN0	F		373.1	E
VSSL9912TVN0	F		373.1	E
VSSL9911TVN0	F		373.1	E
VSSL9910TVN0	F		373.1	E
VSSL9909TVN0	F		373.1	E
VSSL9908TVN0	F		373.1	E
VSSL9907TVN0	F		373.1	E
VSSL9906TVN0	F		373.1	E
VSSL9905TVN0	F		373.1	E
VSSL9904TVN0	F		373.1	E
VSSL9903TVN0	F		373.1	E
VSSL9902TVN0	F		373.1	E
VSSL9901TVN0	F		373.1	E
VSSL9918VLN-R0	F	0.0		E
VSSL9917VLN-R0	F	0.0		E
VSSL9916VLN-R0	F	0.0		E
VSSL9915VLN-R0	F	0.0		E
VSSL9914VLN-R0	F	0.0		E
VSSL9913VLN-R0	F	0.0		E
VSSL9912VLN-R0	F	0.0		E
VSSL9911VLN-R0	F	0.0		E
VSSL9910VLN-R0	F	0.0		E
VSSL9909VLN-R0	F	0.0		E
VSSL9908VLN-R0	F	0.0		E
VSSL9907VLN-R0	F	0.0		E
VSSL9906VLN-R0	F	0.0		E
VSSL9905VLN-R0	F	0.0		E
VSSL9904VLN-R0	F	0.0		E
VSSL9903VLN-R0	F	0.0		E
VSSL9902VLN-R0	F	0.0		E
VSSL9901VLN-R0	F	0.0		E
VSSL9918VLN-T0	F	0.0		E
VSSL9917VLN-T0	F	0.0		E
VSSL9916VLN-T0	F	0.0		E
VSSL9915VLN-T0	F	0.0		E
VSSL9914VLN-T0	F	0.0		E
VSSL9913VLN-T0	F	0.0		E
VSSL9912VLN-T0	F	0.0		E
VSSL9911VLN-T0	F	0.0		E
VSSL9910VLN-T0	F	0.0		E
VSSL9909VLN-T0	F	0.0		E
VSSL9908VLN-T0	F	0.0		E
VSSL9907VLN-T0	F	0.0		E
VSSL9906VLN-T0	F	0.0		E
VSSL9905VLN-T0	F	0.0		E
VSSL9904VLN-T0	F	0.0		E
VSSL9903VLN-T0	F	0.0		E
VSSL9902VLN-T0	F	0.0		E
VSSL9901VLN-T0	F	0.0		E
VSSL9918VLN-Z0	F	0.0		E

