GE Energy

**David H. Hinds**
Manager, ESBWR

PO Box 780 M/C L60
Wilmington, NC 28402-0780
USA

T 910 675 6363
F 910 362 6363
david.hinds@ge.com

*Proprietary and Security Notice*
*This letter forwards both proprietary and Security-Related information in accordance with 10CFR2.390. Upon the removal of Enclosures 1 and 3, the balance of this letter may be considered non-proprietary and non-Security-Related.*

MFN 06-189
Supplement 1

Docket No. 52-010

December 8, 2006

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

Subject: **Response to Portion of RAI Letter Number 20 Related to ESBWR Design Certification Application – Seismic Design – RAI Numbers 3.7-8S1, 3.7-11S1, 3.7-25S1, 3.7-26S1, 3.7-52S1, and 3.7-55S1 – Supplement 1**

Enclosures 1 through 3 contain supplemental responses to the subject RAIs resulting from the November 2006 NRC Seismic Audit. GE's original responses were transmitted via the Reference 1 letter.

Enclosure 1 contains Security-Related information identified by the designation "{{{Security-Related Information - Withhold Under 10 CFR 2.390}}}." GE hereby requests this information be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390. A public version is contained in Enclosure 2

Enclosure 3 contains GE proprietary information as defined by 10 CFR 2.390. GE customarily maintains this information in confidence and withholds it from public disclosure.

The affidavit contained in Enclosure 4 identifies that the information contained in Enclosure 3 has been handled and classified as proprietary to GE. GE hereby requests that the information of Enclosure 3 be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 9.17. The Enclosure 3 report is entirely proprietary and a non proprietary version is not available.

If you have any questions about the information provided here, please let me know.

Sincerely,

Kathy Sedney for

David H. Hinds
Manager, ESBWR

Reference:

1. MFN 06-189, Letter from David Hinds to U.S. Nuclear Regulatory Commission, *Response to Portion of RAI Letter Number 20 Related to ESBWR Design Certification Application – Seismic Design – RAI Numbers 2.5-1, 3.7-5, 3.7-7, 3.7-8, 3.7-11, 3.7-12, 3.7-25, 3.7-26, 3.7-29, 3.7-34, 3.7-52, and 3.7-55*, June 29, 2006

Enclosures:

1. MFN 06-189, Supplement 1 – Response to Portion of RAI Letter Number 20 Related to ESBWR Design Certification Application – Seismic Design – RAI Numbers 3.7-8S1, 3.7-11S1, 3.7-25S1, 3.7-26S1, 3.7-52S1, and 3.7-55S1 – Security-Related Information
2. MFN 06-189, Supplement 1 – Response to Portion of RAI Letter Number 20 Related to ESBWR Design Certification Application – Seismic Design – RAI Numbers 3.7-8S1, 3.7-11S1, 3.7-25S1, 3.7-26S1, 3.7-52S1, and 3.7-55S1 – Public Version
3. MFN 06-189, Supplement 1 – Validation Test Report for DAC3N Version 97, S/VTR-D3N Revision D – GE Proprietary Information
4. Affidavit – George B. Stramback – dated December 8, 2006

| | | |
|---|---|---|
| cc: | AE Cubbage | USNRC (with enclosures) |
| | GB Stramback | GE/San Jose (with enclosures) |
| | eDRF | 0000-0060-8445 |

**ENCLOSURE 2**

**MFN 06-189**

**SUPPLEMENT 1**

**Response to Portion of RAI Letter Number 20**

**Related to ESBWR Design Certification Application**

**Seismic Design**

**RAI Numbers 3.7-8S1, 3.7-11S1, 3.7-25S1, 3.7-26S1, 3.7-52S1, and 3.7-55S1**

**Public Version**

## NRC RAI 3.7-8

*In DCD Section 3.7.1.1 and DCD Section 3.7.1.1.1, respectively, the applicant stated that for generic site (1) the peak ground acceleration (PGA) of the SSE is 0.3g at the foundation level, and (2) the design response spectra are specified at the foundation level in the free field. It is the staff's understanding that the foundation level of the reactor/fuel building is located at 20m (66.0 ft) below grade and the foundation level of the control building is located at 15.05 m (49ft) below grade. The applicant is requested to provide its technical basis to justify why the PGAs and ground response spectra are the same at these two (2) different foundation elevations.*

## GE Response

The use of the same 0.3g RG 1.60 spectra at different foundation elevations is a conservative approach for developing enveloping seismic loads for the ESBWR standard plant design. In COL a site-specific SSE probabilistic site response analysis will be performed and the resulting free-field outcrop spectrum at the foundation level of each Seismic Category I building will be compared to the ESBWR standard plant design spectrum as stated in the response to RAI 3.7-5.

Please note that the embedment depths are 20m for the reactor and fuel buildings and 14.9m for the control building.

A markup of DCD Tier 2 Section 3.7.1.1.3, DCD Tier 2 Tables 3.8-13 and 3A.2-1 was provided under MFN 06-189.

**NRC RAI 3.7-8, Supplement 1**

**NRC Assessment Following the November 2, 2006 Audit**

*Demonstrate conservatism in the approach for developing enveloping seismic loads.*

**GE Response**

The first paragraph of the response provided in MFN 06-189 is revised as follows to remove the reference to conservatism:

"0.3g RG 1.60 spectra at different foundation elevations is the approach used for developing enveloping seismic loads for the ESBWR standard plant design. In COL a site-specific SSE probabilistic site response analysis will be performed and the resulting free-field outcrop spectrum at the foundation level of each Seismic Category I building will be compared to the ESBWR standard plant design spectrum as stated in the response to RAI 3.7-5."

No DCD change will be made in response to this RAI Supplement.

**NRC RAI 3.7-11**

*In the fourth sentence of the first paragraph of DCD Section 3.7.1.1.3 (Page 3.7-4), the applicant stated that, since the low frequency part of North Anna SSE ground response spectra are enveloped by the 0.3g RG 1.60 generic site response spectra with large margins, only the high frequency part needs to be explicitly taken into account. The staff requests the applicant to provide justifications for the conclusion drawn in the DCD and a comparison plot of these two sets of ground response spectra in Tier 2 DCD Section 3.7.1, "Seismic Design Parameters."*

**GE Response**

The spectra of Figure 3.7-7 (1) are the envelops of high and low frequency target spectra used to define outcrop ground motions at horizons within the site rock profile. Figure 3.7-11 (1) reproduces the CB and RB/FB spectra of Figure 3.7-7 (1) and adds RG 1.60 anchored to a PGA of 0.3g. Comparison of this figure with DCD Figure 2.5-1 implies that the high frequency target spectra (shown in DCD Figure 2.5-1) control motions for frequencies above about 2 Hz, and that the low frequency target spectra (enveloped by the low frequency part of the spectra in Figure 3.7-7 (1) above) control motions for lower frequencies. It is apparent that the RG 1.60 spectrum envelopes by a factor of over 5 the low frequency part of the site-specific ground motion spectra for all evaluated North Anna Early Site Permit horizons (including the CB and RB/FB base horizons).

