ArevaEPRDCPEm Resource

From: WILLIFORD Dennis (AREVA) [Dennis.Williford@areva.com]
Sent: Wednesday, July 06, 2011 9:26 AM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (AREVA); DELANO Karen (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 22
Attachments: RAI 371 Supplement 22 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28. On January 20, 2011, AREVA NP submitted Supplement 10 to provide a revised schedule for a response to questions 03.07.02-67, 03.07.02-68, and 03.07.02-69. AREVA NP submitted Supplement 11 to the response on February 11, 2011 to provide a revised schedule for a response to question 03.07.02-66. On February 28, 2011, AREVA NP submitted Supplement 12 to provide a revised schedule for Question 03.07.01-28 and Question 03.07.02-69. AREVA NP submitted Supplement 13 on March 8, 2011, to provide an INTERIM response to Question 03.07.02-69. On March 24, 2011, AREVA NP submitted Supplement 14 to provide a revised schedule for Question 03.07.02-66. AREVA NP submitted Supplement 15 on April 1, 2011, to provide a revised schedule for Question 03.07.02-68. On April 27, 2011, AREVA NP submitted Supplement 16 to provide a revised schedule for Questions 03.07.02-67 and 03.07.02-69. AREVA NP submitted Supplement 17 on May 2, 2011, to provide a revised schedule for Question 03.07.02-68. On May 20, 2011, AREVA NP submitted Supplement 18 to provide a revised schedule for Question 03.07.02-66. AREVA NP submitted Supplement 19 on June 17, 2011, to provide a final response to Question 03.07.02-68 and a revised schedule for Question 03.07.01-28. On June 24, 2011, AREVA NP submitted Supplement 20 to provide a final response to Question 03.07.02-69. Supplement 21 was submitted also on June 24, 2011 to provide revised INTERIM responses to Questions 03.07.02-66 and 03.07.02-67 and a revised schedule for final responses to these 2 questions.

The attached file, “RAI 371 Supplement 22 Response US EPR DC.pdf” provides a technically correct and complete final response to Question 03.07.01-28. Appended to this file are the affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 371 Question 03.07.01-28.

The following table indicates the respective pages in the response document, “RAI 371 Supplement 22 Response US EPR DC.pdf,” that contain AREVA NP’s response to the subject question.

Question #	Start Page	End Page
RAI 371 — 03.07.01-28	2	22

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.02-66	July 29, 2010 (Actual) June 24, 2011 (Actual)	October 10, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual) June 24, 2011 (Actual)	September 14, 2011

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Friday, June 24, 2011 9:40 AM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 21

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28. On January 20, 2011, AREVA NP submitted Supplement 10 to provide a revised schedule for a response to questions 03.07.02-67, 03.07.02-68, and 03.07.02-69. AREVA NP submitted Supplement 11 to the response on February 11, 2011 to provide a revised schedule for a response to question 03.07.02-66. On February 28, 2011, AREVA NP submitted Supplement 12 to provide a revised schedule for Question 03.07.01-28 and Question 03.07.02-69. AREVA NP submitted Supplement 13 on March 8, 2011, to provide an INTERIM response to Question 03.07.02-69. On March 24, 2011, AREVA NP submitted Supplement 14 to provide a revised schedule for Question 03.07.02-66. AREVA NP submitted Supplement 15 on April 1, 2011, to provide a revised schedule for Question 03.07.02-68. On April 27, 2011, AREVA NP submitted Supplement 16 to provide a revised schedule for Questions 03.07.02-67 and 03.07.02-69. AREVA NP submitted Supplement 17 on May 2, 2011, to provide a revised schedule for Question 03.07.02-68. On May 20, 2011, AREVA NP submitted Supplement 18 to provide a revised schedule for Question 03.07.02-66. AREVA NP submitted Supplement 19 on June 17, 2011, to provide a final response to Question 03.07.02-68 and a revised schedule for Question 03.07.01-28. On June 24, 2011, AREVA NP submitted Supplement 20 to provide a final response to Question 03.07.02-69.

The attached file, "RAI 371 Supplement 21 Response US EPR DC - INTERIM.pdf" provides revised INTERIM responses to Question 03.07.02-66 and Question 03.07.02-67. Appended to this file are the affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 371 Question 03.07.02-66.

The following table indicates the respective pages in the response document, "RAI 371 Supplement 21 Response US EPR DC - INTERIM.pdf," that contains AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 371 — 03.07.02-66	2	9
RAI 371 — 03.07.02-67	10	10

The schedule for final responses to Question 03.07.02-66 and Question 03.07.02-67 is being revised. The schedule for the remaining question is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	July 22, 2011
RAI 371-03.07.02-66	July 29, 2010 (Actual) **June 24, 2011 (Actual)**	**October 10, 2011**
RAI 371-03.07.02-67	July 29, 2010 (Actual) **June 24, 2011 (Actual)**	**September 14, 2011**

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Friday, June 24, 2011 9:08 AM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 20

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted

Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28. On January 20, 2011, AREVA NP submitted Supplement 10 to provide a revised schedule for a response to questions 03.07.02-67, 03.07.02-68, and 03.07.02-69. AREVA NP submitted Supplement 11 to the response on February 11, 2011 to provide a revised schedule for a response to question 03.07.02-66. On February 28, 2011, AREVA NP submitted Supplement 12 to provide a revised schedule for Question 03.07.01-28 and Question 03.07.02-69. AREVA NP submitted Supplement 13 on March 8, 2011, to provide an INTERIM response to Question 03.07.02-69. On March 24, 2011, AREVA NP submitted Supplement 14 to provide a revised schedule for Question 03.07.02-66. AREVA NP submitted Supplement 15 on April 1, 2011, to provide a revised schedule for Question 03.07.02-68. On April 27, 2011, AREVA NP submitted Supplement 16 to provide a revised schedule for Questions 03.07.02-67 and 03.07.02-69. AREVA NP submitted Supplement 17 on May 2, 2011, to provide a revised schedule for Question 03.07.02-68. On May 20, 2011, AREVA NP submitted Supplement 18 to provide a revised schedule for Question 03.07.02-66. AREVA NP submitted Supplement 19 on June 17, 2011, to provide a final response to Question 03.07.02-68 and a revised schedule for Question 03.07.01-28.

The attached file, “RAI 371 Supplement 20 Response US EPR DC.pdf” provides a technically correct, complete and final response to Question 03.07.02-69, as committed. Appended to this file are the affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 371 Question 03.07.02-69.

The following table indicates the respective pages in the response document, “RAI 371 Supplement 20 Response US EPR DC.pdf,” that contain AREVA NP’s response to the subject question.

Question #	Start Page	End Page
RAI 371 — 03.07.02-69	2	31

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	July 22, 2011
RAI 371-03.07.02-66	July 29, 2010 (Actual)	July 8, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	July 8, 2011

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: RYAN Tom (RS/NB)
Sent: Friday, June 17, 2011 3:36 PM
To: 'Tesfaye, Getachew'
Cc: CORNELL Veronica (External RS/NB); WILLIFORD Dennis (RS/NB); BENNETT Kathy (RS/NB); DELANO Karen

(RS/NB); ROMINE Judy (RS/NB); WILLIFORD Dennis (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 19

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28. On January 20, 2011, AREVA NP submitted Supplement 10 to provide a revised schedule for a response to questions 03.07.02-67, 03.07.02-68, and 03.07.02-69. AREVA NP submitted Supplement 11 to the response on February 11, 2011 to provide a revised schedule for a response to question 03.07.02-66. On February 28, 2011, AREVA NP submitted Supplement 12 to provide a revised schedule for Question 03.07.01-28 and Question 03.07.02-69. AREVA NP submitted Supplement 13 on March 8, 2011, to provide an INTERIM response to Question 03.07.02-69. On March 24, 2011, AREVA NP submitted Supplement 14 to provide a revised schedule for Question 03.07.02-66. AREVA NP submitted Supplement 15 on April 1, 2011, to provide a revised schedule for Question 03.07.02-68. On April 27, 2011, AREVA NP submitted Supplement 16 to provide a revised schedule for Questions 03.07.02-67 and 03.07.02-69. AREVA NP submitted Supplement 17 on May 2, 2011, to provide a revised schedule for Question 03.07.02-68. On May 20, 2011, AREVA NP submitted Supplement 18 to provide a revised schedule for Question 03.07.02-66.

