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Subject: Modified Reactor Building/Fuel Building Truncated Model, SER-ESB-038 Rev. 5

As discussed during the December 2006 Structural Follow-up Audit, the subject report has been revised to document resolution of issues identified by the NRC and BNL. The revised report is contained in Enclosure 1 and the applicable input and output data is provided in the Enclosure 2 CD.

Sincerely,

Bathy Sedney for

James C. Kinsey Project Manager, ESBWR Licensing



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References:

- 1. MFN 06-262 Letter from David H. Hinds to U.S. Nuclear Regulatory Commission, *Reactor Building/Fuel Building Truncated Finite Element Model Analysis Data*, August 7, 2006
- 2. MFN 06-262, Supplement 1 Letter from David H. Hinds to U.S. Nuclear Regulatory Commission, *Reactor Building/Fuel Building Finite Element Model Analysis Data – Truncated and Full Models*, August 21, 2006
- 3. MFN 06-262, Supplement 2 Letter from David H. Hinds to U.S. Nuclear Regulatory Commission, *Final Reactor Building/Fuel Building Truncated Models*, November 8, 2006
- 4. MFN 06-262, Supplement 3 Letter from David H. Hinds to U.S. Nuclear Regulatory Commission, *Modified Reactor Building/Fuel Building Truncated Models*, December 5, 2006

Enclosures:

- MFN 06-262, Supp. 4 Shimizu Engineering Report SER-ESB-038, Rev. 5, "Modified RBFB Truncated FE Model Analysis Data," January 9, 2007
- 2. MFN 06-262, Supp. 4 NASTRAN Analysis Input Data and NASTRAN Analysis Results (CD)

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ENCLOSURE 1

MFN 06-262 Supplement 4

Shimizu Engineering Report SER-ESB-038, Rev. 5,

"Modified RBFB Truncated FE Model Analysis Data,"

January 9, 2007

	Shimizu Engineering Report						
Proj	ect G ES	eneral Electric Company SBWR Project		Shimiz Docum	u ent No.	SER-ES	B-038
Title				Re	ev.	5	
	le $\begin{bmatrix} M \\ D \end{bmatrix}$	odified RBFB Truncated	FE Model Analysis	Issued	l Date	9/22	/06
		ila	Revis		d Date	1/9/	07
Revised Date 1/9/07 NOTE: This document provides the data for the truncated Reactor/Fuel Buildings Finite Element (FE) model analysis in response to NRC's request in the DCD audit for RAI 3.8 held on July, 2006. NRC requested some modification for the FE model and the method of applying loads. This document provides the data modified in accordance with NRC's request. [Note for Rev.5] The modifications in accordance with NRC's request in this report were followings. • The SFP pool gate gap was closed to meet the BNL's model. The plots of the force Nxy were added. • The table which shows the relation NASTRAN element forces and BNL's that was added. The sketch of the direction of force on plane was provided. • SFP wall (F3) model was offset to it' thickness center. The thickness of basemat inside RPV pedestal was changed from 4.0m to 5.1m. • The hydrostatic load for SFP pool was modified to meet the BNL's analysis. Details of NRC's requests and GE responses are described in Appendix C.							
5	1/9/07	NRC's requests.	FE model and load application method were updated per Y.O. N.M. T.T.			T.T.	
4	11/30/00	Revision to correct errors	Addition of the plots of analysis resultsY.O.N.M.T.T.Revision to correct errors in analysis model and resultsY.O.N.M.T.T.				
3	10/26/00	6 Addition of analysis resu	lts		Y.O.	N.M.	T.T.
2	10/12/00	6 Load conditions were up	Load conditions were updated per NRC comments. Y.O. N.M. T.T.			T.T.	
1	9/27/06	Additional of modified tr	runcated model		Y.O.	T.T.	T.T.
0	9/22/06	Initial Issue	Initial Issue Y.O. T.T. T.T.			T.T.	
Rev.	Date		Note Approve Review Prepa			Prepare	
			Prepared by	T. Toyot	T. Toyota 9/22/0		2/06
		imizu Cornoration	Reviewed by	T. Takah	ashi	9/22	2/06
		innizu Corporation	Approved by	Y. Orito		9/22	2/06

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1. Scope

At NRC's audit on the ESBWR DCD RAI 3.8, NRC requested GE to provide the data needed to perform their verification analyses using a truncated Reactor Building and Fuel Building (RB/FB) Finite Element (FE) model. Per NRC's request, the data of the original truncated model analysis were provided by Reference 1. However, after reviewing of the original data, NRC requested to simplify and clarify the analysis data.

This report provides the load conditions and analysis model modified in accordance with NRC's request. NASTRAN analysis results for the modified load conditions are also included in this report.

Major modifications on the analysis data are as follows.

a. Load conditions: Loads applied to the model are simplified.

b. Analysis model: The model is modified for the following portions.

- Increase of Spent Fuel Pool slab (Basemat) thickness
- Increase of cylindrical wall thickness at the half north side under the Suppression Pool
- Addition of radial walls under the Suppression Pool

In addition to the above items, several changes are made per NRC's request provided at the 2^{nd} structural audit held in December, 2006. Details of NRC's requests at the audit and GE's responses are described in Appendix C.

2. Reference

1. SER-ESB-027 "Reactor Building/Fuel Buildings Truncated FE Model Analysis Data," Rev. 1

3. Load Condition

Analyses are performed for the following loads individually.

- Dead Load, one case
- Pressure Load (at 72 hr. after LOCA), one case
- Seismic Load, 3 individual cases (North to South, West to East, Vertical upward)
- Hydrostatic Load, one case

The load conditions are summarized in Tables 3-1 through 3-6 and Figures 3-1 and 3-2. Figure 3-3 shows the names and locations of the walls in the truncated FE model.

The evaluation methods of the applied loads are described in the following sections.

It should be noted that the applied loads described in this report mean those applied to the top boundary nodes of the truncated model, i.e. boundary loads, unless noted otherwise.

In addition, loads are not applied to the cylindrical walls and radial walls under the Suppression Pool, since these walls are not connected to the RCCV wall nor RPV pedestal wall through normal rigid slabs. The walls are modeled to consider their constraint effects to the basemat.

The results from the dead load, pressure load, and hydrostatic load are combined with seismic loads which are combined with the 100/40/40 method. For the combinations of the seismic loads, refer to Section 3.2.

3.1 Dead Load

Dead loads applied to the model are evaluated based on the weight of the seismic stick model, which is described in the ESBWR DCD, Revision 1. Weights of the RBFB, RCCV, and RPV pedestal in the seismic model are converted to the uniform line loads as shown in Tables 3-7 through 3-9. For the RBFB walls, the weights are distributed to the modeled walls and columns in proportion to their sectional area.

It should be noted that the weights of the seismic stick model used in the calculations in Tables 3-7 through 3-9 do not include the self weights of structures included in the truncated FE model. Therefore, self weights of modeled structures need to be considered using the weight densities shown in Table 3-10. In the table, Young's modulus and Poisson's ratio used for analyses are also included for clarification. The values shown in the table are the same with those in Table 3G.1-12 of DCD, Rev.1.

Weights of equipments, such as the spent fuels and racks, on the basemat are not applied, since they are negligibly small in comparison with the self weight of the basemat.

3.2 Seismic Load

The following three direction loads are analyzed separately for seismic loads.

- Horizontal North to South: includes shear forces and overturning moments
- Horizontal West to East: includes shear forces and overturning moments
- Vertical upward

In the ESBWR DCD design, three components, i.e., two horizontal and one vertical, of the seismic loads are combined using the 100/40/40 method which is consistent with RG 1.92, Revision 2 requirements. Although the 100/40/40 method includes 48 cases of load combinations, few critical cases are selected and the combined results are provided together with the analysis results of three components of seismic loads.

3.2.1 Shear Force

Seismic shear forces are evaluated using the design seismic loads at the base of the buildings, which are described in the ESBWR DCD, Revision 1. As shown in Table 3-11, the loads for the RBFB are applied to the box walls which are parallel to the direction of the applied shear force. In the seismic stick model, stiffnesses of not only box walls but several inner walls are also considered. However, shear forces are applied to the box walls only in the truncated model analysis for simplification.

For the RCCV and RPV pedestal, loads are applied to the half areas of the walls as described in Tables 3-12 and 3-13.

3.2.2 Overturning Moment

Seismic overturning moments are evaluated based on the design seismic loads, which are described in the ESBWR DCD, Revision 1. Since the design overturning moment is defined at each floor level, the values at the top of the truncated model are calculated by the equation shown in Table 3-14.

Overturning moments are applied as vertical forces to the RBFB box walls, RCCV, and RPV pedestal. Evaluation methods of the applied loads are shown in Tables 3-15 through 3-17. For the RBFB box walls, loads are applied to not only the flange walls but also the web walls.

3.2.3 Vertical Force

Applied loads for the vertical earthquake are determined using the maximum axial forces obtained from seismic analyses, which are described in the ESBWR DCD, Revision 1. The loads are distributed to the wall in the same manner as the dead load. Tables 3-18 through 3-20 summarize the calculation results of the vertical seismic load.

3.3 Pressure Load

Analysis is performed for the pressure load at the LOCA after 72 hr (45 psig = 0.31 MPa). The loads are applied to the inside surface of the RPV pedestal and the top surface of the Basemat as a uniform pressure load as shown Figure 3-1.

As the boundary loads at the top of model, the loads in the radial and vertical directions, which are evaluated from the results of the global FE model analysis, are applied together with pressure loads. The loads are summarized in Table 3-21 and 3-22. The loads in the hoop direction are not considered since they are negligibly small.

3.4 Hydrostatic Load

Hydrostatic load applied to the inside surfaces of Spent Fuel Pool walls and slab are shown in Figure 3-2. The boundary loads are calculated as shown in Table 3-23.

The hydrostatic load and dead load are analyzed separately and the results are combined afterward.

4. Modified Truncated Model

The following modifications were made for the truncated model. They are summarized in Figure 4-1.

- Increase of Spent Fuel Pool slab (Basemat) thickness
- Increase of cylindrical wall thickness at the half north side under the Suppression Pool
- Addition of radial walls under the Suppression Pool

In addition, the following changes were made per NRC's request at the 2^{nd} structural audit held in December 2006.

- One of the pool gate gaps (south side gate) is closed to maintain consistency with the NRC model.
- The fuel storage pool wall on F3 wall is updated using offset function.
- The thickness of basemat inside the RPV pedestal is increased to 5.1 m.

4.1 Spent Fuel Pool slab

The region of the Spent Fuel Pool slab is shown as the dot pattern in Figure 4-1. The thickness of slab elements is increased form 4.0 m to 5.5 m as shown in Figure 4-2.

4.2 Cylindrical Wall

The cylindrical wall at the north side, i.e. from 90° to 270°, under the Suppression Pool is indicated as the diagonal line pattern in Figure 4-1. Its thickness increased from 0.6 m to 1.4 m as shown in Figure 4-2.

4.3 Radial Wall

The radial walls shown as cross diagonal line pattern in Figure 4-1 are added to the modified truncated model. Their thicknesses are shown in the Figure 4-1. The radial walls in the modified truncated model are shown in Figure 4-2. As shown in Appendix A, the radial walls are modeled to the middle of B3F, EL -8700, as well as other walls.

The configurations of modified truncated model are shown in Appendix A. In the figures, node ID and element ID are indicated.

These elements are modeled as shell elements which have membrane, bending, and transverse shear stiffnesses. The modeling method of the shell element in the NASTRAN analysis is excerpted from the NASTRAN manual and attached in Appendix B for reference.

4.4 NASTRAN Analysis Input Data

Contents of NASTRAN input data provided are summarized in Tables 4-1 through 4-3.

5. Results of Analysis for Truncated Model

5.1 Table of Analysis Results

The analysis results obtained from NASTRAN Analysis are summarized in Table 5-1. They are NASTRAN output files.

Nodal displacements and element forces and moments obtained from each load case are shown in Excel files named "NASTRANNodeDisplacements.xls" and "NASTRANElementForces.xls."

Nodal displacements listed in the Excel files are defined in terms of the global coordinate system. Element forces and moments listed in the Excel files are defined in terms of the element coordinate system shown in Figures 5-1 and 5-2.

Table 5-2 summarizes the relations of force components between NRC's ANSYS model and GE's NASTRAN model.

5.2 Combined Nodal Displacements and Element Forces and Moments

Nodal displacements and element forces and moments of NASTRAN results are combined in accordance with load combinations shown in Tables 5-3, and they are shown in "CombinedNodeDisplacements.xls" and "CombinedElementForces.xls." Dead load combination considers the boundary force, self weight of model structures and hydrostatic load.

Seismic load combination for a critical case is selected using the following procedure. Chosen load combination is shown as LOAD #6 in Table 5-3.

- a. Select typical areas which are representative of design forces in seismic load cases on basemat design. See Figure 5-3.
- b. Calculate vertical displacements of each node for all cases of seismic load combination in accordance with 100/40/40 method. See Table5-4.
- c. Choose the combination which generates the maximum displacement.