No DCD change was required for this RAI response.

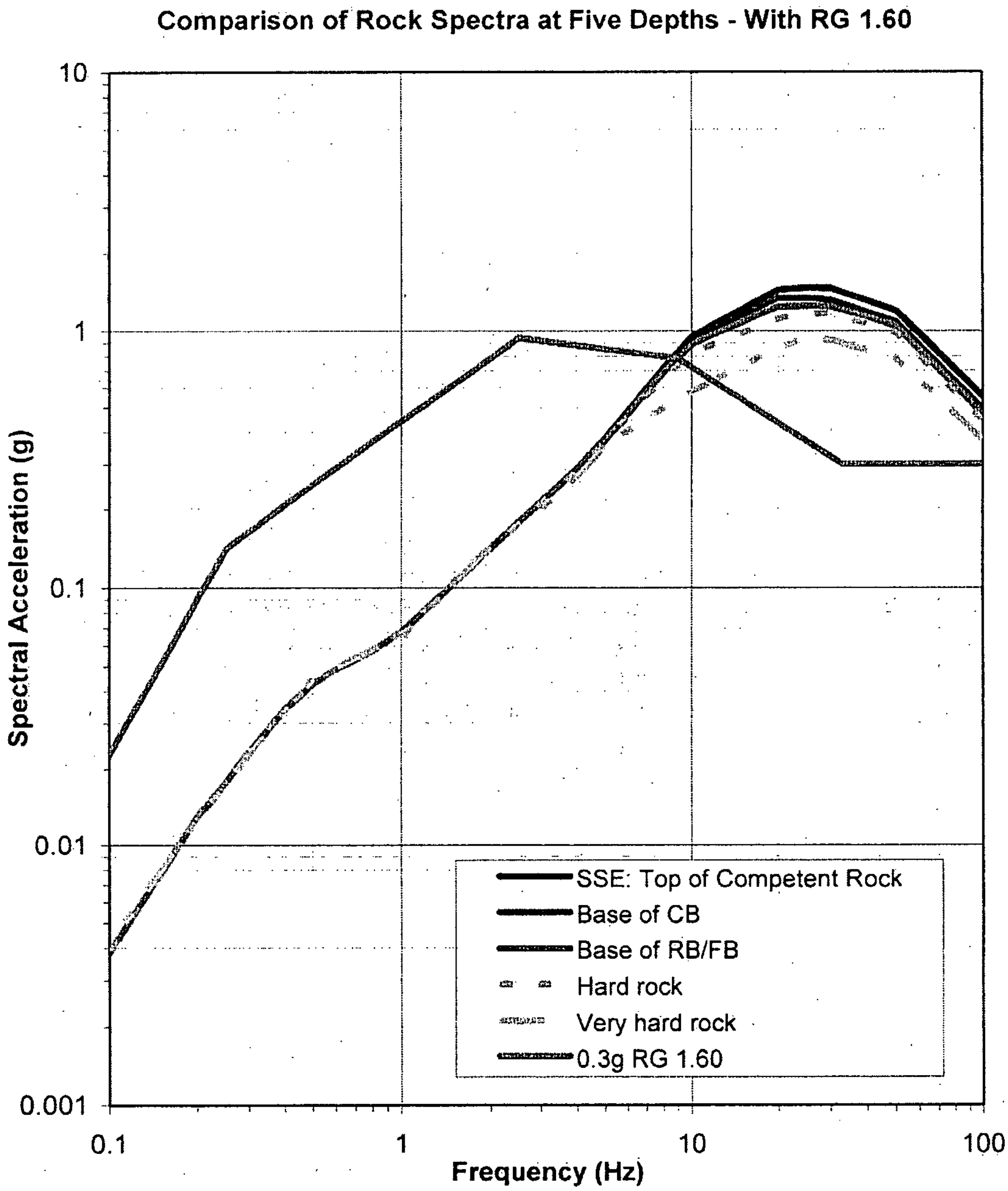



**Figure 3.7-11 (1) - Comparison of North Anna ground motion spectra at the CB and RB/FB (and other) horizons with a RG 1.60 spectrum anchored to 0.3g PGA.**

**NRC RAI 3.7-11, Supplement 1**

**NRC Assessment Following the November 2, 2006 Audit**

*Provide additional clarification for the second sentence description provided in the last response submitted.*

**GE Response**

The response provided in MFN 06-189 is revised as follows to clarify the response:

"The spectra of Figure 3.7-7 (1) are the envelops of high and low frequency target spectra used to define outcrop ground motions at horizons within the site rock profile. Figure 3.7-11 (1) reproduces the CB and RB/FB spectra of Figure 3.7-7 (1) and adds RG 1.60 anchored to a PGA of 0.3g. It is apparent that the RG 1.60 spectrum envelopes by a factor of over 5 the low frequency part of the site-specific ground motion spectra for all evaluated North Anna Early Site Permit horizons (including the CB and RB/FB base horizons)."

No DCD change will be made in response to this RAI Supplement.

