ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Friday, September 03, 2010 3:02 PM
To: Tesfaye, Getachew; Miernicki, Michael
Cc: DELANO Karen (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); HALLINGER Pat (EXTERNAL AREVA); COLEMAN Sue (AREVA); BALLARD Bob (AREVA); CORNELL Veronica (EXTERNAL AREVA); BREDEL Daniel (AREVA); RYAN Tom (AREVA); SLAY Lysa (AREVA); CONNELL Kevin (AREVA); GARDNER Darrell (AREVA); SLOAN Sandra (AREVA)
Subject: DRAFT Response to U.S. EPR Design Certification Application RAI No. 422, FSARCh. 3
Attachments: RAI 422 Response Question 3.9.2-86 & 143 US EPR DC - DRAFT.pdf

Getachew,

Attached is the Draft response to RAI 422 Questions 3.9.2-86 and 143. Let me know if the staff has questions or if these draft responses can be submitted as final.

Thanks,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

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From: BRYAN Martin (EXTERNAL AREVA)

Created By: Martin.Bryan.ext@areva.com

Recipients:
"DELANO Karen (AREVA)" <Karen.Delano@areva.com>
Tracking Status: None
"ROMINE Judy (AREVA)" <Judy.Romine@areva.com>
Tracking Status: None
"BENNETT Kathy (AREVA)" <Kathy.Bennett@areva.com>
Tracking Status: None
"HALLINGER Pat (EXTERNAL AREVA)" <Pat.Hallinger.ext@areva.com>
Tracking Status: None
"COLEMAN Sue (AREVA)" <Sue.Coleman@areva.com>
Tracking Status: None
"BALLARD Bob (AREVA)" <Robert.Ballard@areva.com>
Tracking Status: None
"CORNELL Veronica (EXTERNAL AREVA)" <Veronica.Cornell.ext@areva.com>
Tracking Status: None
"BREDEL Daniel (AREVA)" <Daniel.Bredel@areva.com>
Tracking Status: None
"RYAN Tom (AREVA)" <Tom.Ryan@areva.com>
Tracking Status: None
"SLAY Lysa (AREVA)" <Lysa.Slay@areva.com>
Tracking Status: None
"CONNELL Kevin (AREVA)" <Kevin.Connell@areva.com>
Tracking Status: None
"GARDNER Darrell (AREVA)" <Darrell.Gardner@areva.com>
Tracking Status: None
"SLOAN Sandra (AREVA)" <Sandra.Sloan@areva.com>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None
"Miernicki, Michael" <Michael.Miernicki@nrc.gov>
Tracking Status: None

Post Office: AUSLYNCMX02.adom.ad.corp

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Response to

Request for Additional Information No. 422(4792), Revision 0
Questions 03.09.02-86 and 03.09.02-143

8/3/2010

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
Application Section: 3.9.2

QUESTIONS for Engineering Mechanics Branch 2 (ESBWR/ABWR Projects) (EMB2)

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Question 03.09.02-86:

Follow-up to RAI 160, Question 03.09.02-18

The staff reviewed the assumptions used in the analysis of non-seismic piping systems. In RAI 03.09.02-18, the applicant is requested to justify why the assumption that all flanges on bolted connections on the non-seismic piping system are assumed to fail, thus allowing each section of piping to fall independently is conservative with respect to the impact evaluation of target components. The applicant responded to RAI 03.09.02-18 by stating that the information in ANP-10264(NP)-A, Section 4.4.2 was evaluated and approved by the NRC in Section 3.2.8 of the Final Safety Evaluation Report for ANP-10264NP-A, which states "All other non-seismic/seismic interaction criteria discussed in TR Sections 4.4.1 and 4.4.2 are found reasonable and acceptable to the staff."

The staff reviewed the applicant's response and noted that in the SER of ANP-10264(NP)-A, the staff had raised questions on non-seismic piping isolation criteria in RAI EPR-14 (dated November 2007). The applicant agreed to remove (emphasis added to highlight the issue) some of the interaction criteria given in TR Section 4.4.2 and two other criteria on the failure of the non-seismic piping based on the pipe break analysis procedures. The staff could not determine when the applicant added the assumption that all flanges on bolted connections on the non-seismic piping system are assumed to fail, thus allowing each section of piping to fall independently was added to TR Section 4.4.2, and if this assumption was reviewed and accepted by the staff. Therefore, this issue remains open.