The attached file, “RAI 371 Supplement 19 Response US EPR DC.pdf” provides a technically correct, complete and final response to Question 03.07.02-68, as committed. Appended to this file are the affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 371 Question 03.07.02-68.

The following table indicates the respective pages in the response document, “RAI 371 Supplement 19 Response US EPR DC.pdf,” that contain AREVA NP’s response to the subject question.

Question #	Start Page	End Page
RAI 371 — 03.07.02-68	2	27

In addition, the schedule for Question 03.07.01-28 is being revised. The schedule for the remaining questions is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	**July 22, 2011**
RAI 371-03.07.02-66	July 29, 2010 (Actual)	July 8, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	July 8, 2011
RAI 371-03.07.02-69	October 18, 2010 (Actual) March 21, 2011 March 8, 2011 (Actual)	July 8, 2011

Sincerely,

Tom Ryan for
Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WELLS Russell (RS/NB)
Sent: Friday, May 20, 2011 7:43 AM
To: Tesfaye, Getachew
Cc: CORNELL Veronica (External RS/NB); WILLIFORD Dennis (RS/NB); BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 18

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28. On January 20, 2011, AREVA NP submitted Supplement 10 to provide a revised schedule for a response to questions 03.07.02-67, 03.07.02-68, and 03.07.02-69. AREVA NP submitted Supplement 11 to the response on February 11, 2011 to provide a revised schedule for a response to question 03.07.02-66. On February 28, 2011, AREVA NP submitted Supplement 12 to provide a revised schedule for Question 03.07.01-28 and Question 03.07.02-69. AREVA NP submitted Supplement 13 on March 8, 2011, to provide an INTERIM response to Question 03.07.02-69. On March 24, 2011, AREVA NP submitted Supplement 14 to provide a revised schedule for Question 03.07.02-66. AREVA NP submitted Supplement 15 on April 1, 2011, to provide a revised schedule for Question 03.07.02-68. On April 27, 2011, AREVA NP submitted Supplement 16 to provide a revised schedule for Questions 03.07.02-67 and 03.07.02-69. AREVA NP submitted Supplement 17 on May 2, 2011, to provide a revised schedule for Question 03.07.02-68.

The schedule for Question 03.07.02-66 is being revised. The schedule for the remaining questions is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	June 21, 2011
RAI 371-03.07.02-66	July 29, 2010 (Actual)	**July 8, 2011**
RAI 371-03.07.02-67	July 29, 2010 (Actual)	July 8, 2011

RAI 371-03.07.02-68	July 29, 2010 (Actual)	July 8, 2011
RAI 371-03.07.02-69	October 18, 2010 (Actual) March 21, 2011 March 8, 2011 (Actual)	July 8, 2011

Sincerely,

Russ Wells
U.S. EPR Design Certification Licensing Manager
AREVA NP, Inc.
3315 Old Forest Road, P.O. Box 10935
Mail Stop OF-57
Lynchburg, VA 24506-0935
Phone: 434-832-3884 (work)
434-942-6375 (cell)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: WELLS Russell (RS/NB)
Sent: Monday, May 02, 2011 10:30 AM
To: Tesfaye, Getachew
Cc: CORNELL Veronica (External RS/NB); BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 17

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28. On January 20, 2011, AREVA NP submitted Supplement 10 to provide a revised schedule for a response to questions 03.07.02-67, 03.07.02-68, and 03.07.02-69. AREVA NP submitted Supplement 11 to the response on February 11, 2011 to provide a revised schedule for a response to question 03.07.02-66. On February 28, 2011, AREVA NP submitted Supplement 12 to provide a revised schedule for Question 03.07.01-28 and Question 03.07.02-69. AREVA NP submitted Supplement 13 on March 8, 2011, to provide an INTERIM response to Question 03.07.02-69. On March 24, 2011, AREVA NP submitted Supplement 14 to provide a revised schedule for Question 03.07.02-66. AREVA NP submitted Supplement 15 on April 1, 2011, to provide a revised schedule for Question 03.07.02-68. On April 27, 2011, AREVA NP submitted Supplement 16 to provide a revised schedule for Questions 03.07.02-67 and 03.07.02-69.

Due to changes in the schedule for FSAR Sections 3.7 and 3.8 as discussed with NRC, the schedule for Question 03.07.02-68 is being revised. The schedule for the remaining questions is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	June 21, 2011
RAI 371-03.07.02-66	July 29, 2010 (Actual)	May 26, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	July 8, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	**July 8, 2011**
RAI 371-03.07.02-69	October 18, 2010 (Actual) March 21, 2011 March 8, 2011 (Actual)	July 8, 2011

Sincerely,

Russ Wells
U.S. EPR Design Certification Licensing Manager
AREVA NP, Inc.
3315 Old Forest Road, P.O. Box 10935
Mail Stop OF-57
Lynchburg, VA 24506-0935
Phone: 434-832-3884 (work)
434-942-6375 (cell)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: WELLS Russell (RS/NB)
Sent: Wednesday, April 27, 2011 8:25 AM
To: 'Tesfaye, Getachew'
Cc: CORNELL Veronica (External RS/NB); BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 16

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28. On January 20, 2011, AREVA NP submitted Supplement 10 to provide a revised schedule for a response to questions 03.07.02-67, 03.07.02-68, and 03.07.02-69. AREVA NP submitted Supplement 11 to the response on February 11, 2011 to provide a revised schedule for a response to question 03.07.02-66. On February 28, 2011, AREVA NP submitted Supplement 12 to provide a revised schedule for Question 03.07.01-28 and Question 03.07.02-69. AREVA NP submitted Supplement 13 on March 8, 2011, to provide an INTERIM response to Question 03.07.02-69. On March 24, 2011, AREVA NP submitted Supplement 14 to provide a revised schedule for Question 03.07.02-66. AREVA NP submitted Supplement 15 on April 1, 2011, to provide a revised schedule for Question 03.07.02-68.

The schedule for Questions 03.07.02-67 and 03.07.02-69 is being revised. The schedule for the remaining questions is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	June 21, 2011
RAI 371-03.07.02-66	July 29, 2010 (Actual)	May 26, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	**July 8, 2011**
RAI 371-03.07.02-68	July 29, 2010 (Actual)	May 26, 2011
RAI 371-03.07.02-69	October 18, 2010 (Actual) March 21, 2011 March 8, 2011 (Actual)	**July 8, 2011**

Sincerely,

Russ Wells
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AREVA NP, Inc.
3315 Old Forest Road, P.O. Box 10935
Mail Stop OF-57
Lynchburg, VA 24506-0935
Phone: 434-832-3884 (work)
434-942-6375 (cell)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: WELLS Russell (RS/NB)
Sent: Friday, April 01, 2011 2:23 PM
To: 'Tesfaye, Getachew'
Cc: CORNELL Veronica (External RS/NB); BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 15

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted

Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28. On January 20, 2011, AREVA NP submitted Supplement 10 to provide a revised schedule for a response to questions 03.07.02-67, 03.07.02-68, and 03.07.02-69. AREVA NP submitted Supplement 11 to the response on February 11, 2011 to provide a revised schedule for a response to question 03.07.02-66. On February 28, 2011, AREVA NP submitted Supplement 12 to provide a revised schedule for Question 03.07.01-28 and Question 03.07.02-69. AREVA NP submitted Supplement 13 on March 8, 2011, to provide an INTERIM response to Question 03.07.02-69. On March 24, 2011, AREVA NP submitted Supplement 14 to provide a revised schedule for Question 03.07.02-66.

