APR1400 Design Certification Review Mechanical Engineering Topics

Office of New Reactors – Mechanical Engineering Branch
U.S. Nuclear Regulatory Commission

April 2015

United States Nuclear Regulatory Commission
Protecting People and the Environment

Enclosure 1

Meeting Agenda

- April 14
  - ★ 9:00-12:00 – Piping Design
  - ★ 1:00-2:30 – Design Specifications
  - ★ 2:45-5:00 – Functional Design, Qualification, and Inservice Testing (IST) of Pumps, Valves, and Dynamic Restraints
- April 15
  - ★ 9:00-12:00 – Pipe Rupture Hazards Analysis [CLOSED]
  - ★ 1:00-5:00 – Additional Mechanical Engineering Topics

4/14/2015 – AM session

PIPING DESIGN

Piping Design: Graded Approach

- White paper dated 3/14/2014 (ML14065A067)
- Introduced in 3/18/2014 public meeting for mPower
- Discussed in more detail in 5/2/2014 public meeting on APR1400
- Implemented to a large extent in APR1400 design control document (DCD)
- Not yet formally incorporated into agency guidance – appreciate engagement

Piping Design: Graded Approach

- "Essentially complete" design per 10 CFR 52.47, as described further in SECY-90-377 (11/8/1990, ML003707889) and its Staff Requirements Memorandum (2/15/1991, ML003707892)
  - ★ Graded approach to level of detail according to the relationship to safety of the structure, system, or component (SSC)
- Design acceptance criteria (DAC) described in SECY-92-053 (2/19/1992, ML003707942)
  - ★ Focus on methodology, design processes, acceptance criteria
  - ★ Appropriate for rapidly-changing methodology (I&C, human factors) or where as-procured/as-built information needed (piping)
  - ★ Refer generally to piping, but also have used DAC for pipe rupture hazards analyses (PRHA) in the past, so graded approach extends to PRHA

Piping Design: Graded Approach

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- When designers have sufficient design information to complete piping analyses (e.g., simplified design, construction experience), can implement a graded approach:
    1. The design certification would continue to present essentially complete designs for the overall systems, consistent with past design certifications, regardless of the use of DAC.
    2. The proposed inspections, tests, analyses, and acceptance criteria (ITAAC) for the design certification would continue to include verification of design (including reconciliation), fabrication, installation, inspection, and testing for all ASME *Boiler and Pressure Vessel Code* (BPV Code) Class 1, 2, and 3 components, including piping.
    3. The design certification application would document the overall methodology to be employed in completing the detailed piping design for all systems.
    4. The NRC review of the piping design in the design certification application would employ a graded approach. The level of detail of the piping design review would be commensurate with the importance of the safety function to be performed, with the highest level of detail being expected for most Class 1 reactor coolant pressure boundary piping, as these piping systems have the most significant effect on plant safety. A similar level of detail would also typically be expected for the Class 2 steam and feedwater lines to the first anchor beyond the isolation valves outside containment, since breaks in these lines could directly affect the reactor. Less detail would be needed for other portions of Class 2 and 3 piping, as well as potentially for portions of Class 1 piping that the NRC staff judges to be of lower safety significance (e.g., certain small-bore lines or branch lines).

Piping Design: Graded Approach

- NRC staff evaluates information to ensure that it is sufficient to support a final safety determination and meet the applicable requirements of 10 CFR 52.47
- NRC staff determines level of detail needed considering factors such as:
  - ★ The similarity of each respective plant design, layout, and operating conditions to existing standard plant designs
  - ★ The potential issues with innovative design approaches such as a compact containment size that can affect pipe routing and inspectability
  - ★ The importance of the safety functions to be performed by each piping system
- Precedent in AP1000 DCD, which includes a list of piping packages needed to demonstrate the piping design (Class 1 > 1”, plus some Class 2 and 3 lines in Table 3.9-20)

Piping Design: APR1400 Use of Graded Approach

- Graded approach is described well in DCD Section 14.3
- DAC for environmentally assisted fatigue (EAF) is still included – should be further justified or removed [addressed on KHNP slides]
  - ★ Also relates to selection of break postulation criteria in DCD Section 3.6.2.1.4.1.1
- COL items for application-stage actions should generally be removed unless they address site-specific information [addressed on KHNP slides]
- DCD Sections 3.6.2 and 3.12 should summarize analysis approach and results as well as methodology

