ArevaEPRDCPEm Resource

From: BRYAN Martin (EXT) [Martin.Bryan.ext@areva.com]
Sent: Tuesday, March 02, 2010 1:00 PM
To: Tesfaye, Getachew
Cc: DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); ROMINE Judy (AREVA NP INC); HAMMOND Philip R (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 331, FSAR Ch. 3, Supplement 1
Attachments: RAI 331 Supplement 1 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided a schedule for a technically correct and complete response to RAI No. 331 on January 7, 2010. The attached file, "RAI 331 Supplement 1 Response US EPR DC.pdf," provides technically correct and complete responses to 3 of the remaining 7 questions, as committed.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 331 Questions 03.09.02-62 and 03.09.02-67.

The following table indicates the respective pages in the response document, "RAI 331 Supplement 1 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 331 — 03.09.02-62	2	4
RAI 331 — 03.09.02-67	5	9
RAI 331 — 03.12-22	10	10

The schedule for a technically correct and complete response to the remaining questions is unchanged and provided below.

Question #	Response Date
RAI 331 — 03.09.02-63	April 8, 2010
RAI 331 — 03.09.02-64	April 8, 2010
RAI 331 — 03.09.02-65	April 8, 2010
RAI 331 — 03.09.02-66	April 8, 2010

Sincerely,

Martin (Marty) C. Bryan
Licensing Advisory Engineer
AREVA NP Inc.
Tel: (434) 832-3016
Martin.Bryan@areva.com

From: Pederson Ronda M (AREVA NP INC)
Sent: Thursday, January 07, 2010 6:28 PM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); HAMMOND Philip R (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 331, FSAR Ch. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 331 Response US EPR DC.pdf," provides the schedule for technically correct and complete responses to these questions.

The following table indicates the respective pages in the response document, "RAI 331 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 331 — 03.09.02-62	2	3
RAI 331 — 03.09.02-63	4	4
RAI 331 — 03.09.02-64	5	5
RAI 331 — 03.09.02-65	6	7
RAI 331 — 03.09.02-66	8	8
RAI 331 — 03.09.02-67	9	11
RAI 331 — 03.12-22	12	12

The schedule for technically correct and complete responses to these questions is provided below.

Question #	Response Date
RAI 331 — 03.09.02-62	March 4, 2010
RAI 331 — 03.09.02-63	April 8, 2010
RAI 331 — 03.09.02-64	April 8, 2010
RAI 331 — 03.09.02-65	April 8, 2010
RAI 331 — 03.09.02-66	April 8, 2010
RAI 331 — 03.09.02-67	March 4, 2010
RAI 331 — 03.12-22	March 4, 2010

Sincerely,

Ronda Pederson
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Monday, November 30, 2009 12:04 PM
To: ZZ-DL-A-USEPR-DL
Cc: Spicher, Terri; Hsu, Kaihwa; Dixon-Herrity, Jennifer; Patel, Jay; Miernicki, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 331 (4024, 4026),FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on November 18, 2009, and on November 24, 2009, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The schedule we have established for

review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 1207

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Subject: Response to U.S. EPR Design Certification Application RAI No. 331, FSAR Ch. 3, Supplement 1
Sent Date: 3/2/2010 1:00:29 PM
Received Date: 3/2/2010 1:00:34 PM
From: BRYAN Martin (EXT)

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Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Response to

Request for Additional Information No. 331 (4024, 4026), Supplement 1, Revision 0

11/30/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.09.02 - Dynamic Testing and Analysis of Systems Structures and Components
SRP Section: 03.12 - ASME Code Class 1, 2, and 3 Piping Systems and Piping Components and Their Associated Supports

Application Section: FSAR Chapter 3

QUESTIONS for Engineering Mechanics Branch 1 (AP1000/EPR Projects) (EMB1)

Question 03.09.02-62:

Follow-up to RAI Question 03.09.02-40:

Upon review of FSAR Tier 2, Section 3.9.2.1, the staff determined that the applicant did not provide a list of selected locations in the piping system at which visual inspections and measurements (as needed) will be performed during testing as recommended in SRP 3.9.2 subsection II.1 (Acceptance Criteria) C. In **RAI 03.09.02-12**, the staff requested the applicant to provide a list of selected locations in the piping system at which visual inspections and measurements (as needed) will be performed during testing. The applicant responded to **RAI 03.09.02-12** in their Response to Request for Additional Information No. 160, Revision 0, by stating that SRP 3.9.2, subsection II.1, Acceptance Criteria C states that an acceptable test program will include a list of selected locations in a piping system at which visual inspections and measurements will be performed during the tests. These locations will be at pipe supports, particularly supports with allowances for free thermal movements (e.g., spring and snubber supports). The criteria for determining these locations are described in U.S EPR FSAR Tier 2, Section 3.9.2.1. Additionally, this FSAR section states: "Specific information concerning the locations where visual inspection or measurements are to be taken is also addressed in the applicable test procedures." The staff could not identify the locations in test procedures cited by the applicant. Based on the applicant's response, the staff determined that a list of the selected locations as required and requested has not been provided. Therefore, the staff initiated follow-up **RAI 03.09.02-40** requesting the locations where visual inspections or measurements will be taken. The applicant responded to **RAI 03.09.02-40** in their Response to **Request for Additional Information No. 245 (2981, 3036), Revision 0** by stating that there are several tests that will require monitoring vibration, thermal expansion, and dynamic effects as part of the initial test program (ITP) (e.g., U.S. EPR FSAR Tier 2, Section 14.2, Tests 035, 164, 165, etc.). The ITP plan will include a list of locations in the specific piping systems that are selected for visual inspection and other measurements during the vibration, thermal expansion, and dynamic effects testing program, as recommended by SRP 3.9.2. This is consistent with SRP Acceptance Criteria 1 which states:

> "Relevant requirements of GDCs 1, 2, 4, 14, and 15 are met if vibration, thermal expansion, and dynamic effects testing are conducted during startup functional testing for specified high- and moderate-energy piping and their supports and restraints. The purposes of these tests are to confirm that the piping, components, restraints, and supports have been designed to withstand the dynamic loadings and operational transient conditions encountered during service as required by the code and to confirm that no unacceptable restraint of normal thermal motion occurs."

SRP Acceptance Criteria Item 1.C notes that an acceptable test program includes a list of selected locations in the piping system where visual inspections and measurements (as needed) will be performed during the tests. In addition, the ITP plan will include acceptance criteria for the deflection, pressure, and/or other appropriate criteria to be obtained during the tests to determine if the stress and fatigue limits are within design levels. To clarify that the recommendations of SRP 3.9.2 are incorporated in the ITP plan, U.S. EPR FSAR Tier 2, Section 3.9.2.1 will be revised to state that the list of locations for visual inspection and other measurements, as well as acceptance criteria, are part of the ITP plan.

The staff reviewed the applicant's response to **RAI 03.09.02-40** and the proposed revision to U.S. EPR FSAR Tier 2, Section 3.9.2.1 on page 3.9-25. The staff agrees that the proposed

revision to U.S. EPR FSAR Tier 2, Section 3.9.2.1 is acceptable. However, based on the applicant's response that a list of locations for visual inspection and other measurements, as well as acceptance criteria, are part of the ITP plan described in U.S. EPR FSAR Tier 2, Section 14.2 for the required piping systems, the staff developed the following question:

The staff reviewed U.S. EPR FSAR Tier 2, Section 14.2 description of the proposed initial test program (ITP) to determine if the list of locations for visual inspection and other measurements, as well as acceptance criteria, are part of the ITP plan for the required piping systems to be tested. The applicant stated in U.S. EPR FSAR Tier 2, Section 3.9.2.1 that testing is performed on piping systems identified in U.S. EPR FSAR Tier 2, Table 3.2.2-1 and high and moderate energy piping systems listed in U.S. EPR FSAR Tier 2, Table 3.6.1-1 and Table 3.6.1-3. The staff noted that the ITP vibration, thermal expansion, and dynamic effects testing for piping systems described in U.S. EPR FSAR Tier 2, Section 14.2 is limited to Balance of Plant Piping Thermal Expansion Measurement (Test #034), BOP Piping Vibration Measurement (Test #035), and Pre–Core Reactor Coolant System Expansion Measurements (Test #165). The staff could not determine if the proposed ITP met the requirements of GDCs 1, 2, 4, 14, and 15 to perform vibration, thermal expansion, and dynamic effects testing during startup functional testing for specified high- and moderate-energy piping and their supports and restraints. Therefore, the staff requests the applicant to explain if all piping systems identified in U.S. EPR FSAR Tier 2, Tables 3.2.2-1, Table 3.6.1-1 and Table 3.6.1-3 are included in the ITP.