The schedule for Question 03.07.02-68 is being revised to allow AREVA NP additional time to address NRC comments. The schedule for the remaining questions is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	June 21, 2011
RAI 371-03.07.02-66	July 29, 2010 (Actual)	May 26, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	April 28, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	**May 26, 2011**
RAI 371-03.07.02-69	October 18, 2010 (Actual) March 21, 2011 March 8, 2011 (Actual)	April 28, 2011

Sincerely,

Russ Wells
U.S. EPR Design Certification Licensing Manager
AREVA NP, Inc.
3315 Old Forest Road, P.O. Box 10935
Mail Stop OF-57
Lynchburg, VA 24506-0935
Phone: 434-832-3884 (work)
434-942-6375 (cell)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: WELLS Russell (RS/NB)
Sent: Thursday, March 24, 2011 1:11 PM
To: 'Tesfaye, Getachew'
Cc: CORNELL Veronica (External RS/NB); BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 14

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28. On January 20, 2011, AREVA NP submitted Supplement 10 to provide a revised schedule for a response to questions 03.07.02-67, 03.07.02-68, and 03.07.02-69. AREVA NP submitted Supplement 11 to the response on February 11, 2011 to provide a revised schedule for a response to question 03.07.02-66. On February 28, 2011, AREVA NP submitted Supplement 12 to provide a revised schedule for Question 03.07.01-28 and Question 03.07.02-69. AREVA NP submitted Supplement 13 on March 8, 2011, to provide an INTERIM response to Question 03.07.02-69.

The schedule for Question 03.07.02-66 is being revised. In addition, the schedule for Question 03.07.01-28 is being revised to allow additional time for AREVA NP to address NRC comments. The schedule for the remaining questions is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	**June 21, 2011**
RAI 371-03.07.02-66	July 29, 2010 (Actual)	**May 26, 2011**
RAI 371-03.07.02-67	July 29, 2010 (Actual)	April 28, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	April 5, 2011
RAI 371-03.07.02-69	October 18, 2010 (Actual) March 21, 2011 March 8, 2011 (Actual)	April 28, 2011

Sincerely,

Russ Wells
U.S. EPR Design Certification Licensing Manager
AREVA NP, Inc.
3315 Old Forest Road, P.O. Box 10935
Mail Stop OF-57
Lynchburg, VA 24506-0935
Phone: 434-832-3884 (work)
434-942-6375 (cell)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: WELLS Russell (RS/NB)
Sent: Tuesday, March 08, 2011 3:45 PM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 13

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28. On January 20, 2011, AREVA NP submitted Supplement 10 to provide a revised schedule for a response to questions 03.07.02-67, 03.07.02-68, and 03.07.02-69. AREVA NP submitted Supplement 11 to the response on February 11, 2011 to provide a revised schedule for a response to question 03.07.02-66. On February 28, 2011, AREVA NP submitted Supplement 12 to provide a revised schedule for Question 03.07.01-28 and Question 03.07.02-69.

The attached file, “RAI 371 Supplement 13 Response US EPR DC-INTERIM.pdf” provides a technically correct INTERIM response to the Question 03.07.02-69, as committed.

The following table indicates the page in the response document, “RAI 371 Supplement 13 Response US EPR DC-INTERIM.pdf” that contains AREVA NP’s response to the subject question.

Question #	Start Page	End Page
RAI 371 – 03.07.02-69	2	32

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	March 24, 2011
RAI 371-03.07.02-66	July 29, 2010 (Actual)	April 8, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	April 28, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	April 5, 2011
RAI 371-03.07.02-69	October 18, 2010 (Actual) March 21, 2011 **March 8, 2011 (Actual)**	April 28, 2011

Sincerely,

Russ Wells
U.S. EPR Design Certification Licensing Manager
AREVA NP, Inc.
3315 Old Forest Road, P.O. Box 10935
Mail Stop OF-57
Lynchburg, VA 24506-0935
Phone: 434-832-3884 (work)

434-942-6375 (cell)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: WELLS Russell (RS/NB)
Sent: Monday, February 28, 2011 5:09 PM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 12

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28. On January 20, 2011, AREVA NP submitted Supplement 10 to provide a revised schedule for a response to questions 03.07.02-67, 03.07.02-68, and 03.07.02-69. AREVA NP submitted Supplement 11 to the response on February 11, 2011 to provide a revised schedule for a response to question 03.07.02-66.

The schedule for the FINAL response to Question 03.07.01-28 is being revised to allow additional time for AREVA NP to interact with the NRC. In addition, the schedule for the INTERIM response to Question 03.07.02-69 is being revised to allow additional time for AREVA NP to address NRC comments. The schedule for the remaining questions is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	**March 24, 2011**
RAI 371-03.07.02-66	July 29, 2010 (Actual)	April 8, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	April 28, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	April 5, 2011
RAI 371-03.07.02-69	October 18, 2010 (Actual) **March 21 2011**	April 28, 2011

Sincerely,

Russ Wells
U.S. EPR Design Certification Licensing Manager
AREVA NP, Inc.

3315 Old Forest Road, P.O. Box 10935
Mail Stop OF-57
Lynchburg, VA 24506-0935
Phone: 434-832-3884 (work)
434-942-6375 (cell)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: BRYAN Martin (External RS/NB)
Sent: Friday, February 11, 2011 1:55 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 11

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28. On January 20, 2011, AREVA NP submitted Supplement 10 to provide a revised schedule for a response to questions 03.07.02-67, 03.07.02-68, and 03.07.02-69.

The schedule for Question 03.07.02-66 has changed. The schedule for the remaining questions is unchanged

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	February 28, 2011
RAI 371-03.07.02-66	July 29, 2010 (Actual)	April 8, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	April 28, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	April 5, 2011
RAI 371-03.07.02-69	October 18, 2010 (Actual) February 28, 2011	April 28, 2011

Sincerely,

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

From: BRYAN Martin (External RS/NB)
Sent: Thursday, January 20, 2011 6:53 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 10

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69. On November 11, 2010, AREVA NP submitted Supplement 9 to provide a revised schedule for a response to question 03.07.01-28.

The schedule for the responses to Question 03.07.02-67 and Question 03.07.02-68 is being revised to allow additional time for AREVA NP to address NRC comments. The schedule for the response to Question 03.07.02-69 is also being revised to allow additional time for AREVA NP to prepare and submit a revised INTERIM response. The schedule for the remaining questions is unchanged

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	February 28, 2011
RAI 371-03.07.02-66	July 29, 2010 (Actual)	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	April 28, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	April 5, 2011
RAI 371-03.07.02-69	October 18, 2010 (Actual) February 28, 2011	April 28, 2011

Sincerely,

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

From: BRYAN Martin (External RS/NB)
Sent: Thursday, November 11, 2010 11:24 AM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 9

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29. On October 18, 2010, AREVA NP submitted Supplement 8 to provide an INTERIM response to question 03.07.02-69.

The schedule for the response to Question 03.07.01-28 is being revised to allow additional time for AREVA NP to address NRC comments. The schedule for the remaining questions is unchanged

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	February 28, 2011
RAI 371-03.07.02-66	July 29, 2010 (Actual)	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-69	October 18, 2010 (Actual)	January 20, 2011

Sincerely,

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

From: BRYAN Martin (External RS/NB)
Sent: Monday, October 18, 2010 4:30 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 8

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29. On October 4, 2010, AREVA NP submitted Supplement 7 to provide a FINAL response to question 03.07.01-29.