5.3 The Plots of Displacements and Section Forces and Moments

Displacements of walls and basemat are shown in Figure 5-5 through 5-64, and Section forces and moments of wall and basemat are shown in Figure 5-65 through 5-244. The basemat cut sections are shown in Figure 5-4.

Table 5-5 explains the locations and the load cases for the plots.

Displacements data and element forces and moments data used for the plots are included in the Excel files named "Plot_Displacement.xls" and "Plot_ElementForces.xls," respectively.

•	,	5	· · ·
Components	Wall	Load Value	Direction
	Name	(MN/m)	
Axial	RA	-2.665	Vertical
	RG	-2.665	(+:Upward)
	R1	-2.665	
	R7	-2.665	
	F3-1	-4.797	
	F3-2	-2.665	
	Iw-R1	-1.333	
	Iw-R2	-1.333	
	Iw-R3	-1.333	-
	Iw-R4	-1.333	
	Iw-F1	-2.332	
	Iw-F2	-1.999	
	Iw-F3	-1.999	
	Iw-F4	-1.999	-
	Iw-F5	-1.333	-
	Iw-F6	-0.800	
	Iw-F7	-2.532	-
	Iw-F8	-2.665]
	Iw-F9	-1.333	
	Iw-F10	-1.333	-
	Iw-F11	-1.333	
	Iw-F12	-1.532]
	Iw-F13	-1.333	1
	RCCV	-5.328	
	Pedestal	-4.246	

Table 3-1(1) Summary of Dead Load (Wall)

Note1: These loads are applied to top of the wall shown in the table Note2: For the locations of walls, see Figure 3-3.

Table 3-1(2) Summary of Dead Load (Column)

Components	Column	Load Value	Direction
	Name	(MN)	
Axial	C1	-2.998	Vertical
	C2	-2.998	(+:Upward)

Note1: These loads are applied to top of the wall shown in the table Note2: For the locations of columns, see Figure 3-3.

ESBWR I	Project
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Components	Wall	Load Value	Direction
	Name	(MN/m)	
Shear	RA	6.693	Horizontal
(N to S)	RG	6.693	(+:X)
	RCCV_ns	4.225	
	Pedestal_ns	4.718	
Shear	R1	6.687	Horizontal
(W to E)	R7	6.687	(+:Y)
	F3-1	12.037	
	F3-2	6.687	
	RCCV_ew	5.096	
	Pedestal ew	5.687	

Table 3-2 Summary of Seismic Shear Force

Note1: These loads are applied to top of the wall shown in the table Note2: For the locations of walls, see Figure 3-3.

Note3: Not all the walls in the seismic stick model are considered as loaded walls in the truncated model for purpose of simplicity.

Components	Wall	Loa	Direction		
		North Edge	South Edge	Constant]
Moment	RA	6.594	-5.312	-	Vertical
(N to S)	RG	6.594	-5.312	-	(+:Upward)
	R1	-	-	6.594	
	R7	-	-	-1.635]
	F3-1	-	-	-9.562]
	F3-2	_	-	-5.312]
	RCCV_ew	9.931	-9.931	-]
	Pedestal_ew	9.847	-9.847	-	1

Table 3-3(1)	Summary	of Seismic	Overturning	Moment	(N to	5 S)
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Note1: These loads are applied to top of the wall shown in the table

Note2: For the locations of walls, see Figure 3-3.

Note3: Not all the walls in the seismic stick model are considered as loaded walls in the truncated model for purpose of simplicity.

Note4: The loads on the RA and RG walls are linearly distributed between the edges.

Note5: For the RCCV and RPV pedestal, the loads are applied their flange portions as equivalently distributed loads.

Components	Wall	Loa	Direction		
		West Edge	East Edge	Constant	
Moment	RA	-	-	-7.126	Vertical
(W to E)	RG		-	7.561	(+:Upward)
	R1	7.561	-7.126	-	
	R7	7.561	-7.126	-]
	F3-1	-3.490	-12.827	-	
	F3-2	7.561	-1.939	-	
	RCCV_ns	13.141	-13.141	-	1
	Pedestal_ns	12.460	-12.460	-	1

Table 3-3(2) Summary of Seismic Overturning Moment (W to E)

Note1: These loads are applied to top of the wall shown in the table

Note2: For the locations of walls, see Figure 3-3.

Note3: Not all the walls in the seismic stick model are considered as loaded walls in the truncated model for purpose of simplicity.

Note4: The loads on the R1, R7, F3-1 and F3-2 walls are linearly distributed between the edges.

Note5: For the RCCV and RPV pedestal, the loads are applied their flange portions as equivalently distributed loads.

ESBWR	Project

Components	Wall	Load Value	Direction
	Name	(MN/m)	
Vertical	RA	1.241	Vertical
(Axial)	RG	1.241	(+:Upward)
	R1	1.241	1
	R7	1.241]
	F3-1	2.234	
	F3-2	1.241	1
	Iw-R1	0.621	1
	Iw-R2	0.621	1
	Iw-R3	0.621	
	Iw-R4	0.621	1
	Iw-F1	1.086	
	Iw-F2	0.931	
	Iw-F3	0.931]
	Iw-F4	0.931	1
	Iw-F5	0.621	
	Iw-F6	0.372	
	Iw-F7	1.179	
	Iw-F8	1.241	1
	Iw-F9	0.621	1
	Iw-F10	0.621	
	Iw-F11	0.621	
	Iw-F12	0.714	
	Iw-F13	0.621]
	RCCV	3.102]
	Pedestal	2.429	

Table 3-4(1) Summary of Seismic Vertical Force (Wall)

Note1: These loads are applied to top of the wall shown in the table Note2: For the locations of walls, see Figure 3-3.

Table 3-4(2) Summary of Seismic Vertical Force (Column)

Components	Column	Load Value	Direction
	Name	(MN)	
Axial	C1	1.396	Vertical
	C2	1.396	(+:Upward)

Note1: These loads are applied to top of the wall shown in the table Note2: For the locations of columns, see Figure 3-3.

Components	Wall	Load Value	Direction
	Name	(MN/m)	
Radial	RCCV	0.309	Radial (Outward: +)
&		0.816	Vertical (+:Upward)
Vertical	Pedestal	0.909	Radial (Outward: +)
		-1.608	Vertical (+:Upward)

Table 3-5 Summary of Pressure Load

Note1: These loads are applied to top of the wall shown in the table. Note2: Pressure loads applied to elements directly are shown in Figure 3-1.

Table 3-6 Summary of Hydrostatic Pressure	Load
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Components	Wall	Load Value	Direction
	Name	(MN/m)	
Horizontal	RA	0.835	+Y
	F3-1	0.835	+X
	Iw-F2	-0.835	+Y
	Iw-F3	-0.835	+Y
	Iw-F7	-0.835	+X

Note1: These loads are applied to top of the wall shown in the table.

Note2: Hydrostatic pressure loads applied to elements directly are shown in Figure 3-2.

Load ^{*1}	Por	tion	Direction	Thickness*2	Length ^{*2}	Area	Unit Load 1*3	Unit Load 2 ^{*4}
(MN)				(t: m)	(l: m)	(A: m ²)	(MN/m^2)	(MN/m MN)
-1030.3	Wall	RA	Х	2.00	68.0	136.000		-2.665
		RG	Х	2.00	68.0	136.000		-2.665
		R1	Y	2.00	47.0	94.000		-2.665
		R7	Y	2.00	47.0	94.000		-2.665
		F3-1	Y	3.60	16.6	59.760		-4.797
		F3-2	Y	2.00	30.4	60.800		-2.665
		Iw-R1	X	1.00	12.0	12.000		-1.333
		Iw-R2	X	1.00	12.0	12.000		-1.333
		Iw-R3	Y	1.00	12.0	12.000		-1.333
		Iw-R4	Y	1.00	12.0	12.000		-1.333
		Iw-F1	X	1.75	4.2	7.350		-2.332
		Iw-F2	Х	1.50	2.1	3.150		-1.999
		Iw-F3	X	1.50	12.9	19.350		-1.999
		Iw-F4	X	1.50	8.1	12.150		-1.999
		Iw-F5	X	1.00	12.9	12.900		-1.333
		Iw-F6	X	0.60	16.8	10.080		-0.800
		Iw-F7	Y	1.90	16.6	31.540		-2.532
		Iw-F8	Y	2.00	4.1	8.200		-2.665
		Iw-F9	Y	1.00	8.4	8.400		-1.333
		Iw-F10	Y	1.00	5.5	5.500		-1.333
		Iw-F11	Y	1.00	6.8	6.800		-1.333
		Iw-F12	Y	1.15	5.5	6.325		-1.532
		Iw-F13	Y	1.00	8.4	8.400		-1.333
	Column	C1	-	1.50	1.5	2.250		-2.998
		C2	-	1.50	1.5	2.250		-2.998
	Total		-	-	-	773.205	-1.333	-

Table 3-7 Evaluation of Dead Load for the RBFB

*1: Load is the same value as the stick model weight.

*2: Thickness and length are dimensions in the FE Model

*3: "Unit Load 1" is the load per unit area. Unit Load 1 = Load / Total A

*4: "Unit Load 2" of wall is the load per unit length.(MN/m) Unit Load 2 = Unit Load 1 * t

"Unit Load 2" of column is the nodal force. (MN) Unit Load 2 = Unit Load 1 * A

Load ^{*1}	Portion	Direction	Thickness	Length ^{*2}	Unit Load*3
(MN)			(t: m)	(l: m)	(MN/m)
-636.1	RCCV	-	2.00	119.4	-5.328

Table 3-8 Evaluation of Dead Load for the RCCV

*1: Load is the same value as the stick model weight.

*2: Length = 19.0 (Radius of the modeled RCCV wall) * 2 * π

*3: "Unit Load" is the load per unit length. Unit Load = Load / l

Table 3-9 Evaluation of Dead Load for the RPV Pedestal

Load ^{*1}	Portion	Direction	Thickness	Length ^{*2}	Unit Load ^{*3}
(MN)			(t: m)	(l: m)	(MN/m)
-181.4	Pedestal	-	2.40	42.7	-4.246

*1: Load is the same value as the stick model weight.

*2: Length = 6.8 (Radius of the modeled RPV pedestal) * 2 * π

*3: "Unit Load" is the load per unit length. Unit Load = Load / 1

Table 3-10 Weight Densities and Other Material Constants for Analysis

	Reinforce	d Concrete	Steel
	Basemat f'c=4000psi 27.6MPa	Others f [°] c=5000psi 34.5MPa	Carbon Steel Liner
Young's Modulus (MPa)	2.49×10^4 2.78×10^4		2.00×10 ¹
Poisson's Ratio	0.	0.3	
Weight Density (MN/m ³)	0.0	0.0770	

Seismic	Load*1	Portion ^{*6}	Direction ^{*2}	Thickness*3	Length*3	Area	Unit Load 1*4	Unit Load 2 ^{*5}
Direction	(MN)			(t: m)	(l: m)	(A: m ²)	(MN/m ²)	(MN/m)
N to S	910.3	RA	X	2.00	68.0	136.00		6.693
		RG	X	2.00	68.0	136.00		6.693
		Total	-	-	-	272.00	3.347	-
W to E	1031.7	R1	Y	2.00	47.0	94.00		6.687
		R7	Y	2.00	47.0	94.00		6.687
		F3-1	Y	3.60	16.6	59.76		12.037
		F3-2	Y	2.00	30.4	60.80		6.687
		Total	-	-	-	308.56	3.344	-

Table 3-11 Evaluation of the Seismic Shear Force for the RBFB

*1: Load is the design seismic shear force at the bottom of the RBFB Walls.

*2: Walls in the same direction as seismic direction are considered.

*3: Thickness and length are dimensions on the FE Model

*4: "Unit Load 1" is the load per unit area. Unit Load 1 = Load / Total A

*5: "Unit Load 2" is the load per unit length. Unit Load 2 = Unit Load 1 * t

*6: Not all the walls in the seismic stick model are considered as loaded walls in the truncated model for purpose of simplicity.

Seismic	Load*1	Portion ^{*2}	Direction	rection Thickness		Unit Load ^{*4}
Direction	(MN)			(t: m)	(l: m)	(MN/m)
N to S	252.2	RCCV_ns	Х	2.00	59.7	4.225
W to E	304.2	RCCV_ew	Y	2.00	59.7	5.096

 Table 3-12 Evaluation of the Seismic Shear Force for the RCCV

*1: Load is the design seismic shear force at the bottom of RCCV.

*2: For the portion where the load is applied, see Figure 3-3.

*3: Length is evaluated as effective length. Length = 19.0 (Radius on the FE Model) * 2 * $\pi/2$

*4: "Unit Load" is the load per unit length. Unit Load = Load / 1

Seismic	Load ^{*1}	Portion ^{*2}	Direction Thickness		Length ^{*3}	Unit Load ^{*4}
Direction	(MN)			(t: m)	(l: m)	(MN/m)
N to S	100.8	Pedestal_ns	Х	2.40	21.4	4.718
W to E	121.5	Pedestal_ew	Y	2.40	21.4	5.687

*1: Load is the design seismic shear force at the bottom of RPV Pedestal.

*2: For the portion where the load is applied, see Figure 3-3.