Response to Question 03.09.02-62:

The first bullet in U.S. EPR FSAR Tier 2, Section 3.9.2.1 states that piping systems tested include ASME Code, Section III, Class 1, 2, and 3 piping systems as shown in U.S. EPR FSAR Tier 2, Table 3.2.2-1. All such ASME piping systems for the U.S. EPR will be Seismic Category I, and will therefore be safety-related. Safety-related piping systems are included in the initial ITP, and to clarify this U.S. EPR FSAR Tier 2, Section 14.2.1.1.2 will be modified as shown in the attached markup to indicate that ASME Class 1, 2 and 3 piping systems as described in U.S. EPR FSAR Tier 2, Section 3.9.2.1 are included in the ITP.

The second bullet in U.S. EPR FSAR Tier 2, Section 3.9.2.1 states that the piping systems tested include high-energy piping systems inside Seismic Category I structures, or those whose failure would reduce the safety level of Seismic Category I structures, systems and components (SSCs), as shown in U.S. EPR FSAR Tier 2, Tables 3.6.1-1 and 3.6.1-3. Most high-energy piping inside Seismic Category I structures will be safety-related, and therefore, included in the testing described in the first paragraph of this response. However, U.S. EPR FSAR Tier 2, Section 14.2.1.1.2 will be modified as shown in the attached markup to clarify that any non-safety-related portions of high-energy piping systems in Seismic Category I structures are also included in the scope of the ITP. Note that the high-energy piping given in U.S. EPR FSAR Tier 2, Table 3.6.1-3 is a subset of the piping listed in U.S. EPR FSAR Tier 2, Table 3.6.1-1.

The third bullet in U.S. EPR FSAR Tier 2, Section 3.9.2.1 states that the piping systems tested include Seismic Category I portions of moderate-energy piping systems located outside of containment, as shown in U.S. EPR FSAR Tier 2, Tables 3.2.2-1 and 3.6.1-1. As discussed in the first paragraph of this response, all Seismic Category I piping is ASME piping for the U.S. EPR. Therefore, this Seismic Category I moderate-energy piping is included in the ITP.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 14.2.1.1.2 will be revised as described in the response and indicated on the enclosed markup.

Question 03.09.02-67:

Follow-up to Question 03.09.02-61:

The staff reviewed the applicant's response to each issue identified in RAI 287, Question 03.09.02-61 and provided the following comments:

1. U.S. EPR FSAR Tier 2 Revision 1, Section 3A.2.2.1 Page 3A-2

The applicant stated that U.S. EPR FSAR Tier 2, Section 3A.2.2.1 will be revised to align the HVAC ductwork loads with Paragraph AA-4211 "Loads", and to clarify the following:

The seismic loads considered are only for safe shutdown earthquake (SSE) events, as operating basis earthquake (OBE) events are not a part of the U.S. EPR design basis.

SSE loads are included in Levels C and D, and Level B combinations will not include seismic loads.

The applicant provided clarification to U.S. EPR FSAR Tier 2, Section 3A.2.2.1 to address the use of OBE loads in the seismic load component. The staff also noted that the applicant revised U.S. EPR FSAR Tier 2, Section 3A.2.2.1 to address system operational pressure transient (SOPT) loads and normal loads (N) as defined by paragraph AA-4211 of ASME AG-1, 2003.

The staff reviewed the proposed U.S. EPR FSAR Tier 2, Section 3A.2.2.1 markup with respect to the commitment to align to paragraph AA-4211 and noted the following discrepancies that should be resolved by the applicant:

a. The description of Seismic Loads (SL) does not agree with paragraph AA-4211.
b. The clarification provided by the applicant for "SL" loads includes a reference to paragraph SA-4211(f). This appears to be an incorrect reference if the applicant is intending to comply with AA-4211.
c. The existing description of "FML" loads includes a reference to paragraph SA-4211. This appears to be an incorrect reference if the applicant is intending to comply with AA-4211.
d. The existing description of "ADL" loads does not include liquid slosh in tanks and vessels and mechanical shock loads as required by paragraph AA-4211.
e. The existing description of "L" loads is based on SA-4211, which includes the load requirement for a 250 lb construction or maintenance midspan man load over a 10 square inch area. The requirement for a 250 lb construction or maintenance midspan man load over a 10 square inch area is not required by paragraph AA-4211.
f. The applicant stated that "For ease of design, a duct system may be designed using one pressure value that envelops NOPD and SOPT." The applicant also stated that Normal loads (N) = NOPT + SOPT + DW + EL + FML The applicant is requested to clarify how Normal Loads will be determined if a duct system may be designed using one pressure value that envelops NOPD and SOPT.

2. U.S. EPR FSAR Tier 2 Revision 1, Section 3A.2.3.1 Page 3A-3

The applicant revised the load combinations defined in U.S. EPR FSAR Tier 2, Section 3A.2.3.1 to align with combinations required by AA-4321of ASME AG-1, 2003.

