North Anna 3

North Anna 3 COLA

Slides for Discussion with NRC
Response to NRC February 1, 2016
Questions and Comments

NRC Teleconference
February 17, 2016

Dominion

NRC Question 1

- *The RCCV report (WG3-T11-DRD-S-0001) indicates that the method using "thermal ratios" evaluated by 3D nonlinear analyses applied in the standard design, is not used for NA3. The effects of concrete cracking due to the thermal load are considered by reducing the thermal stress in SSDP-2D.*

1. *Is this change in the method of calculating thermal stresses considered a departure from the method used in the standard design?*
   - *The applicant is requested to explain why this change is acceptable and does not result in the less conservative results.*
   - *During Audit 2, the staff requests that Dominion provide a detailed presentation of the DCD method and the NA 3 method for site-specific evaluation of the thermal effect in combination with other applicable loads.*
2. *Also, are the design thermal loads considered same as the DCD thermal loads?*

NRC Question 1

1. *Is this change in the method of calculating thermal stresses considered a departure from the method used in the standard design?*

Response:

Yes. The use of SSDP-2D is identified in the Departures Report as a difference from the DCD evaluation for the RCCV thermal loads

- The use of SSDP-2D for addressing thermal loads in the NA3 RCCV structural evaluation is described in:
  - **FSAR Section 3G.7.5.2: "**For the RCCV thermal loads, a method using 3D nonlinear analyses applied in the standard design is not used for the site-specific structural evaluation. The effects of concrete cracking due to the thermal load are considered by reducing the thermal stress using the SSDP-2D method described in DCD Section 3G.1.5.4. Because the method using SSDP-2D is more conservative than the 3D nonlinear method, and because the SSDP-2D method is used for the normal operation loads, it is acceptable to use the SSDP-2D method for the reduction of thermal stresses in the RCCV structural evaluation."
  - **COLA Part 7, NAPS DEP 3.7-1: "**The thermal loads for the RCCV are reduced using the SSDP-2D process (which is described in DCD Section 3G.1.5.4) for evaluating stresses in concrete and rebar for the structural evaluations as described in FSAR Section 3G.7.5.2."

NRC Question 1

- *The applicant is requested to explain why this change is acceptable and does not result in the less conservative results.*

Response:

- In the DCD RCCV report, thermal loads for the structural evaluations were evaluated by the “thermal ratios” and SSDP-2D methods
- The DCD RCCV structural evaluation report explains and compares of the two methods
  - Knock-down factors stemming from a nonlinear analysis of the RCCV for LOCA thermal loads was used for design (“thermal ratios” 3D nonlinear method)
  - SSDP-2D was used in the DCD report for all thermal loads, other than LOCA, in the RCCV and was used for the thermal loads in other Seismic Category I structures
    - The SSDP-2D computer program has a thermal option that can be selected to address thermal loads

NRC Question 1

- *During Audit 2, the staff requests that Dominion provide a detailed presentation of the DCD method and the NA 3 method for site-specific evaluation of the thermal effect in combination with other applicable loads.*

Response:

- For the DCD thermal loads, the NRC reviewed and approved both the SSDP-2D method and the 3D nonlinear method for use in section design for flexure and membrane forces, concluding that the SSDP-2D method and the less conservative "thermal ratios" method provided acceptable results
  - In response to DCD RAI 3.8-107 and its supplements, information was provided on thermal loads regarding (1) the SSDP-2D method (including review of the Shimizu validation test report for SSDP-2D) and (2) the Anatech report entitled "Thermal Cracking Demonstration Analysis for Use of Thermal Ratios in ESBWR Design"
    - As presented in responses to DCD RAI 3.8-107 and its supplements, the SSDP-2D method for handling thermal loads is more conservative than using knock-down factors from the 3D nonlinear analysis
    - NRC review and approval of the linear (SSDP-2D) and 3D nonlinear methods are described in the ESBWR DCD Final Safety Evaluation Report (NUREG-1966), Section 3.8.1.3.4

NRC Question 1

2. *Also, are the design thermal loads considered the same as the DCD thermal loads?*