*3: Length is evaluated as effective length. Length = 6.8 (Radius on the FE Model) * 2 * $\pi/2$

*4: "Unit Load" is the load per unit length. Unit Load = Load / 1

	Level	Stick I	Model		Moment [*] (MNm)			
	(m)	EID	NID	4	Direction of	f Earthquake		
	(III)	LID		#	NS	EW		
RBFB	-6.4		101	Mi	29734	30234		
	-8.7	1101		<u>M</u>	<u>31614</u>	32604		
	-11.5		2	Мj	33902	35490		
RCCV	-6.4		201	Mi	9560	12719		
	-8.7	1201		<u>M</u>	<u>10140</u>	<u>13418</u>		
	-11.5		2	Mj	10846	14269		
RPV Pedestal	-6.4		301	Mi	1056	1350		
	-8.7	1301		<u>M</u>	<u>1288</u>	<u>1630</u>		
	-11.5		2	Mj	1570	1970		

Table 3-14 Moment of the Top of Truncated Model

Note1: Mi, Mj: design overturning moment

Note2: Moments (M) at EL-8.7m are applied as boundary loads.

The moment (M) is calculated from the following equation.



Load ^{•1}	Portion ^{*8}	Direction*2	Thickness*3	Length*3	Area	Distance (d0: m)	C. of Stiff.	Distance (d: m)	Moment of	Distan C. of S	ce from tiff (m)	Unit Load1 ^{*6}	Uni	t Load (MN	J/m)*7
(MN ∙m)			(t: m)	(l: m)	(A: m ²)	R1 ~ Wall C.	from R1 (m)*4	C. of Stiff ~Wall C.	Inertia (I: m ⁴) ^{*5}	North Edge	South Edge	(MN/m²/m)	North Edge	South Edge	Constant
31614	RA	parallel	2.00	68.0	136.000	34.00		3.660	54227	37.660	-30.340		6.594	-5.312	
	RG	parallel	2.00	68.0	136.000	34.00		3.660	54227	37.660	-30.340		6.594	-5.312	
	R1	perpendicular	2.00	47.0	94.000	0.00		37.660	133352	-	-				6.594
	R7	perpendicular	2.00	47.0	94.000	47.00		-9.340	8231	-	-				-1.635
	F3-1	perpendicular	3.60	16.6	59.760	68.00		-30.340	55073	-	-				- 9.562
	F3 - 2	perpendicular	2.00	30.4	60.800	68.00		-30.340	55986	-	-				-5.312
	Total	-	-	-	580.560		37.660		361097			0.088			

Table 3-15(1) Evaluation of the Seismic Moment for the RBFB (N to S)

*1: Refer to Table 3-14.

*2: Direction of wall relative to direction of seismic load

*3: Thickness and length are dimensions on the FE Model.

*4: Center of Stiffness = $\Sigma(A*d0)/Total A$

*5: Moment Inertia (parallel Wall) = $A * d^2 + t * l^3 / 12$

Moment Inertia (perpendicular Wall) = $A * d^2 + 1 * t^3 / 12$

*6: Unit Load1 = Load / Total I

*7: Unit Load2 is calculated from the following equations.

Parallel Wall: Unit Load2 = Unit Load1 * t * Distance from C. of Stiff.

Perpendicular Wall: Unit Load2 = Unit Load1 * t * d

*8: Not all the walls in the seismic stick model are considered as loaded walls in the truncated model for purpose of simplicity.

Load*1	Portion*8	Direction*2	Thickness*3	Length*3	Area	Distance (d0: m)	C. of Stiff.	Distance (d: m)	Moment of	Distan C. of S	ce from tiff (m)	Unit Load1*6	Uni	t Load (MN	√m) ^{*7}
(MN·m)			(t: m)	(l: m)	(A: m²)	R1 ~ Wall C.	from R1 (m)*4	C. of Stiff .~Wall C.	Inertia (I: m ⁴) ^{•5}	West Edge	East Edge	(MN/m²/m)	West Edge	East Edge	Constant
32604	RA	perpendicular	2.00	68.0	136.000	47.00		-22.805	70772	-	-				-7.126
	RG	perpendicular	2.00	68.0	136.000	0.00		24.195	79662	-	-				7.561
	Rl	parallel	2.00	47.0	94.000	23.50		0.695	17349	24.195	-22.805		7.561	- 7.126	
	R7	parallel	2.00	47.0	94.000	23.50		0.695	17349	24,195	-22.805		7.561	-7.126	
	F3-1	parallel	3.60	16.6	59.760	38.70		-14.505	13945	-6.205	-22.805		-3.490	-12.827	
	F3-2	parallel	2.00	30.4	60.800	15.20		8.995	9602	24.195	-6.205		7.561	-1.939	
	Total	-	-		580.560		24.195		208680			0.156			

Table 3-15(2) Evaluation of the Seismic Moment for the RBFB (W to E)

*1: Refer to Table 3-14.

*2: Direction of wall relative to direction of seismic load

*3: Thickness and length are dimensions on the FE Model.

*4: Center of Stiffness = $\Sigma(A^*d0)/Total A$

*5: Moment Inertia (parallel Wall) = $A * d^2 + t * l^3 / 12$

Moment Inertia (perpendicular Wall) = $A * d^2 + l * t^3 / 12$

*6: Unit Load1 = Load / Total I

*7: Unit Load2 is calculated from the following equations.

Parallel Wall: Unit Load2 = Unit Load1 * t * Distance from C. of Stiff.

Perpendicular Wall: Unit Load2 = Unit Load1 * t * d

*8: Not all the walls in the seismic stick model are considered as loaded walls in the truncated model for purpose of simplicity.

Seismic	Load ^{*1}	Portion	Direction	Model Radius	Unit Load ^{*2}
Direction	(MN·m)			(<i>r</i> : m)	(q: MN/m)
N to S	10140 .	RCCV_ew	Y	19.00	9.931
W to E	13418	RCCV_ns	X	19.00	13.141

 Table 3-16 Evaluation of the Seismic Moment for the RCCV

*1: Refer to Table 3-14.

*2: Unit Load = Load / $(2 * 20.5 * r^2)$ (Refer to the following figure.)



Table 3-17 Evaluation of the Seismic Moment for the RPV Pedestal

Seismic	Load ^{*1}	Portion	Direction Model Radius		Unit Load ^{*2}
Direction	(MN·m)			(r: m)	(q: MN/m)
N to S	1288	Pedestal_ew	Y	6.80	9.847
W to E	1630	Pedestal_ns	X	6.80	12.460

*1: Refer to Table 3-14.

*2: Unit Load = Load / $(2 * 20.5 * r^2)$ (Refer to the figure in Table 3-16.)

Load ^{*1}	Port	ion	Direction	Thickness*2	Length ^{*2}	Area	Unit Load 1 ^{*3}	Unit Load 2*4
(MN)				(t: m)	(l: m)	(A: m ²)	(MN/m ²)	(MN/m MN)
479.8	Wall	RA	X	2.00	68.0	136.000		1.241
		RG	X	2.00	68.0	136.000		1.241
		R1	Y	2.00	47.0	94.000		1.241
		R7	Y	2.00	47.0	94.000		1.241
		F3-1	Y	3.60	16.6	59.760		2.234
		F3-2	Y	2.00	30.4	60.800		1.241
		Iw-R1	X	1.00	12.0	12.000		0.621
		Iw-R2	X	1.00	12.0	12.000		0.621
		Iw-R3	Y	1.00	12.0	12.000		0.621
		Iw-R4	Y	1.00	12.0	12.000		0.621
		Iw-F1	X	1.75	4.2	7.350		1.086
		Iw-F2	Х	1.50	2.1	3.150		0.931
		Iw-F3	Х	1.50	12.9	19.350		0.931
		Iw-F4	Х	1.50	8.1	12.150		0.931
		Iw-F5	X	1.00	12.9	12.900		0.621
		Iw-F6	X	0.60	16.8	10.080		0.372
		Iw-F7	Y	1.90	16.6	31.540		1.179
		Iw-F8	Y	2.00	4.1	8.200		1.241
		Iw-F9	Y	1.00	8.4	8.400		0.621
		Iw-F10	Y	1.00	5.5	5.500		0.621
		Iw-F11	Y	1.00	6.8	6.800		0.621
		Iw-F12	Y	1.15	5.5	6.325		0.714
		Iw-F13	Y	1.00	8.4	8.400		0.621
	Column	C1	-	1.50	1.5	2.250		1.396
		C2	-	1.50	1.5	2.250		1.396
	Total		-	-	-	773.205	0.621	-

Table 3-18 Evaluation of the Seismic Vertical Force for the RBFB

*1: Load is the maximum axial force of dynamic analysis by the stick model.

*2: Thickness and length are dimensions on the FE Model

*3: "Unit Load 1" is the load per unit area. Unit Load 1 = Load / Total A

*4: "Unit Load 2" is the load per unit length. Unit Load 2 = Unit Load 1 * t.

	Table 3-19	Evaluation of	f the Seismic	Vertical Force	for the RCCV
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Load ^{*1}	Portion	Direction	Thickness	Length ^{*2}	Unit Load*3
(MN)			(t: m)	(l: m)	(MN/m)
370.3	RCCV	-	2.00	119.4	3.102

*1: Load is the maximum axial force obtained from the stick model seismic analysis.

*2: Length = 19.0 (Radius on the FE Model) * 2 * π

*3: "Unit Load" is the load per unit length. Unit Load = Load / 1

Table 3-20 Evaluation of the Seismic Vertical Force for the RPV Pedestal

Load ^{*1}	Portion	Direction	Thickness	Length ^{*2}	Unit Load*3
(MN)			(t: m)	(l: m)	(MN/m)
103.8	Pedestal	-	2.40	42.7	2.429

*1: Load is the maximum axial force obtained from the stick model seismic analysis.

*2: Length = 6.8 (Radius on the FE Model) * 2 * π

*3: "Unit Load" is the load per unit length. Unit Load = Load / 1

Table 3-21	Evaluation of the	Pressure	Load for th	ne RCCV
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Average Force	e ^{*1} (MN/node)	Nodal Tributary	Unit Load (MN/m) *3	
Radial	Vertical	Length ^{*2} (L: m)	Radial	Vertical
0.768	2.031	2.487	0.309	0.816

Note1: Average Forces are calculated from nodal force at EL -8.7m of the global FE model analysis Note2: L = 19.0(Radius of the modeled RCCV wall) * 2 * π / 48(nodes) Note3: Unit Load = [Average Force] / L

Table 3-22 Evaluation of the	e Pressure Load	for the RPV Pedestal
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Average Force	e ^{*1} (MN/node)	Nodal Tributary	Unit Load (MN/m) *3	
Radial	Vertical	Length ^{*2} (L: m)	Radial	Vertical
0.809	-1.432	0.890	0.909	-1.608

Note1: Average Forces are calculated from nodal force at EL -8.7m of the global FE model analysis Note2: L = 6.8(Radius of the modeled RPV pedestal) * 2 * π / 48(nodes) Note3: Unit Load = [Average Force] / L

Table 3-23 Evaluation of the Hydrostatic Pressure Load for the Spent Fuel Pool

Spent Fuel Pool Water				Truncated Model	
Тор	Bottom	Depth	Model Top	Depth above Model	Boundary Load [*]
(EL. m)	(EL. m)	(m)	(EL. m)	d (m)	L (MN/m)
4.35	-10.00	14.35	-8.7	13.05	0.835

*: Boundary Load is calculated by the following equation. (Refer to Figure 3-2.)