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VSSL9917VLN-Z0   F 0.0           E
VSSL9916VLN-Z0   F 0.0           E
VSSL9915VLN-Z0   F 0.0           E
VSSL9914VLN-Z0   F 0.0           E
VSSL9913VLN-Z0   F 0.0           E
VSSL9912VLN-Z0   F 0.0           E
VSSL9911VLN-Z0   F 0.0           E
VSSL9910VLN-Z0   F 0.0           E
VSSL9909VLN-Z0   F 0.0           E
VSSL9908VLN-Z0   F 0.0           E
VSSL9907VLN-Z0   F 0.0           E
VSSL9906VLN-Z0   F 0.0           E
VSSL9905VLN-Z0   F 0.0           E
VSSL9904VLN-Z0   F 0.0           E
VSSL9903VLN-Z0   F 0.0           E
VSSL9902VLN-Z0   F 0.0           E
VSSL9901VLN-Z0   F 0.0           E
*23456789012345678901234567890123456789*1234567890123456789012345678901234567 89E
VSSL9918VOL0     R09 1.0 526.8 526.8 526.8 526.8 526.8 526.8 526.8 526.8  1.0  E
VSSL9917VOL0     R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9916VOL0     R09 1.0 0.900 0.900 0.900 0.477 0.900 0.962 0.900 0.869  0.90 E
VSSL9915VOL0     R09 1.0 0.315 0.315 0.900 0.900 0.900 0.692 0.692 0.588  0.90 E
VSSL9914VOL0     R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9913VOL0     R09 1.0 0.404 0.900 0.900 0.900 0.900 0.894 0.894 0.947  0.90 E
VSSL9912VOL0     R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9911VOL0     R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9910VOL0     R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9909VOL0     R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9908VOL0     R09 1.0 0.404 0.900 0.900 0.900 0.900 0.900 0.900 0.947  0.90 E
VSSL9907VOL0     R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9906VOL0     R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9905VOL0     R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9904VOL0     R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9903VOL0     R09 1.0 0.034 0.034 0.034 0.900 0.900 0.438 0.438 0.207  0.90 E
VSSL9902VOL0     R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9901VOL0     R09 1.0 0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900  0.90 E
VSSL9918VVN-R0   F 0.0           E
VSSL9917VVN-R0   F 0.0           E
VSSL9916VVN-R0   F 0.0           E
VSSL9915VVN-R0   F 0.0           E
VSSL9914VVN-R0   F 0.0           E
VSSL9913VVN-R0   F 0.0           E
VSSL9912VVN-R0   F 0.0           E
VSSL9911VVN-R0   F 0.0           E
VSSL9910VVN-R0   F 0.0           E
VSSL9909VVN-R0   F 0.0           E
VSSL9908VVN-R0   F 0.0           E
VSSL9907VVN-R0   F 0.0           E
VSSL9906VVN-R0   F 0.0           E
VSSL9905VVN-R0   F 0.0           E
VSSL9904VVN-R0   F 0.0           E
VSSL9903VVN-R0   F 0.0           E
VSSL9902VVN-R0   F 0.0           E
VSSL9901VVN-R0   F 0.0           E
VSSL9918VVN-T0   F 0.0           E
```

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VSSL9917VVN-T0    F 0.0              E
VSSL9916VVN-T0    F 0.0              E
VSSL9915VVN-T0    F 0.0              E
VSSL9914VVN-T0    F 0.0              E
VSSL9913VVN-T0    F 0.0              E
VSSL9912VVN-T0    F 0.0              E
VSSL9911VVN-T0    F 0.0              E
VSSL9910VVN-T0    F 0.0              E
VSSL9909VVN-T0    F 0.0              E
VSSL9908VVN-T0    F 0.0              E
VSSL9907VVN-T0    F 0.0              E
VSSL9906VVN-T0    F 0.0              E
VSSL9905VVN-T0    F 0.0              E
VSSL9904VVN-T0    F 0.0              E
VSSL9903VVN-T0    F 0.0              E
VSSL9902VVN-T0    F 0.0              E
VSSL9901VVN-T0    F 0.0              E
VSSL9918VVN-Z0    F 0.0              E
VSSL9917VVN-Z0    F 0.0              E
VSSL9916VVN-Z0    F 0.0              E
VSSL9915VVN-Z0    F 0.0              E
VSSL9914VVN-Z0    F 0.0              E
VSSL9913VVN-Z0    F 0.0              E
VSSL9912VVN-Z0    F 0.0              E
VSSL9911VVN-Z0    F 0.0              E
VSSL9910VVN-Z0    F 0.0              E
VSSL9909VVN-Z0    F 0.0              E
VSSL9908VVN-Z0    F 0.0              E
VSSL9907VVN-Z0    F 0.0              E
VSSL9906VVN-Z0    F 0.0              E
VSSL9905VVN-Z0    F 0.0              E
VSSL9904VVN-Z0    F 0.0              E
VSSL9903VVN-Z0    F 0.0              E
VSSL9902VVN-Z0    F 0.0              E
VSSL9901VVN-Z0    F 0.0              E
*
*****          PIPE
*
PIPE02000    2     "FW BREAK AND VESSEL"
*            NCELLS    NODES    JUN1     JUN2      MAT
PIPE02010     1         0        1        2         0
PIPE02DX0              0.355             E
PIPE02VOL0             0.0233            E
PIPE02TL0              545.5           E
PIPE02TV0              545.5           E
PIPE02P0               7.235E+06         E
PIPE02PA0              0.0               E
PIPE02ALP              0.0               E
PIPE02FRICN0    0.0         1.0          E
PIPE02FRICP0    0.0         0.0          E
PIPE02FA0       0.0656      0.0656       E
PIPE02VL0       0.0         0.0          E
PIPE02VV0       0.0         0.0          E
PIPE02ICHOKE0   0           0            E
*
```

```
*****          FILL
*
FILL01000      1   "FW PIPE VELOCITY BOUNDARY"
*              JUN1     IFTY     IFTR     NFTX
FILL01010         1        0        0        4
*              DXIN     VOLIN     ALPIN    VIN    TIN     PIN     BORCIN
FILL01011      0.355    0.0233    0.0      31.8   545.5 7.235E+06  0
*
.END OF INPUTS
```