Response:

- Yes – the NA3 and DCD design basis temperatures for normal and accident conditions are the same

NRC Question 1

Proposed Action:

- To better clarify the basis and justification for using the SSDP-2D method in the NA3 RCCV structural evaluation, Technical Report WG3-T11-DRD-S-001 will be revised
- No additional action is required regarding a presentation during Audit 2 (see DCD RAI 3.8-107)
- Action will be tracked as AI# 021716001

NRC Question 2

- *The local models were developed for GDCS pool stress analysis (Figs 4.17 through 19 of WG3-T12-ERD-S-0001 - Internal structure design report) and seismic loads are evaluated using spectral analysis.*

1. *Are these models the same as the DCD model?*
2. *Please describe the spectral analysis method and explain any differences between the DCD and site-specific model in this regard. Is this method discussed in the FSAR?*
3. *Is the lateral seismic pressure load on the pool walls due to vertical compression of the pool water due to vertical component of the earthquake included in the evaluation?*

For purposes of discussion with NRC.

Dominion

NRC Question 2

1. *Are these models same as the DCD model?*

Response:

- The GDCS pool structural models shown in Figures 4-17 through 4-19 of the report are the same as the models used for the DCD

2. *Please describe the spectral analysis method and explain any differences between the DCD and site-specific model in this regard. Is this method discussed in the FSAR?*

Response:

- The GDCS pool structural analysis methodology used for the NA3 evaluation is the same as used for the DCD evaluation
  - The analysis method used for the GDCS pool structure in the NA3 FSAR and in the DCD is the static coefficient method described in DCD Subsection 3.7.2.1.3

NRC Question 2

3. *Is the lateral seismic pressure load on the pool walls due to vertical compression of the pool water due to vertical component of the earthquake included in the evaluation?*

Response:

- NA3 hydrodynamic pressures on the GDCS pool structure walls are determined using the same methodology as used for the DCD
- NA3 seismic hydrodynamic pressures on the GDCS pool walls are less than the DCD seismic hydrodynamic pressures, hence the higher DCD seismic hydrodynamic pressures were used in determining overall stresses for the NA3 site-specific evaluation

NRC Question 2

Proposed Action:

- The NA3 approach is consistent with the DCD methodology
- AI# 021716002 will document that this item was discussed and no further action is needed until Audit 2

NRC Question 3

1. *On Page 5 of 002N8530 Revision 2, please clarify the sentence "all spectra for the **fuel racks** are taken at 3% damping consistent with Reference 1," since the report is related to PCCS.*
2. *Page 4 of this report indicates that the analysis is performed using the first 10 modes of the model up to 45.3 Hz. However, the input appears to have some energy content beyond this cut-off frequency. Please justify.*

NRC Question 3

1. *On Page 5 of 002N8530 Revision 2, please clarify the sentence "all spectra for the **fuel racks** are taken at 3% damping consistent with Reference 1," since the report is related to PCCS.*

Response:

- The reference to the "fuel racks" in the PCCS report is a typo

For purposes of discussion with NRC.

NRC Question 3

2. *Page 4 of this report indicates that the analysis is performed using the first 10 modes of the model up to 45.3 Hz. However, the input appears to have some energy content beyond this cut-off frequency. Please justify.*

Response:

- The PCCS model is cut off at 45.3 Hz in the horizontal and vertical directions. In the horizontal directions, this cutoff frequency is an appropriate approximation of the ZPA frequency. To account for the missing mass, the spectral accelerations at 45.3 Hz were applied in an equivalent static evaluation and combined with the results of the response spectrum evaluation.
- In the vertical direction, the structure's fundamental frequency is above 90 Hz and, thus, the response of the structure is composed entirely of inertial response to the static acceleration. The 100% missing mass is accounted for in a static evaluation at 4.3 g, which is the spectral acceleration at 45.3 Hz.
- The lower cutoff frequency is used to avoid many tube horizontal tube modes that exist between 45.3 Hz and the ZPA frequency in the vertical direction of roughly 90 Hz.
- The effects of missing mass in the response spectra analysis are accounted for using pseudo-static evaluation consistent with Appendix A of Reg. Guide 1.92 (documentation is available for NRC audit).
- This approach is consistent with the DCD PCCS condenser evaluation and the technical content provided in the DCD report.