## NRC RAI 3.7-25

*For the development of the RB/FB seismic model, the staff requests the applicant to specify in the DCD where the heavy crane (with trolley) is to be parked during plant operation. This information is needed to properly locate the mass and assess the effects of mass eccentricity in the seismic analysis. This information also needs to be identified as an interface item for the COL applicant.*

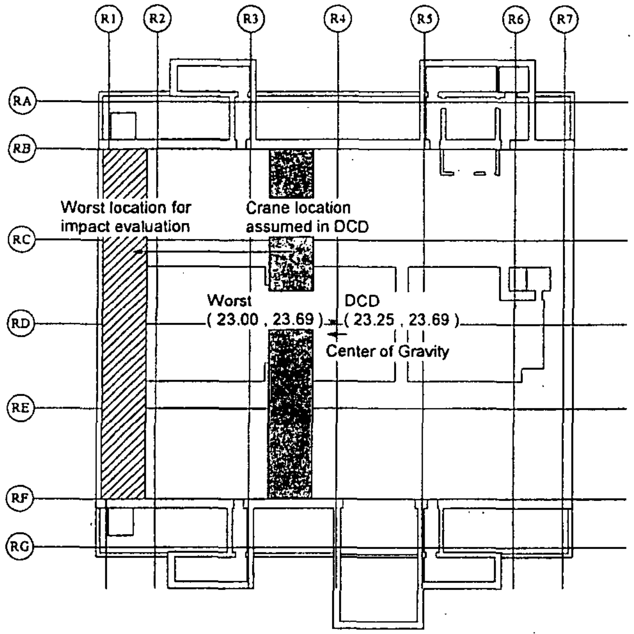
## GE Response

For the development of the RB/FB seismic model, the heavy crane (with trolley) is assumed to be parked between col-rows R3 and R4 in the RB and between col-rows FB and FC in the FB.

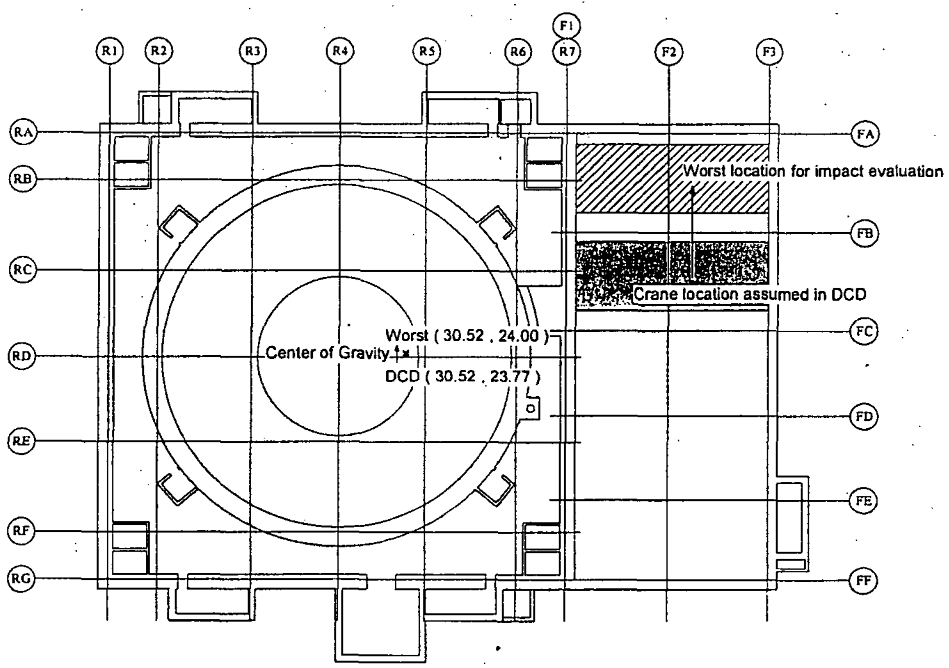
In order to assess the effects of crane location in the seismic analysis, the change of mass eccentricity was calculated varying the crane locations. A worst location is considered in the sensitivity analysis. Figure 3.7-25(1) shows the changes of the centers of gravity at the RB and FB crane floors. The centers of gravity moved only 25 cm maximum. Table 3.7-25 (1) shows comparison of eigenvalue analysis results for RBFB model in Fixed-base case. It is found that the difference of frequencies due to the crane location is negligibly small.

Hence, there is no need to identify crane location as an interface item for the COL applicant.

No DCD change was required in response to this RAI.




(a) EL 34.00




(b) EL 13.57

**Figure 3.7-25 (1) - Crane Location for Seismic Analysis**

**Table 3.7-25 (1) - Comparison of Eigenvalue Analysis Results for RBFB Model in Fixed-base Case**

| MODE | FREQUENCY (Hz) | | Difference |
|---|---|---|---|
| | DCD*1 | Worst*2 | |
| 1 | 2.74 | 2.74 | 0.00% |
| 2 | 3.81 | 3.81 | 0.00% |
| 3 | 3.81 | 3.81 | 0.00% |
| 4 | 3.94 | 3.94 | 0.03% |
| 5 | 4.36 | 4.36 | 0.02% |
| 6 | 5.21 | 5.21 | 0.00% |
| 7 | 5.22 | 5.22 | 0.00% |
| 8 | 5.98 | 5.98 | 0.00% |
| 9 | 5.99 | 5.99 | 0.00% |
| 10 | 6.09 | 6.09 | -0.03% |
| 11 | 6.75 | 6.75 | 0.00% |
| 12 | 8.02 | 8.01 | 0.06% |
| 13 | 8.58 | 8.58 | 0.04% |
| 14 | 10.24 | 10.24 | -0.02% |
| 15 | 10.32 | 10.32 | 0.00% |
| 16 | 10.52 | 10.52 | 0.00% |
| 17 | 10.67 | 10.67 | 0.03% |
| 18 | 11.23 | 11.23 | 0.00% |
| 19 | 11.25 | 11.25 | 0.00% |
| 20 | 11.89 | 11.89 | 0.00% |
| 21 | 12.26 | 12.26 | -0.01% |
| 22 | 12.28 | 12.28 | 0.00% |
| 23 | 12.56 | 12.56 | -0.02% |
| 24 | 12.82 | 12.82 | -0.03% |
| 25 | 13.38 | 13.37 | 0.05% |
| 26 | 13.73 | 13.72 | 0.06% |
| 27 | 14.86 | 14.86 | 0.01% |
| 28 | 15.44 | 15.43 | 0.08% |
| 29 | 15.88 | 15.89 | -0.02% |
| 30 | 16.25 | 16.25 | 0.00% |

Note: Assumed crane locations are shown in Figure 3.7-25 (1).

*1: Crane location assumed in DCD.

*2: Worst location for impact evaluation.

**NRC RAI 3.7-25, Supplement 1**

**NRC Assessment Following the November 2, 2006 Audit**

*Describe the effect of location of the main RB crane parking location on the design loads for individual structural members.*

**GE Response**

For the NASTRAN stress analysis, the crane locations are assumed as shown in Figures 3.7-25 (1) and 3.7-25 (2). The column R3/RB (i.e. column at the intersection of grid line R3 and grid line RB) and column R4/RB support the heaviest load from the RB crane. The columns F3/FB and F3/FC support the heaviest load from the FB crane.. By using the stresses obtained from the stress analyses for these heaviest loaded columns, all the columns are designed and sized for the worst loading possible. Therefore, the crane can be parked anywhere from a structural design viewpoint.