The attached file, “RAI 371 Supplement 8 Response US EPR DC-INTERIM.pdf” provides a technically correct and complete INTERIM response to question 03.07.02-69, as committed.

The following table indicates the respective pages in the response document, “RAI 371 Supplement 8 Response US EPR DC-INTERIM.pdf,” that contain AREVA NP’s response to the subject question.

Question #	Start Page	End Page
RAI 371 — 03.07.02-69	2	4

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	November 12, 2010
RAI 371-03.07.02-66	July 29, 2010 (Actual)	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-69	October 18, 2010 (Actual)	January 20, 2011

Sincerely,

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

From: BRYAN Martin (External RS/NB)
Sent: Monday, October 04, 2010 4:57 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 7

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to questions 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72. On September 9, 2010, AREVA NP submitted Supplement 6 to provide a revised schedule for a FINAL response to question 03.07.01-29.

The attached file, "RAI 371 Supplement 7 Response US EPR DC.pdf" provides technically correct and complete FINAL response to question 03.07.01-29, as committed.

The following table indicates the respective pages in the response document, "RAI 371 Supplement 7 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 371 — 03.07.01-29	2	5

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	November 12, 2010
RAI 371-03.07.02-66	July 29, 2010 (Actual)	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-69	October 18, 2010	January 20, 2011

Sincerely,

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

From: BRYAN Martin (External RS/NB)
Sent: Thursday, September 09, 2010 12:44 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 6

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to question 03.07.02-66 through question 03.07.02-68. AREVA NP submitted Supplement 5 to the response on August 31, 2010, to provide technically correct and complete FINAL responses to questions 03.07.02-70 through 03.07.02-72.

The schedule for the FINAL response to Question 03.07.01-29 is being revised to allow time for AREVA NP to address NRC comments. The schedule for the remaining questions is unchanged.

The schedule for a technically correct and complete interim response and responses to the following questions is provided below.

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	November 12, 2010
RAI 371-03.07.01-29	N/A	**October 5, 2010**
RAI 371-03.07.02-66	July 29, 2010 (Actual)	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-69	October 18, 2010	January 20, 2011

Sincerely,

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

From: BRYAN Martin (External RS/NB)
Sent: Tuesday, August 31, 2010 4:55 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 5

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to question 03.07.02-66 through question 03.07.02-68.

The attached file, “RAI 371 Supplement 5 Response US EPR DC.pdf” provides technically correct and complete FINAL responses to 3 of the remaining 9 questions, as committed.

The following table indicates the respective pages in the response document, "RAI 371 Supplement 5 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 371 — 03.07.02-70	2	3
RAI 371 — 03.07.02-71	4	10
RAI 371 — 03.07.02-72	11	11

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

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	November 12, 2010
RAI 371-03.07.01-29	N/A	September 17, 2010
RAI 371-03.07.02-66	July 29, 2010 (Actual)	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-69	October 18, 2010	January 20, 2011

Sincerely,

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From: BRYAN Martin (EXT)
Sent: Thursday, July 29, 2010 8:08 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 4 - Interim

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments.

The attached file, "RAI 371 Supplement 4 Response US EPR DC.pdf" provides technically correct and complete INTERIM responses to 3 of the remaining 10 questions, as committed.

The following table indicates the respective pages in the response document, "RAI 371 Supplement 4 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 371 — 03.07.02-66	2	2
RAI 371 — 03.07.02-67	3	3
RAI 371 — 03.07.02-68	4	8

The schedule for an interim response and the technically correct and complete response to these questions is unchanged and is provided below.

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	November 12, 2010
RAI 371-03.07.01-29	N/A	September 17, 2010
RAI 371-03.07.02-66	July 29, 2010 (Actual)	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-69	October 18, 2010	January 20, 2011
RAI 371-03.07.02-70	N/A	September 3, 2010
RAI 371-03.07.02-71	N/A	September 3, 2010
RAI 371-03.07.02-72	N/A	September 3, 2010

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From: BRYAN Martin (EXT)
Sent: Thursday, July 08, 2010 4:02 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 3

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the 9 questions of RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 on June 7, 2010, to provide a revised date for 1 of the questions (03.07.01-29) on June 7, 2010. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities.

To provide for further interaction with the NRC on the response for question 03.07.01-29, a revised schedule is provided below. Dates for the other 8 questions remain unchanged.

The revised schedule for the technically correct and complete response to these questions has been changed and is provided below.

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	November 12, 2010

RAI 371-03.07.01-29	N/A	September 17, 2010
RAI 371-03.07.02-66	July 29, 2010	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010	January 20, 2011
RAI 371-03.07.02-68	July 29, 2010	January 20, 2011
RAI 371-03.07.02-69	October 18, 2010	January 20, 2011
RAI 371-03.07.02-70	N/A	September 3, 2010
RAI 371-03.07.02-71	N/A	September 3, 2010
RAI 371-03.07.02-72	N/A	September 3, 2010

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From: BRYAN Martin (EXT)
Sent: Thursday, June 24, 2010 12:58 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT); RYAN Tom (AREVA NP INC); GARDNER George Darrell (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a schedule for the remaining 9 questions, 8 of which were affected by the work underway to address NRC comments from the April 26, 2010, audit.

Based upon the civil/structural re-planning activities and revised RAI response schedule presented to the NRC during the June 9, 2010, Public Meeting, and to allow time to interact with the NRC on the responses, the schedule has been changed. The schedule for 03.07.01-29 remains unchanged.

Prior to submittal of the final RAI response, AREVA NP will provide an interim RAI response that includes:

(1) a description of the technical work (e.g., methodology)
(2) U.S. EPR FSAR revised pages, as applicable

The revised schedule for an interim response and the technically correct and complete response to these questions is provided below.

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	November 12, 2010
RAI 371-03.07.01-29	N/A	July 8, 2010
RAI 371-03.07.02-66	July 29, 2010	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010	January 20, 2011
RAI 371-03.07.02-68	July 29, 2010	January 20, 2011
RAI 371-03.07.02-69	October 18, 2010	January 20, 2011
RAI 371-03.07.02-70	N/A	September 3, 2010
RAI 371-03.07.02-71	N/A	September 3, 2010

RAI 371-03.07.02-72	N/A	September 3, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
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From: BRYAN Martin (EXT)
Sent: Monday, June 07, 2010 5:07 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); CORNELL Veronica (EXT); VAN NOY Mark (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 1

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010.

As agreed with NRC, AREVA NP is providing a revised date for RAI 371 Supplement 1 Question 03.07.01-29 to allow time to interact with the NRC on the response.

The schedule for technically correct and complete responses to the remaining question has been changed and is provided below. The dates for questions 03.07.02-66 through 03.03.02-69 will be revised based on the information that will be presented at the June 9, 2010 public meeting and subsequent NRC feedback.

Question #	Response Date
RAI 371-03.07.01-28	August 3, 2010
RAI 371-03.07.01-29	July 8, 2010
RAI 371-03.07.02-66	July 27, 2010
RAI 371-03.07.02-67	July 27, 2010
RAI 371-03.07.02-68	August 3, 2010
RAI 371-03.07.02-69	August 3, 2010
RAI 371-03.07.02-70	August 3, 2010
RAI 371-03.07.02-71	August 3, 2010
RAI 371-03.07.02-72	August 3, 2010

Sincerely,

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From: BRYAN Martin (EXT)
Sent: Monday, April 26, 2010 12:45 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); ROMINE Judy (AREVA NP INC); VAN NOY Mark (EXT); RYAN Tom (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 371 Response US EPR DC.pdf" provides a schedule since a technically correct and complete response to the 9 questions is not provided.