The staff noted that Article AA-4000 does not include separate HVAC support loading criteria comparable to those identified in SA-4216. Table AA-4212 defines the required load combinations for both components and their supporting elements. In addition, note (a) of Table AA-4212 addresses the need to evaluate fluid momentum loads (FML) associated with each service level. The applicant is requested to explain why FML is not included in the Normal Load (N) combination for support design.

3. U.S. EPR FSAR Tier 2 Revision 1, Section 3A.2.4.1 Page 3A-3

The applicant stated that as a result of the ASME response for ductwork stress allowables, U.S. EPR FSAR Tier 2, Section 3A.2.4.1 will be revised to show the combined membrane and bending stress allowable for Level C as 1.8 x 0.6Fy to be consistent with Table AA-4321 of ASME AG-1, 2003.

The applicant provided a markup to U.S. EPR FSAR Tier 2, Section 3A.2.4.1. The staff reviewed the proposed revision to U.S. EPR FSAR Tier 2, Section 3A.2.4.1 and identified the following issues:

A. The applicant has identified various references for ductwork stresses. For example, the applicant stated in U.S. EPR FSAR Tier 2, Section 3A.2 that safety related, seismic category I and II HVAC ductwork, supports and restraints meet the stress allowables provided in ASME AG-1-2003, Code on Nuclear Air and Gas Treatment, with 2004 Addenda (reference 2). The applicant also stated in U.S. EPR FSAR Tier 2, Section 3A.2.4.1 that ductwork stresses are based on Reference 4, (American Iron and Steel Institute (AISI), North American Specification for the Design of Cold-Formed Steel Structural Members, 2001 Edition with 2003 Errata), which is referenced in paragraph SA-4220 of ASME AG-1. However, the applicant stated in response to RAI 287 03.09.02-61 that ductwork stresses are based on paragraph AA-4300 of ASME AG-1. The applicant is requested to clarify what is the basis for ductwork stresses.

B. The applicant stated the ductwork allowable stress is consistent with Table AA-4321 of ASME AG-1, 2003. ASME AG-1 Table AA-4321 primary stress allowables are based on design stress (S). Design stress (S) for ASME materials is tabulated in various tables, such as Tables 1A and 1B of ASME Section II, Part D. The design stress (S) for the materials in each table is derived as described in mandatory appendices. For example, design stress (S) in Tables 1A and 1B is derived as described in Mandatory Appendix-1, “Basis for Establishing Stress values in Tables 1A and 1B” of ASME Section II, Part D. The design stress (S) includes affects of various factors such as factor of safety against yield, factor of safety against rupture, yield at at room temperature, yield at design temperature and others factors. The staff noted that allowable stress in American Iron and Steel Institute (AISI) is based on the term (F_y). The applicant is requested to reconcile the use of the term ($0.6F_y$) in place of the design stress (S) term in Table AA-4321 to derive the stress allowables for service levels A through D.

4. U.S. EPR FSAR Tier 2 Revision 1, Table 3A-1, and Table 3A-2 Page 3A-11

The applicant stated that as a result of the ASME response, load combinations for ductwork and ductwork supports shown in U.S. EPR FSAR Tier 2, Tables 3A-1 and 3A-2 will be revised to align with combinations defined in AA-4300 of ASME AG-1, 2003, as shown below. The applicant noted that AA-4300 references AA-4212 for load combinations for ductwork and supports, which in turn references Table AA-4212 of ASME AG-1, 2003.

The staff reviewed the applicant's proposed revisions to U.S. EPR FSAR Tier 2, Tables 3A-1 and 3A-2 as shown below with respect to AA-4300 of ASME AG-1, 2003. The revisions to the Load Combinations are in agreement with Table AA-4212 and are acceptable.

The staff noted that stress criteria referenced in Tables 3A-1 and 3A-2 are applicable to the service limits for levels A through D service defined in paragraph AA-4214.2 of ASME AG-1. The applicant has included "Category" to U.S. EPR FSAR Tier 2, Tables 3A-1 and 3A-2 and correlated each service level to a "Category" as follows:

- Service Level A is aligned with "Normal Condition"
- Service Level B is aligned with "Upset Condition"
- Service Level C is aligned with "Emergency Condition"
- Service Level D is aligned with "Faulted Condition"

The staff noted that normal, upset, emergency and faulted terminology is not used in ASME AG-1 but is common in ASME Section III. Normal and Upset conditions can be compared against Level A and B service limits. However, Level C and D service limits that allow large deformations and permit damage requiring repair do not correlate with ASME III Emergency and Faulted conditions.