L = 1.0(t/m3) * d * 9.807 * d / 2 / 1000

Table 4-1 NASTRAN Control Data Files

Load	Control Data File	Note
Dead Load	DL.dat	Boundary Force
	GRAV.dat	Self Weight of Modeled Structures
Seismic Load	EQNS.dat	N to S
	EQEW.dat	W to E
	EQZ.dat	Vertical
Pressure Load	PL.dat	
Hydrostatic Load	FL.dat	

Table 4-2 NASTRAN Model Data Files

	Model Data File	Note
Common	cood	Coordinate System Definition
	node_truncated.txt	Grid points (Building)
	soil_node.prn	Grid points (Soil)
	elem_truncated.txt	Shell and bar elements
	rbar_truncated.txt	Rigid bar
	pshell_truncated.txt	Properties of shell elements.
	pbar_truncated.txt	Properties of bar elements.
	mat_truncated.txt	Material properties
Soil	elas_o.prn	Soil spring for vertical loads
Spring	elas_s.prn	Soil spring for horizontal loads

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Load	Load Data File	Note	Reference Table and Figure	
Dead Load	DL.prn	Vertical Force at Top of Model	Table 3-1	
	grav.txt	Self Weight of Modeled Structures	Table 3-10	
Seismic Load	EQNS.prn	Shear Force (NS) at Top of Model	Table 3-2	
	EQEW.prn Shear Force (WE) at Top of Model		Table 3-2	
	EMNS.prn Moment (NS) Top of Model		Table 3-3	
	EMEW.prn	Moment (WE) at Top of Model	Table 3-3	
	EQZ.prn	Vertical Force at Top of Model	Table 3-4	
Pressure Load	PL.prn	Pressure at Top of Model	Table 3-5	
	pl_truncated.txt	Pressure inside RPV Pedestal	Figure 3-1	
Hydrostatic Load	FL.prn	Pressure at Top of Model	Table 3-6	
	fl_truncated.txt	Pressure inside SF Pool	Figure 3-2	

Table 4-3 NASTRAN Load Data Files

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Load	Control Data File	Note		
Dead Load	DL.f06	Boundary Force		
	GRAV.f06	Self Weight of Modeled Structures		
Seismic Load	EQNS.f06	N to S		
	EQEW.f06	W to E		
	EQZ.f06	Vertical		
Pressure Load	PL.f06			
Hydrostatic Load	FL.f06			

Table 5-1 NASTRAN Output Files

Table 5-2 Force Table

Dention	Force Components				
Portion	ANSYS	NASTRAN			
	N	Ny			
	Nz	Nx			
Wall	Qx	Nxy			
&	Qy	Qy			
Basemat Section C	Qz	Qx			
	Mx	My			
	Mz	Mx			
	N	Nx			
	Nz	Ny			
Basemat Section A	Qx	Nxy			
Basemat Section A & Basemat Section B	Qy	Qx			
	Qz	Qy			
	Mx	Mx			
	Mz	My			

				Table	e 5-	3 Load	d Combi	nat	tion		
LOAD	#	Combination							Note		
			Factor	Label		Factor	Label		Factor	Label	
Dead Load	1		1.00 ×	MDL1*1	+	1.00 ×	MDL2 ^{*2}				Combined Dead Load
Pressure Load	2		1.00 ×	MPL*3							
Seismic Load	3		1.00 ×	MEQN*4							N to S
	4		1.00 ×	MEQE*5					4m	-	W to E
	5	1	1.00 ×	MEQZ*6							Vertical Upward
State	6	-	0.40 ×	MEQN	-	1.00 ×	MEQE	-	0.40 ×	MEQZ	See Section 5.2 and Table 5-4 for details of case selection
Hydrostatic	7		1.00 ×	MFLO*7							
Overall	8		1.00 ×	MDL1	+	1.00 ×	MDL2				
		+	1.00 ×	MPL	+	1.00 ×	MFLO				
		-	0.40 ×	MEQN	-	1.00 ×	MEQE	-	0.40 ×	MEQZ	

Note: *1: MDL1: Case applied the boundary force of Dead Load

*2: MDL2: Case applied the self weight of model structures of Dead Load

*3: MPL : Case applied the Pressure Load

*4: MEQN: Case applied the horizontal seismic load (N to S)

*5: MEQE: Case applied the horizontal seismic load (W to E)

*6: MEQZ: Case applied the vertical seismic load (upward)

*7: MFLO: Case applied the Hydrostatic load

Node	Maximum Vertical	Max	Combination	Note		
ID	Displacement	Horiz	zontal	Vertical		
	(mm)	N to S	W to E	Upward		
80001	20.0	0.4	-0.4	-1.0		
80201	22.7	0.4	-0.4	-1.0		
80213	26.6	0.4	0.4	-1.0		
80225	26.0	-0.4	-0.4	-1.0		
80237	26.6	0.4	-0.4	-1.0	·····	
80551	23.2	0.4	-0.4	-1.0		
80563	60.2	-0.4	1.0	-0.4		
80575	49.5	-1.0	-0.4	-0.4		
80587	61.3	-0.4	-1.0	-0.4		
90001	121.2	-0.4	-1.0	-0.4	Critical Combination	
90031	97.8	0.4	-1.0	-0.4		
90481	118.0	-0.4	1.0	-0.4		
90511	111.1	0.4	1.0	-0.4		

Table 5-4 Maximum Vertical Displacement of Basemat and Load Cases

	Portion	Locati	on	Load Cases	Components
Displacement	Wall	R1	wall top		
		R7/F1	wall top		
		F3	wall top		
		RA	wall top		Displacements
		RG	wall top	Dead Load	X Dir.
		below RCCV	wall top		Y Dir Z Dir.
		RPV Pedestal	wall top	Pressure Load	
	Basemat	Section A		Soismia Lond	
		Section B	·	(NtoS)	
		Section C	·······		
Section Force	Wall	R1	wall base	Seismic Load	
		R7/F1	wall base	(WtoE) Seismic Load (Upward)	
		F3	wall base		Axial Force Nx, Ny
		RA	wall base		
		RG	wall base		Moments
		below RCCV	wall base	Hydrostatic Load	Mx, My
		RPV Pedestal	wall base		
	Bàsemat	Section A]	Snear Forces
		Section B]	Qx, Qy
				-	

Table 5-5 Location and Load Cases for the Plots


Figure 3-1 Pressure Load Applied to the RCCV Wall and the Basemat at 72 hr. after LOCA





Figure 3-2 Hydrostatic Load Applied to the Spent Fuel Pool Walls and the Basemat

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(F1) (R7) RI R2 R3 R4 RS R6 (F2) (F3) - 1 X=-23.5 X=-18.5 X=-90 X = 9.0X=0.0 X=18.5 X=23.5 X = 34.0X= 44.5 RA 4.2 RA RA<u>Y≈ 23.5</u> <u>2.0</u> <u>2.0</u> <u>Y= 23.5</u> (FA) 2.5 <u>1.0</u> 4.5 Iw-R1 RCCV_ns lw-F1 $\frac{Y=18.5}{18.5}$ 2.0 RCCV <u>1.75</u> F3-1 1.0 <u>3.6</u> lw-F7 <u>1.9</u> Iw-R3 Y= 13,05 0.6 RC<u>Y= 9.0</u> **Iw-F2** 2.4 2.4 Iw-F3 2.5 Pedestal ns Iw-F8 2.1 lw-F10 <u>2.4</u> lw-F12 4.1 <u>1.0</u> Pedestal 1.15 <u>Y= 2.8</u> (FC) 4 R = 6.8<u>1.5</u> lw-F4 R= 12.0 $\mathbb{R}D^{\underline{Y=0.0}}$ <u>1.0</u> Iw-F5 -RCCV_ew RCCV_ew Pedestal_ev <u>2.0</u> R1 Pedestal_ew F3-2 2.0 R= 19.0 Y= -6.2 2.5 -R7 CI Pedestal_ns <u>2.0</u> (RE) Y = -9.0<u>1.0</u> Iw-R4 Y=-15.1 (FE) 0.6 Iw-F6 C2 _ (RF)<u>Y≕-18.5</u> RCCV_ns Iw-F9 Iw-F11 Iw-F13 1.0 1.0 1.0 lw-R2 <u>1.0</u> 2.5 (RG) Y= -23.5 Y=-23.5 (FF) <u>2.0</u> RG <u>2.0</u> RG 4.2 4.2 Unit: m Underlined Text: Wall Thickness Highlited Text: Values different from GA

Figure 3-3 Wall Information of Truncated Model

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(R.4)

RB-

RC



(R3)

(R4)

8 t = 600'

t= 1000

t= 600 - 1400

R

SER-ESB-038 Rev.5

(R5)

9500

t= 900

F1 R7

(

5000

(72)

10500

21000

t = 4000 - 5500 mm

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Ŧ(FA)

- (73)





Figure 4-2 Modified Truncated Model

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Figure 5-1 Forces and Moments in Shell Element

.



Figure 5-2 Positive Direction of Forces



Figure 5-3 Selected Points for Combination of Seismic Loads





Figure 5-5 Displacement at R1 Wall for Dead Load



Figure 5-6 Displacement at R1 Wall for Pressure Load



Figure 5-7 Displacement at R1 Wall for Seismic Load (N to S)



Figure 5-8 Displacement at R1 Wall for Seismic Load (W to E)





Figure 5-9 Displacement at R1 Wall for Seismic Load (Vertical; Upward)



Figure 5-10 Displacement at R1 Wall for Hydrostatic Load



Figure 5-11 Displacement at R7/F1 Wall for Dead Load



Figure 5-12 Displacement at R7/F1 Wall for Pressure Load



Figure 5-13 Displacement at R7/F1 Wall for Seismic Load (N to S)



Figure 5-14 Displacement at R7/F1 Wall for Seismic Load (W to E)



Figure 5-15 Displacement at R7/F1 Wall for Seismic Load (Vertical; Upward)



Figure 5-16 Displacement at R7/F1 Wall for Hydrostatic Load



Figure 5-17 Displacement at F3 Wall for Dead Load



Figure 5-18 Displacement at F3 Wall for Pressure Load



Figure 5-19 Displacement at F3 Wall for Seismic Load (N to S)



Figure 5-20 Displacement at F3 Wall for Seismic Load (W to E)



Figure 5-21 Displacement at F3 Wall for Seismic Load (Vertical; Upward)





Figure 5-23 Displacement at RA Wall for Dead Load



Figure 5-24 Displacement at RA Wall for Pressure Load



Figure 5-25 Displacement at RA Wall for Seismic Load (N to S)



Figure 5-26 Displacement at RA Wall for Seismic Load (W to E)



Figure 5-27 Displacement at RA Wall for Seismic Load (Vertical; Upward)



Figure 5-28 Displacement at RA Wall for Hydrostatic Load



Figure 5-29 Displacement at RG Wall for Dead Load



Figure 5-30 Displacement at RG Wall for Pressure Load



Figure 5-31 Displacement at RG Wall for Seismic Load (N to S)



Figure 5-32 Displacement at RG Wall for Seismic Load (W to E)



Figure 5-33 Displacement at RG Wall for Seismic Load (Vertical; Upward)



Figure 5-34 Displacement at RG Wall for Hydrostatic Load



Figure 5-35 Displacement at Wall below RCCV for Dead Load



Figure 5-36 Displacement at Wall below RCCV for Pressure Load



Figure 5-37 Displacement at Wall below RCCV for Seismic Load (N to S)



Figure 5-38 Displacement at Wall below RCCV for Seismic Load (W to E)



Figure 5-39 Displacement at Wall below RCCV for Seismic Load (Vertical; Upward)



Figure 5-40 Displacement at Wall below RCCV for Hydrostatic Load



Figure 5-41 Displacement at RPV Pedestal Wall for Dead Load



Figure 5-42 Displacement at RPV Pedestal Wall for Pressure Load



Figure 5-43 Displacement at RPV Pedestal Wall for Seismic Load (N to S)



Figure 5-44 Displacement at RPV Pedestal Wall for Seismic Load (W to E)



Figure 5-45 Displacement at RPV Pedestal Wall for Seismic Load (Vertical; Upward)



Figure 5-46 Displacement at RPV Pedestal Wall for Hydrostatic Load



Figure 5-47 Displacement at Basemat Section A for Dead Load



Figure 5-48 Displacement at Basemat Section A for Pressure Load



Figure 5-49 Displacement at Basemat Section A for Seismic Load (N to S)



Figure 5-50 Displacement at Basemat Section A for Seismic Load (W to E)



Figure 5-51 Displacement at Basemat Section A for Seismic Load (Vertical; Upward)



Figure 5-52 Displacement at Basemat Section A for Hydrostatic Load



Figure 5-53 Displacement at Basemat Section B for Dead Load



Figure 5-54 Displacement at Basemat Section B for Pressure Load



Figure 5-55 Displacement at Basemat Section B for Seismic Load (N to S)



Figure 5-56 Displacement at Basemat Section B for Seismic Load (W to E)



Figure 5-57 Displacement at Basemat Section B for Seismic Load (Vertical; Upward)



Figure 5-58 Displacement at Basemat Section B for Hydrostatic Load


Figure 5-59 Displacement at Basemat Section C for Dead Load



Figure 5-60 Displacement at Basemat Section C for Pressure Load



Figure 5-61 Displacement at Basemat Section C for Seismic Load (N to S)



Figure 5-62 Displacement at Basemat Section C for Seismic Load (W to E)



Figure 5-63 Displacement at Basemat Section C for Seismic Load (Vertical; Upward)



Figure 5-64 Displacement at Basemat Section C for Hydrostatic Load



Figure 5-65 Axial Forces at R1 Wall for Dead Load



Figure 5-66 Moments at R1 Wall for Dead Load



Figure 5-67 Shear Forces at R1 Wall for Dead Load



Figure 5-68 Axial Forces at R1 Wall for Pressure Load



Figure 5-69 Moments at R1 Wall for Pressure Load



Figure 5-70 Shear Forces at R1 Wall for Pressure Load



Figure 5-71 Axial Forces at R1 Wall for Seismic Load (N to S)



Figure 5-72 Moments at R1 Wall for Seismic Load (N to S)



Figure 5-73 Shear Forces at R1 Wall for Seismic Load (N to S)



Figure 5-74 Axial Forces at R1 Wall for Seismic Load (W to E)



Figure 5-75 Moments at R1 Wall for Seismic Load (W to E)



Figure 5-76 Shear Forces at R1 Wall for Seismic Load (W to E)

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Figure 5-77 Axial Forces at R1 Wall for Seismic Load (Vertical; Upward)



Figure 5-78 Moments at R1 Wall for Seismic Load (Vertical; Upward)



Figure 5-79 Shear Forces at R1 Wall for Seismic Load (Vertical; Upward)



Figure 5-80 Axial Forces at R1 Wall for Hydrostatic Load



Figure 5-81 Moments at R1 Wall for Hydrostatic Load



Figure 5-82 Shear Forces at R1 Wall for Hydrostatic Load



Figure 5-83 Axial Forces at R7/F1 Wall for Dead Load



Figure 5-84 Moments at R7/F1 Wall for Dead Load



Figure 5-85 Shear Forces at R7/F1 Wall for Dead Load



Figure 5-86 Axial Forces at R7/F1 Wall for Pressure Load



Figure 5-87 Moments at R7/F1 Wall for Pressure Load



Figure 5-88 Shear Forces at R7/F1 Wall for Pressure Load



Figure 5-89 Axial Forces at R7/F1 Wall for Seismic Load (N to S)



Figure 5-90 Moments at R7/F1 Wall for Seismic Load (N to S)



Figure 5-91 Shear Forces at R7/F1 Wall for Seismic Load (N to S)



Figure 5-92 Axial Forces at R7/F1 Wall for Seismic Load (W to E)



Figure 5-93 Moments at R7/F1 Wall for Seismic Load (W to E)



Figure 5-94 Shear Forces at R7/F1 Wall for Seismic Load (W to E)



Figure 5-94 Axial Forces at R7/F1 Wall for Seismic Load (Vertical; Upward)



Figure 5-96 Moments at R7/F1 Wall for Seismic Load (Vertical; Upward)



Figure 5-97 Shear Forces at R7/F1 Wall for Seismic Load (Vertical; Upward)



Figure 5-98 Axial Forces at R7/F1 Wall for Hydrostatic Load



Figure 5-99 Moments at R7/F1 Wall for Hydrostatic Load



Figure 5-100 Shear Forces at R7/F1 Wall for Hydrostatic Load

.