Piping Design: Additional DCD Section 3.12 Items

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- 3.12.5.3.3: Exclusion of thermal anchor movements less than 1/16" based on industry practice – should be excluded only if necessary, depending on as-built verification of gap size
  - ★ Related issue in 3.12.4.4 was corrected in 2014 submittal (header movements will be applied as anchor motions)
- 3.12.6.11: Nominal cold gap of 1/16" on each side in restrained direction – not typical for vertical supports (e.g., no clearance on bottom if restraining deadweight)
- Decoupling criteria in 3.12.4.4 do not match 3.7.2.3.2 – difference, if retained, should be justified as conservative
- Are stiff pipe clamps and pipe clamps of the type identified in Information Notice 83-80 and Generic Safety Issue 89, described in NUREG-0933, used on piping? If so, how does the piping design account for local pipe stresses induced by these pipe clamps?
- Pipe support mass consideration in the piping stress analysis for deadweight and seismic loadings is not discussed – need methodology and criteria

Piping Design: Discussion and Path Forward

- Schedule for submitted and audited information should be discussed – current staff review plan relies on:
  - ★ Piping and PRHA analysis results audit and submittal of updated summary information (DCD markup) by mid-August 2015 [later presentation on PRHA]
  - ★ Follow-up audit in early 2016 (may be able to address EAF then)
  - ★ Public meetings as needed to address issues

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DESIGN SPECIFICATIONS

Design Specifications

- 10 CFR 52.47:
  *The information submitted for a design certification must include performance requirements and **design information sufficiently detailed** to permit the preparation of acceptance and inspection requirements by the NRC, and **procurement specifications and construction and installation specifications by an applicant**. The Commission will require, before design certification, that **information normally contained in certain procurement specifications and construction and installation specifications be completed and available for audit** if the information is necessary for the Commission to make its safety determination.*
- Not the final <u>certified</u> design specifications – but documents should contain similar information
  - ★ Often already prepared to support detailed design and construction (vs. generating just for design certification)
  - ★ Possibly multiple types of documents, not just a design specification
- Staff's design specification audits:
  - ★ Confirm that DCD commitments for codes, methodologies, qualification, classification, etc. have been translated into the lower-level design documents
  - ★ Focus on a sample of safety/risk significant components
  - ★ Support safety determinations on multiple DCD Sections: 3.2.1, 3.2.2, 3.9.3, 3.9.4, 3.9.5, 3.9.6, 3.11, 3.12

Design Specifications

- Discuss schedule for audited information
  - ★ Current staff review plan relies on audit by mid-August 2015, with possible follow-up audit in early 2016
  - ★ Audit may be performed electronically if feasible

Design Specifications

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- Path forward
  - ★ Check terminology on "NSSS" vs. "BOP" in slides and application
    - Staff review typically focuses on safety-related systems, and may sample (e.g., in audit) systems/components with high risk/safety significance
    - Dividing line between NSSS/BOP not clear – safety injection in slide 6 <u>and</u> slide 12
    - May be more appropriate to refer to NSSS, engineered safety features (ESF) systems and their safety-related support systems, and true "BOP" (non-safety) systems
    - Also will hear "reactor systems" and "plant systems" – NRC branch designators
  - ★ Planned scope for audit (schedule in June?)
    - Sample prepared NSSS design/procurement specifications
    - Sample prepared "BOP" ASME Section III design specifications
    - Audit process documents ("crosswalk") that shows how procurement specifications are prepared from detailed design documents
    - Sample "BOP" reference procurement specifications and associated detailed design documents (e.g., system design criteria) that would be used to prepare procurement specifications
  - ★ Observe that COL applicants would also need access to similar design detail (see 10 CFR 52.63)

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FUNCTIONAL DESIGN, QUALIFICATION, AND IST OF PUMPS, VALVES, AND DYNAMIC RESTRAINTS

Pump and Valve ITAAC

- Functional qualification ITAAC for pumps and valves should reflect latest guidance
- Preoperational testing ITAAC for pumps and valves should reflect latest guidance
- NRC staff preparing standard ITAAC that may be used as guidance for current and future applicants – may be appropriate to delay final revision to ITAAC

