DEPARTURES

Introduction

A *departure* is a plant-specific deviation from design information in a standard design certification rule. Departures from the reference ESBWR Design Control Document (DCD) are identified and evaluated consistent with regulatory requirements and guidance. Each departure is examined in accordance with 10 CFR 52 requirements. Although the ESBWR Design Certification Application is currently under review with the NRC, departures are evaluated utilizing the guidance provided in Regulatory Guide 1.206, Section C.IV.3.3.

It is anticipated that the final certification rulemaking for the ESBWR would have the same change process as that in current appendices to 10 CFR 52 and in the proposed 10 CFR 52 Appendix E, "Design Certification Rule for the ESBWR Design." References in this part to the Design Certification Rule (DCR) or 10 CFR 52 Appendix E are understood to mean the proposed 10 CFR 52 Appendix E and the anticipated final ESBWR DCR.

The following departures are evaluated in this report:

NAPS DEP 3.7-1, Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

NAPS DEP 8.1-1: Figure 8.1-1, Sheet 1, *Electrical Power Distribution System*

NAPS DEP 8.1-2: Table 8.1-1, On-site Power System SRP Criteria Applicability Matrix

NAPS DEP 11.4-1: Long-term, Temporary Storage of Class B and C Low-Level Radioactive Waste

NAPS DEP 12.3-1: Liquid Radwaste Effluent Discharge Piping Flow Path

Departure: NAPS DEP 3.7-1, Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

1. Summary of Departure

DCD Table 2.0-1, *Envelope of ESBWR Standard Plant Site Parameters*, defines the safe shutdown earthquake (SSE) horizontal and vertical design ground response spectra of 5 percent damping, also termed the Certified Seismic Design Response Spectra (CSDRS), as the free-field outcrop spectra at the foundation level (bottom of the base slab) of the Reactor Building/Fuel Building and Control Building structures, as shown in DCD Figures 2.0-1 and 2.0-2. As specified in DCD Table 2.0-1, Note (9) for the Firewater Service Complex, which is essentially a surface founded structure, the CSDRS is 1.35 times the values shown in DCD Figures 2.0-1 and 2.0-2 and is defined as free-field outcrop spectra at the foundation level (bottom of the base slab) of the Firewater Service Complex structure. The Unit 3 site-specific horizontal and vertical seismic response spectra exhibit exceedances at certain frequencies, when compared to the CSDRS. As a

result of these exceedances, Dominion performed site-specific soil-structure interaction (SSI) ised the SSE definition to include the response spectra (FIRS) for each design, analysis, and qualification of

ADD: The Unit 3 plant-shutdown OBE response spectrum limit is based on (a) one-third of the CSDRS and (b) one-third of the performance-based surface response spectra (PBSRS). Because all safety-related SSCs will be designed, analyzed, and qualified to meet both the CSDRS and site specific FIRS, plant shutdown is required, as discussed in FSAR Section 3.7.4.4, only if both response spectra in (a) and (b) are exceeded.

1-1, the changes to the site-specific n. Therefore, a request for exemption from DCD Tier 1 information is provided in Exemption 3.

Finally, DCD Section 3.7 defines, as Tier 2* information, the ESBWR Operating Basis Earthquake (OBE) as one-third of the SSE ground motion. ~~Because the Unit 3 SSE is being defined through this departure as consisting of both the CSDRS and FIRS for each structure, two spectra are used to define the Unit 3 OBE design ground motion: one third of the CSDRS and a site dependent spectrum, both of which must be exceeded in order to require a plant shutdown.~~

Delete the marked text.

2. Scope/Extent of Departure

This departure is for the site-specific FIRS exceeding the CSDRS at certain frequencies and a revision of the SSE definition to include the site-specific FIRS for each seismically qualified structure. The changes are identified in FSAR Sections 1.3, 2.0, 3.7, 3.8, 4.2, 19.2, and Appendices 3A, 3C, and 19A. The departure also involves redefinition of the OBE. The changes to the OBE definition are identified in FSAR Section 3.7.

As noted above, an associated request for exemption from DCD Tier 1 information is provided in Exemption 3.

3. Departure Justification

For the RB/FB and CB structures, DCD Table 2.0-1 defines the CSDRS associated with the SSE for horizontal and vertical directions as those presented in DCD Figures 2.0-1 and 2.0-2, respectively. For the FWSC, DCD Table 2.0-1, Note (9) defines the CSDRS. Comparisons of site-specific spectra with the CSDRS are presented in FSAR Figures 2.0-201, 2.0-202, 2.0-203, and 2.0-204 for both full column outcrop motions and geologic outcrop motions. As discussed in FSAR Section 3.7.1.1, these figures show that the site-dependent FIRS exceed the CSDRS for Seismic Category I structures. The site-specific SSI analyses results are presented in FSAR Section 3.7.2.4 for the RB/FB, CB and FWSC structures.