The applicant is requested to:

A. Explain what is meant by "Category Column" and how it is used

B. Clarify that the Service Levels A, B, C and D indicated in the tables meet the definitions of the Service Limits provided in AA-4214.2 and

Clarify how the Service Levels A, B, C and D meet the corresponding definitions of Normal, Upset, Emergency and Faulted Conditions given in U.S. EPR FSAR Tier 2 Section 3.9.1.1.

Response to Question 03.09.02-67:

Item 1:

The following is in response to the question asked in relating to U.S. EPR FSAR Tier 2, Section 3A.2.2.1:

a) Although the ASME did not state in its letter (attached to the response to RAI 287, Question 03.09.02-61) that load definitions from Section SA were not to be used, the Seismic Loads description will be changed as shown on the attached U.S. EPR FSAR Tier 2, Section 3A.2.2.1 markup to more directly align with paragraph AA-4211.

b) As shown on the attached U.S. EPR FSAR Tier 2, Section 3A.2.2.1 markup discussed in (a), the reference to Section SA will be removed.

c) The ASME response letter to the question posed by AREVA NP about load combinations (attached to the Response to RAI 287, Question 03.09.02-61) did not state that load definitions given in Section SA were not to be used. ASME stated that load combinations should follow the guidance of Section AA. Section AA provides general criteria for ASME AG-1, while Section SA provides criteria more specifically related to heating, ventilation, air conditioning (HVAC) duct design. Therefore, it is appropriate to include the additional information given in Section SA for Fluid Momentum Loads, as part of that load definition.

d) The additional description information for Additional Dynamic Loads will be added as shown on the attached U.S. EPR FSAR Tier 2, Section 3A.2.2.1 markup.

e) As discussed in Item (c), the load definition given in Section SA will be used for this more specific case in HVAC duct design.

f) As discussed in Item (c), since the use of an envelop of normal operating pressure differential (NOPD) and SOPT is allowed in HVAC duct design per Section SA, a second option for Normal Loads will be added for this case to U.S. EPR FSAR Tier 2, Sections 3A.2.2.1 and 3A.2.3.1, as shown on the attached markup.

Item 2:

In response to the question relating to U.S. EPR FSAR Tier 2, Section 3A.2.3.1, the FML loads were left out of the support load combinations based on the assumption that such loads were unlikely to apply actual significant forces to the supports (as also indicated by the present load combinations in Section SA for supports). However, since paragraph AA-4321 is for both ductwork and supports, and refers the reader to paragraph AA-4212 for load combinations, which include FML loads, the U.S. EPR FSAR Tier 2, Section 3A.2.3.1 will be changed as shown on the attached markup to include FML loads in Normal Loads for the supports.

Item 3:

The following is in response to the question relating to U.S. EPR FSAR Tier 2, Section 3A.2.4.1:

A. HVAC ductwork stresses are calculated utilizing the AISI Specification for the Design of Cold-Formed Steel Structural Members (U.S. EPR FSAR Tier 2, Section 3A, Reference 4), which is appropriate for such cold formed sections. This is appropriately stated in the first sentence of U.S. EPR FSAR Tier 2, Section 3A.2.4.1.

   Allowable stress criteria for use with these calculated stresses is presently designated in the second paragraph of U.S. EPR FSAR Tier 2, Section 3A.2 as that defined in paragraph SA-4220 of ASME AG-1 (U.S. EPR FSAR Tier 2, Section 3A, Reference 2). This was changed by the subsequent ASME direction described in the Response to RAI 287, Question 03.09.02-61, to paragraph AA-4300 of ASME AG-1. Therefore U.S. EPR FSAR Tier 2, Section 3A.2 will be changed as shown in the attached markup. Note that the Response to RAI 287, Question 03.09.02-61 did not say ductwork stresses are based on AA-4300, but rather that ductwork stress allowables are based on AA-4300.

B. As noted in Item (A), the allowable stresses will be based on Section AA of ASME AG-1. Since Table AA-4321 is based on design stress S, and ultimate stress S_U, U.S. EPR FSAR Tier 2, Section 3A.2.4.1 will be revised as shown on the attached markup to

change the allowable terms of 0.6 F_Y to S in all cases. Note that the term 0.6 F_Y was used in the Section SA allowables previously listed.