The following table indicates the respective pages in the response document, "RAI 371 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 371-03.07.01-28	2	3
RAI 371-03.07.01-29	4	4
RAI 371-03.07.02-66	5	5
RAI 371-03.07.02-67	6	6
RAI 371-03.07.02-68	7	7
RAI 371-03.07.02-69	8	9
RAI 371-03.07.02-70	10	10
RAI 371-03.07.02-71	11	11
RAI 371-03.07.02-72	12	12

A complete answer is not provided for 9 of the 9 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 371-03.07.01-28	August 3, 2010
RAI 371-03.07.01-29	June 7, 2010
RAI 371-03.07.02-66	July 27, 2010
RAI 371-03.07.02-67	July 27, 2010
RAI 371-03.07.02-68	August 3, 2010
RAI 371-03.07.02-69	August 3, 2010
RAI 371-03.07.02-70	August 3, 2010
RAI 371-03.07.02-71	August 3, 2010
RAI 371-03.07.02-72	August 3, 2010

Sincerely,

Martin (Marty) C. Bryan
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Thursday, March 25, 2010 2:05 PM
To: ZZ-DL-A-USEPR-DL
Cc: Chakravorty, Manas; Hawkins, Kimberly; Miernicki, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 371 (4273,4271,4280), FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on February 25, 2010, and on March 24, 2010, 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: 3191

Mail Envelope Properties (2FBE1051AEB2E748A0F98DF9EEE5A5D47AF6D0)

Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 22
Sent Date: 7/6/2011 9:26:29 AM
Received Date: 7/6/2011 9:26:36 AM
From: WILLIFORD Dennis (AREVA)

Created By: Dennis.Williford@areva.com

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Tracking Status: None

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Files	**Size**	**Date & Time**
MESSAGE	73354	7/6/2011 9:26:36 AM
RAI 371 Supplement 22 Response US EPR DC.pdf		535772

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

Response to

Request for Additional Information No. 371, Supplement 22

3/25/2010

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.07.01 - Seismic Design Parameters
SRP Section: 03.07.02 - Seismic System Analysis

Application Section: 03.07

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

Question 03.07.01-28:

Follow Up to RAI 215, Question 03.07.01-23:

Acceptance Criteria II.3 of SRP 3.7.2 states that to be acceptable the stiffness, mass and damping characteristics of structural systems should be adequately incorporated into the analytical models. Since it is still not clear to the staff how cable tray systems are modeled and analyzed including modeling of the localized yielding of support during higher excitation level to determine their response under a seismic load, the staff requests the following additional information described below:

A. In the first paragraph of the response it states that localized yielding of support connections were observed in a few test cases where the connections experienced large amplitude loading. This is accounted for in analysis and design by modeling connections as flexible joints with appropriately degraded rotational stiffness obtained from experimental tests of representative strut and joint configurations. It then states that if modeling with flexible connections is determined to not be conservative, other boundary conditions that produce more conservative results will be used. The applicant is requested to provide the following additional information:

   1. Describe how an appropriately degraded rotational stiffness is calculated and how it will be determined that the use of flexible connections in the model is not providing conservative results.

   2. Define whether the test results and the observed reduction in frequency are applicable to all three directions of motion. The applicant should provide test results or other backup information which form the basis of its response.

   3. If the test results and reduction in frequency are not applicable to all three directions of response, the applicant should describe how the frequencies and loads are determined in the other direction(s).

   4. Describe how the damping values were determined in the test program.

B. The third paragraph of the response makes a reference to Figure 03.07.01-23-1 which is supposed to show analytical and computer models that were developed and calibrated to evaluate the cable tray systems that were experimentally tested. The analytical and computer models were not provided in the response. The applicant is requested to provide these models and describe how they were calibrated to evaluate the cable tray systems.

C. In the fifth paragraph of the response it states that the trays were rigidly mounted during the tests but then states that actual cable tray systems will be mounted using flexible supports. The applicant should provide examples of the flexible support systems, how they differ from those in the test program and why the test program results are still applicable especially since the test results are being used to determine the reduction in natural frequencies that occur with increasing ZPAs.

D Regarding note 2 in revised Figure 3.7.1-16, the applicant is requested to provide the criteria used for determining that the cable tray system is significantly different from those tested and thus require a damping value of 10 percent for tray greater than 50 percent loading. The criteria should be added to the FSAR.

E. In subparagraph (b), a brief description is given regarding the determination of a reduced fundamental frequency and bracketing this frequency by +/- 20 percent. However the response is incomplete in its description of how cable tray systems are to be analyzed and design loads determined. The applicant should provide a complete description of this process containing the following information and include a description of this process in the FSAR.

  1. Describe how the fundamental frequency of the cable tray system is determined.
  2. Describe the seismic model of the cable tray system.
  3. Describe how modal analysis is performed and if modal analysis is not used describe the methods that are used to develop cable tray design loads.
  4. If modal analysis is used, describe how the modal frequencies of the cable tray system are determined and what damping values are associated with these higher frequencies.
  5. Describe how three components of earthquake motion are considered and the responses combined for cable tray design.

F. In the FSAR markup on page 3.7-15 it states in note 3.D that the selected damping value, i.e. 10 percent, is to be justified when cable loadings are less than 50 percent of the maximum. However, note 3.A states that 10 percent damping is to be used with maximum cable loadings. Note 3 to Figure 3.7.1-16 states that a damping value of 7 percent should be used for cable tray systems that are unloaded or loaded less than 50 percent while note 2 to the same figure states that for cable tray systems that are significantly different than those tested use a damping value of 10 percent for tray with greater than 50 percent loading. The applicant is requested to clear up the discrepancy between the notes in the table and the notes in the Figure regarding the use of 10 percent damping.

Response to Question 03.07.01-28:

Part A1:

The term “degraded rotational stiffness of connections” refers to the softening of the cable tray system supports resulting from plastic deformation of the support clip angles and support struts (localized near the clip angles). This condition occurs when the system side-sway responses produce support rotations sufficient to cause the support connections to yield. Characteristics of the connection response are primarily associated with the cable tray system response in the transverse direction (horizontal perpendicular to tray run). Longitudinal side-sway is resisted by longitudinal bracing and cyclical prying of clip angles resulting from negligible vertical movement, such as when connecting members are subjected to smaller flexural strains than those experiencing side-sway. As addressed in the Response to RAI 215, Question 03.07.01-23, degraded rotational stiffness is dependent on input acceleration. When input acceleration increases, rotations become larger and further soften the connections. The degraded rotational stiffness results in reduced system fundamental frequencies and potentially higher seismic demands. To account for degraded rotational stiffness, spring constants appropriate for modeling and analysis of cable tray systems are obtained from connection load tests performed in the Bechtel-ANCO test program for various strut/connection details.

Strong axis bending of the support member is associated with transverse (direction perpendicular to the cable tray longitudinal axis) displacements of a strut trapeze cable tray support. Weak axis bending is associated with longitudinal (direction parallel to the cable tray side rails) displacements. The function of the transverse rotational springs is to resist side-sway via frame action. At locations where transverse bracing is not provided, the transverse rotational springs are the primary component in seismic qualification of the cable tray supports. Some amount of transverse bracing is typically required, but may be provided at alternating support locations.