FSAR Figures 2.0-201, 2.0-202, 2.0-203, and 2.0-204 present the CSDRS and Unit 3 site-specific FIRS for the horizontal and vertical directions, for all of the Unit 3 Seismic Category I structures. These figures reflect the Unit 3 site-specific horizontal and vertical seismic spectra, therefore DCD Figures 2.0-1 and 2.0-2 for the RB/FB and CB structures and DCD Table 2.0-1, Note (9) for the FWSC structure, which defined the CSDRS, are not replaced by this departure. Unit 3 seismic design, analyses, and qualification of site-specific structures, systems, and components use both the CSDRS and the Unit 3 site-specific FIRS for purposes of establishing the SSE ground motion

response spectra, as defined in FSAR Section 3.7.1. This approach satisfies the minimum requirements for design ground motion as described in 10 CFR 50, Appendix S (as discussed in FSAR Section 3.7.1.1).

FSAR Section 3.7.2.4 discusses the site-specific SSI analyses that are performed to validate design of the standard plant Seismic Category I structures, based on the site-specific SSI input motions. The results of the site-specific SSI analyses, documented in FSAR Section 3.7.2.4.1.6.1, demonstrate that the standard plant seismic design of structural members envelops the site-specific seismic responses for the RB/FB, CB and FWSC (as discussed in FSAR Section 3.7.2.4.1). FSAR Section 3.7.2.8 states that the same process is used for design and analyses for the Seismic Category II and Radwaste Building structures.

FSAR Section 19.2.3.2.4 discusses the Unit 3 seismic risk evaluation.

In FSAR Section 3.7.2.4.1.6.1, the site-specific floor response spectra for the best estimate, lower bound, and upper bound subsurface profiles are compared with the DCD enveloping floor response spectra at 5 percent damping. Figures are added to FSAR Section 3.7.2 to compare the site-specific in-structure response spectra (ISRS), to the DCD corresponding floor response spectra at 5 percent damping. In some locations, the Unit 3 floor response spectra exceed the DCD enveloping floor response spectra. The floor response spectra used for seismic design of systems and components considers the DCD floor response spectra and the site-specific ISRS.

~~The OBE is defined for purposes of requiring a plant shutdown, as described in FSAR Section 3.7.4.4. The OBE for Unit 3 is based on two spectra defining the OBE design ground motion at grade. The first plant-shutdown OBE spectrum is one-third of the CSDRS, and the second plant-shutdown OBE spectrum is the site-dependent OBE described in FSAR Section 3.7.1.1.6. The use of two sets of spectra for the plant shutdown OBE is justified because the SSCs will be designed, analyzed, and qualified to the higher of the two sets of SSE spectra. Therefore, only for events which result in measured ground motion exceeding both sets of spectra of the plant shutdown OBE would a plant shutdown be required.~~

4. Departure Evaluation

As discussed above, appropr ctures have been conducted to asse encies and a revision of the SSE defi . This departure has been evaluate esign Certification Rule, Section VIII

Accordingly, this departure do

1. Result in more than a cident previously evaluated in th

INSERT: A Unit 3 plant-shutdown OBE response spectrum limit is established, as described in FSAR Section 3.7.1, for purposes of requiring a plant shutdown, as described in FSAR Section 3.7.4.4. The Unit 3 plant-shutdown OBE response spectrum limit is established based on one-third of the Unit 3 ground motion response spectra used in the design of seismic SSCs. This approach is consistent with Appendix S of 10 CFR Part 50 and Section 4.1.2 of Regulatory Guide 1.166 for purposes of ensuring margin to the ground motion response spectra used in the design of seismic SSCs in the event of an earthquake.

2. Result in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the plant-specific DCD;

3. Result in more than a minimal increase in the consequences of an accident previously evaluated in the plant-specific DCD;

4. Result in more than a minimal increase in the consequences of a malfunction of a SSC important to safety previously evaluated in the plant-specific DCD;

5. Create a possibility for an accident of a different type than any evaluated previously in the plant-specific DCD;

6. Create a possibility for a malfunction of an SSC important to safety with a different result than any evaluated previously in the plant-specific DCD;

7. Result in a design basis limit for a fission product barrier as described in the plant-specific DCD being exceeded or altered; or

8. Result in a departure from a method of evaluation described in the plant-specific DCD used in establishing the design bases or in the safety analyses.

This departure does not affect resolution of an ex-vessel severe accident design feature identified in the DCD.

This departure does not modify design features and functional capabilities that are supported in a required assessment of a DCD design regarding aircraft impact hazards (i.e., as required by 10 CFR 50.150(a)(1)).