No DCD change will be made in response to this RAI Supplement.

**Figure 3.7-25 (1) Assumed Location for RB Crane**
**{{{Contains Security-Related Information – Withheld Under 10 CFR 2.390}}}**

**Figure 3.7-25 (2) Assumed Location for FB Crane**
**{{{Contains Security-Related Information – Withheld Under 10 CFR 2.390}}}**

## NRC RAI 3.7-26

*For seismic subsystem analysis, accurate in-structure response spectra are needed at the subsystem support points. The staff requests the applicant to describe in the DCD how it has considered the effects of out-of-plane vibration of floors and walls in the seismic structural models and the development of in-structure response spectra.*

## GE Response

As described in DCD Appendix 3A.7, a finite element model was used to obtain the vertical floor frequencies at major floor locations. The obtained frequencies were included in the stick model by a series of vertical single degree-of-freedom oscillators at the corresponding floor elevations. The in-structure response spectra were calculated using the oscillator responses.

Compared to the floors, the out-of-plane vibration frequencies of walls, which support subsystem designed using in-structure response spectra, are very high. Table 3.7-26 (1) shows the calculated out-of-plane fundamental frequencies for the typical walls in the RBFB. It is found from the calculations that the out-of-plane fundamental frequencies for the walls are higher than the highest frequency of interest at 50 Hz. Therefore, the effects of out-of-plane vibration of walls are not considered in the seismic structural models.

No DCD change was required for this RAI response.

**Table 3.7-26 (1) - Out-of-plane Fundamental Frequencies for Typical Walls**

| Building | Elevation (m) | Wall Thickness (m) | Frequency (Hz) |
|---|---|---|---|
| RBFB | EL -11.5 to EL-6.4 | 2.0 | 224 |
| RBFB | EL-4.65 to EL -9.06 | 1.5 | 183 |
| RBFB | EL27.0 to EL 34.0 | 1.0 | 68 |
| RBFB | Above EL 34.0 | 1.0 | 53 |
| CB | EL-2.0 to EL4.65 | 0.9 | 60 |

**NRC RAI 3.7-26, Supplement 1**

**NRC Assessment Following the November 2, 2006 Audit**

*Review calculations for out-of-plane vibrations and document the results.*

**GE Response**

The out-of-plane vibration frequencies of walls were reviewed. As shown in Table 3.7-26 (1), the calculated out-of-plane fundamental frequencies for the typical walls in the RBFB and the CB are higher than the highest frequency of interest of 50 Hz. However, since the RB walls above the refueling floor at EL 34.0m and the FB walls at EL 4.65m have large heights to the upper floor, their frequencies are expected to be lower than 50 Hz. They are evaluated by using FEM model in the same manner as the slab frequencies. The eigenvalue analysis results are shown in Tables 3.7-26 (2) and 3.7-26 (3). Their mode shapes are shown in Figures 3.7-26 (1) through 3.7-26 (8).

To obtain design loads of these walls and design FRS for the components attached to these walls, seismic analysis will be performed using wall oscillators calculated by the above analysis, in the same manner as floor oscillators. The seismic analysis model is shown in Figure 3.7-26 (9). The cracked concrete effect will be addressed by reducing the oscillator's spring values by 50%.

DCD Tier 2 Appendix 3A will be revised to include the results of this analysis in the next update.

### Table 3.7-26 (1) Out-of-plane Fundamental Frequencies for Typical Walls

| Building | Elevation (m) | Wall Thickness (m) | Frequency (Hz) |
|---|---|---|---|
| RBFB | EL -11.5 to EL-6.4 | 2.0 | 224 |
| RBFB | EL-4.65 to EL -9.06 | 1.5 | 183 |
| RBFB | EL27.0 to EL 34.0 | 1.0 | 64 |
| CB | EL-2.0 to EL4.65 | 0.9 | 60 |

### Table 3.7-26 (2) Eigenvalue Analysis Results for RB Walls above EL34000

| Mode No. | Frequency (Hz) | Effective Weight (MN) | | Group No. | Average Frequency (Hz) | Total Weight (MN) | Stiffness (MN/m) | Note |
|---|---|---|---|---|---|---|---|---|
| | | R1 | RB | | | | | |
| 1 | 14.14 | 0.00 | 4.56 | 1-RB | 14.14 | 4.56 (38.0%) | 3666 | RB |
| 2 | 15.14 | 7.16 | 0.00 | 1-R1 | 15.87 | 8.13 (93.1%) | 8238 | R1 |
| 3 | 17.23 | 0.00 | 0.00 | | | | | |
| 4 | 21.22 | 0.97 | 0.01 | | | | | R1 |
| 5 | 21.88 | 0.00 | 1.41 | 2-RB | 24.51 | 5.10 (42.5%) | 12332 | RB |
| 6 | 25.29 | 0.00 | 2.44 | | | | | RB |
| 7 | 25.95 | 0.00 | 1.25 | | | | | RB |
| 8 | 26.99 | 0.00 | 0.01 | | | | | |
| 9 | 30.63 | 0.00 | 0.00 | | | | | |
| 10 | 35.22 | 0.54 | 0.01 | 2-R1 | 35.22 | 0.54 (6.2%) | 2714 | R1 |
| 11 | 38.07 | 0.01 | 0.56 | 3-RB | 43.36 | 2.28 (19.0%) | 17234 | RB |
| 12 | 39.44 | 0.01 | 0.00 | | | | | |
| 13 | 40.40 | 0.00 | 0.01 | | | | | |
| 14 | 40.88 | 0.00 | 0.00 | | | | | |
| 15 | 41.73 | 0.00 | 0.02 | | | | | |
| 16 | 42.51 | 0.00 | 0.00 | | | | | |
| 17 | 43.61 | 0.01 | 0.01 | | | | | |
| 18 | 44.12 | 0.00 | 0.37 | | | | | RB (to 3-RB) |
| 19 | 45.59 | 0.00 | 0.02 | | | | | |
| 20 | 47.49 | 0.02 | 0.02 | | | | | |
| 21 | 48.01 | 0.00 | 1.30 | | | | | RB (to 3-RB) |
| | R1 Total | 8.7MN | | | Total | 8.7MN (99.3%) | | |
| | RB Total | | 12.0MN | | Total | 11.9MN (99.4%) | | |

Note: R7 wall is considered to be identical to R1 wall. RF wall is considered to be identical to RB wall.