For the transverse direction, degraded rotational spring stiffness representing the rotational behavior of a strut and clip angle support connection is obtained from moment versus rotation curves (also referred to as “strength” or “backbone” curves) determined from static connection load tests. Figure 03.07.01-28-1 shows connection types that were load tested. The methodology used for these connection load tests is documented in Reference 1. An example of a typical strength curve obtained from a strut connection load test is shown in Figure 03.07.01-28-2. In Figure 03.07.01-28-2, the applied moment is plotted against single amplitude rotation of the connection. During the connection load test, rotation amplitude was increased linearly from zero to the rotation at failure. The degraded rotational spring constant for a particular strut connection is defined as the slope of the line from the origin to the point on the strength curve corresponding to one-half the maximum tested rotation of the connection (see the dashed line in Figure 03.07.01-28-2). System frequency analyses based on this method of defining degraded rotational spring stiffness correlated well with fundamental frequency results obtained from cycles of seismic testing after connection softening occurred and this results in a conservative estimate of the cable tray system fundamental frequency. Although the degraded rotational stiffness shown in Figure 03.07.01-28-2 (slope of the dashed line) is obtained from a static connection load test, the adjustment in rotational stiffness is able to capture the connection flexibility after many cycles.

Connection configurations not representative of the configurations evaluated during the Bechtel-ANCO test program require connection load tests using the same testing methodology described in the Bechtel-ANCO report and Reference 1 to determine appropriate degraded rotational spring stiffness for the transverse direction. Part D of this response provides similarity criteria for determining applicability of existing connection load test data.

The function of longitudinal springs is different from that for the transverse direction. Trapeze cable tray strut supports exhibit little resistance against longitudinal swaying from frame action, and longitudinal bracing is provided. Because of the high stiffness of longitudinal bracing, longitudinal rotational spring constants have a negligible influence on the calculated system fundamental frequency longitudinally. For modeling purposes, weak axis rotation spring constants for strut angle fittings are approximately 50 to 60 percent of the spring constants used in the transverse direction. This approximation is appropriate because the weak axis joint rotation is limited by truss action from longitudinal bracing.

Vertically, the cable tray system fundamental frequency is primarily associated with the vertical bending stiffness of the cable tray side rails and axial stiffness of the supports in the vertical direction. Because the axial stiffness of the support struts is approximately two to three orders of magnitude higher than the vertical bending stiffness of the cable tray side rails, the supports have a negligible influence on the system fundamental frequency vertically. Also, the clip angle connections have no significant influence on the system fundamental frequency vertically. Degraded stiffness in the vertical direction is not used in the analysis of cable tray systems.

The process for determining degraded rotational spring constants, as previously described in this response, for modeling of cable tray supports in the transverse and longitudinal directions will be added to U.S. EPR FSAR Tier 2, Section 3A.3.6.3.

The localized nonlinearities associated with cable tray support connections are accounted for in models using degraded rotational spring constants (obtained from strength curves, such as Figure 03.07.01-28-2) to facilitate linear modeling of the cable tray system, and allow usage of linear methods of analysis. The calculated rotational demands of the connections are qualified against corresponding low-cycle fatigue tests. These tests, for various strut connection configurations, were performed at prescribed rotation amplitudes to verify that the connection can sustain stable hysteresis for a number of cycles equivalent to five operating basis earthquake (OBE) seismic events and one safe shutdown earthquake (SSE) seismic event, consistent with the criteria defined in U.S. EPR FSAR Tier 2, Section 3.7.3.2. The hysteresis curves developed during the connection load tests demonstrate stable hysteresis. Figure 03.07.01-28-3 shows hysteresis plots of a typical bolted clip angle connection for the first cycle of motion and for four different prescribed maximum rotation amplitudes. Figure 03.07.01-28-3 shows that plastic deformations near the support provide additional energy dissipation (area inside the hysteresis curves). This damping is in addition to the 15 percent (or greater) damping caused by friction between cables, and movement and bouncing of cables within the tray as a result of unyielding connections. Additional conservatism is provided. Further information on implementation of degraded rotational stiffness and low-cycle fatigue in the modeling and analysis process is provided in Part E of this response.

Design basis broadened response spectra used in conjunction with 15 percent damping will be modified so that the peak acceleration is applied to frequencies less than the frequency defining the peak to confirm conservative results. Modeling strut connections with rotational springs that account for degradation effects resulting from cyclic side-sway results in a more flexible connection than observed during initial response cycles. Implementing degraded rotational stiffness of the strut connection provides a lower-bound estimate of the fundamental frequency of the cable tray system in the transverse direction. Using lower fundamental frequencies and the modified broadened spectra results in higher amplitude accelerations and produces more conservative seismic demands.

Part A2:

The cable tray system exhibits different stiffness characteristics and dynamic behavior in each of the three orthogonal directions. A reduction in the system fundamental frequency because of degraded rotational stiffness of connections is applicable only to the transverse direction. During the Bechtel-ANCO test program, seismic testing of cable tray systems was performed with bi-axial shaking (either simultaneous vertical and longitudinal or simultaneous vertical and transverse, depending on tests being performed). Sensor measurements were recorded in each of the three orthogonal directions. However, the data presented in the Bechtel-ANCO report was predominantly associated with the transverse direction.

Because of the limited test data available in the longitudinal and vertical directions, the justification for using a damping ratio of 15 percent is applicable only to the transverse direction. The damping ratio values in RG 1.61, Revision 1 are used for responses in the longitudinal and vertical directions.

The majority of earthquake-type shaking table testing, during the Bechtel-ANCO test program, was performed using a synthetic earthquake having a spectrum enveloping an RG 1.60, Revision 1 spectrum scaled to have a zero-period acceleration (ZPA) of 1.0 g and peak acceleration of approximately 3.3 g for five percent damping.

Part A3:

Sway action of the strut support frames is limited longitudinally by bracing. Vertical movement is limited by axial stiffness of struts as previously addressed in Part A1 of this response. Higher damping will not be used when calculating the response to vertical and longitudinal seismic inputs. Longitudinal bracing stiffness governs the system fundamental frequency in the longitudinal direction. Vertical bending stiffness of the cable tray side rails governs the system fundamental frequency in the vertical direction.

Two options are available for calculating fundamental system frequencies in the vertical and longitudinal directions. The first option is to perform hand calculation techniques using conservative simplifying assumptions. The second option is to create a three-dimensional computer model of a segment of the cable tray system from which the system frequencies can be computed through eigenvalue analysis. Methodologies of both options are further addressed in Part E of this response.

When natural frequencies in each orthogonal direction are determined, loads can be calculated using one of the methods described in U.S. EPR FSAR Tier 2, Section 3.7.3.1 (e.g., equivalent static load method or response spectrum method).

Part A4:

The cable tray test program included three accelerometers rigidly mounted to the shaking table to measure input total acceleration in the three orthogonal directions. Three additional accelerometers were attached at midspan of the cable tray between supports to measure output (response) total acceleration. The input and output acceleration time histories in the three orthogonal directions were recorded and then transformed into the frequency domain using Fourier transforms. Frequency response functions (FRF), defined as the ratio of the Fourier transform of output total acceleration to the Fourier transform of input total acceleration, were generated and amplitude (magnitude) and phase angle plots were constructed. Resonant frequencies were identified where there was a peak in the FRF amplitude and a corresponding shift in phase angles. Using the FRF generated for the transverse direction, the peak amplitude occurring at the lowest frequency was identified as the system fundamental frequency. The lowest frequencies in the longitudinal and vertical directions were identified at significantly higher frequencies than in the transverse direction.

For each cable tray test performed, with the exception of free vibration tests, the damping ratio associated with the system fundamental frequency (lowest resonant frequency in the transverse direction) was identified using the half-power bandwidth method. This method is documented in Section 3.2.6 of Reference 2.

During free vibration tests (snapback tests), the damping ratio was identified using the logarithmic decrement method. This method is documented in Section 2.2.3 of Reference 2.