Functional Design and Qualification

- DCD Tier 2, Sections 3.9.3.3 and 3.9.6.1 should specify functional qualification of pumps, valves, and dynamic restraints (all aspects) in accordance with ASME Standard QME-1-2007 as accepted in Revision 3 to Regulatory Guide (RG) 1.100
  - ★ QME-1-2007 addresses seismic and dynamic qualification (Section 3.10) and environmental qualification of non-metallics (Section 3.11) as well
- This provision should be established such that it cannot be modified without NRC review
  - ★ Other applicants have designated as Tier 2*
  - ★ May be described in a way that connects clearly to a need for NRC review in the change criteria expected to be in Section VIII of the design certification rule
  - ★ Typically, code/standard <u>years</u> not included in Tier 1 to facilitate later updates to enhanced versions

Functional Capability

- DCD Tier 2, Sections 3.9.3.3.1 through 3.9.3.3.4 should be consistent with ASME QME-1-2007, such as the following:
  - ★ Use of functionality (not operability)
  - ★ Functional qualification by test or combination of test and analysis
  - ★ Use of ASME OM Code as incorporated by reference (IBR) in 10 CFR 50.55a
  - ★ Use of ASME QME-1-2007 as accepted in RG 1.100 Revision 3

DCD Section 3.9.6
IST Program

- Specify provision to require that design provides access for IST activities consistent with 10 CFR 50.55a(f)(3)
- Indicate whether DCD will provide full description of IST operational program (plant-specific aspects to be addressed by COL applicant); if so, provide the following information for completeness:
  - ★ General:
    - Indicate that 10 CFR 50.55a requires COL licensee to update IST program 12 months before initial fuel loading
    - Specify edition and addenda of ASME OM Code used as basis for PST and IST program description
    - Indicate plans to apply NUREG-1482 (Rev. 2) guidelines for IST
    - Indicate that IST program applies to safety-related components
  - ★ Pumps (3.9.6.2):
    - Specify that full-flow testing of pumps will be accommodated in design
    - Describe ASME OM Code, Subsection ISTB provisions for Group A, Group B, and Comprehensive Testing, and their frequency for pumps in the IST program
  - ★ Valves (3.9.6.3):
    - Specify that full-flow testing of valves will be accommodated in design
    - Specify provisions to supplement position indication provisions in ASME OM Code as provided in NUREG-1482

DCD Section 3.9.6
IST Program

- Motor-Operated Valves (MOVs) (3.9.6.3.1):
  - Update references to 10 CFR 50.55a(b)(3)(ii), not Generic Letter (GL) 89-10 (not applicable)
  - Describe periodic verification program, such as specifying Code Case OMN-1 as accepted in RG 1.192 as IBR in 10 CFR 50.55a, or use of Appendix III to Subsection ISTC of ASME OM Code (2009 Edition)
  - Describe use of Joint Owners Group (JOG) MOV Periodic Verification Program as accepted in NRC staff evaluations
- Power-Operated Valves (POVs) (3.9.6.3.2):
  - Specify attributes from Regulatory Issue Summary 2000-03 for air-operated valves (AOVs) and application to other POVs
  - Describe use of JOG program for AOV periodic verification, including NRC staff comments documented in letter dated October 8, 1999 (ML020360077)
- Check Valves (3.9.6.3.3):
  - Specify that design allows bi-directional flow testing
  - Specify that valve obturator movement during exercise testing will be demonstrated by performing both an open and close test
  - Discuss plans to implement Appendix II to Subsection ISTC of ASME OM Code for condition monitoring
  - Describe types of check valves (such as swing check and nozzle check), and plans to satisfy ASME OM Code provisions for each type

