AREVAEPRDCPEm Resource

From: Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
Sent: Monday, March 09, 2009 4:08 PM
To: Getachew Tesfaye
Cc: DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 187 (1910), FSARCh. 3
Attachments: RAI 187 Response US EPR DC.pdf

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 187 Response US EPR DC.pdf" provides technically correct and complete responses to 2 of the 2 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 187 Questions 03.07.03-20, and 03.07.03-21.

The following table indicates the respective pages in the response document, "RAI 187 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 187 — 03.07.03-20	2	2
RAI 187 — 03.07.03-21	3	3

This concludes the formal AREVA NP response to RAI 187, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Ronda Pederson
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From: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, February 11, 2009 9:51 AM
To: ZZ-DL-A-USEPR-DL
Cc: Manas Chakravorty; Sujit Samaddar; Michael Miernicki; Joseph Colaccino; Meena Khanna; AREVAEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 187 (1910), FSARCh. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on February 5, 2009, and on February 10, 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: 302

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From: Pederson Ronda M (AREVA NP INC)

Created By: Ronda.Pederson@areva.com

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MESSAGE	2357	3/9/2009 4:08:19 PM
RAI 187 Response US EPR DC.pdf	113354	

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Response to

Request for Additional Information No. 187 (1910), Revision 0

02/11/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.07.03 - Seismic Subsystem Analysis
Application Section: 03.07.03

QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)

Question 03.07.03-20:

This is a follow-up question to Question RAI ID 1463 Question Number 5299 (RAI 03.07.03-2).

Provide the technical basis for the criterion in FSAR Section 3.7.3.1.2 which states that the cutoff frequency is determined so that the number of modes calculated will produce dynamic analysis results within 10 percent of the results of the dynamic analysis including the next higher mode. Is the next higher mode also included in the dynamic analysis results? State why this criterion is acceptable for the design of safety related seismic Category I SSCs and provide examples of its implementation including its effect on the results for accelerations, ISRS, member forces, and moments by comparing these to the results obtained using a smaller cutoff frequency criterion.

Response to Question 03.07.03-20:

The statement regarding the 10 percent criterion will be deleted from the U.S. EPR FSAR Tier 2, Section 3.7.3.1.2, because the missing mass method will be used.

Missing mass is accounted for in time history modal superposition analyses in accordance with Appendix A of Regulatory Guide 1.92, Revision 2. This is consistent with Section 3.2.4 of AREVA NP Topical Report ANP-10264NP-A, “U.S. EPR Piping Analysis and Pipe Support Design,” Revision 0 (second to last paragraph of Page 13), which is approved by the NRC.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.7.3.1.2 will be revised as described in the response and indicated on the enclosed markup.

Question 03.07.03-21:

This is a follow-up question to RAI ID 1463, Question 5305 (RAI 03.07.03-8).

The applicant is requested in U.S. EPR FSAR Section 3.7.3.3 to include the fact that 243 kg/m^2 (50 psf) is added to the dynamic model to account for miscellaneous dead loads.

Response to Question 03.07.03-21:

U.S. EPR FSAR Tier 2, Section 3.7.3.3, will be revised to state that miscellaneous dead loads of at least 50 psf is accounted for in the dynamic model.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.7.3.3 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

decoupling of the differential equations of motion, considering a linear elastic system. The total response of the system is determined by integrating the decoupled equations for each mode and combining the results of the modes at each time step using algebraic addition.

03.07.03-20

Mode shapes and frequencies are determined in the response spectrum analysis method. The cutoff frequency for determining modal properties is selected to account for the principal vibration modes of the subsystem based on mass and stiffness properties, modal participation factors, and the frequency content of the input forcing function. The missing mass effects of high frequency modes are included based on the same principles described in Section 3.7.3.7. The cutoff frequency is determined so that the number of modes calculated does not produce dynamic analysis results within 10 percent of the same results combined with the next higher mode.

The time step is set to be no larger than one-tenth of the shortest period of importance (e.g., the reciprocal of the cutoff frequency). cutoff frequency period, without justification. Other factors that are considered in the selection of an acceptable time step are the fundamental frequency of the subsystem being analyzed and the input time history.

To account for uncertainties in the structural analysis, one of two methods may be used following the guidance of ASCE-4-98 (Reference 4). Similar to peak shifting in the response spectrum method of analysis, three separate input time histories from the structure dynamic analysis may be analyzed with modified time steps. In this approach, the frequency content of the input data is varied by minimum ±15 percent to account for uncertainties in the analysis of the supporting structure. Variation in the frequency content is done by using the same time history date with at least three different time steps, the initial time step Δt and $\Delta t(1 \pm 0.15)$. Additional variations of the time step shall be determined based on consideration of the subsystem frequencies and the frequency content of the excitation data.

Alternatively, a more conservative approach using a generated synthetic time history may be used as a subsystem forcing function. This approach conservatively accounts for uncertainties in the structure frequencies if the response spectra computed from the synthetic time history envelop the broadened ISRS. When this method is used, the additional variation of frequency content is not required because the effects of uncertainties in the supporting structure are included in the broadened ISRS.

Damping values and procedures are addressed in Section 3.7.3.5.

The total response of the subsystems due to excitation in three directions is calculated by methods described in Section 3.7.3.6.

locations including locations where mass concentration or a drastic change in stiffness or orientation occurs, and by connecting the lumped masses with beam elements or spring elements. In lieu of a lumped multiple-mass model, a finite element model may also be used for the seismic analysis of the system. Dynamic properties of the supporting structural elements such as floor slab, roof slab, walls, miscellaneous steel platforms, and framing on which the system is attached, are included in the analysis model of the system unless:

- Such structural element may be demonstrated to be dynamically rigid.
- The particular floor slab, roof slab, or wall is dynamically flexible but an amplified ISRS that accounts for both the mass of the system and the flexibility of the floor slab, roof slab, or wall is available.

03.07.03-21

When developing the dynamic model of such structural elements (i.e., floor slab, roof slab, wall, miscellaneous steel platform, or framing) supporting the system, masses equal to 25 percent of the floor live load or 75 percent of the roof snow load, whichever is applicable, and miscellaneous dead loads of at least 50 psf, are included.

In most cases, the subsystems, equipment, and components are analyzed (or tested) as a decoupled system from the primary structure. For the decoupling of the subsystem and the supporting system, the following criteria are used:

- If R_m <0.01, decoupling can be done for any R_f. Mass of the subsystem is considered in the supporting system model through uniformly distributed load.
- If 0.01 ≤R_m ≤0.1, decoupling can be done if R_f ≤0.8 or R_f ≥1.25. When R_f ≥1.25, mass of the subsystem is included in the supporting system model. When R_f ≤0.8, mass of the subsystem is not included in the supporting system model.
- If R_m >0.1, an approximate model of the subsystem should be included in the primary system model.

Where:

R_m and R_f are defined as:

R_m = Ratio of total mass of the supported system to total mass of the supporting system.

R_f = Ratio of fundamental frequency of the supported subsystem to dominant frequency of the support motion.

~~It is sufficient to include only the mass of the subsystem at the support point in the primary system model when the subsystem is rigid in comparison to the supporting system, and is rigidly connected. On the other hand, in case of a subsystem supported by flexible connections, the subsystem may be excluded from the primary model.~~