Figure 5-101 Axial Forces at F3 Wall for Dead Load



Figure 5-102 Moments at F3 Wall for Dead Load



Figure 5-103 Shear Forces at F3 Wall for Dead Load



Figure 5-104 Axial Forces at F3 Wall for Pressure Load



Figure 5-105 Moments at F3 Wall for Pressure Load



Figure 5-106 Shear Forces at F3 Wall for Pressure Load



Figure 5-107 Axial Forces at F3 Wall for Seismic Load (N to S)



Figure 5-108 Moments at F3 Wall for Seismic Load (N to S)



Figure 5-109 Shear Forces at F3 Wall for Seismic Load (N to S)



Figure 5-110 Axial Forces at F3 Wall for Seismic Load (W to E)



Figure 5-111 Moments at F3 Wall for Seismic Load (W to E)





Figure 5-113 Axial Forces at F3 Wall for Seismic Load (Vertical; Upward)



Figure 5-114 Moments at F3 Wall for Seismic Load (Vertical; Upward)



Figure 5-115 Shear Forces at F3 Wall for Seismic Load (Vertical; Upward)



Figure 5-116 Axial Forces at F3 Wall for Hydrostatic Load



Figure 5-117 Moments at F3 Wall for Hydrostatic Load



Figure 5-118 Shear Forces at F3 Wall for Hydrostatic Load



Figure 5-119 Axial Forces at RA Wall for Dead Load



Figure 5-120 Moments at RA Wall for Dead Load



Figure 5-121 Shear Forces at RA Wall for Dead Load



Figure 5-122 Axial Forces at RA Wall for Pressure Load



Figure 5-123 Moments at RA Wall for Pressure Load



Figure 5-124 Shear Forces at RA Wall for Pressure Load



Figure 5-125 Axial Forces at RA Wall for Seismic Load (N to S)



Figure 5-126 Moments at RA Wall for Seismic Load (N to S)



Figure 5-127 Shear Forces at RA Wall for Seismic Load (N to S)



Figure 5-128 Axial Forces at RA Wall for Seismic Load (W to E)



Figure 5-129 Moments at RA Wall for Seismic Load (W to E)



Figure 5-130 Shear Forces at RA Wall for Seismic Load (W to E)


Figure 5-131 Axial Forces at RA Wall for Seismic Load (Vertical; Upward)



Figure 5-132 Moments at RA Wall for Seismic Load (Vertical; Upward)



Figure 5-133 Shear Forces at RA Wall for Seismic Load (Vertical; Upward)



Figure 5-134 Axial Forces at RA Wall for Hydrostatic Load



Figure 5-135 Moments at RA Wall for Hydrostatic Load



Figure 5-136 Shear Forces at RA Wall for Hydrostatic Load



Figure 5-137 Axial Forces at RG Wall for Dead Load



Figure 5-138 Moments at RG Wall for Dead Load



Figure 5-139 Shear Forces at RG Wall for Dead Load



Figure 5-140 Axial Forces at RG Wall for Pressure Load



Figure 5-141 Moments at RG Wall for Pressure Load



Figure 5-142 Shear Forces at RG Wall for Pressure Load



Figure 5-143 Axial Forces at RG Wall for Seismic Load (N to S)



Figure 5-144 Moments at RG Wall for Seismic Load (N to S)



Figure 5-145 Shear Forces at RG Wall for Seismic Load (N to S)



Figure 5-146 Axial Forces at RG Wall for Seismic Load (W to E)



Figure 5-147 Moments at RG Wall for Seismic Load (W to E)



Figure 5-148 Shear Forces at RG Wall for Seismic Load (W to E)



Figure 5-149 Axial Forces at RG Wall for Seismic Load (Vertical; Upward)



Figure 5-150 Moments at RG Wall for Seismic Load (Vertical; Upward)



Figure 5-151 Shear Forces at RG Wall for Seismic Load (Vertical; Upward)



Figure 5-152 Axial Forces at RG Wall for Hydrostatic Load



Figure 5-152 Moments at RG Wall for Hydrostatic Load



Figure 5-154 Shear Forces at RG Wall for Hydrostatic Load



Figure 5-155 Axial Forces at Wall below RCCV for Dead Load



Figure 5-156 Moments at Wall below RCCV for Dead Load



Figure 5-157 Shear Forces at Wall below RCCV for Dead Load



Figure 5-158 Axial Forces at Wall below RCCV for Pressure Load



Figure 5-159 Moments at Wall below RCCV for Pressure Load



Figure 5-160 Shear Forces at Wall below RCCV for Pressure Load



Figure 5-161 Axial Forces at Wall below RCCV for Seismic Load (N to S)



Figure 5-162 Moments at Wall below RCCV for Seismic Load (N to S)



Figure 5-163 Shear Forces at Wall below RCCV for Seismic Load (N to S)



Figure 5-164 Axial Forces at Wall below RCCV for Seismic Load (W to E)



Figure 5-165 Moments at Wall below RCCV for Seismic Load (W to E)



Figure 5-166 Shear Forces at Wall below RCCV for Seismic Load (W to E)



Figure 5-167 Axial Forces at Wall below RCCV for Seismic Load (Vertical; Upward)



Figure 5-168 Moments at Wall below RCCV for Seismic Load (Vertical; Upward)



Figure 5-169 Shear Forces at Wall below RCCV for Seismic Load (Vertical; Upward)



Figure 5-170 Axial Forces at Wall below RCCV for Hydrostatic Load



Figure 5-171 Moments at Wall below RCCV for Hydrostatic Load



Figure 5-172 Shear Forces at Wall below RCCV for Hydrostatic Load



Figure 5-173 Axial Forces at RPV Pedestal Wall for Dead Load



Figure 5-174 Moments at RPV Pedestal Wall for Dead Load



Figure 5-175 Shear Forces at RPV Pedestal Wall for Dead Load



Figure 5-175 Axial Forces at RPV Pedestal Wall for Pressure Load

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Figure 5-176 Moments at RPV Pedestal Wall for Pressure Load



Figure 5-178 Shear Forces at RPV Pedestal Wall for Pressure Load



Figure 5-179 Axial Forces at RPV Pedestal Wall for Seismic Load (N to S)



Figure 5-180 Moments at RPV Pedestal Wall for Seismic Load (N to S)



Figure 5-181 Shear Forces at RPV Pedestal Wall for Seismic Load (N to S)



Figure 5-182 Axial Forces at RPV Pedestal Wall for Seismic Load (W to E)



Figure 5-183 Moments at RPV Pedestal Wall for Seismic Load (W to E)



Figure 5-184 Shear Forces at RPV Pedestal Wall for Seismic Load (W to E)



Figure 5-185 Axial Forces at RPV Pedestal Wall for Seismic Load (Vertical; Upward)



Figure 5-186 Moments at RPV Pedestal Wall for Seismic Load (Vertical; Upward)



Figure 5-187 Shear Forces at RPV Pedestal Wall for Seismic Load (Vertical; Upward)



Figure 5-188 Axial Forces at RPV Pedestal Wall for Hydrostatic Load



Figure 5-189 Moments at RPV Pedestal Wall for Hydrostatic Load



Figure 5-190 Shear Forces at RPV Pedestal Wall for Hydrostatic Load



Figure 5-191 Axial Forces at Basemat Section A for Dead Load



Figure 5-192 Moments at Basemat Section A for Dead Load



Figure 5-193 Shear Forces at Basemat Section A for Dead Load



Figure 5-194 Axial Forces at Basemat Section A for Pressure Load



Figure 5-195 Moments at Basemat Section A for Pressure Load



Figure 5-196 Shear Forces at Basemat Section A for Pressure Load



Figure 5-197 Axial Forces at Basemat Section A for Seismic Load (N to S)



Figure 5-198 Moments at Basemat Section A for Seismic Load (N to S)



Figure 5-199 Shear Forces at Basemat Section A for Seismic Load (N to S)



Figure 5-200 Axial Forces at Basemat Section A for Seismic Load (W to E)



Figure 5-201 Moments at Basemat Section A for Seismic Load (W to E)



Figure 5-202 Shear Forces at Basemat Section A for Seismic Load (W to E)


Figure 5-203 Axial Forces at Basemat Section A for Seismic Load (Vertical; Upward)



Figure 5-204 Moments at Basemat Section A for Seismic Load (Vertical; Upward)

ESBWR Project



Figure 5-205 Shear Forces at Basemat Section A for Seismic Load (Vertical; Upward)



Figure 5-206 Axial Forces at Basemat Section A for Hydrostatic Load



Figure 5-207 Moments at Basemat Section A for Hydrostatic Load



Figure 5-208 Shear Forces at Basemat Section A for Hydrostatic Load



Figure 5-209 Axial Forces at Basemat Section B for Dead Load



Figure 5-210 Moments at Basemat Section B for Dead Load

ESBWR Project



Figure 5-211 Shear Forces at Basemat Section B for Dead Load



Figure 5-212 Axial Forces at Basemat Section B for Pressure Load



Figure 5-213 Moments at Basemat Section B for Pressure Load



Figure 5-214 Shear Forces at Basemat Section B for Pressure Load



Figure 5-215 Axial Forces at Basemat Section B for Seismic Load (N to S)



Figure 5-216 Moments at Basemat Section B for Seismic Load (N to S)

ESBWR Project



Figure 5-217 Shear Forces at Basemat Section B for Seismic Load (N to S)



Figure 5-218 Axial Forces at Basemat Section B for Seismic Load (W to E)



Figure 5-219 Moments at Basemat Section B for Seismic Load (W to E)



Figure 5-220 Shear Forces at Basemat Section B for Seismic Load (W to E)



Figure 5-221 Axial Forces at Basemat Section B for Seismic Load (Vertical; Upward)



Figure 5-222 Moments at Basemat Section B for Seismic Load (Vertical; Upward)

ESBWR Project



Figure 5-223 Shear Forces at Basemat Section B for Seismic Load (Vertical; Upward)



Figure 5-224 Axial Forces at Basemat Section B for Hydrostatic Load

ESBWR Project



Figure 5-225 Moments at Basemat Section B for Hydrostatic Load



Figure 5-226 Shear Forces at Basemat Section B for Hydrostatic Load

ESBWR Project



Figure 5-227 Axial Forces at Basemat Section C for Dead Load



Figure 5-228 Moments at Basemat Section C for Dead Load



Figure 5-229 Shear Forces at Basemat Section C for Dead Load



Figure 5-230 Axial Forces at Basemat Section C for Pressure Load



Figure 5-231 Moments at Basemat Section C for Pressure Load



Figure 5-232 Shear Forces at Basemat Section C for Pressure Load



Figure 5-233 Axial Forces at Basemat Section C for Seismic Load (N to S)



Figure 5-234 Moments at Basemat Section C for Seismic Load (N to S)



Figure 5-235 Shear Forces at Basemat Section C for Seismic Load (N to S)



Figure 5-236 Axial Forces at Basemat Section C for Seismic Load (W to E)



Figure 5-237 Moments at Basemat Section C for Seismic Load (W to E)



Figure 5-238 Shear Forces at Basemat Section C for Seismic Load (W to E)



Figure 5-239 Axial Forces at Basemat Section C for Seismic Load (Vertical; Upward)



Figure 5-240 Moments at Basemat Section C for Seismic Load (Vertical; Upward)



Figure 5-241 Shear Forces at Basemat Section C for Seismic Load (Vertical; Upward)