Part B:

The Response to RAI 215, Question 03.07.01-23 states, “Figure 03.07.01-23-1 shows analytical and computer models that were developed and calibrated to evaluate the cable tray systems….” The intent of Figure 03.07.01-23-1 was to show that the cable tray system fundamental frequency tends to decrease linearly (as with tray system input acceleration) with the rate of decrease dependent on cable loading. The data points shown in Figure 03.07.01-23-1 represent actual raw test results for various manufacturers. These results were extracted from the Bechtel-ANCO report and are not results from analytical or computer models. The lines shown in Figure 03.07.01-23-1 are linear trend lines fitted to the test data using a linear least squares regression analysis.

Part C:

The rigidly mounted tests referred to in the Response to RAI 215, Question 03.07.01-23 represent only one of the various test configurations used during the Bechtel-ANCO test program. Cable trays were tested in a rigidly mounted configuration to identify the dynamic behavior and damping attributed to the loaded cable tray and cable movement (friction between cables, and movement and bouncing of cables within the tray). The test results demonstrate that cable trays that are 50 to 100 percent loaded exhibit damping ratios in excess of 15 percent regardless of support flexibility. The Bechtel-ANCO test program was not limited to testing rigidly mounted cable tray systems. Instead, the majority of tests were performed on flexibly supported cable tray systems.

The Bechtel-ANCO test program contained more than 2,000 individual dynamic tests that captured a wide spectrum of configurations to identify dynamic characteristics of various cable tray systems; including system natural frequency, damping, mode shapes, fatigue life, failure modes, and localized connection flexibility. Test phases included tests of rigidly mounted and flexibly supported cable tray systems, a selection of cable tray types from several manufacturers, single and multi-tier trays (e.g., one, three and five tiers of tray), various anchor connection details, and various bracing configurations. The cable tray systems were evaluated using a variety of vibration tests, including free vibration (referenced in the Bechtel-ANCO report as “snapback” tests), and forced vibration tests (both sinusoidal and seismic inputs). The data points in the Response to RAI 215, Figure 03.07.01-23-3 show damping ratio results, and include results of flexibly supported cable tray systems for a variety of configurations that were evaluated during the Bechtel-ANCO test program.

The Bechtel-ANCO test program results apply to a wide range of support configurations. Details on criteria used for assessing cable tray configuration similarity to the test program, and applicability of results, are provided in Part D of this response.

Part D:

U.S. EPR FSAR Tier 2, Figure 3.7.1-16, Note 1 will be revised to state, “For cable tray systems, meeting the cable tray system similarity criteria in Table 3.7.1-7—Criteria for Cable Tray System Similarity with Bechtel-ANCO Test Program, a damping value of up to 15 percent in transverse direction only may be used for 50 percent to fully loaded tray subject to the following limitations.”

U.S. EPR FSAR Tier 2, Figure 3.7.1-16, Note 2 will be revised to state, “For cable tray systems that do not meet cable tray similarity criteria in Table 3.7.1-7—Criteria for Cable Tray System.

Similarity with Bechtel-ANCO Test Program, use a damping value of 10 percent for fully loaded tray. In accordance with RG 1.61, when a tray is at least 50 percent loaded, but not fully loaded, a damping value of up to 10 percent may be used provided it is justified and documented."

Cable tray system similarity criteria used for evaluating the similarity of U.S. EPR cable tray system configurations with the cable tray systems tested in the Bechtel-ANCO test program are listed in Table 03.07.01-28-1 and will be added as U.S. EPR FSAR Tier 2, Table 3.7.1-7. Applicability of test results from cable tray systems tested in the Bechtel-ANCO test program is dependent on meeting the criteria in Table 03.07.01-28-1.

Despite various makes and models of standard 12 gauge channel-type strut, there is a distinct uniformity in shapes and sizes across the industry. For this reason, there are no restrictions on manufacturers or specific models. Table 03.07.01-28-1 provides limitations on struts that can be considered similar to those tested in the Bechtel-ANCO test program. Struts with holes or slots are excluded because these types were not tested and it is unclear whether similar fragility levels can be achieved for struts with holes or slots. The strut length limitation in Table 03.07.01-28-1 reflects the lower and upper bound of strut lengths tested during the Bechtel-ANCO test program. Support struts longer than 11 feet 6 inches may exhibit similar behavior observed in the Bechtel-ANCO test program; however the limitation is imposed to reflect current test results. The struts tested in the Bechtel-ANCO test program are shown in Figure 03.07.01-28-4.

Table 03.07.01-28-1, Note 5 indicates that all industry standard tray types are applicable. While there is standardization of cable tray width among manufacturers, the cable tray shapes (e.g., section of side rails, ladder rungs) vary from one manufacturer to another. Various cable trays can be properly modeled and analyzed using equivalent section properties in the vertical and transverse directions. Section properties of cable tray for various manufacturers and models are obtained from static load tests performed by the manufacturer. During these tests, the cable tray is subjected to static loading in incremental steps and deflection measured at various locations, from which a load-deflection curve is plotted and equivalent section properties determined. For analysis, cable trays can be modeled as beam elements using the equivalent section properties obtained from static load tests as input for the beam element properties.

The criteria for maximum support spacing in Table 03.07.01-28-1, Note 3 represents the maximum support spacing of the cable tray system configurations tested in Bechtel-ANCO test program. The criteria for longitudinal bracing in Table 03.07.01-28-1, Note 7 is based on constraints of the shake table apparatus used to test various cable tray system configurations during the Bechtel-ANCO test program.

The Bechtel-ANCO test program load tested a number of connection configurations, including B-Line Systems, Inc. clip angle models B101, B104 and B144L combined with Unistrut Corporation model equivalent P1001, P5501 and P5001 struts. For these configurations, values for degraded rotational stiffness are obtained from the Bechtel-ANCO test report using the methodology described in Part A of this response. Results of these connection load tests are proprietary and are not provided in the U.S. EPR FSAR. If clip angle models and/or manufacturers different than those tested are used, new connection load tests will be performed using the testing methodology provided in the Bechtel-ANCO test report, which is also publicly available in Reference 1. Reference to this publication will be added to U.S. EPR FSAR Tier 2, Table 3.7.1-7. The degraded rotational spring constant for a particular strut and clip angle configuration will be obtained from moment versus rotation strength plots as described in Table 03.07.01-28-1, Note 4 and in Part A of this response.

Cable tray system parameters in the Bechtel-ANCO test program determined to have negligible influence on cable tray system dynamics include tray side rail, splice plate locations, type of tray (manufacturer), mix of cable sizes in the cable tray, and the presence of cable ties. Although cable ties do not influence cable tray system dynamics, Table 03.07.01-28-1 and Note 6 specifies cable tie spacing limitations. In the Bechtel-ANCO test program, cable tie spacing of 2 feet on center was a lower bound spacing to achieve at least 15 percent damping of the cable tray system. Cable tie spacing closer than two feet on center may reduce the friction between cables, and movement and bouncing of cables within the tray, which has been shown to be a significant contributor to damping. Tying cable bundles to other cable bundles also reduces cable friction and movement. Restrictions shown in Table 03.07.01-28-1 and Note 6 are based on these findings.

Part E1:

Seismic analysis is performed using either the equivalent static load method (includes peak response approach and frequency determination approach) or the response spectrum method. For both methods, material models and system responses are considered to be linear. Nonlinearities in the system fundamental frequency observed in the Bechtel-ANCO test program are associated with localized plastic deformation of support clip angles and support struts (in vicinity of the clip angles). Nonlinearity is addressed by using degraded rotational springs when modeling cable tray systems. Nonlinearities in system damping are predominantly associated with friction between cables, movement and bouncing of cables within the tray, and partially due to hysteretic damping from the localized plastic deformation of the support connections (the hysteretic damping component is neglected as addressed in Part A1 of this response). The damping behavior in the transverse direction is accounted for by conservatively limiting maximum damping to 15 percent for cable tray systems meeting similarity criteria defined in Table 03.07.01-28-1. The 15 percent, damping is a lower bound value as indicated in the Response to RAI 215, Question 03.07.01-23. Results from the Bechtel-ANCO test program demonstrated that making adjustments to account for the effects of nonlinear behavior allows utilization of linear analysis methods capable of predicting system response.