Attachment 3 - Break Boundary Conditions

Feedwater Line Break

The FW line break flow is from both sides of the break. From ref. 2, attachment 2, the RPV side break area is limited by the sum of nozzle areas attached to the feedwater sparger. The flow feeding the feedwater line sees a limiting flow area at the break between the RPV and RSW.

The feedwater line thermal hydraulic conditions are obtained from the reactor heatbalance of reference 3. The pressure at the feedwater line break is based on the steady state TRACG calculation in reference 3 for nominal conditions, (from reference 4 the feedwater component is tee 0061, cell 10 connects to the vessel and represents the safe end break location).

$A_1 := 0.0280\text{m}^2$	$A_1 = 0.301\,\text{ft}^2$	RPV side - 18 sparger nozzle areas (ref. 2)
$A_2 := 0.0656\text{m}^2$	$A_2 = 0.706\,\text{ft}^2$	RSW side - FW pipe flow area (ref. 2)
$A := \frac{(A_1 + A_2)}{2}$		Combined flow area is 1/2 actual flow area since we are modeling only 1/2 the annulus.
$A = 0.0468\,\text{m}^2$	$A = 0.504\,\text{ft}^2$	
$P := 7.305\cdot 10^6\cdot\text{Pa}$	$P = 1060\,\text{psi}$	FW line pressure, from ref. 3, TRACG component TEE0061, cell 9.
$h := 0.925\cdot 10^6\cdot\frac{\text{joule}}{\text{kg}}$	$h = 397.7\frac{\text{BTU}}{\text{lb}}$	FW enthalpy (ref. 3)
$T := 488.75\text{K}$		FW temperature (ref. 3)
$v_f := 1.176\cdot 10^{-3}\frac{\text{m}^3}{\text{kg}}$	$v_f = 0.0188\frac{\text{ft}^3}{\text{lb}}$	specific volume from steam tables (ref. 6)
$P_{annulus} := 0.101325\cdot 10^6\text{Pa}$	$P_{annulus} = 14.7\,\text{psi}$	

The critical mass flux may be used to find the mass flow rate through the break.

$G_c := 9.389\times 10^4\cdot\frac{\text{kg}}{\text{s}\cdot\text{m}^2}$ $\quad G_c = 19230\frac{\text{lb}}{\text{s}\cdot\text{ft}^2}$ $\quad$ From reference 7 using above input

Note: in the ref. 1 analysis, the critical mass flow rate has been adjusted by correcting for the over-prediction of the critical mass flux during inventory depletion. This was done by applying a critical flow inventory multiplier, f (see reference 5). For conservatism, the reduction multiplier is not applied for the ESBWR analysis (value set to 1.0). If the multiplier had been included, the break flow would be significantly reduced, thus lowering the peak AP load.