This departure involves a change to DCD Tier 1 and DCD Tier 2* information. Pursuant to Section VIII.B.2.b.5a of the ESBWR design certification rule, NRC approval is necessary; Exemption 3 requests the approval for the exemption from the DCD Tier 1 information.

Departure: NAPS DEP 8.1-1 - Figure 8.1-1, Sheet 1, *Electrical Power Distribution System*

1. Summary of Departure

DCD Tier 2, Figure 8.1-1, Sheet 1, *Electrical Power Distribution System*, has a horizontal dashed line with components in the “Turbine Island/Transformer Yard” shown below the line and components in the “Switchyard” shown above the line. This figure shows the location of the main generator circuit breaker and its motor-operated disconnects (MODs) below the dashed line in the “Turbine Island/Transformer Yard” area of the plant. The space available at the North Anna Power Station site for Unit 3 does not allow installing these components in this area of the plant. As shown

3.6 Protection Against Dynamic Effects Associated with the Postulated Rupture of Piping

This section of the referenced DCD is incorporated by reference with no departures or supplements.

3.7 Seismic Design

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

3.7.1 Seismic Design Parameters

Replace the last four sentences of this section with following.

NAPS DEP 3.7-1

SSE design ground motion for purposes of seismic design, analysis, and qualification of Unit 3 plant structures, systems, and components, is defined by two sets of ground motion acceleration response spectra:

- the single envelope design ground motion response spectra or Certified Seismic Design Response Spectra (CSDRS) described in Section 3.7.1.1.3 that defines the SSE design motion for seismic design of ESBWR Standard Plant, and
- the site-specific FIRS described in Section 3.7.1.1.4.2, representative of the Unit 3 site specific seismological and geological conditions.

Figures 2.0-201 through 2.0-204 present these 5 percent damped acceleration response spectra that define the site-specific design ground motion as a free-field outcrop motion at the foundation bottom of each Seismic Category I structure. DCD Figures 2.0-1 and 2.0-2 present the standard design CSDRS.

For each structure and each equipment location within the buildings, in-structure response spectra (ISRS) are developed. The site-specific ISRS that exceed the standard design ISRS, are used in conjunction with the standard design ISRS for seismic design and qualification of equipment and components.

This approach applies to SSCs that are required to withstand SSE loads. Similarly, other SSCs that are specifically required to meet SSE seismic demands are designed, analyzed, and qualified using the process in Sections 3.7.1 and 3.7.2 for applying the CSDRS and site-specific FIRS. The same approach is applied for the Seismic Category II and Radwaste Building structures.

Replace with Insert 3.7.1.

The plant shutdown OBE is defined as 1/3 of the SSE. The following two sets of horizontal and vertical OBE response spectra at grade serve as the reference against which OBE exceedance checks are performed for the purpose of plant shutdown:

(a) 1/3 of the CSDRS presented in Figures 2.0-201 and 2.0-202 that define the free field ground motion at bottom of the RB/FB and CB foundations;

(b) 1/3 of the performance-based surface response spectra (PBSRS) presented in Figure 2.5.2-311 that define the Unit 3 site specific free field ground motion at grade.

The use of CSDRS in (a) above as the basis for defining the OBE at grade for the purpose of plant shutdown is conservative since it neglects to consider the amplifications of the standard design ground motion as it propagates from the bottom of the RB/FB and CB foundations to the plant grade. Plant shutdown is required only if there is an exceedance of both OBE spectra. See Section 3.7.4.4 for discussion on seismic monitoring instrumentation.

3.7.1.1 Design Ground Motion

Add the following at the end of this section.

NAPS SUP 3.7-7

As shown in Figures 2.0-201 through 2.0-204, the site-specific FIRS calculated for Seismic Category I structures of Unit 3 exceed the CSDRS. Therefore, site-specific SSI analyses of these structures are carried out using the site-specific seismic design parameters described in this section. The site-specific seismic design parameters are developed as described in detail in Sections 3.7.1.1.4 and 3.7.1.1.5. These design parameters include the SSI input strain compatible soil profiles, SSI input response spectra, and SSI input acceleration time histories for the following Seismic Category I structures:

- Reactor Building/Fuel Building
- Control Building
- Fire Water Service Complex

The development of the site-dependent SSE at-grade and the OBE at-grade spectra are described in Section 3.7.1.1.6.

Insert for Section 3.7.1:

NAPS DEP 3.7-1

The Unit 3 plant-shutdown OBE response spectrum limit is established to ensure (1) that, if not exceeded, plant equipment designed to withstand seismic loads will have margin to the design ground motion response spectra; and (2) that the seismic instrumentation system timely alerts plant operators within four hours and supports decision-making within eight hours as to whether or not to shut down the plant following a seismic event.