Figure 5-242 Axial Forces at Basemat Section C for Hydrostatic Load





Figure 5-243 Moments at Basemat Section C for Hydrostatic Load



Figure 5-244 Shear Forces at Basemat Section C for Hydrostatic Load

MFN 06-262, Supplement 4 Enclosure 1

Appendix A Figures of Analysis Model



Modified Truncated Model

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RCCV & Cylinder Wall below RCCV

A-2

View: from Inside to Outside

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RPV Pedestal

A-3

View: from Inside to Outside



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11133 11134 11135 11137 11137 11138 11137 11138 11139 11139 11139 11140 11541 11541 70607] 70607] 70603] 70604] 70605] 70607] 70607] 70609] 70609] 70609] 70609]	11044 11045 11046 11047 11047	47 11068 11069 11050 30804 30805 30806 30807	11051 11052 11053 110553 110553 1105	110541105511 30#1130#12	3087 11057 11058 30873 30874 30875 1
10933 10954 10955 10956 10977 10958 10958 10958 10958 10959 1095	10845 10845 10845 10845	47	10657 10652 10653 30609 30609 30670 1	10854 10855 10 30617 30612	30613 10657 10858 30613 30614 30615 1
19733 19734 19735 19735 19735 19737 19737 19739	10044 10045 10046 10044 10044 10044 10044	47 10548 10649 10550 30404 30405 30408 30407	10051 10053 10055 10053 10055 10053 10055	10854 10855 10 30412 30412 1	30417 30414 30415 1
		47 10448 10449 10450 2004 1 2005 1 2007 1 2007		10454 10455 10 20171 1 1	мя <u> </u>
	10244 10245 10246 10246	47	10251 10252 10253 10253	10254 10255 10 10254 10255 10	10256 10257 10257 10258
	10044 10045 10048 10048	47 h0048	10051 10052 10053	10054	3007-3 30074 30075 10057 10058

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External Wall (RA)

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A-4



View: from Outside (East) to Inside (West)

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	15601	15402	15603	15804	15805	15408	15607	15408 15	15409	15610	15611	15612	15613	15814	15615	15616	15617 1	5618 15418	15619	15420	15621 Z				
	15401	15202	15403	15404	15405	15206	15407	15408 15	15200	15410	15411	15212	15413	15414	15415	15418	154171	15218	15279	15420	15421	< <			
	15201	15202	15203	15204	15206	15206	15207	15204 15 15008	15000	15210	15211	15212	15213	15214	15215	15218 15016	15217 1	5218t	15019	15220	15221	~	270		
	15001	15002	15003	15004	15005	15008	15007	15008 15	14800	15010	15011	15012	15013	15014	15015	15015	1 <u>5017</u> 1	5018	54279	15020	15021				\sim
	14801	14802 14602	14803	14804 74604	14805	14806	14807	14808 14508	14600	14810	14811	14812	14813	14814	14815	14616	14817 1	4 <u>610</u> 14612]	14519	14520	14821				
	14601	14802	14603	14604 74404	14005	14606	14807	14608	14400	14610	14611	14612	14813	14814	14615	14815 54616	14817 1 34417 1	•••••••	14619	14620	14621				
	14401	14402	14403	14204	14205	14206	14407	14208	14200	14410	14411	1412	14212	14414	14415	14418 14218	14171	4418 54258	1415	14220	14421				
	14201	14202	14203	14204	14205	14206	14207	14200	14200	14210	14211	14212	14213	14214	14215	14216	14017	4218	14019	14220	54001	54002	54063	14303 1 54004	4304 54005
	14001	14002	14003	14004	14005	14008	14007	14006	14009	14010	14011	140121	14013	14014	14015	14016	14017 1	4018 1	13819	14020	14021 53807	53802	53860	14103 1 53804	4104
	13801 13801	13802 13802	13803 13803	13804	13805 13805	13808 13808]	13807	13808	13809	13810	(3811) (3817]	13812	13813	13814	13815 13815	13818	15817 11 13817 1	38181 13618]	13819	13820	13821 53607	13901 53602	13902 53860]	1380 <u>1</u>	3804 53605]
	13601	13602	13403	13604 13404	13605 73405	13606	13407	13608	13009	13610	13611	13612	C19613	13614	13815	13819	13617 1	13418 13418	13419	13620	53401	13701 63402	13702 53403	13703 1 63404]	53405
	13201	13202	1200	13204	13205	13206	13207	13208	13200	13210	13211		13213	12214	13215	13216	13217	13218	13219	13220	53207	53202	53502 53200	63204	53205
	13007	13002	13000	13004	13005	13000	13007	13000	13000	13010	13211	_13212	13012	13214	13215	13218	13017	13018	13019	13220	53001	53002	53003	53004	53005
	12801	12802	12803	12804	12805	12900	12807	12808	12809	12810	12811	13012	(281)	12814	12815	13015 52816	12817	12818	12818	12820	52801	52802	52803	57804	52805
	12601	12602	12803	12804	12005	12805	12907	12608	12609	12010	12611	12012	12813	12014	12415	12818	12617	12614	12619	12620	52907	52802	52962	52864	52805
	12401	12402	12403	12404	12405	12408	12407	12408	12409	12410	12411	12412	CINS:	12014	12415	12418	12817	12018	12419	12420	52401	52402	52403	57464	52405
	12201	12202	12203	12204	12205	12208	12207	12208	12209	12210	12211	122112	12213	12214	12215	12210	12217	12210	12219	12220	52201	52292	\$2203	52264	\$2205
	12001	12002	12000	12004	12005	12008	12007	12008	12008	12010	12011	12012	12013	12014	12015	12016	12017	12018	12010	12220	52001	52007	52002	52004 1	2304
	12001 	12002 11802 11802	12003 11803	12004 11804	12005 17805 11805	12006 11806	12007 11807	12008 11808	12009 11809	12010 17870	12011 12811	12012 11812	12013 11873	12014 17814 11814	12015 11815	12016 71816	12017 1 12817 1 11817 1	2018 17858 1818	12019 11819	12020 17820	51801	12101	12102 57803	12103 1 57804 1	2104
	11601	11602	11603	11604	11605	11606	11807	11608	11609	11610	11611	11612	11613	11614	11615	21618 11816	11617	1418	11619	11620	57607	51502 11701	57000	57604] 11703 1	51605
	13401	11402	11403	11404 11404	11405	11406	11407	11408	11409	15410	, 1411 11411	11412	C1411	15454 11414	11415	75478 (11478	15417	11418	11418 11419	15420	51401	51402	51403 11502	51404	51405
	11201	11202	11203	11204	11205	11206	11207	1/208	11200	11210	11211	11212	11213	11214	11215	11276	11217	11218	11219	11220	51201	51202	s1203	51204 11303	51205
	11001	11002	11003	11004	11005	11005	11007	51008	11009	11010	11011	11012	11011	31014	11015	11018	11017	51018	11019	11020	51001	51002	51003	51004	51005
	10801	10802	10803	10804	10805	r0808	10807	10808	10809	10610	10811	10812	10813	10814	10815	10816	10817	10818	10819	10820	50807	50802	50803	50804	50805
	10801	10602	10603	10504	10605	10505	10807	10608	10800	10610	10671	10812	10673	10014	10015	10616	10617	10618	10619	10620	50507	50602	50803	50604	50805
	10401	10402	19403	10404	10405	10406	10407	10408	10408	10410	10411	10412	10413	10454	10415	10-10	10417	10418	10419	10620	50401	50402	50400	50404	50405
z 1	16201	10402	10403	10404	10405	10408	10207	10408	10409	10410	10411	10412	10413	10414	10415	10416	10417 1	10218	10/19	10420	50207	50202	50203	50704	50205
	10201	10202 10002	10003	10204 10004	10206 10005	10206 10000	10207	10000	10209 10009	10210	10211	10212	10213	10214	10215	10216	10017	10018	10019	10020	10221	10301 50002	50002	10000 11 50004 1	50005
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A-5



View: from Outside (West) to Inside (East)

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		18066 1806 47803 4 17866 1786	7 13068 1804 47805	47806 17869	47807	47608 4767	2 18073 7809 47810 17873	18074	18075 47812	47813	47814 17877 180	47815 47815 78 17879	18080	18081 47816	47819 17842	18083 47820	18084	. 52.05	
		47603 4 17668 1766	47605 17668	47606	47607 17570	47508	7609 47610 2 17673	47611	47612 17675	47613 17575	47674 17677 176	47615 78] 47617 17680	47618 17681	47619 17582	47620 17683	17684		
		47403 4 17486	404 47405 17468	47406 17469	47407	47408 4 17471 1747	7409 47410 2 17473	17474	47412 17475	47413 17478	47454 17473-174	47415 4741 78	1 47417 17480-	47418 17481	47419 17482	47420 17483	17484		
		47203 4 17268	17204 17208 17268	47206 17269	47207 17270	47298	7209 47210 2	47211	47212 17275	47213	47214 17277	47215 47210	47217	47218 17281	47219 17282	47220 17283	(724		
		47003 4 17088 1708	1004 47005	47006 17069	47007 17070	47008 4 17071 1707	7009 47010 17073-	17074	47012 17075	47013	47014 17077 170	47015 4701	47017 17080	47018 17081-	47019 17082	47020 17083	17064		
		45903 4	1004 4500 1006	45806 16869	45807 16870	45808 4	6809 46870		45812	46813 16876	46874 16877 - 168	46815 46810 78	45817	46818	45819 16882	46820	16844		
		45803 4 16666 1655	<u>,</u>	45606	46607 16670	46508 4	46670	45671	45612	45613	40674 16677	46615 4851 78 16579	46617	40518	46619 16682	46620	16684		
		48403 4 16468 1646	HOH 45400	46408 16469	48407 18470	48408 4 15471 1847	5409 45410 15473	18474	45412	46413 18478	48474 16477-164	46415 4641	48417 15480	46418	48419 16482	46420	15484		
		45203 4 16266 1626	1204 45205 16268	45205	45207 16270	45208 4 16271 1627	6209 40210		45212	46213 16276	48214 16277-162	46215 46210 78 16279	46217	46218 16281	46219 16282	46220 16283	16284		
		45003 4	5004 40005 16068	45005	46007 18070	46008 4	15073	40011	46012	40013	48014 16077 160	45015 4501 78 16079-	48017	46018	46019	48020	16064		
		45803 4	15805 15885	45808	45807	45808 4	5809 45810 2	45811	45812	45813	45814 15877 158	45815 4581	45817	45818	45819 15882	45820 15883	15884		
	15684 15685	45603 4	45605	45806	45807	45608 4	5609 45870 2 15673	45611	45612	45673	45614	45815 4567	45817	45618	45679 15682	45620 15683	15684	15685	15601 <u>EL 34.0</u>
	45401 45402 15484 15485	45403 4 15488 1548	5404 45405 15468	45406 15469	45407 15470	45408 4	5409 45410 2 15473-	45411	45412	45413 15476	45414	45415 78	45417	45418 15481	45419 15482	45420 15483	45421	45422	15401
	45207 45202 15264	45203 4 15268 1526	5204 45205 15268	45206 15269	45207 15270	45208 4 15271 1527	5209 45210 2 15273	45211	45212 15275	45213 15276	45214 15277 152	45215 4521 78	45217	45218 15261	45219 15282	45220 15283	45221 15284	45222	15201
	45007 45002 15064 15065	45003 4 15068 1506	5004 45005 15065	45006 15069	45007	45008 4 15071 1507	5009 45010 2 15073	45011	45012 15075	45013 15076	45014	45015 4501 78 15079	45017	45018 15081	45019 15082	45020 15083	45021 15064	45022 15085	15001
	+4801 +4802 14864	44803 4	4804 44805	44806 14869	44807 14870	44808 4	4809 44810	14574	44812	44813	44814	44815 78	44817	44818 14881	44819 14882	44820 14883	44821 14884	44822	14801
	44801 44802 14864	44603 4 14668 1466	14605 14668	44606 14669	44607	44508 4 14671 1467	4609 44610	44611	44612 14675	44813 14676	44574 14677 146	44515 4461 78 14679	14617	44878	44619	44620 14683	44621 14684	44622 14685	••••• <u>EL 25.8</u>
	14407 14402	144861448	1 1	14406	14470	14471						14479	1 4417	14481	14482	1	14421	14485	14401
	44201 44202 14284 14285	44203 4 14266 1426	7 14268	44208	44207	14271						1421	44219	14201	44221	44222	44223	44224	54201 <u>EL 22.5</u>
	44001 44002 14084 14085	44003 4 14065 1406	1004 44005 14065	44006 14065	44007 14070	14071						4401	44015	44016 14081	44017 14082	44018 14083	44019 14084	44020 14085	14001
	43807 43802	40000	1804 43803	43808	43807							4385	43815	43816	43817	43818	43819	43820	
	13864 13865 13864 13865 13865 13665 13665	13866 1386 4360J 4 13666 1366	7 13868 1804 43805 7 13668	13859 43606 13665	43607	13671	13672	13674	13675	13676	13678	13879 4361 13679	13880 1 43675 13580	13891 43676 13681	13882 43617 13682	13883 43678 13683	13884 43610 13684	13885 43620 13685	13801 13801 <u>EL 17.2</u>
	43407 43402 13484 13465 43202 43207 43202	43403 4 13466 1346 43203 4	43405 13468 1204 43205	43406 13469 47206	43407 13470 43207	43408 13471	13472 43409	43410	43411	43412 13476 43212	13476 4341 13476 4321	1 4341 13479	43415	43416 13481 43216	43417 13482 43217	43418 13483 43218	43419 13484 43219	43420 13485 43220	13401
	13264 43001 1 43002	43000 4	7 xxx4]xxxx5]	13269 43006	13270 43007	43038	13772 43009	43010	13275-	43012	1 400	13279 3] 4301	13280-	13281	43017	43018	43019	43020	13201
	13064	13068 1308 42803 4	7 2804] 42805]	13069 42606	13070	42808	42809	42810	13175	13078] 13078] 428	13079 3 1 4281	42815	42816	13082	13083 42818	42819	42820	13001 <u>EL 13.07</u>
	12864 12865 42601 42602	12866 1286	7	12859 42606	42607	42608	42609	42610	12475	42512	12878-	12879 3 4261	1 42615	42676	12882 42617	42618	12864 42619	42820	12801
	12864	12666 1256 42400 4	7 <u> </u>	42406	42407	42408	12672	42410	42411	42412	12678	12679- 3 4241	42415	42415	42417	12683 42418	42419	42420	12801 EI 8 56
	42201 42202	42203 4	7 <u> </u>	42206	42207	42208	42200	42210	42211	42212	4221	3 4221	42215	42215	42217	42218	42219	42220	12401 <u>CC 0.00</u>
	12264 12265 42007 42002	12268 1226	7 12268 1 2004 42005	12269	42007	12271	12272	42010	12275	12276	1 12276	4201	12280	12281	42017	42018	42019	42020	12201
90°	12064 12085 12085	12065 1200		12069	12070 41 8 07	12071	12072 41809	12074	12075	12076	12078	12079	12080	12081	12082	12083	12064	12085	12001 FI 3 65
	11604 11605 11665	47603 4 11665 1160	1604 41605 7 11668	41508 11669	41607 11670	41608 11671	11672 11672	41610] 11674	41811	41612 1 11676	11878 11878	118/9_ 13 4165 11679_	41615	41616 11681	41617 11682	41618 11683	41619 11584	41620 11685	11601
	41401 41402 11484 11485	41403	1404 7 11458	41406 11469	45407 11470	41408	11472	41410	45455	41412		13 4141 11479	1 41415 11480	41416	41417	41418 11483	47419 11484	41420 11485	11401
	41201 41202	41203	1204 41205	41206	41207	41208	41209	41210	41211	41212	1 412	13 4121	41215	41216	41217	41218	41219	41220	FL -1.5
	41001 41002	41003	1004 41005	41006	41007	41008	41009	41010	41011	41012	1 410	112/19	41015	41018	41017	41018	41019	41020	
	40807 40802	40900	0804 40805	40805	40807	40808	1	40810	40811	40812	1	110/5	40815	40818	40817	40818	40819	40820	
180°	40801 40802	40603	accel 40005	40606	40607	40505	1 40400	40610	40611	40612	10678	13 4001 1000	40615	40076	40617	40818	40519	40620	
	40401 40402	40403	40405	40406	49407	40408	1	40410	40411	40412	1 404		40415	40478	40417	40418	40419	40420	
Z	40207 40202	40203	0204 40205	40206	40207	40208	40200	40210	40211	40212	1 402	10479	40215	40216	40217	40218	40219	40220	10-01
Y•	10264 10265 40001 40002 10064 10065	10256 1025 40003 10066 1000	7 10268 0004 40005 7 10068	10269 40006 10069	40007 10070	10271 40008	10272 40009 1 10072	10274 40010 10074	10275 40011 10075	10276 40012 10076	10275 10078 400	10279 13 4001 10079	10280 40015 10080	10281 40016 10081	40017 10082	40018 10083	40019 10064	10285 40020 10085	10001 <u>EL -11.5</u>
(RA (I	RB			R	0		(L RD			RE				F	L RF	R	G



