As a result of the NRC staff review relating to confirmatory item relating to RAI 03.04.01-6 (Revision 1), the applicant incorporated a new COL information item.

COL 3.4(10) The COL applicant is to establish procedures and programmatic controls to ensure that the functional capability and availability of the drain system is maintained throughout the life of the plant.

3.4.1(F) Conclusions

Pending satisfactory resolution of **13 Confirmatory Items [03.04.01-1, -3, -4, -5, -6, -7, -8, -9, CI 03.04.01-0 Sub-items AI 3-49.3, -49.4, -49.5, -49.15, and -49.16] discussed above**, the review of the DCD application supported that the APR1400 internal flood protection design is acceptable for the reasons set forth above and meets the requirements of GDC 2, GDC 4.

As set forth above, the staff found that the ITAAC, Technical Specifications, and COL applicant information Items specified ensure that site-specific information not provided in the DCD is identified and addressed with respect to internal flood protection, and that flood protection features incorporated in the plant design can be properly inspected, tested and operated in accordance with DCD requirements.

3.4.2 Analysis Procedures

3.4.2(A) Introduction

This section reviews the applicant's data on highest flood and groundwater levels and the analysis procedure used to transform the static and dynamic effects of the waters into effective design loads for use in the design of structures important to safety. In doing so, the staff evaluates the acceptability of the data and processes used to meet the requirements of GDC 2, - by which SSC's important to safety must be designed to withstand the effects of the highest probable maximum flood (PMF) and maximum groundwater levels without loss of their capability to perform the safety functions. This section documents the staff's review, evaluation, and findings regarding the procedure for converting the maximum flood water heights to effective applied loads and the analytical procedures to be applied for the evaluation of building components and structures of the AP1000 design that are important to safety from the effects of this natural phenomena in combination with other concurrent loads.

APR1400

3.4.2(B) Summary of Application

FSAR Tier 1: The FSAR Tier 1information associated with this section is found in FSAR Tier 1 Section 2.1, "Site Parameters," Section 2.2.1, "Nuclear Island," Section 2.2.2, "Emergency Diesel Generating Building," and Section 2.2.5, "Protection against Hazards," which cover the design basis flood loads applied to as well as protection measures implemented in Section 2.2.5.1.1 "External Flooding" for the effect of external flooding on safety related buildings and structures.

FSAR Tier 2: The applicant has provided a description of analysis procedures for flood design of structures important to safety in Section 3.4.2, "Analysis Procedures," and external flood protection description in Section 3.4.1.4, "Evaluation of External Flooding," summarized here in part, as follows:

this section, DCD Tier 2, Section 3.4.2 “Analysis Procedures,” the staff found that the applicant did not provide the information on the transforming procedures here in this section (rather refers the procedures to DCD Sec.3.8). This was requested in RAI 75-8023 (ML15196A602) Question Item (b). In response (ML15225A569), the applicant provided methods on how to evaluate hydrostatic loading, buoyancy load and hydrodynamic loading including hydrodynamic water pressure due to earthquakes from design basis water heads prescribed in the above table, based on engineering principles on hydrostatics and soil dynamics. The applicant stated that the hydrostatic loading is calculated as linearly distributed pressure on external walls based on the design basis water level according to the basic equation of hydrostatics. The dynamic ground water pressure is calculated based on Matsuo and O’Hara hydro-dynamic formula in the textbook, (DAS, Braja, Principles of Soil Dynamics, PWS Kent Publishing 1993). For hydrodynamic water pressure induced by earthquakes, the formula gives a parabolic distributed pressure. The buoyant force acting in the direction opposite to the gravitational force at the bottom of the basemat for all loading cases is calculated as the weight of the water displaced by the building. Since the adopted procedures are based on well-established practices in engineering community, the staff concludes that they are in conformance with SRP 3.4.2 acceptance criteria 2 and 3 and thus, are acceptable.

DCD Tier 2, Section 3.8.5.3 and Table 3.8-2 provide the loads and load combinations used for the design of seismic Category I structures. In the response to RAI 75-8023, Question Item (c), the applicant stated that those individual loads involving flood water head include:

- Hydrostatic load (L_h) in the category of “normal load”
- Flooding load (Y_f) in the category of “abnormal load”
- Design flood or precipitation load (H) in in the category of “severe environmental load”
- PMF or PMP (H_s) in in the category of “extreme environmental load”
- Hydrodynamic load in seismic excitation (E_s) in the category of “extreme environmental load”

These loadings are used as design inputs for load combinations in the design of seismic Category I structures. DCD Tier 2, Table 3.8-2 is used for the reactor containment building, whereas Table 3.8-9A for other seismic Category I structures. In addition, the buoyant forces in normal and flood conditions are considered in the stability check of overturning, sliding, and flotation as shown in DCD Tier 2, Table 3.8-10. The staff reviewed these loadings and their classifications, and found they comply with American Concrete Institute (ACI) 349 Chapter 9 code specifications, and SRP Section 3.4.2 acceptance criteria 2, thus are acceptable. However, the link between the water head sources (in Table ~~6.1~~ 3.4.11) and each individual loading (see bulleted items above), and the soil pressure evaluation as affected by the presence of water are not provided. These two issues were discussed in a meeting on August 20, 2015 when the applicant committed to providing written material to support the meeting discussion, and implementing those needed information in the DCD update. RAI 75-8023 was being tracked as an open item in the PSER Section 3.4.2 with open items.

3.4.2(D)(c) Protective Measures Implemented for the Effects of Flooding and Groundwater

DCD Tier 2, Section 3.4.1.4 covers evaluation of external flooding from sources including natural phenomena and failure of onsite tanks or large buried pipes. The applicant stated that

The applicant responded to **RAI 117-8061, Question 03.05.01.01-**3 in letter dated December 22, 2015 (ML15356A714) and stated that DCD Tier 1, Table 2.2.5-1, item 4 will be revised to include all structures, (e.g., RCB, AB, and ESW/CCW heat exchanger buildings) that house SSCs requiring internal missile protection. The staff finds the applicant's response to **RAI 117-8061, Question 03.05.01.01-3**, acceptable because the inclusion all structures that house SSCs required to be protected from missiles in the acceptance criteria ensures that the ITAAC are consistent with the design description in DCD Tier 1, Section 2.2.5.1.4, and DCD Tier 2, Sections 3.5.1.1 and 3.5.1.2. The incorporation of DCD markups provided as part of **RAI 117-8061, Question 03.05.01.01-3** into the DCD is being tracked as **Confirmatory Item 3.5.1.1-3**.

The staff finds that the ITAAC are sufficient to provide reasonable assurance that safety-related SSCs will be protected from internally generated missiles outside containment. Therefore, the staff concludes that the missile protection provided for APR1400 SSCs located outside containment is adequate.