$f_1 := 1.0$ — subscript 1 is the RPV side

$f_2 := 1.0$ — subscript 2 is the FW supply side

$m_1 := f_1\cdot G_c\cdot A_1$

$m_2 := f_2\cdot G_c\cdot A_2$

$m_1 = 2629\frac{kg}{s}$

$m_2 = 6159\frac{kg}{s}$

The total mass flow rate is found by combining the flow from the two sources. Since we are modeling only 1/2 the annulus, the total mass flow rate entering the model is 1/2 the total flow rate.

$m_{tot} := \frac{1}{2}(m_1 + m_2)$

$m_{tot} = 4394\frac{kg}{s}$

$V := \frac{m_{tot} \cdot v_f}{(A_1 + A_2)}$ velocity at break

$V = 55.207\frac{m}{s}$ value applied to TRACG boundary condition (component FILL01)

<u>RWCU/SDC Line Break</u>

The RWCU/SDC line break flow is from both sides of the break. The flow area is based on the piping ID from ref. 2, attachment 2

The RWCU line thermal hydraulic conditions are obtained from the reactor heatbalance of reference 3. The pressure at the feedwater line break is based on the conditions in the downcomer at the elevation of the RWCU/SDC line. This is obtained from the steady state TRACG calculation in reference 3 for nominal conditions, (VSSL level 15, theta node 19).

$A_1 := 0.0656m^2$	$A_1 = 0.706ft^2$	RPV side - 18 sparger nozzle areas (ref. 2)
$A_2 := 0.0656m^2$	$A_2 = 0.706ft^2$	RSW side - FW pipe flow area (ref. 2)
$A := \frac{(A_1 + A_2)}{2}$		Combined flow area is 1/2 actual flow area since we are modeling only 1/2 the annulus.
$A = 0.0656m^2$	$A = 0.706ft^2$	
$P := 7.235 \cdot 10^6 \cdot Pa$	$P = 1049psi$	Downcomer pressure at RWCU elevation (ref 3)
$h := 1.1967 \cdot 10^6 \cdot \frac{joule}{kg}$	$h = 514.5\frac{BTU}{lb}$	Downcomer enthalpy at RWCU elev. (ref. 3)
$T := 545.5K$		FW temperature (ref. 3)
$v_f := 1.305 \cdot 10^{-3}\frac{m^3}{kg}$	$v_f = 0.0209\frac{ft^3}{lb}$	specific volume from steam tables (ref. 6)
$P_{annulus} := 0.101325 \cdot 10^6 Pa$	$P_{annulus} = 14.7psi$	

The critical mass flux may be used to find the mass flow rate through the break.

$G_c := 4.868 \cdot 10^4 \cdot \frac{kg}{m^2 s}$ $G_c = 9970 \frac{lb}{s \cdot ft^2}$ From reference 7 using above input.

Note: in the ref. 1 analysis, the critical mass flow rate has been adjusted by correcting for the over-prediction of the critical mass flux during inventory depletion. This was done by applying a critical flow inventory multiplier, f (see reference 5). For conservatism, the reduction multiplier is not applied for the ESBWR analysis (value set to 1.0). If the multiplier had been included, the break flow would be reduced, thus lowering the peak AP load.