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External Wall (R1) A-6 Page 169 of 234

View: from Outside (North) to Inside (South)

				27803	18024 27804	18025 27805	27806	27807	18028 1 27808	8029 27809	27810	150	27811	18012	¹²	27813	18035 27814	15035 27815	18037	27817	27818	27819	18041 27620	18942 <u>EL</u>	. 52.05	<u>i</u>	
				27803	27604 17624	27605 17625	27605 17525	27507 17627	27608 17628	27809	27610 17630] 178	27811	2761	"],	27613	27614 17635	27615 17638	27616 17637	27617	27618 17639	27679	27620	17642			
				27403	27404 17424	27405 17425	27406 17426	27407 174271	27408 17428	27400 7429	27410 17430	1	27411 31]	2741 17432—	¹²]	27413	27414 17435	27415	27418	27417	27418 17439	27419 17440	27420	17442			
				27203 17223	27204 17224	27205	27206 17226	27207	27208 17228	27209 7229	27210	 1	27211	2721	<u>"</u>	27213	27214	27215	27216	27217	27218 17239	27245	27220	17242			
				27003	27004 17024	27005	27008 17028	27007	27008 17028	2/009 7029	2/010	 1	2/011	2701	<u></u>	27073	27014	27015	27016	27017	27018 17039 25818	27019 17040	27020	17042			
				16823	16824 28604	16825	15829 25608	26507	16828	5829 21609	16830-	 1	208/1	16832	<u> </u>	26673	16835	16836	16837 26616	25617	16839 26618	20013	26620	16842			
				18623 26403	18624 28404	16825-	16626 26406	16627 26407	16628 1 25408	29400	16530 26410	1 166	25411	16632 2641	11 12 1	1634] 26473]	26414	16636 26415	18637	16538 25417	16639 26478	16640	28420	18642			
				16423 26203	16424	16425	15426 26206	26207	16429 1 26208]	8429- 26209	1 64 30 26210	<u> </u> 1	21211	164.32 2621	<u> </u>	26213	15435 26214	16436 26215	16437 26216	16438	18439- 26218	16440	18441- 26220	16442			
				28003	28004	16225	25006	26007	26008	28000	26010	1 162	25011	167 <u>32</u> 2601	12	25073	26014	26015	26018	26017	16239 26018	26019	26020	16242			
 				25803	25804	25805	25404	25807	25808	25809	25810	1	25811	258	"]	25813	25814	25875	25818	25817	25818	25819	25820	16042			
		15621	15622	25603	25604 15624	25805 15825	25608	25607 15627	25008	25600	25610	1	25611	2561	"]	25613	25814	25815	25618	25817	25618 15639	25879	25620	15642	15643	EL 34.0	
		25407	25402	25400	25404	25405 15425	25408 15478	25407	25408	25400	25410	1	25411 31	<pre> The second se</pre>													
		25201	25202	25203	25204	25205	25206	25207	25208	25209	25210	1	25211	257	"1	25213	25214	25215	25218	25217	25218	25219	25220	25221	25222	15344	
		25001	25002	25003	25004	25005	25008	25007	25000	25009	25010	1	25011	250	1	25013	25014	25015	25016	25017	25018	25019	25020	25021	25022		
El 23 de la construcción de l		24801	24802	24803	24804	24805	24808	34807	24808	2400	24810	1	24811	248	12	24813	24814	24815	24816	24817	24818	24819	24820	24821	24822		
 		24601	24802 14622	24603 14623	24804	24605 14625	24608 14626	24607	24608 1	24609 4629	24610	The set of the															
El 225		24401 14421 1	24402	24403 14423	24424	24405 14425 1	24408 14126	24407	14408 14428	24409	24410] <u></u> 1	1 <u>1</u>	244	"], 17/1	2413 431 1	24414 14435 1	24115	2418	2417 1138	24418 1435	24419 14440	2420 1	24421 14442 1	24422 1443	14444	
Hernel Wall (Rt)		24201	24202 14222	24203	24294 14224	24205	24206	24207	24208 14228	14229	242	Image:															
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View: from FB (South) to RB (North)

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View: from Outside (South) to Inside (North)



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| 0°

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| 180°



| 270°

Cylindrical Inner Wall

| 180°

View: from Inside to Outside

| 90°

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Inner Wall (in Reactor Building)







Inner Wall (X Direction 1; in Fuel Building)












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View: from North to South

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View: from North to South



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Radial Inner Wall (No.1: 7.5°)



Radial Inner Wall (No.2: 82.5°)



Radial Inner Wall (No.3: 97.5°)



Radial Inner Wall (No.4: 142.5°)



Radial Inner Wall (No.5: 180.0°)





Radial Inner Wall (No.6: 195.0°)



Radial Inner Wall (No.7: 217.5°)



Radial Inner Wall (No.8: 262.5°)



Radial Inner Wall (No.9: 277.5°)



Radial Inner Wall (No.10: 352.5°)



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270⁶

`180°



RPV Pedestal Liner

A-21

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⁵⁰⁵²⁰¹-----180°

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Appendix B Definition of Shell Element Property in NASTRAN User Manual

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PSHELL Shell Element Property

Defines the membrane, bending, transverse shear, and coupling properties of thin shell elements.

Format:

1	2	3	4	5	6	7	8	9	10
PSHELL	PID	MID1	Т	MID2	12I/T++3	MID3	TS/T	NSM	
	Z1	Z2	MID4						

Example:

PSHELL	203	204	1.90	205	1.2	206	0.8	6.32	
	+.95	95							

Field	Contents
PID	Property identification number. (Integer > 0)
MID1	Material identification number for the membrane. (Integer ≥ 0 or blank)
Т	Default membrane thickness for Ti on the connection entry. If T is blank then the thickness must be specified for Ti on the CQUAD4, CTRIA3, CQUAD8, and CTRIA6 entries. (Real or blank)
MID2	Material identification number for bending. (Integer \geq -1 or blank)
12I/T**3	Bending moment of inertia ratio, $12I/T^3$ Ratio of the actual bending moment inertia of the shell, <i>I</i> , to the bending moment of inertia of a homogeneous shell, $T^3/12$. The default value is for a homogeneous shell. (Real > 0.0; Default = 1.0)
<u>MID3</u>	<u>Material identification number for transverse shear</u> . (Integer > 0 or blank; unless MID2 > 0 , must be blank.)
TS/T	Transverse shear thickness ratio, T_s/T . Ratio of the shear thickness, (T_s) , to the membrane thickness of the shell, T . The default value is for a homogeneous shell. (Real > 0.0; Default = .833333)
NSM	Nonstructural mass per unit area. (Real)



Z1, Z2	Fiber distances for stress calculations. The positive direction is determined by the right-hand rule, and the order in which the grid points are listed on the connection entry. See Remark 11. for defaults. (Real or blank)
MID4	Material identification number for membrane-bending coupling. See Remarks 6. and 13. (Integer > 0 or blank, must be blank unless MID1 > 0

and MID2 > 0, may not equal MID1 or MID2.)

Remarks:

- 1. All PSHELL property entries should have unique identification numbers with respect to all other property entries.
- 2. The structural mass is calculated from the density using the membrane thickness and membrane material properties. If MID1 is blank, then the density is obtained from the MID2 material.
- 3. The results of leaving an MID field blank (or MID2 = -1) are:

MID1	No membrane or coupling stiffness					
MID2	No bending, coupling, or transverse shear stiffness					
MID3	No transverse shear flexibility					
MID4	No bending-membrane coupling unless ZOFFS is specified on the connection entry. See Remark 6.					
MID2=-1	See Remark 12.					
	Note:	MID1 and MID2 must be specified if the ZOFFS field is also specified on the connection entry.				

- 4. The continuation entry is not required.
- 5. The structural damping (GE on the MATi entry) is obtained from the MID1 material. If MID1 is blank, then it is obtained from the MID2 material. If PARAM,SHLDAMP,DIFF or DIFF is any other character except SAME, then the structural damping κ^4 matrix is computed using the GE entries on the MATi entries according to rules in the following table. If a single PSHELL corresponds to row 8 of the table, then all PSHELLs in the model will follow the rule of row 8. Rows 1-7 is an attempt to maintain upward compatibility, if a user inadvertently places a SHLDAMP,DIFF in the model

Caution:	Large values of damping associated with an MID4 entry, when using
	PARAM,SHLDAMP,DIFF, can cause structural instability in transient
	dynamics.