3.5.1.1(E) Combined License Information Items

Table 3.5.1.1-1 of this report provides a list of internal missile related COL Information Item numbers and descriptions from DCD Tier 2, Table 1.8-2:

Table 3.4.2(F-1 APR1400 Combined License Information Items

Table 3.5.1.1-1

Item No.	Description	DCD Tier 2 Section
COL 3.5(1)	The COL applicant is to provide the procedure for heavy load transfer to strictly limit the transfer route inside and outside containment during plant maintenance and repair periods.	3.5.1.1 3.5.1.2

The staff finds the above list of COL information items to be complete, and adequately describing the actions necessary from the COL applicant. No additional COL information items need to be included in DCD Tier 2, Table 1.8-2, for protection from internally generated missiles outside the containment.

3.5.1.1(F) Conclusions

[Pending resolution of the aforementioned confirmatory items,] the staff's review concludes that the applicant's design bases for SSCs important to safety necessary to maintain a safe plant shutdown, ensure the integrity of the reactor coolant pressure boundary, and prevent a significant uncontrolled release of radioactivity meet the 10 CFR Part 50, Appendix A, GDC 4 requirements for SSCs to be protected from internally-generated missiles (outside containment), because the applicant has conformed with the guidance recommended in: RG 1.115, Positions C.1 and C.3, as to the identification and protection of SSCs important to safety from the effects of turbine missiles, respectively; and RG 1.117 as to which SSCs should be protected from missile impacts.

effects associated with pipe rupture are identified, and the criteria for separation and the evaluation of adverse consequences are defined.

3.6.1(B) Summary of Application

DCD Tier 1: Information related to protection against pipe rupture effects is discussed in DCD Tier 1, Section 2.3, "Piping Systems and Components." Table 2.3-3 identifies the high- and moderate-energy lines that must be evaluated for pipe break analysis.

DCD Tier 2: The methodology used in designing the protection of essential systems and components from the consequences of postulated piping failures outside containment is described in DCD Tier 2, Section 3.6.1. Such methodology includes: (1) identification of essential systems and components located near high- or moderate-energy pipe systems that need to be protected; (2) identification of the failures for which protection is being provided and assumptions used; and (3) identification of protection considerations in the design. Separation and redundancy of essential systems, methods of analyzing piping failures, and habitability of the main control room are also addressed.

ITAAC: Tier 1 Table 2.3-3, "High and Moderate Energy Piping Systems," identifies all the piping systems that must be evaluated in the pipe rupture hazard analysis report. The Tier 1 Section of each of these system includes an ITAAC related to the pipe rupture hazard analysis.

3.6.1(C) Regulatory Basis

The relevant regulatory requirements for this area of review and the associated acceptance criteria are given in NUREG-0800, Section 3.6.1, "Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment," Revision 3 and are summarized below. Review interfaces with other SRP sections can be found in Section 3.6.1.I of NUREG-0800.

- GDC 2, "Design bases for protection against natural phenomena," as it relates to the protection of SSCs important to safety to withstand the effects of natural phenomena, such as earthquakes.

- GDC 4, "Environmental and dynamic effects design bases," as it relates to SSCs important to safety being designed to accommodate the effects of and to be compatible with the environmental conditions associated with postulated pipe rupture.

- 10 CFR 52.47(b)(1), "Contents of applications, technical information," as it relates to the requirement that a ~~U.S. EPR~~ design certification application contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

3.6.1(D) Technical Evaluation

In DCD Tier 2, Section 3.6.1, the applicant describes the methodology used in designing the APR1400 to protect essential systems and components from the consequences of postulated piping failures outside containment. The steps include identification of the essential systems and components that are located near high- or moderate-energy piping systems, identification of

[[The applicant stated that Section 4.2 of the technical report will be updated to add the two-phase flow design guide for evaluating affected SSCs.]] Because the two-phase flow design guide described in other portions of the technical report is technically acceptable, this clarification is acceptable to address the identified issue.

An additional three issues were discussed at the December 1-2, 2015, meeting and documented in the December 9, 2015 letter referenced above. While the overall approach presented at the meeting appeared to address the NRC staff's concerns, the applicant requested formal RAIs to facilitate providing a complete docketed response. As a result, the NRC staff issued **RAI 359-8448** to capture these issues, as described below.

Clarification on the V&V of the CFD model.

[[In the technical report, the applicant used the CFD model to assess the dynamic effects of jet impingement and blast wave resulting from the postulated HELB. The applicant indicated that the CFD model using the Star-CCM+ CFD solver platform is qualified for use through V&V, as per ASME NQA-1, following techniques documented in ASME V&V 20-2009. The V&V of the Star-CCM+ CFD is provided in Appendix A of the technical report.]] The NRC staff issued **RAI 359-8448, Question ~~28886~~** 03.06.02-6 to address specific issues regarding this V&V activity.

The NRC staff determined that the following additional information was needed on the V&V of the Star-CCM+ CFD to determine that it meets the requirements of 10 CFR Part 50, Appendix B, and GDC 1, as described in the relevant SRP Section 3.9.1, Subsection II, SRP Acceptance Criterion 2.

- In Appendix A of the technical report, the applicant described how the verification and validation of the APR1400 CFD modeling using the Star-CCM+ CFD computer code were performed by using the four validation problems described in Section A9.0 of the technical report. This appendix also includes numerous tables to show the results from the validation for the four validation problems. It further concludes that these validation results demonstrate the convergence of the ~~APR1000~~ APR1400 CFD modeling using the Star-CCM+ CFD computer program. However, based on the information currently included in the Appendix A, it is not clear how these tables were generated and how the results as shown would demonstrate the convergence of the applicant's CFD modeling. The applicant was requested to provide an explanation of the data used to generate the tables presented in Appendix A of the technical report, including how the results of the four different validation problems as shown in the table demonstrate the convergence of the APR1400 CFD modeling using the Star-CCM+ CFD code.

- The NRC staff noted that numerous statements or equations included in the report refer to either literature or test data. However, the report does not identify the respective literature or test data in the list of references. The applicant was requested to provide a more detailed explanation of the references pertaining to Appendix A of the technical report.

- The applicant was requested to clarify how the uncertainty in the overall approach is addressed, how uncertainties are combined and carried forward to the application, and how specific reference information was applied (such as convergence to the desired goal). The applicant was requested to provide clarifications in other sections (e.g., Subsections 11 and 12 of Appendix A) to support the wording in Section A.15.0, Bullet A.2 regarding the validation of uncertainty with respect to CFD modeling.

RCB and AB as shown in Figures 1 through 12 of the RAI response. The staff found this justification acceptable because (1) the aforementioned comparisons show that the use of extreme ground water level produced conservative response and (2) the difference between the extreme ground water level and the design ground water level is only 0.61 m. Accordingly, the applicant also revised DCD Tier 2, Sections 3.7.1.3, 3.8.4.3.1, 3.8A.1.4.2.3.2, and Technical Reports APR1400-E-S-NR-14001-P, APR1400-E-S-NR- 4003-P, and APR1400-E-S-NR-14005-P. The staff found these changes consistent with the RAI response and thus acceptable.