The plant shutdown OBE is defined as 1/3 of the SSE. The following two sets of horizontal and vertical response spectra serve as the reference against which OBE exceedance checks are performed at grade for the purpose of plant shutdown:

a) One-third of the CSDRS presented in Figures 2.0-201 and 2.0-202 that define the free field ground motion at bottom of the RB/FB and CB foundations; and
b) One-third of the performance-based surface response spectra (PBSRS) presented in Figure 2.5.2-311 that define the Unit 3 site-specific free field ground motion at grade.

Because all safety related SSCs will be designed, analyzed, and qualified to meet both the CSDRS and site-specific FIRS, plant shutdown is required if both response spectra in (a) and (b) are exceeded, as described in Section 3.7.4.4. Exceedance of the response spectra (a) and (b) is evaluated independently (i.e., an envelope of the two response spectra is not used). For example, a response spectrum that falls below the envelope of the two response spectra but exceeds (b) at a low frequency and exceeds (a) at a higher frequency is considered as exceeding the OBE, thus requiring shutdown of the plant, as discussed in Section 3.7.4.4.

The use of CSDRS in (a) above as the basis for defining the OBE at grade for the purpose of plant shutdown is conservative since it neglects the amplifications of the standard design ground motion as it propagates from the bottom of the RB/FB and CB foundations to the plant grade. The OBE ground motion defined with the criteria above constitutes a single OBE ground motion for the entire site. See Section 3.7.4.4 for discussion on seismic monitoring instrumentation.

3.7.3.13 Seismic Category I Buried Piping, Conduits and Tunnels

Replace the sixth paragraph sixth bullet as follows.

NAPS DEP 3.7-1

- [*Seismic input motions are based on the single envelope design response spectra as defined in DCD Table 3.7-2, using the applicable scale factor, and site-specific SSE FIRS.*]*

Replace the seventh paragraph as follows.

[*Seismic Category I utilities and Safety Class RW-IIa radwaste piping installed in trenches or tunnels are analyzed in accordance with the standard requirements of DCD Section 3.7.3. Seismic input motions for the portions located below ground are based on the single envelope design response spectra as defined in DCD Table 3.7-2, using applicable scale factors, and site-specific SSE FIRS.*]*

* Text sections that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2*. Prior NRC approval is required to change.

3.7.4 Seismic Instrumentation

Add the following at the end of the first paragraph.

NAPS SUP 3.7-6

The seismic monitoring program described in this subsection, including the necessary test and operating procedures, will be implemented prior to receipt of fuel on site.

3.7.4.4 Comparison of Measured and Predicted Responses

Add the following after the first paragraph.

NAPS DEP 3.7-1

Replace with Insert 3.7.4.4.

Based on the definition of the SSE for Unit 3 in Section 3.7.1 using two spectra for seismic design, analysis, and qualification of SSCs, the OBE for purposes of plant shutdown (referred to herein as the “plant-shutdown OBE”) is similarly based on two spectra defining the OBE design ground motion at grade. The first plant-shutdown OBE spectrum is 1/3 of the CSDRS, and the second plant-shutdown OBE spectrum is the site-dependent OBE described in Section 3.7.1.1.6. The two sets of horizontal and vertical OBE response spectra derived from the SSE spectra at grade serve as the reference against which OBE exceedance checks are performed for the purpose of plant shutdown. Plant shutdown is required only if there is an exceedance of both OBE spectra.

Insert for 3.7.4.4:

NAPS DEP 3.7-1

Replace the last sentence (including the bulletized list) of the first paragraph as follows:

The plant is shut down if the walkdown inspections discover damage to equipment that would affect the safe operation of the plant, or the recorded motion in the free field in any of the three directions (two horizontal and one vertical) exceeds both the certified design and site-specific response spectrum limits and the cumulative absolute velocity limit as follows:

- Certified design response spectrum limit is exceeded if:
  - at frequencies between 2 and 10 Hz, the recorded response spectral accelerations of 5% damping exceed 1/3 of the corresponding CSDRS values or 0.2g, whichever is greater; or
  - at frequencies between 1 and 2 Hz, the recorded response spectral velocities of 5% damping exceed 1/3 of the corresponding CSDRS values or 6 in/sec (152.4 mm/sec), whichever is greater.
- Site-specific response spectrum limit is exceeded if:
  - at frequencies between 2 and 10 Hz the recorded response spectral acceleration of 5% damping exceed the corresponding site dependent OBE at grade presented in Table 3.7.1-216 or 0.2 g, whichever is greater; or
  - at frequencies between 1 and 2 Hz, the recorded response spectral velocities of 5% damping exceed the corresponding OBE values presented in Table 3.7.1-217 or 6 in/sec (152.4 mm/sec), whichever is greater
- Cumulative absolute velocity limit is exceeded if the cumulative absolute velocity value calculated according to the procedures in EPRI TR-100082, December 1991 (DCD Reference 3.7-12), is greater than 0.16 g-sec.