Item 4:

In response to the question relating to U.S. EPR FSAR Tier 2, Tables 3A-1 and 3A-2, the "Category" column of Table 3A-1 and Table 3A-2 will be removed as shown on the attached markup. The Service Levels identified in U.S. EPR FSAR Tier 2, Tables 3A-1 and 3A-2 meet the definitions of Service Limits provided in AA-4214.2.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 3A.2, 3A.2.2.1, 3A.2.3.1, 3A.2.4.1 and Tables 3A.1 and Table 3A.2 will be revised as described in the response and indicated on the enclosed markup.

Question 03.12-22:

In FSAR Section 3.12.6.11, AREVA referenced Section 6.11 of ANP-10264NP-A to address pipe support gaps and clearances used in the design of pipe supports. AREVA states that the normal design practice for the U.S. EPR will be to use a normal cold condition gap of one-sixteenth inch on each side of the pipe in the restrained direction.

SRP 3.12 states that this gap must account for the diameter expansion of the pipe due to temperature and pressure. The acceptance criteria for the minimum gap (total of opposing sides) between the pipe and the support will be reviewed on a case by case basis.

1. The staff noted that 1/16” cold condition gap on each side of pipe in the restrained direction may not provide sufficient radial expansion of the pipe in the restrained direction for Class 1&2 large bore piping. The staff requests AREVA to demonstrate that 1/16" gap has accounted for radial expansion.
2. The staff also noted that 1/16' cold gap indicates the pipe is not supported vertically during cold condition. The staff requests AREVA to demonstrate that the pipe support design with 1/16” cold gap is adequate during cold condition.

Response to Question 03.12-22:

The information in ANP-10264NP-A, Section 6.11, which specifically addresses pipe support gaps for the U.S. EPR, was evaluated and approved by the NRC in Section 3.5.11 of the Final Safety Evaluation Report for ANP-10264NP-A. This FSER section restates the important aspects of the requirements given in Section 6.11 and, in conclusion states “This is acceptable to the staff.”

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

U.S. EPR Final Safety Analysis Report Markups

3A Criteria for Distribution System Analysis and Support

This appendix provides the design criteria for the U.S. EPR distribution system analysis and supports. As noted in Section 3.7.3, this appendix describes criteria for design of supports for:

- Piping.
- Heating, ventilation, and air conditioning (HVAC) ducts.
- Cable trays.

3A.1 Piping and Supports

Information on piping, instrumentation, and supports is provided in AREVA NP Topical Report ANP-10264NP-A, "U.S. EPR Piping Analysis and Pipe Support Design" (Reference 1).

3A.2 Heating, Ventilation, and Air Conditioning Ducts and Supports

HVAC ductwork and its associated support structures are designed to withstand the loadings and load combinations presented in Section 3A.2.2 and Section 3A.2.3, based on the Codes and Standards provided in Section 3A.2.1. A typical HVAC duct system includes structural components (e.g., sheet metal ducts, duct stiffeners, duct supports) and inline components (e.g., heaters and dampers).

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Safety-related, Seismic Category I HVAC ductwork, supports, and restraints meet the stress allowables provided in paragraph ~~SA-4220~~AA-4321 of ASME AG-1 (Reference 2). Seismic Category II HVAC ductwork, supports, and restraints are analyzed to make sure that a failure would not ~~adversely impact~~impair the safety function of safety-related equipment or components. ~~Seismic Category II requirements are satisfied by conservatively analyzing the Seismic Category II HVAC ductwork, supports, and restraints to the same criteria as Seismic Category I~~Seismic Category II requirements are satisfied by meeting the criteria as established in Section 3.7.2.3.3..

Non-Seismic HVAC ductwork meets Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards (Reference 5). Non-Seismic HVAC ductwork support and restraint systems meet the analysis requirements of the American Institute of Steel Construction (AISC) Manual (Reference 3).

3A.2.1 Codes and Standards

HVAC ductwork, ductwork supports, and ductwork restraints conform to the following codes and standards:

- ASME AG-1-2003, Code on Nuclear Air and Gas Treatment, with 2004 Addenda (Reference 2).
- AISC Manual of Steel Construction, Ninth Edition (Reference 3).
- American Iron and Steel Institute (AISI), North American Specification for the Design of Cold-Formed Steel Structural Members, 2001 Edition with 2003 Errata (Reference 4).
- SMACNA, HVAC Duct Construction Standards, Metal and Flexible, Third Edition, 2005 (Reference 5).
- American Welding Society (AWS) D1.1/D1.1M: 2004, Structural Welding Code-Steel, with errata through June 2005 (Reference 6).
- AWS D1.3-98, Structural Welding Code – Sheet Steel (Reference 7).
- ANSI/AISC-N690-1994, AISC "Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities," with Supplement 2 (10/06/2004) (Reference 8).