Based on the evaluation above, the staff finds that DCD Tier 2, Section 3.7.1.3, provides sufficient information concerning the supporting media and is consistent with SRP Acceptance Criterion 3.7.1.II.3.

3.7.1(D) Combined License Information Items

DCD Tier 2, Revision 0, Section 3.7.1, as modified in the applicant's response including, letter dated November 30, 2015 (ML15334A153) and response to **RAI 182-8160, Question 03.07.01-4**, dated August 8, 2016 (ML16221A559), contains two COL information items pertaining to seismic design parameters. The staff has evaluated the acceptability of these COL items in this SER section. The staff also determined that the original COL information items, COL 3.7(1) and COL 3.7(2), are not applicable because they are not considered part of the DC/COL interface and agreed with the applicant's removal of these two COL information items from the DCD. These COL items are listed below in

Table 3.7.1-1 COL Items Related to DCD Tier 2, Section 3.7.1

COL Item	Description
COL 3.7(12)	The COL applicant is to demonstrate the applicability of soil degradation models used in site-specific site response analysis for the site conditions.
COL 3.7(13)	The COL applicant is to compare the site-specific strain-compatible soil properties with generic soil properties in order to confirm the site meets the generic soil profile used in the standard design.

3.7.1(E) Conclusion

With the condition that all confirmatory items are addressed in the next DCD revision, the NRC staff concludes that the applicant meets the regulatory requirements listed in Section 3.7.1(C) of this SER by adequately addressing seismic design parameters, in accordance with the acceptance criteria given in SRP Section 3.7.1, Revision 4. The applicant meets these requirements specifically by its use of (1) acceptable smooth broadband CSDRS, (2) synthetic acceleration time histories enveloping the CSDRS and with sufficient power in the frequency range of interest to the APR1400 standard design, (3) percentage of critical damping values that conforms to the NRC RG 1.61 guidance, (4) eight generic soil profiles and one fixed-base condition to cover a wide range of site conditions, and (5) HRHF response spectra and the associated synthetic acceleration time histories for the evaluation of the APR1400 seismic Category I SSCs against high-frequency seismic motions. This ensures that the seismic design notable differences between the RCB designs of the previous licensed plants and the APR1400. First, the thickness of the common concrete basemat under the APR1400 RCB and AB ranges from 3.05 m to ~~332.15 m~~ 10.06 m (10 ft to 33 ft). This concrete basemat thickness is much greater than those used for the previously licensed plants, whose basemats are approximately 2.90 m (9 ft, 6 in.) thick on average. The use of a much thicker concrete basemat is not significant; it is related to the design of the RCB walls and dome, and also because the tendon gallery is located within the basemat, unlike other prestressed concrete containments where the tendon gallery is either not integrally connected or is not within the basemat region. The thicker concrete foundation slab does require some special construction techniques and measures, which are discussed in Section 3.8.5 of this safety evaluation report.

The APR1400 RCB does not use a ring girder at the spring line joint between the cylinder and the dome used on the RCBs for some of the existing plants. This ring girder in the prestressed concrete containment provides anchorages for the vertical tendons in the cylinder and for the tendons in the dome; as well as added structural capability to resist discontinuity stresses at the spring line. The APR1400 RCB employs continuous inverted U-shaped vertical tendons in which one end of the tendon is anchored at the base of the tendon gallery. The tendon then runs up inside of the cylindrical wall and dome and comes down through the other side of the wall, where it is anchored to the base at the other side of the tendon gallery of the RCB. Therefore, it is not necessary to use a ring girder. These differences between the existing prestressed containments and the APR1400 RCB do not materially affect the overall structural characteristics of the RCB.

When compared to the RCB used for previously licensed plants, the APR1400 RCB appears to have a reasonable overall design, considering geometry, wall and basemat thicknesses, the general arrangement of prestressing steel tendons and other reinforcement in the RCB wall and dome, prestressing tendons, layouts at large openings and penetrations, and descriptions of major penetrations and attachments. The design of the APR1400 RCB exhibits structural characteristics similar to those of existing U.S. plants using RCB containment structures, including those characteristics that provide desirable seismic design margins.

In DCD Tier 2, Section 3.8.1.1.3, the applicant discussed the physical characteristics of the containment shell, including the attachment of the polar crane into the cylindrical wall. The staff determined that additional information was needed to better understand how equipment (e.g., the electrical conduit, cable tray, spray piping) is attached to the inside and outside surface of the concrete containment. Therefore, in **RAI 8223, Question 03.08.01-07**, the staff asked the applicant to describe the design of the attachments to the inside and outside of the concrete containment. The applicant's response dated January 8, 2016, (ML16008A913), states that the structural steel supports are provided for the electrical conduit, cable tray, and the spray system piping and that the supports are welded to the embedment plates on the inside and outside of the containment wall and dome.

The staff reviewed the applicant's response and considered the applicant's approach for attaching equipment such as the electrical conduit, cable tray, and spray system piping to be acceptable because it is consistent with industry practices and the applicant is committed to using Section III of the ASME Code in its design of the structural steel supports. Accordingly, **RAI 8223, Question 03.08.01-07**, is resolved and is being tracked as Confirmatory Item 3.8-1 pending the applicant's update to DCD Tier 2, Section 3.8.1.1.3.1, "General."

In DCD Tier 2, Section 3.8.1.1.4.4, "Liner Plate Details and Anchorage," the applicant discussed the physical characteristics of the liner plate details and anchorage system. The applicant

Item No.	Description	Section
COL 3.8(14)	The COL applicant is to perform concrete long-term material testing in a way that verifies the physical properties of the materials used during the design stage and the characteristics of long term deformation of concrete.	3.8.1.4.8 3.8.6

Markups for COL 3.8(11) and 3.8(14) were provided in the responses to RAI 8085, Question 03.08.01-05, and RAI 8085, Question 03.08.01, respectively. The staff found the list of COL information items to be complete because it adequately describes actions necessary for the COL applicant to perform. Once the markups for COL 3.8(11) and 3.8(14) are incorporated into DCD Tier 2, Section 3.8.6 and Table 1.8-2, no additional COL information items are needed for the concrete containment.

