North Anna 3

North Anna 3 COLA

Slides for Discussion with NRC

Response to NRC January 15, 2016

Questions on Review of December 2015 FSAR Markups

February 3, 2016

Dominion

NRC Question a)

FSAR Section 3.8.1 does not identify any departures, whereas, Sections 3.8.2, 3.8.3, 3.8.4, and 3.8.5 identify NAPS DEP 3.7-1. This departure relates to the NA3 site-specific ground response spectra for seismic structural loads and floor response spectra.

- **Response:** The information in DCD Section 3.8.1 is incorporated by reference and there are no departures in FSAR Section 3.8.1.
- **Proposed Action:**
  - No further action is needed
  - Add Action Item 01151600A and show this as closed

For purposes of discussion with NRC.

Dominion

NRC Question b)

In FSAR 3.8.2, corresponding to NAPS DEP 3.7-1, the only change is to replace a paragraph in the DCD with a new paragraph which states:

"A finite-element analysis model supplemented with hand calculation is used to determine the stresses in the different components of the PCCS condenser and supports. Details of this analysis, including relevant drawings and results, can be found in DCD Reference 3.8-1, and details of the site specific analysis, which uses the same approach as the DCD but with Unit 3 seismic loads, can be found in Reference 3.8-201."

This reference is the PCCS condenser seismic analysis report. Why aren't comparable departures also given to all structures and structural components in this FSAR Section 3.8.2 and the other FSAR sections?

- **Response:** The change in Section 3.8.2.4.1.5 is necessary for the PCCS condenser to modify the information regarding the site-specific finite element analysis and add the site-specific report to the references to supplement DCD Reference 3.8-1. No similar changes are required for the other components in the 3.8 sections.

Proposed Action:

- No further action is needed
- Add Action Item 01151600B and show this as closed

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Dominion

NRC Question c)

In FSAR Section 3.8.4, corresponding to NAPS DEP 3.7-1, the statement is made that "Unit 3 site-specific structural evaluations for the RB/FB, CB, and FWSC are described in Sections 3G.7 through 3G.10." This statement is important and needed because it ties DCD 3.8.4 to the detailed description in Appendix 3G. Explain why the other FSAR sections do not also include this statement.

- **Response:** FSAR Section 3.8 will be changed to include references to the new site-specific sections in Appendix 3G in instances where the DCD Section 3.8 refers to Appendix 3G.
- **Proposed Action:**
  - Further action is necessary to revise FSAR as noted
  - Add Action Item 01151600C and track proposed action

NRC Question d)

In FSAR Section 3.8.4, a new paragraph is added regarding the structural acceptance criteria. It states:

"The structural acceptance criteria for the site-specific structural evaluations of the RB, CB, FB, and FWSC, which are described in Sections 3G.7 through 3G.10, are the same as the acceptance criteria for the standard design provided in this section, with the exception that the Unit 3 structural evaluations of the non-containment RB and FB structures may use the acceptance criteria of either: 1) the ASME BPVC, Section I II, Division 2, Subsection CC, "Code for Concrete Containments," or 2) the ACI 349-01, rather than apply the more limiting of these two criteria as described in DCD Sections 3.8.4.5.1 and 3.8.4.5.3. This is an acceptable alternative to the standard design approach because the RB and FB are not part of the containment pressure boundary and applying the more limiting ASME BPVC criteria is not required."

Justification would be needed for this change because, the reason the more limiting criterion was placed in the DCD is that the containment is integrally connected to the RB (unlike other containments) and thus, the RB provides support and interacts with the containment. During design certification, the applicant specified this criterion to address this issue. While the revised criterion seems reasonable for structural members sufficiently distant from the RB / containment interface (e.g., FB where an overstressed condition was identified), justification would be needed to completely revise the criterion as defined above.

Background

Standard Design Structural Evaluations:

- For ESBWR standard design reinforced concrete section analyses, a conservative linear concrete stress-strain relationship was adopted for factored loads for all Seismic Category I structures, and implemented in the program SSDP-2D

NA3 Structural Evaluations:

- FSAR reinforced concrete section analyses were performed consistent with the DCD methodology and used SSDP-2D for all Seismic Category I structures
- For outside containment, if SSDP-2D limit was exceeded:
  - Reinforcement was added to meet SSDP-2D limit, or
  - A stress check was performed to determine if ACI 349-01 acceptance criteria were met (if so, then the element was considered acceptable)

Investigation

- FSAR statement quoted in Question d) was evaluated
  - Justification was determined to be overly generalized
  - Dominion agrees that NRC would need additional information to approve approach set forth in FSAR Section 3.8.4.5, as currently written
- Further assessment of the issue has resulted in a revised approach

For purposes of discussion with NRC.