DCD Section 3.9.6
IST Program

- Pressure Isolation Valve Leak Testing (3.9.6.3.4)
  - Update reference to GL 89-04
- Explosively Activated Valves (3.9.6.3.8)
  - Clarify that no squib valves are included in APR1400 design
- Dynamic Restraints (3.9.6.4):
  - Describe plans to apply Code Case OMN-13 as accepted in RG 1.192 as IBR in 50.55a
  - Describe consideration of GL 90-09 for snubber visual inspection intervals
  - Describe evaluation of snubbers that fail acceptance criteria
  - Describe service life monitoring and frequency for evaluation and preventative maintenance (such as snubber regreasing)
- Relief Requests and Alternatives (3.9.6.5):
  - Describe plans to submit alternative requests under 10 CFR 50.55a(z) and relief requests under 50.55a(f)(6) or (g)(6)
  - Describe plans to apply ASME OM Code Cases that will be implemented in IST program for pumps, valves, and dynamic restraints
  - Specify whether OM Code Cases will be implemented in IST program as accepted in RG 1.192 as IBR in 50.55a, or as separate alternative pursuant to 50.55a(z)

DCD Section 3.9.6
Preservice Testing (PST) Program

- Indicate whether DCD will provide full description of preservice testing operational program (plant-specific aspects to be addressed by COL applicant); if so, provide the following information for completeness:
  - ★ Summarize PST requirements in ASME OM Code as IBR in 10 CFR 50.55a

DCD Section 3.9.6 Operational Readiness

- Clarify verification of operational readiness for pumps, valves, and dynamic restraints consistent with ASME OM Code as IBR in 10 CFR 50.55a
- Refer to “operational readiness” when addressing ASME OM Code and “operability” when addressing Technical Specifications

DCD Section 3.9.9
Combined License (COL) Items

- For consistency with lessons learned on previous DC reviews, suggest two COL item changes:
  - ★ COL Action Item 3.9(3) should specify site-specific active and passive valves in addition to site-specific active pumps
  - ★ A new COL item should require a full description of the PST and IST programs for pumps, valves, and dynamic restraints (with scope reduced depending on the amount described in the DCD)

Table 3.9-13: Pump and Valve IST

- Revisions for clarity and consistency with regulations and Standard Review Plan 3.9.6:
  - ★ Pump information should include pump identification number, ASME OM Code Group, and specific test (Group A, Group B, and Comprehensive) and frequency
  - ★ Valve information should include valve safety position (open, closed, open/closed)
  - ★ Relief valves should be specified as active Category A/C valves with position indication (as applicable) with OM Code IST requirements
  - ★ Manual valves should include position indication requirements (as applicable) with OM Code IST requirements
  - ★ Check valves should be categorized as active valves, and tested in both open and close directions
  - ★ Note in paragraph (h) should justify pump curve testing to assess pump degradation, and clarify reference to Section 3.9.6.1
  - ★ Paragraph (i) and Figure 3.9-15 should provide full set of IST tests for pumps (such as Group A, Group B, and Comprehensive Tests) and valves (such as flow tests to periodically verify design-basis capability)

IST/PST: Discussion and Path Forward

- Plans for updated submittals
- Plans for audits
- Plans for additional meetings

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PIPE RUPTURE HAZARDS ANALYSIS

Pipe Rupture Hazards Analysis (PRHA): Jet Impingement Modeling

- Discussed in 2/10/2014 public meeting following 2013 acceptance review
- Potential non-conservatisms in jet modeling in American National Standards Institute (ANSI) / American Nuclear Society (ANS) 58.2 standard
- Issues described in Appendix A to Section 3.6.2 of mPower Design-Specific Review Standard (ML12230A013)
  - ★ Blast waves
  - ★ Jet plume expansion and zone of influence
  - ★ Distribution of pressure within the jet plume
  - ★ Jet dynamic loading (including feedback amplification and resonance effects)
- Details not yet incorporated into SRP 3.6.2 (just high-level statement) – appreciate engagement
- To be addressed through technical report for APR1400 [addressed on KHNP slides]
- Related jet impingement load assumption in DCD Section 3.6.2.3.2.1.2 should be clarified (not acceptable as stated)

PRHA: Additional Items

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- Clarify as-built PRHA ITAAC in two ways:
  - ★ Non-system-based (i.e., include both safety-related and nonsafety-related source piping within a space)
  - ★ Address environmental effects of postulated pipe ruptures
- Address inconsistency in different sections' descriptions of break/crack exclusion area (containment penetration) for which pipe ruptures are not postulated (3.6.2.1.4.1.3.1 and 3.6.2.1.4.1.3.2)
- Clarify DCD discussion of method of dynamic analysis of unrestricted (unrestrained) pipes
  - ★ Crediting some building division walls as pipe rupture barriers (3.6.2.3.2)
  - ★ Impacts on adjacent pipe (see SRP 3.6.2, Section III.2, bottom of p. 3.6.2-5)