3.8.1(F) Conclusion

With the condition of all the confirmatory items addressed in the next DCD revision, the staff concludes that the design of the concrete containment is acceptable and meets the relevant requirements of 10 CFR 50.44, 10 CFR 50.55a, and GDC 1, 2, 4, 16, and 50. This conclusion is based on the following ~~eight~~ seven findings:

1. The applicant has met the requirements of 10 CFR 50.55a and GDC 1 with respect to ensuring that the concrete containment is designed, fabricated, erected, constructed, tested, and inspected to quality standards commensurate with its safety.
2. The applicant has met the requirements of GDC 2 by designing the concrete containment to withstand the most severe earthquake that has been established for the site with sufficient margin and to withstand the combinations of the effects of normal and accident conditions with the effects of environmental loadings such as earthquakes and other natural phenomena.
3. The applicant has met the requirements of GDC 4 by designing the concrete containment to withstand the dynamic effects associated with missiles, pipe whipping, and discharging fluids.
4. The applicant has met the requirements of GDC 16 by designing the concrete containment to be a leaktight barrier to prevent the uncontrolled release of radioactive effluents to the environment.
5. The applicant has met the requirements of GDC 50 by designing the concrete containment to accommodate, with sufficient margin, the design leakage rate, calculated pressure, and temperature conditions resulting from accident conditions and by ensuring that the design conditions are not exceeded during the full course of the accident condition.
6. The applicant has met the requirements of Appendix B to 10 CFR Part 50, in that the quality assurance program provides adequate measures for implementing guidelines relating to structural design.
7. The applicant has met the requirements of 10 CFR 50.44 by designing the concrete containment to accommodate the loads associated with hydrogen gas generated from a fuel-cladding metal-water reaction so that there is no loss of containment structural integrity.

The criteria used in the analysis, design, and construction, testing and inservice surveillance of the concrete containment structure to account for anticipated loadings and postulated conditions and therefore, the staff considered it to be acceptable.

In summary, **RAI ~~255-8283~~ 320-8383, Question 03.08.05-19** is resolved, and is being tracked as Confirmatory Item pending the applicant's update to DCD Tier 2, Sections 2.5.4.5 "Excavation and Backfill," 2.5.6 "Combine License Information," and COL Table 1.8-2 "Combine License Information Items," 3.8.6 "Combine License Information," and Section 6.4 "Bottom Lean Concrete and Side Soil Backfilled with SFG," of TR APR1400-E-S-NR-14002-P, Rev. 0.

The descriptive information and referenced figures in the DCD Tier 2, Section 3.8.5.1 "Description of the Foundation," contain sufficient detail to define the foundations of the RCB and the other seismic Category I structures to perform their safety related functions. The staff finds the description of the foundations of the RCB and the other seismic Category I structures in DCD Tier 2, Section 3.8.5.1, to be acceptable on the basis that they are consistent with SRP Section 3.8.5.1 and RG 1.206 acceptance criteria.

3.8.5(D)(b) Applicable Codes, Standards, and Specifications

The staff reviewed the applicable codes, standards and specifications used for the foundations to ensure that they meet the applicable requirements in 10 CFR 50.55a; 10 CFR Part 50, Appendix B; and GDC 1, GDC 2, GDC 4, and GDC 5, and are in accordance with the guidance provided in SRP Acceptance Criteria 3.8.5.II.2.

In DCD, Tier 2, Section 3.8.5.2, "Applicable Codes, Standards, and Specifications," the applicant indicated that DCD Tier 2, Section 3.8.1.2 describes the applicable codes, standards, and specifications for the foundation of RCB. Therefore, Section 3.8.1(D)(b) of this SER contains the staff's evaluation of referenced codes, standards, and specifications of the foundations of RCB. Furthermore, DCD Tier 2, Section 3.8.5.2, indicates that DCD Tier 2, Section 3.8.4.2 describes the applicable codes, standards, and specifications for the foundations of other seismic Category I structures. Therefore, Section 3.8.4(D)(b) of this SER contains the staff's evaluation of referenced codes, standards, and specifications of the foundations of other seismic Category I Structures.

SRP 3.8.5, Section II.2, "Applicable Codes, Standards, and Specifications," refers to SRP Section 3.8.1, Section II.2 and SRP Section 3.8.4, Section II.2 for the applicable codes, standards, and guidance that apply to seismic Category I foundations. However, in Figure 3-11, "Justification Boundary for Design of NI Common Basemat," in Topical Report APR-E-S-NR-14006-P, Rev. 1, the applicant indicated that the applicable codes for the containment basemat is ASME Section III, Division 2, 2001 Edition through 2003 Addenda, and for the AB portion of the NI basemat is ACI 349-97. Since both structures are on a common basemat, it was not clear to the staff whether the applicant performed a comparative study between the two design codes to determine the differences in the loads and load combinations. Therefore, the staff issued **RAI 255-8285, Question 03.08.05-5** on October 19, 2015 (ML15293A569) requesting that the applicant describe whether a comparative study was performed of the loads and load combinations between ASME Section III, Division 2, 2001 Edition through 2003 Addenda and ACI 349-97 to determine the differences.

The applicant submitted the response to **RAI 255-8285, Question 03.08.05-5** in a letter dated February 5, 2016 (ML16036A129). In its response the applicant described that each code has different philosophies and design methods as well as different loads and load combinations; and concluded that it is difficult to identify which code is always conservative or always produces adverse design results. However, the applicant referred to the response of RAI 199-8223, The applicant submitted the final response to **RAI 255-8285, Question, 03.08.05-9** on January 1, 2016 (ML17009A400). Based on the review, the applicant's response and staff evaluation for each item of this RAI are given below.

1. Criteria related to SRP Section 3.8.5.II.4.E - evaluation of settlement:

   The effects of (a) static and dynamic settlements, (b) short term and long term settlements, (c) of soil type on settlement and (d) of foundation type and size on settlement are addressed under RAI 255-8285, Question 03.08.05-7, which is evaluated below in this SER. **Therefore, item 1 under RAI 255-8285, Question 03.08.05-9 is resolved.**

2. Criteria related to SRP Section 3.8.5.II.4.G - evaluation of stiff and soft spots:

   The applicant responded that the stiff and soft spots are not predictable before the site survey or site excavation for the specific site. The applicant further described that if stiff and soft spots were found during excavation, the COL applicant shall perform basemat analysis considering stiff and soft spots per item 2 of COL item, COL 3.8(12) within RAI 255-~~8283~~ 8285, Question 03.08.05-7. **Therefore, item 2 under RAI 255-8285, Question 03.08.05-9 is resolved.**

3. Criteria related to SRP Section 3.8.5.II.4.J - evaluation of settlement during construction:

   The applicant responded that the evaluation of settlement during the construction sequence is described in RAI 255-~~8283~~ 8285, Question 03.08.05-7. The applicant also described that if the actual soil status and loss of cement from the mudmat were to be expected after the site survey or site excavation, loss of subgrade contact due to loss of cement from a mudmat is considered corresponding to the actual site status as specified in items 4 and 5 of COL item, COL 3.8(12) within RAI 255-~~8283~~ 8285, Question 03.08.05-7. **Therefore, item 3 under RAI 255-8285, Question 03.08.05-9 is resolved.**

4. Criteria related to SRP Section 3.8.5.II.4.K - stiffness modeling of soil material in seismic analysis:

   The applicant described two methods to represent soil stiffness parameters, which are applied to the NI common basemat analysis. Under static loading combinations, soil spring were used based on sugared moduli of the soil. Under seismic loading combinations, the foundation media was modeled to represent the soil using finite elements. The applicant provided further details of the soil modeling in the response to RAI 255-8285 Question 03.08.05-8. **Therefore, item 4 under RAI 255-8285, Question 03.08.05-9 is resolved.**

   The staff determined that the adequacy of the response cannot be determined until the detailed analysis, to be provided in RAI 255-8285, Question 03.08.05-7, is completed.