**Table 3.7-26 (3) Eigenvalue Analysis Results for FB Walls above EL4650**

| Mode No. | Frequency (Hz) | Effective Weight (MN) | | Group No. | Average Frequency (Hz) | Total Weight (MN) | Stiffness (MN/m) | Note |
|---|---|---|---|---|---|---|---|---|
| | | F3 | FA | | | | | |
| 1 | 12.73 | 8.09 | 0.01 | 1-F3 | 12.73 | 8.09 (73.7%) | 5278 | F3 |
| 2 | 13.27 | 0.01 | 4.93 | 1-FA | 13.27 | 4.93 (85.0%) | 3493 | FA |
| 3 | 15.98 | 0.60 | 0.00 | 2-F3 | 18.34 | 2.38 (21.7%) | 3225 | F3 |
| 4 | 19.14 | 1.78 | 0.00 | | | | | F3 |
| 5 | 23.65 | 0.00 | 0.00 | | | | | |
| 6 | 25.75 | 0.03 | 0.00 | | | | | |
| 7 | 29.23 | 0.00 | 0.00 | | | | | |
| 8 | 33.32 | 0.04 | 0.00 | 3-F3 | 35.36 | 0.23 (2.1%) | 1170 | F3 |
| 9 | 35.79 | 0.19 | 0.00 | | | | | F3 |
| 10 | 36.55 | 0.01 | 0.00 | | | | | |
| 11 | 37.55 | 0.00 | 0.00 | | | | | |
| 12 | 37.69 | 0.01 | 0.00 | | | | | |
| 13 | 40.73 | 0.00 | 0.86 | 2-FA | 40.73 | 0.86 (14.8%) | 5733 | FA |
| 14 | 42.50 | 0.20 | 0.00 | 4-F3 | 42.50 | 0.21 (1.9%) | 1522 | F3 |
| 15 | 49.87 | 0.01 | 0.00 | | | | | |
| | F3 Total | 11.0MN | | | Total | 10.9MN (99.5%) | | |
| | FA Total | | 5.8MN | | Total | 5.8MN (99.8%) | | |

Note: FF wall is considered to be identical to FA wall.