SHELL Structural Damping Rules						
Row	MID1	MID2	MID3	MID4	K ⁴ based on	
1*	v	v			MID1 GE value	
2	v				MID1 GE value	
3	v	-1			MID1 GE value	
4	v	v		}	MID1 GE value	
5		v			MID2 GE value	
6		v	v		MID2 GE value	
					$n \rightarrow \text{ total number of non blank vi}$	
					$m \rightarrow \text{ total number of non zero } ge_i$	
7	1	0	0	4	If: $n = m$ and $ge_i = ge_2 = \dots = ge_m$	
	VI	VZ	VS	V4	Or: $m = 1$ and $ge_1 \neq 0$	
					Or: $m = 0$	
	•				MID1 GE value	
					Otherwise:	
					ge_1 · membrane-stiff	
0	1	72	v3		$+ge_2 \cdot \text{bending-stiff}$	
δ	VI	v2		v4	$+ ge_3 \cdot transverse shear-stiff$	
					$+ge_4$ · bending-membrane-stiff is	
				used		
* v \rightarrow MIDi values the same, vi \rightarrow MIDi values different or blank						
$ge_i \rightarrow GE$ value from a MATj entry associated with MIDi						
If for row 8, a $ge_i = 0$ it is replaced by $ge_i = 18$						

Table 8-30 SHELL Structural Damping Rules

6. The following should be considered when using MID4.



- The MID4 field should be left blank if the material properties are symmetric with respect to the middle surface of the shell. If the element centerline is offset from the plane of the grid points but the material properties are symmetric, the preferred method for modeling the offset is by use of the ZOFFS field on the connection entry. Although the MID4 field may be used for this purpose, it may produce ill-conditioned stiffness matrices (negative terms on factor diagonal) if done incorrectly.
- Only one of the options MID4 or ZOFFS should be used; if both methods are specified the effects are cumulative. Since this is probably not what the user intented, unexpected answers will result. Note that the mass properties are not modified to reflect the existence of the offset when the ZOFFS and MID4 methods are used. If the weight or mass properties of an offset plate are to be used in an analysis, the RBAR method must be used to represent the offset. See "Shell Elements (CTRIA3, CTRIA6, CTRIAR, CQUAD4, CQUAD8, CQUADR)" on page 119 of the MSC.Nastran Reference Manual.
- The effects of MID4 are not considered in the calculation of differential stiffness. Therefore, it is recommended that MID4 be left blank in buckling analysis.
- 7. This entry is referenced by the CTRIA3, CTRIA6, CTRIAR, CQUAD4, CQUAD8, and CQUADR entries via PID.
- 8. For structural problems, MIDi must reference a MAT1, MAT2, or MAT8 material property entry
- 9. If the transverse shear material MID3 or the membrane-bending coupling term MID4 references a MAT2 entry, then G33 must be zero. If MID3 references a MAT8 entry, then G1Z and G2Z must not be zero.
- 10. For heat transfer problems, MIDi must reference a MAT4 or MAT5 material property entry.
- 11. The default for Z1 is -T/2, and for Z2 is +T/2. T is the local plate thickness defined either by T on this entry or by membrane thicknesses at connected grid points, if they are input on connection entries.
- 12. For plane strain analysis, set MID2=-1 and set MID1 to reference a MAT1 entry. In-plane loads applied to plain strain elements are interpreted as line-loads with a value equal to the load divided by the thickness. Thus, if a thickness of "1.0" is used, the value of the line-load equals the load value. Pressure can be approximated with multiple line loads where the pressure value equals the line-load divided by the length between the loads.

- 13. For the CQUADR and CTRIAR elements, the MID4 field should be left blank because their formulation does not include membrane-bending coupling.
- 14. If MIDi is greater than or equal to 10^8 , then parameter NOCOMPS is set to +1 indicating that composite stress data recovery is desired. (MIDi greater than 10^8 are generated by PCOMP entries.)
- 15. For a material nonlinear property, MID1 must reference a MATS1 entry and be the same as MID2, unless a plane strain (MID2 = -1) formulation is desired. Also, MID3 cannot reference a MATS1 entry.
- 16. If transverse shear flexibility is specified for a model with curved shells where the loading is dominated by twist, results will not converge and may be inaccurate. PARAM,SNORM should be set for this unique model condition.



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Appendix C Response to Discussion about Truncated Model at NRC 2nd Audit

Appendix C Response to Discussion about Truncated Model at NRC 2nd Audit

Confirmation Items

- 1. Close SFP Poll gate Gap to meet the NRC model
- 2. Confirm load combination 0.4NS+1.0EW-0.4V vs. Rev.3
- 3. BNL: check displacement
- 4. provide the force Nxy
- 5. provide forces table (7 walls and 3 sections): show the relation NASTRAN and model
- 6. provide excel sheet (graph and data, give the clear names to sheet)
- 7. show positive direction of forces on plan view sketch
- 8. BNL: re-estimate graph based on element-center elevation to compare forces of both model
- 9. add offset to SFP wall(F3)
- 10. confirm the possibility of expression forces on line(forces on node)
- 11. basemat thickness inside pedestal to 5.1 m
- 12. confirm the attached level of soil spring on basemat
- 13. confirm the adequacy of hydro-pressure on model
- 14. identify possible reason of differences
- 15. identify possible reason of knuckle and large gradient

GE Response

Items 1), 4) through 7), 9), 11), and 13) are incorporated into Revision 5 of this report.

- 1) One of the pool gate gaps (south side gate) on Modified truncated model is closed to maintain consistency with the NRC model.
- 2) Load combination -0.4NS-1.0EW-0.4V considered in Revision 4 of SER-ESR-038 is confirmed to be the critical load combination.
- 3) BNL seems to have used soil springs for non-seismic loads in the analysis case for seismic load. The soil spring stiffness values for horizontal seismic load and other loads are those shown in DCD Table 3G.1-1.
- 4) New tables including Nxy forces are added.
- 5), 6), 7) The requested table, Excel sheet and sketch are added.
- 8) The elevation of element estimated in truncated model is at center of the bottom row of shell elements. BNL is requested to meet this condition. This elevation is EL -11.0 m.
- 9) The fuel storage pool wall on F3 wall is updated using offset function per NRC's comment.
- 10) It is difficult to obtain the forces on nodes from NASTRAN results. GE expects the differences are not significant.
- 11) Modified truncated model is updated to change the basemat thickness inside pedestal to 5.1 m.
- 12) The soil springs are attached to the basemat at the middle of basemat thickness. GE has confirmed that the results are not sensitive the attached level of soil springs.
- 13) Hydro-pressure is updated to apply actual magnitude onto the modified truncated model in Revision 5 of the subject report.

- 14), 15) In the 2nd structural audit held on December 12, 2006 BNL and GE identified some differences between the results of both models. The possible reasons for the identified differences are summarized below. BNL's ANSYS results received at the audit and recalculated GE's NASTRAN results are compared in Figures C-1 through C-40.
 - i) Forces on the intersection portion of walls: There are differences of forces at the intersections of outer walls as marked in Figure C-13 for instance. BNL's results show the force concentration caused by the stiffening effect of L or T configuration of walls. From structural design point of view there is no impact on the wall design because rebars which come from both walls are arranged into these sections.
 - ii) The knuckles of out-of -plane shear distribution: In the seismic event, the walls in parallel to the seismic direction have knuckles on the edge of the walls. For example, as shown in Figure C-11, the corner portion of R1/RG of R1 wall has a knuckle in out-of-plane shear force (Qy) for the W-E seismic load condition in GE's results, but BNL's results do not have this configuration. Besides, in case of F3 wall, this configuration can also be found in BNL's results. GE considers that the knuckles are caused by the constraint effects of the wall and basemat connected perpendicular to the subject wall. GE assumes the some part of differences comes from the difference of estimation levels between both models as pointed out above 8).
 - iii) The differences of magnitude of forces appeared on basemat inside pedestal: The result of re-analysis using the updated model shows better agreement. In case of seismic load the magnitude of forces has to be re-compared because BNL's soil spring may not be adequate as pointed out above 3).
 - iv) The differences of magnitude of forces appeared on outer wall of Fuel Storage Pool (FSP): For the out-of-plane shear forces and moments on RA and F3 wall located around FSP in case of Hydrostatic load, BNL's results are lower than those of GE. GE assumes the some part of differences comes from the difference of estimation levels between both models as pointed out above 8). In order to have a better understanding of the differences, GE would like to request BNL to confirm the input data for Hydrostatic load.



Figure C-1 Element Forces Comparison NASTRAN to ANSYS (RA FA Wall: Axial Force [MN/m])



Figure C-2 Element Forces Comparison NASTRAN to ANSYS (RA FA Wall: In-plane Shear [MN/m])

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Figure C-3 Element Forces Comparison NASTRAN to ANSYS (RA FA Wall: Out-of-plane Shear [MN/m])

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Figure C-4 Element Forces Comparison NASTRAN to ANSYS (RA FA Wall: Out-of-plane Moment [MN-m/m])

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Figure C-5 Element Forces Comparison NASTRAN to ANSYS (RG FA Wall: Axial Force [MN/m])

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Figure C-6 Element Forces Comparison NASTRAN to ANSYS (RG FF Wall: In-plane Shear [MN/m])

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Figure C-7 Element Forces Comparison NASTRAN to ANSYS (RG FF Wall: Out-of-plane Shear [MN/m])

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Figure C-8 Element Forces Comparison NASTRAN to ANSYS (RG FF Wall: Out-of-plane Moment [MN-m/m])



Figure C-9 Element Forces Comparison NASTRAN to ANSYS (R1 Wall: Axial Force [MN/m])

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R1: In-plane Shear Qx (MN/m)

Figure C-10 Element Forces Comparison NASTRAN to ANSYS (R1 Wall: In-plane Shear [MN/m])

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Figure C-11 Element Forces Comparison NASTRAN to ANSYS (R1 Wall: Out-of-plane Shear [MN/m])

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Figure C-12 Element Forces Comparison NASTRAN to ANSYS (R1 Wall: Out-of-plane Moment [MN-m/m])



Figure C-13 Element Forces Comparison NASTRAN to ANSYS (R7 F1 Wall: Axial Force [MN/m])



Figure C-14 Element Forces Comparison NASTRAN to ANSYS (R7 F1 Wall: In-plane Shear [MN/m])



Figure C-15 Element Forces Comparison NASTRAN to ANSYS (R7 F1 Wall: Out-of-plane Shear [MN/m])

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Figure C-16 Element Forces Comparison NASTRAN to ANSYS (R7 F1 Wall: Out-of-plane Moment [MN/m])

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Figure C-17 Element Forces Comparison NASTRAN to ANSYS (F3 Wall: Axial Force [MN/m])

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Figure C-18 Element Forces Comparison NASTRAN to ANSYS (F3 Wall: In-plane Shear [MN/m])



Figure C-19 Element Forces Comparison NASTRAN to ANSYS (F3 Wall: Out-of-plane Shear [MN/m])

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Figure C-20 Element Forces Comparison NASTRAN to ANSYS (F3 Wall: Out-of-plane Moment [MN-m/m])



Figure C-21 Element Forces Comparison NASTRAN to ANSYS (RCCV: Axial Force [MN/m])

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Figure C-22 Element Forces Comparison NASTRAN to ANSYS (RCCV: In-plane Shear [MN/m])

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Figure C-23 Element Forces Comparison NASTRAN to ANSYS (RCCV: Out-of-plane Shear [MN/m])

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Figure C-24 Element Forces Comparison NASTRAN to ANSYS (RCCV: Out-of-plane Moment [MN-m/m])



Figure C-25 Element Forces Comparison NASTRAN to ANSYS (RPV Pedestal: Axial Force [MN/m])



Figure C-26 Element Forces Comparison NASTRAN to ANSYS (RPV Pedestal: In-plane Shear [MN/m])

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Figure C-27 Element Forces Comparison NASTRAN to ANSYS (RPV Pedestal: Out-of-plane Shear [MN/m])



Figure C-28 Element Forces Comparison NASTRAN to ANSYS (RPV Pedestal: Out-of-plane Moment [MN-m/m])

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Figure C-29 Element Forces Comparison NASTRAN to ANSYS (Basemat Section A-A: Axial Force [MN/m])



Figure C-30 Element Forces Comparison NASTRAN to ANSYS (Basemat Section A-A: In-plane Shear [MN/m])

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Figure C-31 Element Forces Comparison NASTRAN to ANSYS (Basemat Section A-A: Out-of-plane Shear [MN/m])

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Figure C-32 Element Forces Comparison NASTRAN to ANSYS (Basemat Section A-A: Out-of-plane Moment [MN-m/m])

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Figure C-33 Element Forces Comparison NASTRAN to ANSYS (Basemat Section B-B: Axial Force [MN/m])

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Figure C-34 Element Forces Comparison NASTRAN to ANSYS (Basemat Section B-B: In-plane Shear [MN/m])

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Figure C-35 Element Forces Comparison NASTRAN to ANSYS (Basemat Section B-B: Out-of-plane Shear [MN/m])



Figure C-36 Element Forces Comparison NASTRAN to ANSYS (Basemat Section B-B: Out-of-plane Moment [MN-m/m])

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Figure C-37 Element Forces Comparison NASTRAN to ANSYS (Basemat Section C-C: Axial Force [MN/m])

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Figure C-38 Element Forces Comparison NASTRAN to ANSYS (Basemat Section C-C: In-plane Shear [MN/m])





Figure C-39 Element Forces Comparison NASTRAN to ANSYS (Basemat Section C-C: Out-of-plane Shear [MN/m])



Figure C-40 Element Forces Comparison NASTRAN to ANSYS (Basemat Section C-C: Out-of-plane Moment [MN-m/m])

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ENCLOSURE 2

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NASTRAN Analysis Input Data and

NASTRAN Analysis Results

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