Based on the staff's review of the applicant's final response to **RAI 255-8285, Question, 03.08.05-9** on January 1, 2016 (ML17009A400), the applicant deferred to RAI 255-~~8283~~ 8285, Question 03.08.05-7 to resolve items 1, 2 and 3, and the applicant provided further details of the soil modeling in the response to RAI 255-~~8283~~ 8285, Question 03.08.05-8 for item 4. **Therefore, 8285 255-8285, Question 03.08.05-9 is resolved.**

In DCD Tier 2, Section 3.8.6.4, "Design and Analysis Procedures," the applicant stated that "The maximum differential settlement of foundation is 12.7 mm per 15.24 m (0.5 in per 50 ft) within NI common basemat. The maximum differential settlement between buildings is 12.7 mm (0.5 in) based on enveloping properties of subsurface materials. In addition, the common basemat is analyzed for construction sequences to minimize any potential differential settlement during construction." The applicant further described the differential settlement of foundations in TR APR1400-E-S-NR-14006-P, Rev. 1, for the NI and in Appendix A to this technical report for the EDGB and DFOT building. Based on the review of these documents, it was not clear to the staff how the construction sequence and differential settlement of foundations were considered in the load and load combinations. Therefore, the staff issued **RAI 255-8285, Question 03.08.05-7** on October 19, 2015 (ML15293A569) requesting the applicant to describe how the construction sequence and differential settlement of foundations were considered in the load and load combinations.

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The applicant submitted the response to **RAI 255-~~8295~~, Question 03.08.05-7** in a letter dated August 2, 2016 (ML16222A402). In its response, the applicant described the differential settlement analysis approach based on the applied loads under the static load case (dead plus live load) and dynamic load case (seismic) for the three selected soil profiles S1, S4, and S8 corresponding to soft, medium, and stiff, respectively. For the construction sequence evaluation, information was only provided for the basemat. For the construction sequence evaluation of the entire NI (i.e., basemat and superstructures), the response indicated that it will be performed and submitted at a later date. To determine which soil profile should be used for the construction sequence of the NI, the response provided some comparisons of the basemat response due to the S1 and S8 soil profiles. The response also provided COL 3.8(11) and COL 3.8(12) to identify what the COL applicant should evaluate regarding site-specific aspects of construction sequence and the various potential site-specific soil conditions such as stiff/soft soil spots, different soil types (e.g., cohesive soils), loss of cement for the mudmat, and non-uniformity of soil layers.

Based on the review, the staff requested the applicant to address the following:

1. The staff notes that the applicant did not make any conclusion in the response whether the S1 soil condition governs, in which case only the soft soil condition will be evaluated for construction sequence or not. Since in some regions of the basemat, it appeared that S8 member forces were larger than S1, the staff requested the applicant to explain whether both cases of S1 and S8 will be analyzed, and the design will be based on the envelop/governing loads from these cases.

2. The staff provided some comments for clarification of COL 3.8(11). The staff noted that the COL 3.8(11) describes the construction sequence and corresponding differential settlement analysis, however, the site-specific analysis should also consider post-construction settlement analysis through the life of the plant per the guidance in SRP 3.8.5II.4.

3. The staff also noted that the applicant did not provide acceptance criteria for all aspects of settlement which consist of the maximum vertical settlement, tilt settlement, differential settlement between adjacent structures, and angular distortion. The settlement should be based on static (gravity) loads not seismic load because the settlements to be monitored during the COL monitoring program cannot include seismic. Using an upper bound of 0.5 inch per 15 m (50 ft) is not conservative because the

superstructure. Usually, displacement of basemat results in bending distortion between adjacent points, not simply differential displacements. Therefore, the staff requested the applicant to explain how the COL applicant is supposed to check for settlements, and revise the TR, applicable sections of the DCD, and COL item(s) accordingly.

The applicant submitted the response to **RAI 255-~~8295~~, Question 03.08.05-18** in a letter dated August 2, 2016 (ML16222A402). 8285

1. In its response, the applicant chose the soil profile S1 as the representative soil profile; even though, soil profile S2 is softer than S1 at some depths. The applicant calculated the subgrade moduli using the methodology described in TR APR1400-E-S-NR-14006-P, Rev. 1, Section 2.2.1, and "Elastic Modulus of Soil Sites." The results show that subgrade modulus of S1 (35.66 kcf) is less than S2 (49.73 kcf); therefore, the subgrade modulus of S1 was used for the construction sequence analyses performed for the NI basemat. The applicant further described that if the site specific soil information identified by the COL applicant, as a result of performing the actions required by COL 3.8(10), is not enveloped by soil profiles S1 through S9, and the soil condition leads to greater settlement, the COL applicant shall perform the analysis required by COL 3.8 (11). The applicant also referred to the response of RAI 255-8285, Question 03.08.05-7 for determining the acceptability of the site specific settlements.

2. The applicant described the soil profiles in Table 3.7A-1, "Soil Layers and Profiles (S1)," of DCD Tier 2, as sand, soft rock and rock, and that the settlement of APR1400 basemat will be controlled by the instantaneous settlement of sand. The applicant added that, in the actual site, the site-specific soil parameters are determined based on COL 3.8(10). The elastic soil moduli are recalculated based on elastic shear modulus provided in accordance with COL 3.8(10). The applicant described that, in the DCD phase, the static elastic moduli considered in the basemat analysis of seismic Category I was determined with a low reduction factor of 0.1153, as described in the response to RAI 255-8285, Question 03.08.05-16. Therefore, the applicant concluded that the results of settlement from analysis in the DCD phase include sufficient margin for long-term settlement in sand and rock profiles. The applicant further described that if site-specific parameters are different form DCD Tier 2, soil parameters, the COL applicant shall evaluate this based on COL 3.8(12) of RAI 255-8285, Question 03.08.05-7.

3. The applicant referred to RAI 255-8285, Question 03.08.05-7 for the details about settlement and construction sequence.

The staff reviewed the applicant's response to **RAI 255-8285, Question 03.08.05-18** and finds it acceptable because the applicant described that the modulus for the S1 profile leads to a reduced modulus as compared to the S2 profile, and thus S1 leads to a softer soil spring. In addition, the applicant considered three soil cases of S1, S4, and S8 (soft, medium, and stiff) soil profiles in the various ANSYS structural analyses. The applicant also described that if a COL applicant determines that the site-specific conditions are different than those used in the DCD stage, then the COL applicant is to perform a site-specific evaluation per COL 3.8(12) of **RAI 255-8285, Questions 03.08.05-7**. Furthermore, the applicant addressed the question related to the settlements and bending distortion considerations in the related **RAI 255-8285, Questions 03.08.05-7, -9 and -16.** Therefore, **RAI 255-8285, Question 03.08.05-18** is resolved and is being tracked as confirmatory item.