ASME Code and ACI 349-01

- For ASME reinforced concrete section analysis, multiple concrete stress-strain relationships are allowed by Code (CC-3511.1e) for factored loads:
  - linear, parabolic, or any curve backed by test data

- For ACI 349-01 reinforced concrete section analyses, rectangular stress block is used
  - Provides the same section strength as a parabolic stress block

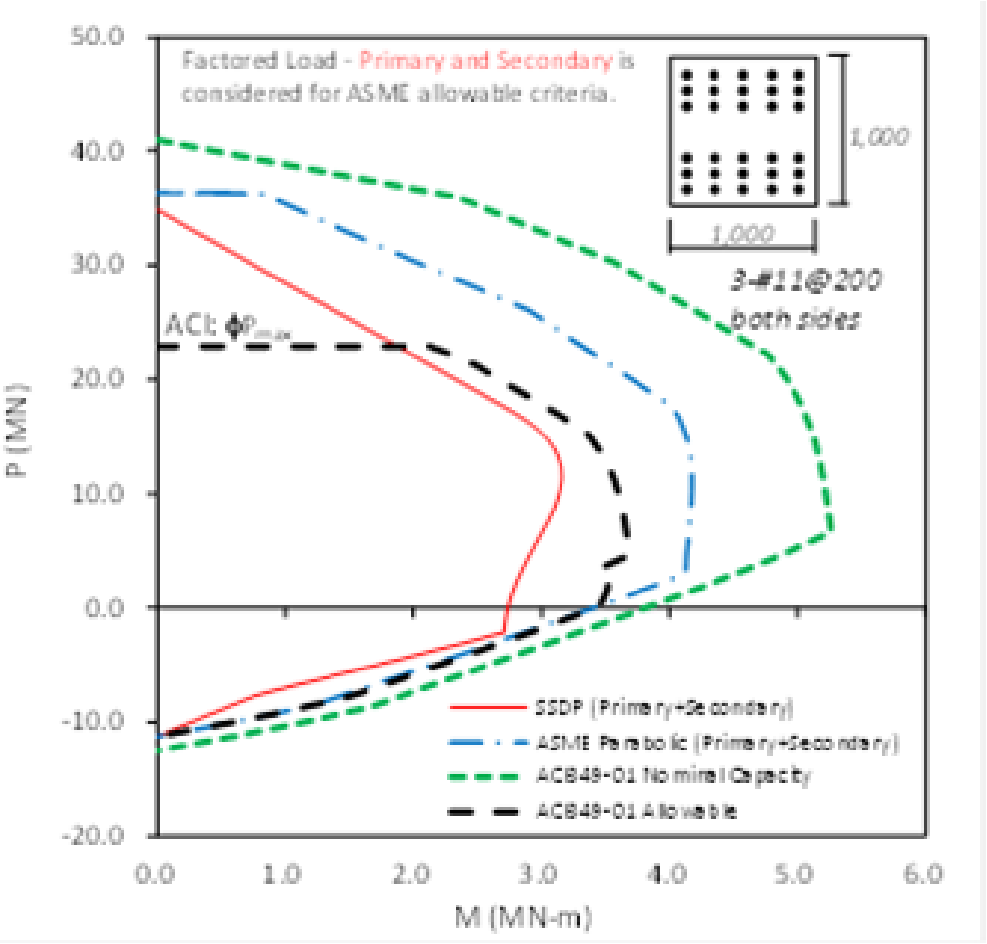
ASME Code and ACI 349-01

- Even though both ASME and ACI 349 section analyses are based on the same parabolic test results, the two codes used different approaches:
  - 2004 ASME uses an allowable stress approach
  - ACI 349-01 uses strength reduction factors

- The next slide shows a typical P-M diagram that compares capacities of a typical section by the different approaches:
  - 2004 ASME Factored Loads, primary + secondary, linear stress block, ASME stress allowable
  - 2004 ASME Factored Loads, primary + secondary, parabolic stress block, ASME stress allowable
  - ACI 349-01 Factored Capacity
  - ACI 349-01 Nominal Capacity

ASME Code and ACI 349-01

Capacities for a Typical Section



For purposes of discussion with NRC.

Dominion

Proposed Revised Approach

- Proposed approach would be used for structural evaluations of Seismic Category I structures when an element is determined to exceed the SSDP-2D limits
- Continue to apply standard design acceptance criteria of ASME Code and ACI 349-01

For purposes of discussion with NRC.

Proposed Revised Approach

- When structural elements are identified as exceeding the conservative SSDP-2D limits, a check using ACI 349-01, along with a P-M curve applicable to the structural element, will be used to demonstrate that both ASME Code and ACI 349-01 acceptance criteria are met
- Structural evaluation reports will include the basis and justification that the acceptance criteria are met

For purposes of discussion with NRC.

Actions for Proposed Revised Approach

- Technical reports will be revised, as necessary (Fuel Building Structural Design Report)
- COLA revisions will be determined:
  - Part 7, Departures Report, will be revised to include the proposed approach
  - FSAR Section 3.8.4.5 will be revised to clarify the approach for demonstrating that the standard design acceptance criteria are met
  - FSAR will be reviewed to determine if any other sections need to be revised
- Response to RAI 03.07.02-17 will be revised
- Proposed Action Item 01151600D will track these actions

For purposes of discussion with NRC.

Conclusion

- ESBWR NA3 FSAR reinforced concrete section analyses will be performed consistent with the DCD methodology using SSDP-2D for all Seismic Category I structures
- NA3 structural evaluations will apply the acceptance criteria consistent with the DCD
  - For overstress conditions identified now and through detailed design, an alternate stress check using a P-M diagram will be performed to show the member meets the limiting of the 2004 ASME and the ACI 349-01 criteria
  - Structural evaluation reports will include the P-M diagram for these alternate stress checks, demonstrating that the acceptance criteria are met
  - Response to RAI 03.07.02-17 will be revised
  - COLA markups will be provided

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Questions?