3A.2.2 HVAC Ductwork

3A.2.2.1 HVAC Ductwork Loads

The structural loads for the HVAC ductwork are listed below:

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- Additional Dynamic Loads (ADL)—loads resulting from system excitations due to structural motion caused by safety relief valve actuation and other hydrodynamic loads due to the design basis accident (DBA), small pipe break accident (SBA), and intermediate pipe break accident (IBA); also, liquid slosh in tanks and vessels and mechanical shock loads.
- Constraint of Free End Displacement Loads (T)—loads caused by constraint of free end displacement that results from thermal or other movements.
- Dead Weight (DW)—weight of the equipment or ductwork including supports, stiffeners, insulation, any contained fluids, and internally and externally mounted components.
- Design Pressure Differential (DPD)—dynamic pressure loads resulting from a DBA, IBA, or SBA. Generally, HVAC is routed outside the local pipe break affected area. If HVAC is subjected to these loads, the design specification shall address the specific design requirements considering a Level D load combination.
- Design Wind Loads (W)—loads due to design hurricane, design tornado, or other abnormal meteorological conditions. See Section 3.3 for a discussion of design wind loads.
- External Loads (EL)—applied loads caused by attached piping, accessories, or other equipment.

- Fluid Momentum Loads (FML)—momentum and pressure forces because of fluid flow, as clarified in SA-4211 of ASME AG-1.

- Live Loads (L)—loads occurring during construction and maintenance and may also include loads due to snow, ice and ponded water. Live loads will not be less than a 250 lb construction or maintenance midspan man load over a 10 square inch area.

- Normal Operating Pressure Differential (NOPD)—maximum positive or negative differential pressure that may occur during normal plant operation including start-up and test conditions; this includes pressures resulting from normal airflow, and valve or damper closure.

  For ease of design, a duct system may be designed using one pressure value that envelops NOPD and SOPT. NOPD and SOPT may be positive or negative pressures. The worst case shall be considered in the design.

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- Seismic Loads (SL)—Loads that are the result of the safe shutdown earthquake (SSE). Both orthogonal components of the horizontal seismic excitation are applied simultaneously with the vertical seismic loading. These seismic forces are applied in the directions that produce worst case stresses and deflections.

- System Operational Pressure Transient Loads (SOPT) – overpressure transient loads due to events such as rapid damper, plenum or housing door, and valve closure, or other normal loads that result in a short duration pressure differential.

  For ease of design, a duct system may be designed using one pressure value that envelops NOPD and SOPT. NOPD and SOPT may be positive or negative pressures. The worst case shall be considered in the design.

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- Normal Loads (N) – loads consisting of normal operating pressure differential, system operating pressure transients, dead weight, external loads, and fluid momentum loads.

  N = NOPD + SOPT + DW + EL + FML

  As noted above for SOPT, if an enveloped pressure valve for NOPD and SOPT is utilized in the design, utilize the following load combination for Normal Loads:

  N = Envelop of (NOPD, SOPT) + DW + EL + FML

3A.2.2.2 HVAC Ductwork Load Combinations

Table 3A-1 lists the HVAC ductwork loading combinations for the design of HVAC ductwork.

3A.2.3 HVAC Duct Supports and Restraints

3A.2.3.1 HVAC Support and Restraint Loads

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Loads ADL, DPD, DW, EL, ~~FML,~~ FML, L, NOPD, SOPT, SL, T, and W (see Section 3A.2.2.1) apply to HVAC ductwork supports and restraints.

For HVAC ductwork supports and restraints, Normal Loads (N) = NOPD + SOPT + DW + EL + FM, or if an enveloped pressure value for NOPD and SOPT is utilized in the design, N = Envelop of (NOPD, SOPT) + DW + EL + FML.

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3A.2.3.2 HVAC Support and Restraint Load Combinations

Table 3A-2 lists the HVAC support and restraint loading combinations for the design of HVAC supports and restraints.

3A.2.4 Design and Analysis

3A.2.4.1 Allowable Stress Criteria

Ductwork stresses are based on Reference 4. Ductwork support stresses are based on AISC "Specification for the Structural Steel Buildings - Allowable Stress Design and Plastic Design," contained in Reference 3.