The staff reviewed DCD Tier 2, Section 3.9.3.4, “Component Supports,” in which the applicant describes the design of ASME Class 1, 2, and 3 component supports and their attachments. The applicant states that the design of ASME Class 1, 2, and 3 component supports and their attachments is in accordance with ASME BPV Code, Section III, Subsection NF up to the interface of the building structure, with jurisdictional boundaries as defined by ASME BPV Code, Section III, Subsection NF. The stress limits are defined in accordance with ASME BPV Code, Section III, Subsection NF and Appendix F; RG 1.124, “Service Limits and Loading Combinations for Class 1 Linear-Type Supports,” Revision ~~2~~ 3, issued ~~February 2007~~ July 2013; and RG 1.130, “Service Limits and Loading Combinations for Class 1 Plate-and-Shell-Type Component Supports,” Revision ~~2~~ 3, issued ~~March 2007~~ July 2013. These design provisions are consistent with the ASME BPV Code, Section III as it is incorporated into 10 CFR 50.55a and with the staff’s regulatory guidance and are therefore acceptable.

Concrete expansion anchors are designed to meet the requirements of ACI-349 and IE Bulletin 79-02 with the provisions identified in DCD Tier 2, Subsection 3.8.4.5. The staff’s evaluation of this material is presented in Section 3.8.4 of this report.

10 CFR Part 50, Appendix A, GDC 2 and Appendix S, require that structures and components important to safety be designed to withstand the effects of earthquakes without loss of capability to perform their safety functions. One aspect of compliance with these requirements, as described in SRP Section 3.9.3, is the inclusion of energy-absorbing snubbers in the design. As stated in the acceptance criteria in SRP Section 3.9.3, Subsection II, the snubber end fitting clearance, mismatch of end fitting clearances, mismatch of activation and release rates, and lost motion should be minimized and should be considered when calculating snubber reaction loads and stress which are based on a linear analysis of the system or component. This provision is especially important in multiple snubber applications where mismatch of end fitting clearance has a greater effect on the load sharing of these snubbers than does the mismatch of activation level or release rate. Equal load sharing of multiple snubber supports should not be assumed if mismatch in end fitting clearance exists.

In DCD Tier 2, Section 3.9.3.4 “Component Supports” the applicant states that “where required, snubber supports are used as shock arrestors for safety-related systems and components. Snubbers are used as structural supports during a dynamic event such as an earthquake or a pipe break but during normal operation act as passive devices that accommodate normal expansions and contractions of the systems without resistance. For the APR1400, snubbers are minimized to the extent practical in the APR1400 design.”

To the extent that snubbers may be used in the detailed design of the APR1400 plant, their general design should be described in DCD Tier 2, Section 3.9.3.4. In **RAI 319 Question 3.9.3-5**, the applicant was requested to provide additional information, with a summary in the DCD, of the following snubber-related information (as well as other general information as appropriate on the snubber design):

- The snubber end fitting clearance, mismatch of end fitting clearances, mismatch of activation and release rates

- The snubber lost motion when calculating snubber reaction loads

- The load sharing, release rate when multiple snubber applications are used.

Technical Report APR1400-E-S-NR-14004-P, "Evaluation of Effects of HRHF Response Spectra on SSCs," 0 for additional details on the qualification of high frequency sensitive equipment.

Delete if it is unnecessary

ITAAC: DCD Tier 1, Se[illegible]sed ITAAC for the seismic qualification of equipment.

3.10(C) Regulatory Basis

The following regulatory requirements and guidelines provide the basis for the acceptance criteria for the review by the staff:

- GDC 1 and GDC 30 of Appendix A to 10 CFR Part 50, as related to qualifying equipment to appropriate quality standards commensurate with the importance of the safety functions to be performed.

- GDC 2 and Appendix S to 10 CFR Part 50, as related to qualifying equipment to withstand the effects of natural phenomena such as earthquakes.

- GDC 4, as related to qualifying equipment to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents.

- GDC 14, as related to qualifying equipment associated with the reactor coolant boundary so as to have an extremely low probability of abnormal leakage, rapidly propagating failure, or gross rupture.

- Appendix B to 10 CFR Part 50, as related to qualifying equipment using the quality assurance criteria provided.

- RG. 1.9, "Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants."

- RG 1.61, "Damping Values for Seismic Design of Nuclear Power Plants."

- RG 1.92, "Combining Modal Responses and Spatial Components in Seismic Response Analysis."

- RG 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants."

- RG 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants."

3.10(D) Technical Evaluation

The NRC staff performed its review of DCD Tier 2, Rev. 0, Section 3.10 and Technical Report APR1400-E-X-NR-14001-P, Rev. 0, Part 2 related to the seismic and dynamic qualification of mechanical and electrical equipment in accordance with the criteria and procedures delineated in SRP Section 3.10, Rev. 3. The staff's review is discussed in the following subsections.

Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," dated October 28, 2005, summarizes the NRC position regarding the full description of operational programs to be provided by COL applicants. The staff would review and approve the proposed implementation milestones for each operational program in the course of reviewing the COL application and will make a reasonable assurance finding on each program and its proposed implementation, including the adequacy of the implementation milestones. These findings will be documented in the staff's safety evaluation report (SER) for the COL application. SECY-05-0197 identified the EQ program as an operational program.

RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," provides guidance in Section C.IV.4, "Operational Programs," for COL applicants with respect to fully describing plant operational programs. The staff implements the staff positions in SECY-05-0197 and RG 1.206, in addition to SRP Section 3.11, in reviewing the descriptions of the EQ program for mechanical and electrical equipment in design certification and COL applications.

3.11(D) Technical Evaluation

3.11(D)(a) Environmental Qualification of Electrical and I&C Equipment

The staff reviewed DCD Tier 2, Section 3.11 that describes the applicant's approach for satisfying 10 CFR 50.49 requirements pertaining to the EQ of equipment located in a harsh environment and identifies equipment that is within the scope of 10 CFR 50.49. The review evaluates whether the applicant's information presented in the DCD Tier 2, Section 3.11 is sufficient to support the conclusion that all items of equipment that are important to safety are capable of performing their design safety functions under: (1) Normal environmental conditions (e.g., startup, operation, refueling, shutdown); (2) anticipated operational occurrences (e.g., plant trip and testing); (3) design-basis accidents (e.g., LOCA and high-energy line break) and post-accident environmental conditions.

The specific equipment within the scope of EQ requirements is mechanical, electrical, and I&C, including digital I&C equipment associated with systems that are (1) essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or (2) otherwise are essential in preventing significant release of radioactive material to the environment. The EQ equipment includes:

- Equipment that initiates the above functions automatically
- Equipment that is used by the operators to initiate the above functions manually
- Equipment whose failure can prevent the satisfactory accomplishment of one or more of the above safety functions
- ~~Safety-related and non-safety-related electrical equipment~~ Electrical equipment important to safety covered by 10 CFR 50.49 (b)(1)
- Certain post-accident monitoring equipment

3.11(D)(a).1 "Equipment Qualification Program" and Compliance with 10 CFR 50.49

The methodology used to develop the EQ program is described in APR1400-E-X-NR-14001-P, "Equipment Qualification Program," Rev. 0.