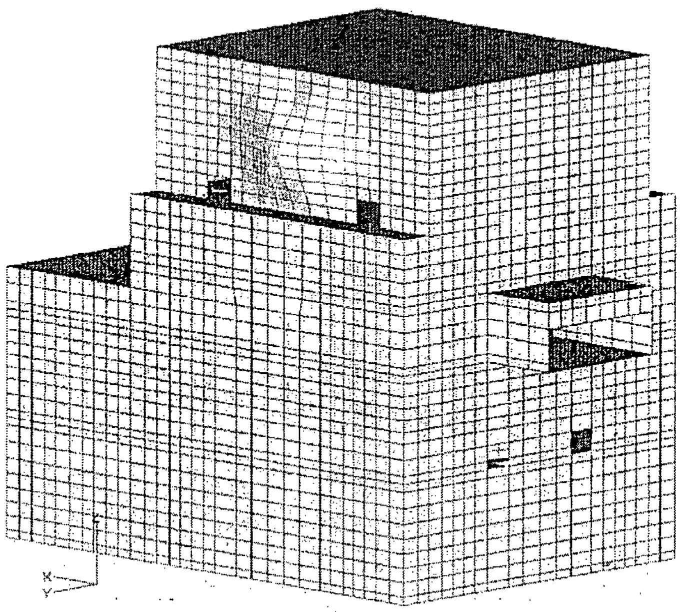


**Figure 3.7-26 (1) RB Walls above EL34000 Mode 1**

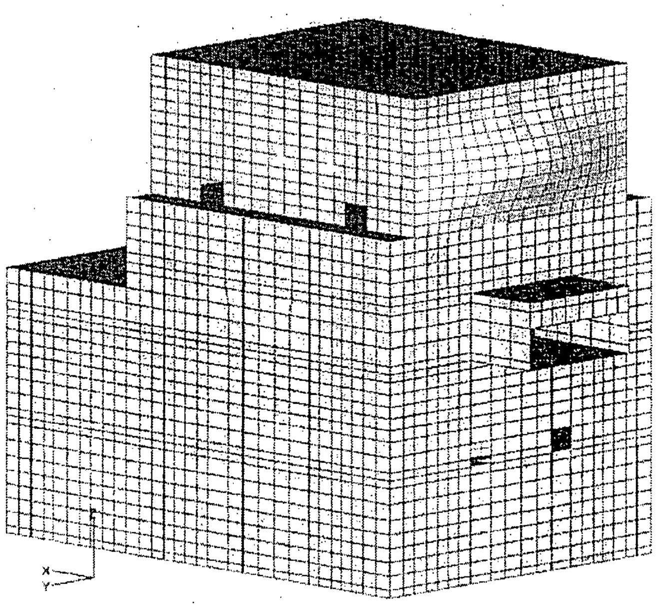


**Figure 3.7-26 (2) RB Walls above EL34000 Mode 2**

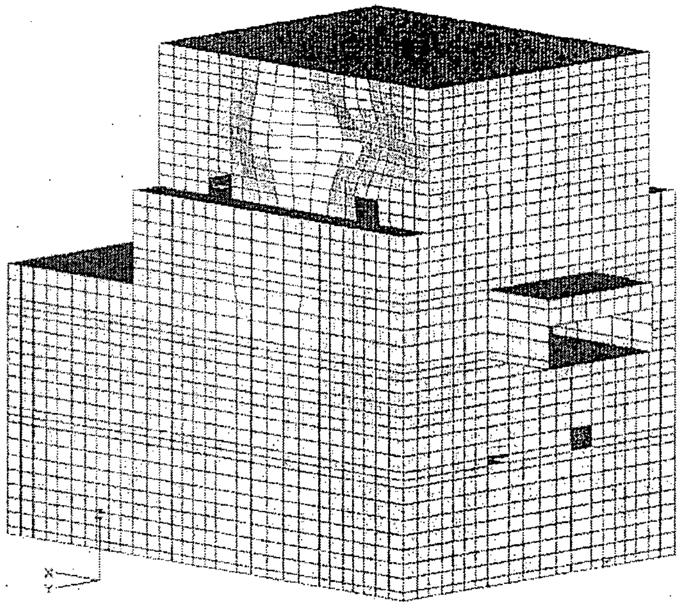


**Figure 3.7-26 (3) RB Walls above EL34000 Mode 5**

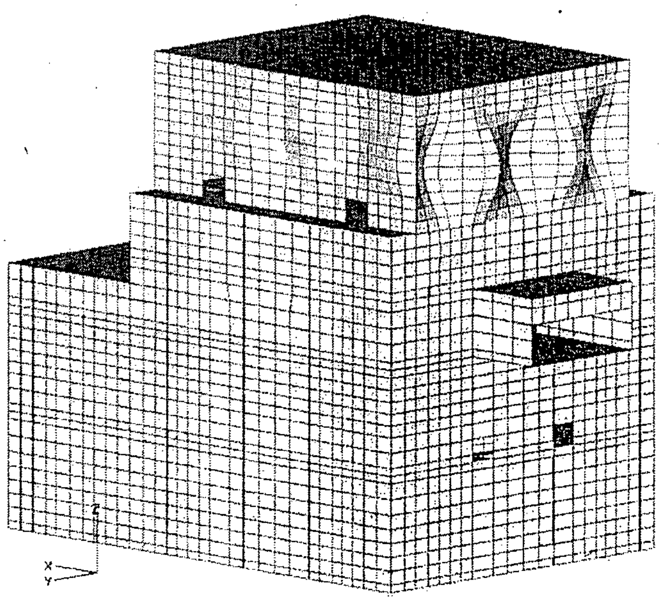


**Figure 3.7-26 (4) RB Walls above EL34000 Mode 10**

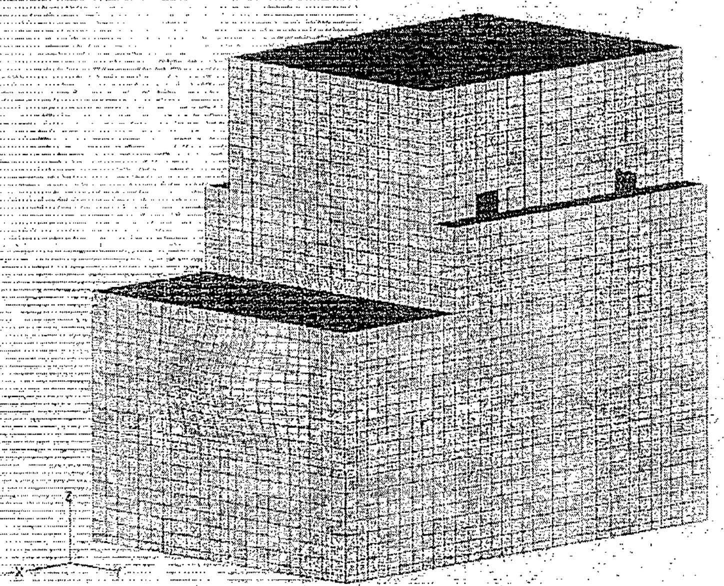



**Figure 3.7-26 (5) FB Walls above EL4650 Mode 1**

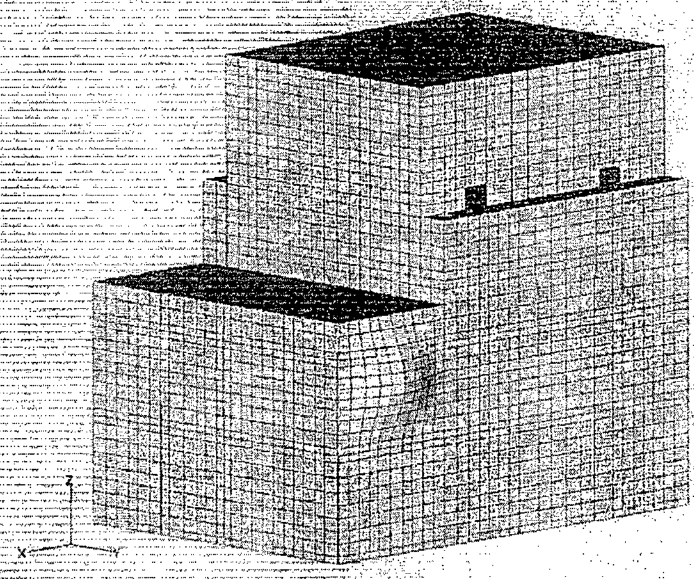



**Figure 3.7-26 (6) FB Walls above EL4650 Mode 2**

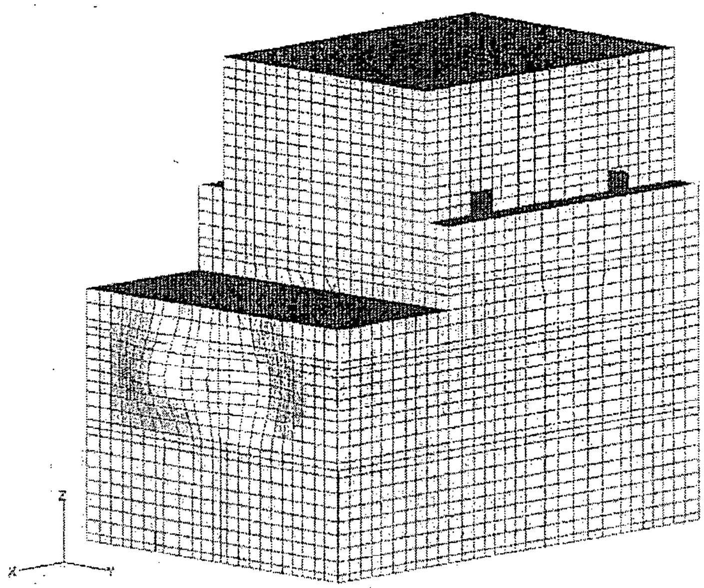



**Figure 3.7-26 (7) FB Walls above EL4650 Mode 3**

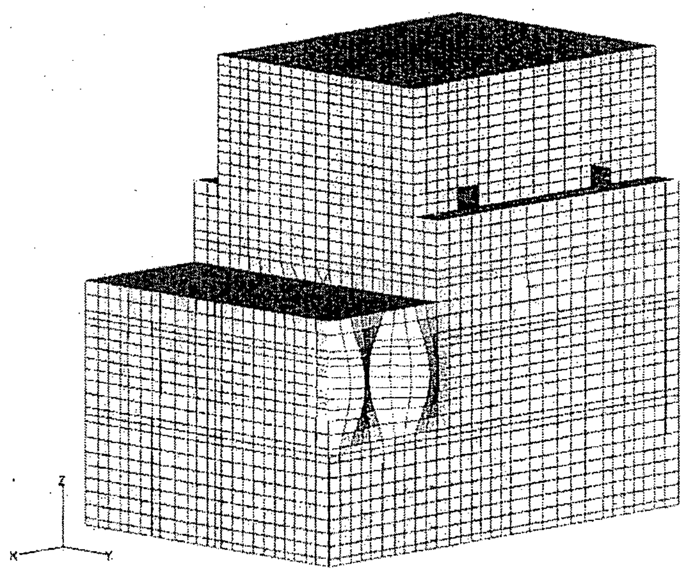
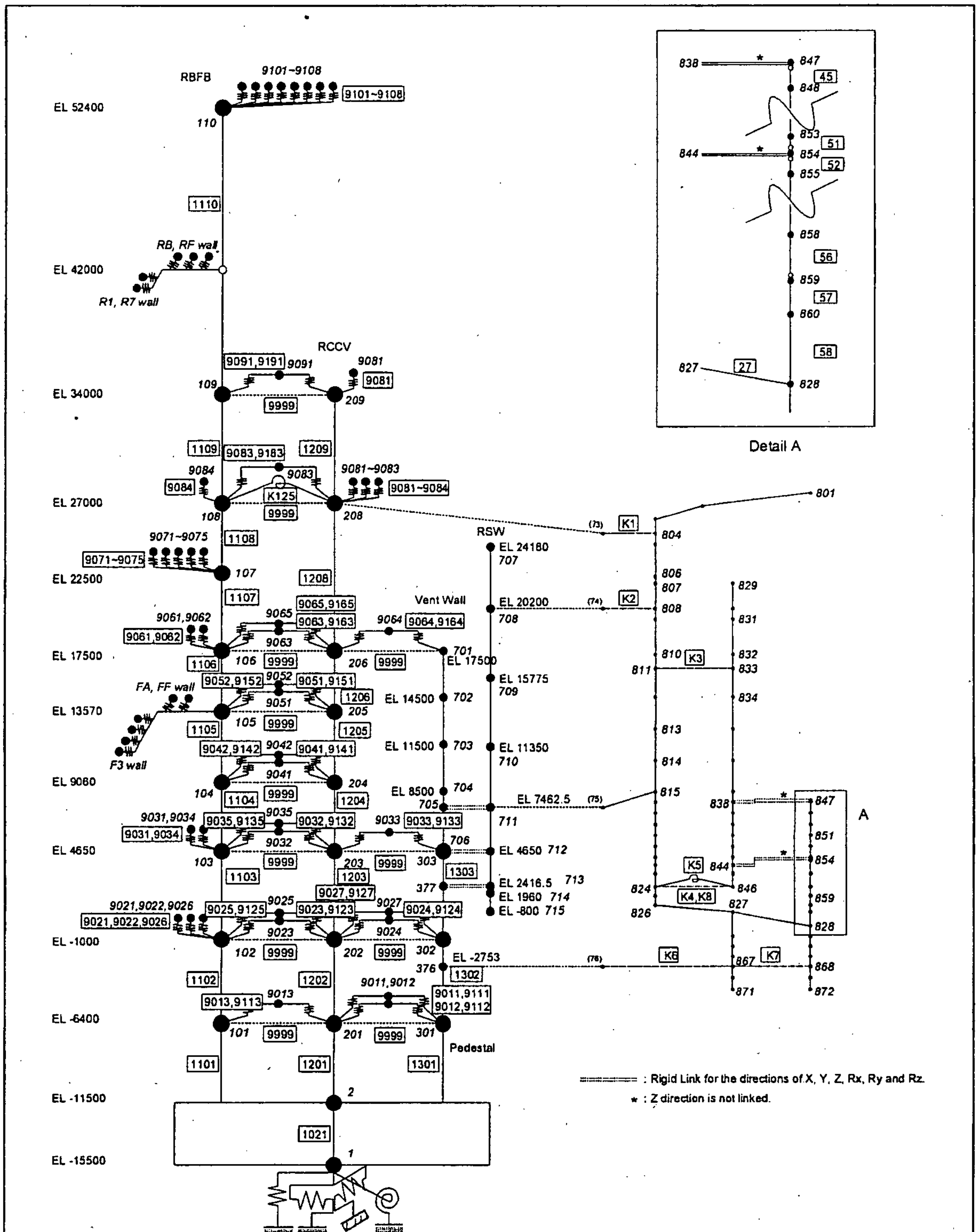



**Figure 3.7-26 (8) FB Walls above EL4650 Mode 13**




Note: Refer to Figures 8.2-1 through 8.2-3 for details of individual stick's eccentricities.

**Figure 3.7-26 (9) RBFB Complex Seismic Model including Wall Oscillators**

## NRC RAI 3.7-52

*DCD Section 3.7.3.13 does not provide any detail about the methods of analysis employed or the acceptance criteria used to determine structural design adequacy of buried conduits, tunnels, and auxiliary systems. In addition, the applicant did not provide the definition for the term "auxiliary systems." The staff requests the following additional information to complete its review:*

*(a) a description of the types of SSCs that are included under the category "auxiliary systems;"*

*(b) a description of the analysis method and acceptance criteria for buried conduits;*

*(c) a description of the analysis method and acceptance criteria for tunnels;*

*(d) a description of the analysis method and acceptance criteria for auxiliary systems.*

## GE Response

(a) See DCD Table 3.2-1 for identification of components in "auxiliary systems". See DCD Chapter 9 for identification and description of "auxiliary systems."

(b) There are no Seismic Class I buried conduits.

(c) There are no C-I tunnels in the ESBWR design. Tunnels in the ESBWR are NS but since some tunnels in the ESBWR carry liquid radwaste, the structural acceptance and materials criteria for tunnels are in accordance with RG 1.143 – Safety Class IIa. The method of seismic analysis is the same as building embedded walls, taking into account the requirements described in DCD Section 3.7.3.13.