PRHA: Discussion and Path Forward

- Schedule for submitted and audited information should be discussed – current staff review plan relies on:
  - ★ Public meeting on jet modeling progress in June 2015
  - ★ Audit of overall PRHA results, submittal of updated summary PRHA information (DCD markup), public meeting on jet modeling, and potential submittal of jet modeling input data and boundary conditions (if confirmatory analysis needed) in August 2015
  - ★ Submittal of technical report in September 2015
  - ★ Follow-up audit on analysis results in early 2016
  - ★ Public meetings as needed to address issues
- General schedule proposed in KHNP slides appears to align with staff review plan

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ADDITIONAL MECHANICAL ENGINEERING TOPICS

DCD Section 3.2.1: Clarifications

- Use of RGs as "guidance" should be clarified – conformance with any deviations justified?"

- Seismic categories are different from the RG 1.29 guidance – should justify difference or correct
  - ★ Seismic Category I: designed to withstand the effects of the safe shutdown earthquake (SSE) and remain functional
  - ★ Non-seismic Category I
    - Within this category, some portions of SSCs of which continued function is not required but of which failure could reduce the functioning of a seismic Category I feature to an unacceptable safety level or could result in incapacitating injury to occupants of the control room should be designed and constructed so that the SSE would not cause such failure
    - Many applicants/licensees refer to this subset as seismic Category II, though RG 1.29 does not (RG 1.206 uses it inconsistently and will be updated)
    - Not all non-seismic Category I SSCs need to be designed in this way (bottom of p. 3.2-4 says otherwise, "[non-nuclear-safety] SSCs are designed…")

DCD Section 3.2.1: Clarifications and Inconsistencies

- References should be checked as some references to other DCD sections are not valid (e.g., Section 3.7.1.1 and 3.7.2.8 on p. 3.2-4)
- Several SSCs listed in Table 3.2-1 have quality assurance (QA) provisions of smaller scope than the statement on p. 3.2-4 that "Seismic Category I SSCs meet the QA requirements of 10 CFR Part 50, Appendix B." This overstatement should be corrected. RG 1.29 indicates that <u>pertinent</u> QA requirements of Appendix B should apply to all activities affecting safety-related functions of SSCs within scope of Regulatory Positions C.1 through C.3. Examples of seismic Category I SSCs that receive only augmented Appendix B requirements are:
  - ECSBS piping and valves from external Siamese hose connection to V1013 (excluding V1013)
  - QIAS-N (P3.2-68)
  - Seismic Monitoring
  - Valves and piping of spent fuel pool external makeup and spray lines
  - Fire protection equipment – seismic Category I fire protection subsystem

DCD Section 3.2.2: Clarifications and Inconsistencies

- Related tables in Tier 1 indicate that item numbers are for information only. Item numbers are used to identify specific valves and components at interfaces (see SI-179 on page 2.4-68 of Tier 1 or Table 2.4.5-1 in Tier 1). If item numbers are not part of the certified material, an alternate approach to identifying specific SSCs of importance should be proposed.

- Codes/standards in Table 3.2-1 should be checked for consistency throughout the DCD with the planned codes of record for the APR1400
  - ★ Multiple years of ASME Standard B31.1 are indicated in Table 3.2-1
  - ★ Multiple editions of the ASME BPV Code Section III are noted (e.g, Section 5.2.1.1 references the 2007 Edition with 2008 Addenda; References 16 and 17 on p. 3.2-14 show 2001 Edition of the ASME BPV Code for metal and concrete containments; Table 3.2-1 includes 2001 Edition with 2003 Addenda and 2007 Edition with 2008 Addenda)
  - ★ The purpose of the exception in this statement on p. 5.2-2 is unclear: “The components and code classes that are listed in Table 5.2-1 are in accordance with the provisions of 10 CFR 50.55a with this exception: the applicable ASME Code edition for the APR1400 is the 2007 Edition with 2008 Addenda”