Table 3.11-2. APR1400 combined license information items for Section ~~Error! Reference source not found.~~.

Item No.	Description	DCD Tier 2 Section
COL 3.11(1)	The COL applicant is to identify and qualify the site-specific mechanical, electrical, I&C, and accident monitoring equipment specified in RG 1.97.	3.11.1.1
COL 3.11(2)	The COL applicant is to document the qualification test results and qualification status in an auditable file for each type of equipment in accordance with the requirements 10 CFR 50.49(j).	3.11.3
COL 3.11(3)	The COL applicant is to describe the EQP implementation milestones based on the APR1400 EQP.	3.11.3
COL 3.11(4)	The COL applicant is to identify the nonmetallic parts of mechanical equipment in the procurement process.	3.11.2
COL 3.11(5)	The COL applicant is to address operational aspects for maintaining the environmental qualification status of components after initial qualification.	3.11.2.2
COL 3.11(6)	The applicant is to provide a full description of the environmental qualification program of mechanical and electrical equipment.	3.11.2.2

DCD Tier 2, Section 3.11.2.2, "Environmental Qualification during and after a Design Basis Accident," states that the COL applicant is to address aspects for maintaining the EQ status of components after initial qualification. However, this COL item is not listed in DCD Tier 2, Section 3.11.7. The staff issued RAI 115-8066, Question 3.11-7 requesting the applicant to address this COL item in DCD Tier 2, Section 3.11.7 and enhance the specificity of its description in DCD Tier 2, Section 3.11.2.2. In response to question 3.11-7 dated December 11, 2015, the applicant proposed to revise DCD Tier 2, Section 3.11-7 and Table 1.8-2 to add COL 3.11(5) for the COL applicant to address operational aspects for maintaining the EQ status of components after initial qualification. The applicant also proposed to revise DCD Tier 2, Section 3.11.2.2 to describe the operational aspects for a COL applicant to address when developing the operational program to maintain the EQ status of components. Staff considers the applicant's response acceptable because it describes the operational aspects and the COL item, and is consistent with the guidance in SRP Section 3.11. This **is Confirmatory Item 3.11-7** pending revision of the DCD.

The SRM for Commission paper SECY-02-0067 stated that ITAAC for an operational program are unnecessary if the program and its implementation are fully described in a COL application and found to be acceptable by the NRC. In its SRM for SECY-04-0032, the Commission defined "fully described" as when the program is clearly and sufficiently described in terms of the scope and level of detail to allow a reasonable assurance finding of acceptability. However, DCD Tier 2, Section 3.11.7 does not specify a COL item for the COL applicant to provide a full description of the EQ of mechanical and electrical equipment program. The staff issued RAI 115-8066, Question 3.11-8 requesting the applicant to include a COL item for a full description of the EQ program. In response to questions 3.11-8 dated December 22, 2015, the applicant proposed to revise DCD Tier 2, Section 3.11-7 and Table 1.8-2 to add COL 3.11(6) for the COL applicant to provide a full description of the EQ of mechanical and electrical program. The applicant also proposed to revise DCD Tier 2, Section 3.11.2.2 to specify that the applicant is to provide a full description of the EQ of mechanical and electrical program. Staff considers the

DCD Tier 2, Section 3.12.6.2 also states that the jurisdictional boundaries between the pipe support and the building structure follow the requirements of Subsection NF-1130 of the ASME BPV Code, Section III. Because the jurisdictional boundaries between piping supports and interface attachment points is in conformance with the criteria recommended in SRP Section 3.12, Subsection II.D.ii, the staff finds the applicant's approach acceptable.

3.12(D)(e).3 Loads and Load Combinations

SRP Section 3.9.3, Subsection II.1 provides acceptance criteria for component and component support design. This SRP section states that the design and service loading combinations should be sufficiently defined to provide the basis for the design of ASME Class 1, 2, and 3 components and component supports for all conditions. This SRP section also states that the acceptability of the combination of design and service loadings applicable to the design of ASME Class 1, 2, and 3 components and component supports is judged by comparison with positions stated in Appendix A of SRP Section 3.9.3.

DCD Tier 2, Section 3.12.6.3, "Loads and Load Combinations," states that the pipe support loads and load combinations are described in DCD Tier 2, Section 3.12.5.3 and it also refers to DCD Tier 2, Table 3.9-10, "Loading Conditions and Load Combinations Requirements for ASME Section III Class 1, 2, and 3 Piping Supports." The NRC staff compared the loads and load combinations listed by the applicant with those presented in SRP Section 3.9.3. Overall, the staff finds the applicant's loads and load combinations consistent with SRP Section 3.9.3 but requested clarification of the following subjects in **RAI 334-8373, Question 03.12-16**. The content of this question also relates to **RAI 319-8360, Question 03.9.3-2**, which is discussed further in Section 3.9.3 of this SER.

- The applicant was requested to identify the loads in category termed "Dynamic system loads", which are included in the loading combination for the emergency operating condition shown in DCD Tier 2 Tables 3.9-10, 3.12-1 and 3.12-2.
- The applicant was requested to describe how loads caused by design basis pipe breaks and LOCAs are included in the loads presented in DCD Tier 2, Table 3.9-10, Table 3.12-2 and other related tables or DCD descriptions
- The applicant was requested to revise DCD Tier 2, Section 3.12.6.3 to clarify how the loading combinations for piping supports are addressed. DCD Tier 2, Section 3.12.6.3 states that loading combinations for piping supports are shown in DCD Tier 2, Section 3.12.5.3. The load combinations discussed in DCD Tier 2, Section 3.12.5.3 are discussed in the context of the pipe stress evaluation and not for pipe support design.

Delete

The staff reviewed the applicant's revised responses to **RAI 334-8373, Question ! 03.12-16** and **RAI 319-8360, Question 3.9.3-2** (ML16232A620 and ML16232A613 respectively, both dated August 19. 2016). "Dynamic system loads," shown in the DCD tables and which are included in the loading combination for the emergency condition, are loads from design basis pipe breaks (DBPB). Thus, the staff determined that the applicant has adequately responded to request No. 1.

From reviewing responses to RAI 3.12-16 and RAI 3.9.3-2 and related DCD markups, the staff determined that for the APR1400 design the reactor coolant makeup system can compensate for the loss of coolant from breaks in Class 1 branch lines up to a 5.56 mm (7/32 in.) internal due to thermal expansion. Snubbers are not used to counteract vibration or support gravity loads. In DCD Tier 2, Section 3.12.6.6, “Use of Snubbers,” the applicant stated that snubbers can be either hydraulic or mechanical in operation. The NRC staff’s evaluation of snubber design, qualification, and functional capability is documented in Sections 3.9.3 and 3.9.6 of this SER.