(d) Same analysis methods and acceptance criteria is used for Auxiliary systems for underground portions of Category I structures, as shown in DCD Sections 3.8.4 and 3.8.5 for analysis and acceptance criteria details. Refer to DCD Chapter 9 for list of auxiliary systems.

Markups of DCD Tier 2 Sections 3.7.3.13, 3.7.3.14 and 3.7.3.15 were provided in MFN 06-189.

## NRC RAI 3.7-52, Supplement 1

## NRC Assessment Following the November 2, 2006 Audit

*Provide an explicit description of the design approach and acceptance criteria for buried C-I SSCs since there are electrical cable banks between the CB and RB.*

## GE Response

The responses provided to RAI 3.7-52 (b) and (c) under MFN 06-189 are revised as follows:

(b) There are no Seismic Class I buried conduits. There are Seismic Class I conduits in two electrical duct banks from the CB to the RB.

(c) There are no C-I tunnels in the ESBWR design. The access tunnels between Seismic Category I or II buildings are C-II. Tunnels carrying liquid radwaste are NS but the structural acceptance and material criteria are in accordance with RG 1.143 – Safety Class IIa.

The electrical duct banks (See (b) above) and yard FPS lines are buried underground utilities with a Seismic Category I classification. The duct banks are located in a closed reinforced concrete trench (or tunnel) covered with backfill and the FPS lines will be located in covered reinforced concrete trenches near the surface with removable covers to facilitate maintenance and inspection access. These items are relatively short since they are routed directly between buildings.

The method of seismic analysis is the same as building embedded walls, taking into account the requirements described in DCD Tier 2 Subsection 3.7.3.13. The effect of wave propagation is accounted for in accordance with Section 3.5.2 and Commentary of ASCE 4-98.

No DCD change is required in response to this RAI supplement.

**NRC RAI 3.7-55**

*To facilitate the staff's evaluation of the adequacy of computer codes used for design and analysis of the ESBWR Seismic Category I structures, the staff requests the applicant submit validation packages, translated into English, for the following computer codes listed in DCD Appendix 3C:*

*SSDP-2D*

*TEMCOM2*

*DAC3N.*

**GE Response**

The following validation packages were enclosed in Attachments 3.7-55(1) through (3) under MFN 06-189. These documents were prepared according to Shimizu QA program.

(1) S/VTR-SD2, *Validation Test Report for SSDP-2D, Rev. C.*

(2) S/VTR-D3N, *Validation Test Report for DAC3N, Rev. C.*

(3) S/VTR-TEM, *Validation Test Report for TEMCOM2, Rev. C.*

No DCD change was required in response to this RAI.

**NRC RAI 3.7-55, Supplement 1**

**NRC Assessment Following the November 2, 2006 Audit**

*Use a large size problem for comparison of results obtained from a commercially available program since the test cases for DAC3N computer code validation are too simple to test the problem size limitation, if any, of the code. State the validation status of the commercial program used.*

**GE Response**

The following validation report, included as Attachment 3.7-55 (4), has been revised to include a large size problem for comparison of results obtained from NASTRAN, which is a commercially available program:

1) S/VTR-D3N, Validation Test Report for DAC3N, Rev. D

For the commercial programs used -- SASSI and SHAKE, the computer code vendor UC Berkeley, performed the code validation. The validation status of other commercial programs used is provided in DCD Tier 2 Appendix 3C.

DCD Tier 2 Appendix 3C will be revised in the next update as noted in the attached markup.

Lysmer. The program is based on the finite-element method formulated in the frequency domain using a substructuring technique.

### *3C.7.2.2 Validation*

SASSI version 2000 was obtained from the University of California, Berkeley and implemented by Shimizu Corporation of Tokyo, Japan on the PC computer on Linux OS. Program validation documentation is available at UC Berkeley.

### *3C.7.2.3 Extent of Application*

SASSI is used to obtain seismic design loads and in-structure floor response spectra for the Seismic Category I buildings accounting for the effects of SSI.

## 3C.7.3 Free-Field Site Response Analysis – SHAKE

### *3C.7.3.1 Description*

SHAKE is a program, which can perform the free-field site response analysis. It was developed at the University of California, Berkeley by B. Schnabel, John Lysmer and H.B. Seed in 1972. The program is based on the theory of one-dimensional propagation of shear waves in the vertical direction in a horizontally-layered visco-elastic soils system overlying an elastic half-space medium.

SHAKE also has a function to account for non-linearities in soil shear modulus and hysteresis damping as functions of shear strain in soil by the use of equivalent-linear soil properties using an iterative equivalent linearization procedure to obtain constant values of shear modulus and hysteresis damping ratio compatible with the effective shear strain in each soil layer.

### *3C.7.3.2 Validation*

SHAKE was developed at the University of California, Berkeley and implemented by Shimizu Corporation of Tokyo, Japan on the Hewlett Packard computer workstation. Program validation documentation is available at UC Berkeley.

### *3C.7.3.3 Extent of Application*

SHAKE is used to generate the free-field site response motions required in the seismic SSI analysis.

# ENCLOSURE 4

# MFN 06-189

# Supplement 1

## Affidavit

# General Electric Company

# AFFIDAVIT

**I, George B. Stramback,** state as follows:

(1) I am Manager, Regulatory Services, General Electric Company ("GE") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Enclosure 3 of GE letter MFN 06-189, Supplement 1, David H. Hinds to NRC, *Response to Portion of RAI Letter Number 20 Related to ESBWR Design Certification Application – Seismic Design – RAI Numbers 3.7-8S1, 3.7-11S1, 3.7-25S1, 3.7-26S1, 3.7-52S1, and 3.7-55S1 – Supplement 1*, dated December 8, 2006. The proprietary information in Enclosure 3, *Validation Test Report for DAC3N Version 97, S/VTR-D3N Revision D,* contains the designation "GE Proprietary Information {3}" on each page. The notation {3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.790(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals aspects of past, present, or future General Electric customer-funded development plans and programs, resulting in potential products to General Electric;

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a., and (4)b, above.

(5) To address 10 CFR 2.390 (b) (4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within GE is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GE are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains detailed ESBWR design information developed by GE and/or its partners over a period of several years at a cost of over one million dollars. This information, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE's comprehensive BWR safety and technology base, and its commercial value extends

beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GE.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GE's competitive advantage will be lost if its competitors are able to use the results of the GE experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GE would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GE of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 8th day of December 2006.

George B. Stramback
General Electric Company