NRC Question 3

Proposed Action:

- Report 002N8530 will be revised to correct the typo
- FSAR reference to this report will be revised to indicate the new revision (the report is incorporated by reference into the FSAR)
- Calculations, which will be available for audit, explain in more detail the basis for the cut-off frequency of the first 10 modes of the model up to 45.3 Hz
- Action will be tracked as AI# 021716003

For purposes of discussion with NRC.

NRC Question 4

1. *Per DE-ES-0089R0 (Drywell Head Report) Table 2-2, the design stress for flange bolt is 198 MPa vs the allowable limit of 198 MPa. While the allowable stress limit is not exceeded, it appears that there is very little design margin for any uncertainties in the calculation.*
2. *Please identify the conservatisms in the analysis that provide assurance that the design bolt stress will not exceed the allowable limit.*
   - *Note that DCD Figure 3G.1-51 shows the standard plant bolt stress as 166 MPa. However, the site-specific bolt stress is 198 MPa.*
   - *The FSAR should reflect this change.*

NRC Question 4

1. *Per DE-ES-0089R0 (Drywell Head Report) Table 2-2, the design stress for flange bolt is 198 MPa vs the allowable limit of 198 MPa. While the allowable stress limit is not exceeded, it appears that there is very little design margin for any uncertainties in the calculation.*

Response:

- The drywell head bolt stresses are not impacted by the NA3 seismic conditions (values did not change from the DCD)
  - Bolt pre-load, accident pressure, and accident temperature govern the design
- 198 MPa value in NA3 report DE-ES-0089 R0 is the design stress of the flange bolt
  - It is the same as the design stress value in the DCD report DE-ES-0001 R3 for the drywell head flange bolt

NRC Question 4

2. *Please identify the conservatisms in the analysis that provide assurance that the design bolt stress will not exceed the allowable limit.*
   - *Note that DCD Figure 3G.1-51 shows the standard plant bolt stress as 166 MPa. However, the site-specific bolt stress is 198 MPa.*
   - *The FSAR should reflect this change.*

Response:

- Initial bolt stress of 166 MPa shown on DCD Figure 3G.1-51 is the bolt pre-load (initial stress) (Table 3-1 of DE-ES-0089R0) and is the same as the DCD report DE-ES-0001R3 (Table 3-1)
- 198 MPa value in NA3 report DE-ES-0089R0 (Table 2-2) is the design stress of the flange bolt (Section 4.1.2.2.13 of the report)
  - This value is the same as the design stress value in the DCD report DE-ES-0001R3 (Table 2-2 and Section 4.1.2.2.13) for the drywell head flange bolt

NRC Question 4

Proposed Action:

- The flange bolt design stress and pre-load values in the NA3 report are the same as the values in the DCD report
- AI# 021716004 will document that this item was discussed and no further action is needed until Audit 2

For purposes of discussion with NRC.

NRC Question 5

- *The staff requests that Dominion provide during Audit 2 a brief presentation on how the site-specific seismic demand (shear force, overturning moments, torsional loads, vertical acceleration) obtained from the lumped mass model was specified in the static NASTRAN model.*

NRC Question 5

Response:

- The methodology used to develop the seismic loads for site-specific structural evaluations from the results of site-specific analyses of lumped-mass-stick models is identical to the methodology used for developing the DCD seismic loads
- The site-specific loads are applied on the NASTRAN models to mimic the same distribution of seismic load demands on the analyzed structure as the one represented in the bounding shear force, overturning, and torsional moments diagrams
- Dominion will provide a presentation on how the site-specific seismic demand obtained from the lump mass model was specified in the static NASTRAN model

NRC Question 5

Proposed Action:

- The presentation will be scheduled for Audit 2 or could be included in a presentation for an NRC closed meeting
- Action will be tracked as AI# 021716005

For purposes of discussion with NRC.

Questions?