3.12(D)(e).7 Pipe Support Stiffness

In DCD Tier 2, Section 3.12.6.7, “Pipe Support Stiffness,” the applicant states that the actual stiffness of variable spring supports may be used in the piping analysis. If the actual support stiffness is used for any support, other than variable spring supports, all supports within the piping model use the actual support stiffness. The NRC staff notes that, in general, rigid pipe supports are modeled in the piping analysis model with a very high “rigid” stiffness. The applicant stated that when the “rigid” stiffness is used, a check is performed on support deflection to verify the rigidity. Each support modeled as rigid is checked with the deflection in the restrained directions to a maximum of 1.6 mm (1/16 inch) for SSE loadings, and a maximum of 3.2 mm (1/8 inch) for other loadings.

The staff reviewed the applicant’s procedure for pipe support stiffness presented in DCD Tier 2, Section 3.12.6.7 and determined that it is reasonable and consistent with industry practices documented in WRC BL 353 and, therefore, found it acceptable.

3.12(D)(e).8 Seismic Self-Weight Excitation

In DCD Tier 2, Section 3.12.6.8, “Seismic Self-Weight Excitation,” the applicant shows that the pipe support structure is considered as a self-weight excitation when SSE loading is considered in the pipe support analysis. The support self-weight SSE response and the piping inertial load SSE response are to be combined by absolute summation. Damping values for welded and bolted structures are taken from the RG 1.61, Revision 1. The NRC staff reviewed the information presented in DCD Tier 2, Section 3.12.6.7 and found it acceptable because it is the same method that the staff approved in past design certification applications, as documented in NUREG-1793, Section 3.12.6.8, and is also consistent with the staff guidelines in SRP Section 3.9.3.

3.12(D)(e).9 Design of Supplementary Steel

In DCD Tier 2, Section 3.12.6.9, “Design of Supplementary Steel,” the applicant states that all seismic Category I pipe supports for the APR1400 are designed to ASME BPV Code, Section III, NF. For non-seismic Category I pipe supports, AISC 360-05 is used for the supplementary steel and the main support structure. As stated in Section 3.12(D)(e)(1), “Applicable Codes,” because ASME BPV Code, Section III, Subsection NF is recommended by SRP Section 3.12 for seismic Category I pipe support evaluation and because the use of AISC 360-05 provides reasonable assurance that the structural adequacy of the non-seismic Category I pipe supports is maintained, the NRC staff finds the applicant’s approach to the design of supplementary steel in pipe supports acceptable.

3.12(D)(e).10 Consideration of Friction Forces

In DCD Tier 2, Section 3.12.6.10, “Consideration of Friction Forces,” the applicant presents its approach for the consideration of frictional forces on pipe supports, which are generated when the pipe slides on its supports during heat-up and cooldown. The forces due to pipe friction on changes into DCD Tier 2 as confirmatory item CI-3.12-5.~~3.12(D)(e)(12) Instrumentation Line Support Criteria~~

Delete

3.12(D)(e).12 Instrumentation Line Support Criteria

In DCD Tier 2, Section 3.12.6.12, "Instrumentation Line Support Criteria," the applicant states that the design loads, load combinations, and acceptance criteria for instrumentation line supports are similar to those used for pipe supports. Design loads include deadweight, thermal, and seismic loads (where appropriate).

The NRC staff notes that the use of pipe support design criteria for instrumentation line supports provides a conservative design and uses standards developed by professional societies, which as shown in Section 3.12(D)(e) above are acceptable to the staff.

3.12(D)(e).13 Pipe Deflection Limits

In DCD Tier 2, Section 3.12.6.13, "Pipe Deflection Limit," the applicant states that manufacturers' recommendations for the limitations in their hardware are followed for those piping supports that use standard manufactured components. Such limitations include travel limits for spring hangers; stroke limits for snubbers; swing angles for rods, struts, and snubbers; alignment angles between clamps or end brackets with their associated struts and snubbers; and the variability check for variable spring supports. The NRC staff finds the applicant's approach acceptable because its approach to use manufacturers' recommendations to limit pipe deflection provides confidence that pipe deflection will not cause the failure of the supports or cause an unanalyzed condition in the piping stress analysis. In addition, the applicant shows that allowances are made in the initial designs for tolerances on the manufacturers' recommended limits. This provision is especially important for snubber and spring design, in which the function of the support may be changed by an exceeded limit. The staff finds these additional tolerances acceptable, because they provide additional confidence that the component movement will remain within intended design limits of the component supports, thus ensuring the functionality of supports.

3.12(D)(e).14 Conclusions Regarding Piping Support Design Criteria

Given the open item identified above the NRC staff is unable to make the evaluation findings associated with this subsection.

3.12(E) Combined License Information Items

The applicant in its letter, dated June 1, 2015, (ML15152A248), provided a proposed revision to the list of COL items in DCD Tier 2, Section 3.12.7 and Table 1.8-2, “Combined License Information Items.” The incorporation of these changes is being tracked as confirmatory item CI-3.12-10.

Table 3.12-1. APR1400 combined license information items for Section 3.12.

Item No.	Description	DCD Tier 2, Section
COL 3.12(1)	~~Safety related piping systems of ASME Class 1, 2, and 3 are designed within the wind/tornado protected structure.~~ If COL applicant finds it necessary to route ~~the~~ piping systems outside the structure, the wind and/or tornado load must be included in the plant design basis loads considering the site-specific loads.	3.12.5.3.6

The NRC staff evaluated the above COL Item and concluded that the applicant appropriately lists the information that will be provided by the COL applicant for the APR1400 plant, pending resolution of the confirmatory item described above.

ASME Class 1,2,or 3

3.12(F) Conclusion

Given the open and confirmatory issues identified above, the NRC staff is unable to make the evaluation findings associated with this section.

3.13 Threaded Fasteners for ASME Code Class 1, 2, and 3 Components

3.13(A) Introduction

The purpose of this section is to review and evaluate the adequacy of the applicant’s criteria with regard to selection of materials, design, inspection, and testing of its threaded fasteners (i.e., threaded bolts, studs, etc.) prior to initial service and during service. The scope id this review is limited to threaded fasters in ASME B&PV Code Class 1, 2, or 3 systems.

3.13(B) Summary of Application

DCD Tier 2, Revision 0, Section 3.13, describes the use of threaded fasteners (e.g., threaded bolts, studs) and specifies requirements pertaining to selection of materials, design, inspection, and testing prior to and during service. Detailed enumeration of ASME Code, Section III subarticles is provided in DCD Tier 2, Tables 3.13-1 and 3.13-2 identifying the appropriate subarticles concerning material selection; material test coupons and specimens for ferritic steel materials; fracture toughness requirements; examination criteria; certified material test report criteria; specific bolting inspections; and system pressure tests. DCD Tier 2, Revision 0, Section 3.13.1.2 also identifies that threaded fasteners are to be cleaned in accordance with Regulatory Guide (RG) 1.28, “Quality Assurance Program Criteria (Design and Construction).”