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The basic general membrane design stress for Service Level A condition does not exceed 0.6 S~~F_y~~ and is reduced as appropriate to account for lateral-torsional buckling of bending members and effective lengths of compression members. The combined membrane and bending stress for Service Level A does not exceed 1.5 x 0.6 S~~F_y~~. The basic general membrane design stress allowable, and the combined membrane and bending stress allowable for Level B are the same as those for Level A. The basic general membrane stress for Service Level C condition does not exceed 1.2 x 0.6 S~~F_y~~ and is reduced as necessary to account for lateral-torsional buckling of bending members and effective lengths of compression members. The combined membrane and bending stress for Service Level C does not exceed ~~0.9~~1.8 x 0.6 S~~F_y~~. The basic general membrane design stress for Service Level D condition does not exceed the lesser of 1.5 x 0.6S or 0.4S_u, where S_u is the ultimate stress. The combined membrane and bending stress for Service Level D does not exceed the lesser of 2.25 x 0.6S or 0.6S_u.

3A.2.4.2 Deflection Limits

The allowable deflections for the load combinations described above are provided in Table 3A-3. Deflection criteria conform to Section SA-4230 of Reference 2.

Table 3A-1—HVAC Ductwork Load Combinations[5]

Service Level	~~Category~~	Load Combination (see Section 3A.2.2.1)	Stress Criteria
A	~~Normal Condition~~	~~DW+NOPD+FML+EL+L+T+W~~N + T N + L	See 3A.2.4.1
B	~~Not Required~~	N + W + T N + T + ADL	See 3A.2.4.1
C	~~Emergency Condition~~	~~DW+NOPD+FML+EL+SL+ADL+W~~N + W + T N + SL + ADL	See 3A.2.4.1
D	~~Not required unless DPD is applicable~~	N + DPD + SL + ADL	See 3A.2.4.1

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Table 3A-2—HVAC Support and Restraint Load Combinations[5]

Service Level	~~Category~~	Load Combination (see Section 3A.2.2.1 and 3A.2.3.1)	Stress Criteria
A	~~Normal Condition~~	~~DW+NOPD+EL+L+T~~N + T N + L	See 3A.2.4.1
B	~~Not Required~~	N + W + T N + T + ADL	See 3A.2.4.1
C	~~Emergency Condition~~	~~DW+NOPD+EL+SL+ADL~~N + W + T N + SL + ADL	See 3A.2.4.1
D	~~Not required unless DPD is applicable~~	N + DPD + SL + ADL	See 3A.2.4.1

Table 3A-3—Deflection Limits[1,2]

Service Level	Deflection Limit
A[3]	$d_{all} \leq 0.6\ d_{max}$
B[3]	$d_{all} \leq 0.6\ d_{max}$
C[4]	$d_{all} \leq 0.9\ d_{max}$
D[4]	$d_{all} \leq 0.9\ d_{max}$

Notes:

1. If particular equipment design criteria require more restrictive limits on deflections, those requirements will be stated in the applicable equipment section of Reference 2.

2. Deflections are limited to prevent transmission of excessive load to other components such as filter frames, coils, bearings, and access doors.

3. Deflections are limited to values that prevent buckling in primary load carrying elements.

Specific construction test requirements shall be established in accordance with the site administrative procedures.

14.2.1.1.2 Phase I - Preoperational Testing

Upon the completion of construction and installation testing, preoperational tests are performed to demonstrate that SSC operate in accordance with design bases. Simulated signals or inputs are often used to demonstrate the full range of the system operation when it would be undesirable to create real system conditions. The general objectives of the preoperational test phase are:

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- To demonstrate that appropriate acceptance criteria are met for SSC for safety-related SSC, including alarms and indications.
- To test all ASME Section III, Class 1, 2 and 3 piping systems as described in Section 3.9.2.1.
- To test high-energy piping systems inside Seismic Category I structures, or those whose failure would reduce the safety level of a Seismic Category I SSC, as described in Section 3.9.2.1.
- To provide documentation of the performance and safety of equipment and systems in all operating modes, including degraded modes (e.g., stuck open miniflow valves, open cross connects) for which the systems are designed to remain operational.
- To demonstrate equipment performance throughout the full design operating range.
- To test, as appropriate, manual operation, operation of systems and their components, automatic operation, operation in alternate or secondary modes of control, and operation and verification tests to demonstrate expected operation following a loss of power sources.
- To test the proper functioning of instrumentation and controls, permissive and prohibit interlocks, and equipment protective devices, for which malfunction or premature actuation may shut down or defeat the operation of systems or equipment.
- To provide baseline test and operating data of equipment and subsystems for future reference.
- To operate equipment for a sufficient period to demonstrate performance so that design, manufacturing, or installation defects can be detected and corrected.
- To provide the permanent plant operating staff with the maximum opportunity to obtain practical experience in the operation and maintenance of equipment and systems and their associated procedures. Maintenance activities should include,