DCD Section 3.2.2: Clarifications and Inconsistencies

- Remark (3)(d) is not consistently applied to SSCs in Table 3.2-1; either remark or classification should be corrected. For example:
  - ★ Non-safety UPS in AB, CPB has a portion classified seismic Category II, but does not have this remark (see other examples on p. 3.2-64)
  - ★ Certain SSCs not classified as seismic Category II have received remark (3)(d)
- Use of “safety class” and “quality group” should be checked for consistency and explained, as the focus of Section 3.2.2 should be on quality group classification
- Classification of supports should be clarified
  - ★ P. 3.2-3: supports have same <u>seismic</u> classification as what they support
  - ★ P. 3.2-13: supports are in the same <u>safety</u> class and have the same QA requirements as what they support
  - ★ Does this mean definitively that supports are in the same quality group as what they support?

DCD Section 3.2.2: Clarifications and Inconsistencies

- Several entries in Table 3.2-1 have multiple classifications assigned; the application should clarify how to distinguish which classification applies. For example:
  - ★ Auxiliary feedwater pump turbines are classified Quality Group C/G. The only Code associated with it is ASME Section III ND-2007 with 2008 addenda.
  - ★ Piping and valve containing radioactive materials (liquid radwaste), RO package, and piping and components containing radioactive material (solid radwaste) are designated seismic Category II/III
  - ★ POSRV piping is indicated as split classification
- Inconsistency between p. 3.2-78 and 6.3-62 and -63: Valve 332 should be Class 1, not Valve 323, and Quality Group transition is inconsistent

DCD Section 3.9.1: Additional Information and Clarification

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- NRC staff typically audit computer code verification and validation information; current staff review plan relies on audit in June 2015, with summary information to be included in the DCD

- No events are classified as Service Level C conditions. Further justification should be provided. Typically, transients such as the following are classified as Service Level C:
  - ★ Loss of offsite power with natural circulation cooldown
  - ★ Steam generator tube failure (one tube)
  - ★ Inadvertent opening of one pressurizer safety valve
  - ★ Reactor coolant system pressurization between hot and cold shutdown
  - ★ Feedwater and steam valve closure events (typically in Levels C and D)

DCD Section 3.9.2: Clarifications

- DCD Section 3.9.2.3.1.1 references a hydrodynamic model used to relate reactor coolant pump (RCP) pulsations to pressure on the core support barrel and use of Palo Verde preoperational test data (References 43 and 44). How was it verified that the inputs and assumptions of the hydrodynamic model were consistent with the test conditions?

- DCD Section 3.9.2.5.1 references a nonlinear analysis in the vertical direction. How have results of this analysis been verified (e.g., through test data) given uncertainties in nonlinear analysis?
  - ★ Relates to SRP 3.9.2 acceptance criterion 2.A.i.5, and consistent with "case-by-case" review of nonlinear analyses in SRP 3.7.2

DCD Section 3.9.2 and Referenced Technical Report: Clarifications

- APR1400-Z-M-NR-14009-P, "Comprehensive Vibration Assessment Program for the Reactor Vessel Internals," Section 2.2 states that the nominal difference between the valid prototype and APR-1400 reactor vessel internals is the inner barrel assembly (IBA). Are there any other reactor internals differences?
  - ★ Note that System 80+ CESSAR-DC Tables 1.3-1, 3.9-17, and 3.9-18 compared the System 80+ and Palo Verde designs. It may be efficient to use this as a starting point for comparison to the APR1400.

- APR1400-Z-M-NR-14009-P, Section 2.3 summarizes Palo Verde startup testing, including predicted measured stresses. Is the component with the smallest stress margin included? [may need closed meeting discussion]

DCD Section 3.9.2 and Referenced Technical Report: Clarifications

- APR1400-Z-M-NR-14009-P, Table 2-5 lists a fatigue endurance limit different from the ASME BPV Code Appendix I, Table I-9.2 limit of 13,600 psi. What is the justification? [may need closed meeting discussion]

- APR1400-Z-M-NR-14009-P, Section 3.2 lists loads from RCP pulsation, random turbulence, and vortex shedding. How are these loads/stresses combined?