Response to Question 03.09.02-86:

Topical Report ANP-10264NP was submitted to the NRC on September 29, 2006 (AREVA NP Letter Number ML 062770021), which included the statement in Section 4.4.2 that "all flanges on bolted connections on the non-seismic piping system are assumed to fail, thus allowing each section of piping to fall independently." Topical Report ANP-10264NP was reviewed and accepted by the NRC staff in its Safety Evaluation Report (SER) dated August 11, 2008. As instructed by the NRC in the August 11, 2008 letter, AREVA NP revised Topical Report ANP-10264NP and designated it as Topical Report ANP-10264NP-A. Topical Report ANP-10264NP-A includes the NRC letter, the SER, the history of the RAI process, and a revised Topical Report that incorporates RAI responses. In addition, the items from Topical Report ANP-10264NP-A, Section 4.4.2 stated in the final Response to RAI 14 were removed.

FSAR Impact:

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

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Question 03.09.02-143:

Follow-up to RAI 287, Question 03.09.02-61

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 proposed markup to U.S. EPR FSAR Tier 2, Section 3A.2.4.1 is shown below.

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.

The basic general membrane design stress for Service Level A condition does not exceed 0.6 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 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 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 F_y. The basic general membrane design stress for Service Level D condition does not exceed the lesser of 1.5 x 0.6F_y 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 0.6F_y or 0.6S_u.

03.09.02-61

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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, which uses the allowable stress from Article AA-3000. The applicant is requested to clarify 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.

Response to Question 03.09.02-143:

a) Ductwork stress evaluations/qualifications are based on the following:

- Applied loadings.
- Load combinations to be checked utilizing the applied loadings.
- Stress formulas and appropriate section properties.
- Allowable stresses.

The applied loadings for ductwork are given in U.S. EPR FSAR Tier 2, Section 3A.2.2.1. The applied loadings for ductwork in U.S. EPR FSAR Tier 2, Section 3A.2.2.1 are based on ASME AG-1-2003, Section AA-4300, with some clarification of the loadings (specifically for ductwork) derived from ASME AG-1-2003, Section SA-4200.

The load combinations used for the four ASME Service Levels for ductwork are shown in U.S. EPR FSAR Tier 2, Table 3A-1 and referenced in U.S. EPR FSAR Tier 2, Section 3A.2.2.2. Using recent ASME guidance described in the Response to RAI 287, Attachment A, these combinations are based on the requirements of ASME AG-1-2003, Section AA-4300.

ASME AG-1-2003, Section AA-4300 applies to the nuclear gas and air treatment distribution types described in the subsequent parts of AG-1, but does not provide specific guidance for calculating actual ductwork stresses. ASME AG-1-2003, Part SA is specific to ductwork. ASME AG-1-2003, Section SA-4220 states that "The ductwork stress shall be based upon the AISI Specification for the Design of Cold-Formed Steel Structural Members." This AISI specification provides the appropriate stress equations and section properties of ductwork used in calculating ductwork stresses from the applied load combinations. U.S. EPR FSAR Tier 2, Section 3A.2.4.1 states that "Ductwork stresses are based on Reference 4," the AISI specification.

The allowable stresses used for the four ASME Service Levels for ductwork are provided in U.S. EPR FSAR Tier 2, Section 3A.2.4.1. Using recent ASME guidance described in the Response to RAI 287, Attachment A, these allowables are based on the requirements of ASME AG-1-2003, Section AA-4300. U.S. EPR FSAR Tier 2, Section 3A.2 states that "Safety-related Seismic Category I HVAC ductwork, supports, and restraints meet the stress allowables provided in paragraph AA-4321 of ASME AG-1 (Reference 2)."

b) ASME AG-1-2003, Section SA-4220 defines the allowable stresses for ductwork and was the basis for using the term F_y in the Response to RAI 287 and in revisions to U.S. EPR FSAR Tier 2, Appendix 3A. Allowable stresses for ductwork are currently based on the

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requirements of ASME AG-1-2003, Section AA-4300. U.S. EPR FSAR Tier 2, Section 3A.2.4.1 provides the stress allowables in terms of design stress (S) and ultimate stress (S_u). U.S. EPR FSAR Tier 2, Appendix 3A does not use the term F_y for ductwork and its supports as shown in Attachment A.

FSAR Impact:

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

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Attachment A

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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.

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.

The basic general membrane design stress for Service Level A condition does not exceed 0.6 S 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. 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 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 1.8 x 0.6 S. 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.

3A.2.4.3 Damping

The damping values for the design of HVAC duct systems are discussed in Section 3.7.1.2 and are contained in Table 3.7.1-1.

3A.2.4.4 Seismic Analysis

This section describes the seismic analysis criteria for HVAC duct systems and their supports.

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