$f_1 := 1.0$ subscript 1 is the RPV side

$f_2 := 1.0$ subscript 2 is the FW supply side

$m_1 := f_1 \cdot G_c \cdot A_1$

$m_2 := f_2 \cdot G_c \cdot A_2$

$m_1 = 3193 \frac{kg}{s}$

$m_2 = 3193 \frac{kg}{s}$

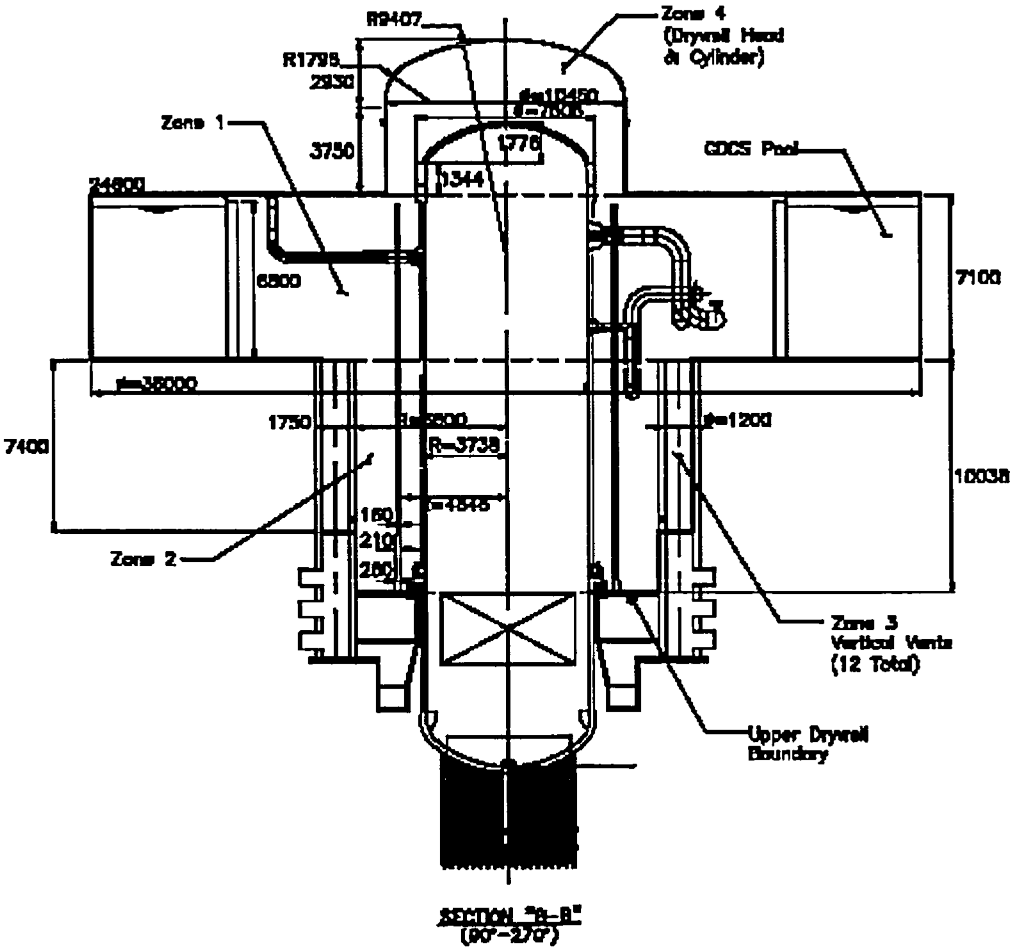
The total mass flow rate is found by combining the flow from the two sources. Since we are modeling only 1/2 the annulus, the total mass flow rate entering the model is 1/2 the total flow rate.

$m_{tot} := \frac{1}{2}(m_1 + m_2)$

$m_{tot} = 3193 \frac{kg}{s}$

$V := \frac{m_{tot} \cdot v_f}{(A_1 + A_2)}$ velocity at break

$V = 31.764 \frac{m}{s}$ value applied to TRACG boundary condition (component FILL01)



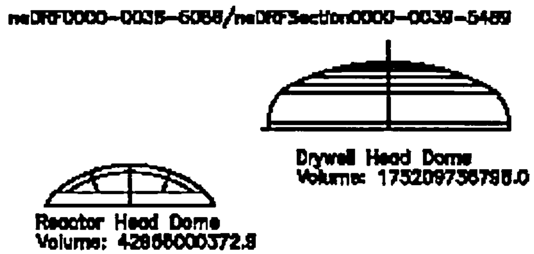


Figure 2. Upper Drywell