- APR1400-Z-M-NR-14009-P, Section 3.2.2 (p. 22) states that the assumption that all pumps are in phase results in the maximum value of pressure. What is the basis for this statement (vs. a combination of operation and phases being the maximum)?

DCD Section 3.9.3: Clarifications

- P. 3.9-57 includes the phrase “design pressure, temperature, and other loading conditions that provide the bases for design” – which other loading conditions are meant?

- P. 3.9-57 states that “stress analysis is also performed by methods outlined in the code appendices or by other methods by reference to analogous codes or other published literature” – statement is vague and should be revised

- COL items 3.9(2) (and references in the text) should be deleted based on the level of detail necessary at the application stage (related guidance in RG 1.206 is expected to be revised); instead, ITAAC for as-built component design reports address this topic

DCD Section 3.9.4: Clarifications

- DCD Section 3.9.4.3 discusses evaluation of the deformation of the control element drive mechanism (CEDM) under seismic conditions to verify scramability, but the referenced Section 3.9.2.7.3 does not provide details of the verification established by analysis or test

- DCD Section 3.9.4.4 discusses changes to the material of the motor housing lower end fitting and thickness of the upper shroud tube, but does not discuss how these changes affect the life cycle of the CEDM

DCD Section 3.9.5: Clarifications

- SRP 3.9.5 specifies review of the physical or design arrangement of all reactor internals structures, including accommodation of dimensional changes and provision for retention of components. Additional information will be requested, including:
  - ★ Description or drawings of the core support barrel assembly and upper guide structure assembly, to clarify interface among various components
  - ★ Description of the attachment and number of control element guide tubes, to support review of alignment and related control rod drop time
  - ★ Description of any usage of threaded structural fasteners and how preload will be maintained throughout their design life
  - ★ The effect of environmental conditions, such as irradiation assisted stress corrosion cracking, on reactor internals stress and fatigue calculations

DCD Section 3.10: Clarification and Inconsistency

- Section 3.10.1.3 states "With the elimination of OBE, analysis checks for fatigue effects can be performed at a fraction of the SSE (such as 50 cycles at one-half of the SSE peak amplitude, or 150 cycles at one-third of the SSE peak amplitude)." How were these numbers of cycles selected? They appear to be different from those listed in Sections 3.9.2.2.3 and 3.7.3.1, as well as SRP 3.10.

- Section 3.10.2.2.d states "A 10 percent margin is added on RRS during testing in accordance with Subsection 6.3.2.5 of IEEE-323." However, IEEE Std 323-2003 does not have Section 6.3.2.5. The reference should be corrected.

DCD Section 3.11 and Referenced Technical Report: Clarifications

- Section 3.11 and APR1400-E-X-NR-14001-P, Rev. 0 should be updated for consistency with referenced guidance on environmental qualification (EQ):
  - ★ For mechanical equipment, SRP 3.11 addresses only nonmetallic parts
  - ★ Nonmetallic parts are environmentally qualified in accordance with Appendix QR-B of ASME QME-1-2007 as accepted in RG 1.100 (Rev. 3) by test or combination of test or analysis
  - ★ Qualification includes both mild and harsh environments
- Any differences between DCD Table 3.11-3 and APR1400-E-X-NR-14001-P, Table 3 should be specified, along with the scope of equipment (safety-related, risk-significant non-safety related, etc.)
- Add ITAAC for EQ of non-metallic parts of mechanical equipment that reflect the latest guidance

DCD Section 3.11: Clarification

- Indicate whether DCD will provide full description of EQ operational program (plant-specific aspects to be addressed by COL applicant); if so, provide the following information for completeness:
  - ★ Scope of mechanical equipment in program
  - ★ Nonmetallic parts
  - ★ Environmental conditions (internal and external)
  - ★ Qualification methodology for equipment in both harsh and mild environments (Appendix QR-B of ASME QME-1-2007)
  - ★ Qualification documentation
- For consistency with lessons learned on previous DC reviews, suggest two COL items for COL applicants to provide:
  - ★ Full description of the EQ program (to the extent not addressed in the DCD)
  - ★ Preservation of qualified condition (i.e., preventive maintenance, testing, and monitoring programs)

Mechanical Issues: Discussion and Path Forward

- Plans for updated submittals
- Plans for audits
- Plans for additional meetings