In the peak response approach described in U.S. EPR FSAR Tier 2, Section 3.7.3.1.4, the peak acceleration value from an appropriate in-structure response spectrum (ISRS) curve is conservatively used in combination with a multi-mode factor of 1.5 in each of the three orthogonal directions in accordance with U.S. EPR FSAR Tier 2, Section 3.7.3.1.4 to determine seismic loads. A static analysis of the cable tray system is performed with a multi-mode factor of 1.5 in each direction in each of the three orthogonal directions. Because the peak response approach takes the peak acceleration value, any variation in the fundamental frequency resulting from the softening of the system is enveloped.

The Frequency Determination Approach to the equivalent static load method considers the response from an ISRS curve at the corresponding fundamental frequency of the cable tray system in each of the three orthogonal directions to determine the seismic loads. Because the seismic demands are calculated on a frequency dependent basis, softening effects of the support connections need to be addressed in determining the system fundamental frequency in the transverse direction (horizontal direction perpendicular to tray run). As described in Part A of this response, softening effects of support connections can be neglected in the longitudinal and vertical directions. System frequencies are calculated using standard methods of analysis with a multi-mode factor of 1.5 in each direction in each of the three orthogonal directions. The system fundamental frequency in each direction is used to determine the acceleration from the appropriate modified ISRS curve. The fundamental frequency for a given cable tray system can be calculated using analytical approaches or computational methods through eigenvalue analysis. Characteristics of cable tray system models used for seismic analysis are described in Part E2 of this response. Results of the Bechtel-ANCO test program concluded that uncertainties in the calculation of system fundamental frequencies are conservatively mitigated by considering a frequency band extending from ±20 percent of the calculated fundamental frequencies in each of the three directions. Within the ± 20 percent frequency band for each direction, the appropriate modified ISRS curve is inspected for maximum spectral acceleration, and corresponding equivalent static forces are evaluated using a multi-mode factor of 1.5 in each of the three orthogonal directions.

A demonstration of how design basis ISRS are modified and ±20 percent frequency bands are implemented for the Frequency Determination Approach is illustrated in a new U.S. EPR Tier 2, Figure 3A-1 and Figure 3A-2. Two possible scenarios are presented with U.S. EPR Tier 2, Figure 3A-1 showing the scenario of a design basis ISRS where the high frequency peak has the highest spectral acceleration and with U.S. EPR Tier 2, Figure 3A-2 showing the scenario of a design basis ISRS where the low frequency peak has the highest spectral acceleration. For both scenarios, the calculated system fundamental frequency is plotted for three example cable tray systems that each have a different fundamental frequency (for a given cable tray system a fundamental frequency is calculated for each orthogonal direction) to illustrate how design accelerations are selected within the corresponding ±20 percent frequency bands at different locations on the design basis ISRS. The modified ISRS in U.S. EPR Tier 2, Figure 3A-1 and Figure 3A-2 show the peak spectral acceleration extended left of the peak in accordance with U.S. EPR FSAR Tier 2, Section 3.7.3.1.4. This extension of the peak spectral acceleration accounts for multi-mode effects and is applicable in each of the three orthogonal directions (since multi-mode factors are derived based on a uniform acceleration spectrum, their implementation requires that spectral accelerations at the frequencies of higher modes must be less than or equal to the acceleration at the fundamental frequency). For each of the three orthogonal directions, the maximum spectral acceleration within the ±20 percent frequency band of the modified ISRS is multiplied by a multi-mode factor of 1.5. In addition, for the manual determination of transverse system fundamental frequencies, selecting boundary conditions so that the frequency approximation underestimates the actual system frequency, as required by the seismic modeling procedure in U.S. EPR FSAR Tier 2, Section 3A.3.6.3, together with extending the peak spectral acceleration to lower frequencies, provides conservative acceleration values for the fundamental mode. The procedures for using the Frequency Determination Approach for cable tray systems, as described in this response, will be added to U.S. EPR FSAR Tier 2, Section 3A.3.6.3. A statement will also be provided in U.S. EPR FSAR Tier 2, Section 3.7.3.1.4, which will clarify that additional considerations specific for cable tray systems are provided in U.S. EPR FSAR Tier 2, Section 3A.3.6.3.

When using the equivalent static load method for analysis of cable tray systems meeting similarity criteria defined in Table 03.07.01-28-1, either the frequency determination approach or the peak response approach to the equivalent static load method is used for each of the three orthogonal directions. For cable tray systems, the system fundamental frequencies in the longitudinal and vertical directions are typically outside the amplified region and closer to the ZPA of a typical ISRS curve. For these systems, use of the peak response approach will generate over-conservative seismic demands in the longitudinal and vertical directions. As a result, it may be more appropriate to use the peak response approach for the transverse direction and the frequency determination approach for the longitudinal and vertical directions. Regardless of the approach to the equivalent static load method used in each direction (i.e., different approaches used for different cable tray orthogonal directions), the seismic acceleration coefficient from the appropriate ISRS curve in each direction is always multiplied by a multi-mode factor of 1.5.

For the response spectrum method, a computational model is developed to perform eigenvalue analysis of the system. Softening effects of support connections in the transverse direction and characteristics of cable tray system computer models are addressed similar to the frequency determination approach. However, accounting for uncertainties in calculation of system fundamental frequencies due to modeling is different. The appropriate ISRS for the transverse direction is smoothed and broadened consistent with U.S. EPR FSAR Tier 2, Section 3.7.3.1.1, and is modified so that the peak is extended from a frequency of zero Hz to a frequency that extends 20 percent beyond the maximum frequency associated with the peak spectral acceleration. This approach is applied in the transverse direction to verify conservatism when using degraded rotational stiffness values for support connections. In the vertical and longitudinal directions, it is sufficient to broaden the peaks of the appropriate ISRS curves by ±20 percent. The ISRS curves are also smoothed and broadened in accordance with U.S. EPR FSAR Tier 2, Section 3.7.3.1.1.

A demonstration of how design basis ISRS are modified when using the response spectrum method is illustrated in the new U.S. EPR Tier 2, Figure 3A-3 and Figure 3A-4. Two possible scenarios are presented, with U.S. EPR Tier 2, Figure 3A-3 showing the scenario of a design basis ISRS where the high frequency peak has the highest spectral acceleration and U.S. EPR Tier 2, Figure 3A-4 showing the scenario of a design basis ISRS where the low frequency peak has the highest spectral acceleration. In both scenarios, the peaks of the design basis ISRS are broadened by 20 percent for the vertical and longitudinal directions to account for uncertainties in fundamental frequency estimates due to modeling. For the transverse direction in both scenarios the design basis ISRS is modified so that the peak spectral acceleration is extended left of the peak frequency to either the next modified ISRS peak or to a frequency of zero Hz, as shown in U.S. EPR Tier 2, Figure 3A-3 and Figure 3A-4. This extension of the peak spectral acceleration accounts for support connection softening effects in the transverse direction. For the transverse direction in both scenarios, the peak of the design basis ISRS is also extended to the right of the peak by 20 percent, as shown in U.S. EPR Tier 2, Figure 3A-3 and Figure 3A-4 to account for uncertainties in fundamental frequency estimates due to modeling. The procedures for using the response spectrum method for cable tray systems, as described in this response, will be added to U.S. EPR FSAR Tier 2, Section 3A.3.6.3. A statement will also be provided in U.S. EPR FSAR Tier 2, Section 3.7.3.1.1, which will clarify that additional considerations specific to cable tray systems are provided in U.S. EPR FSAR Tier 2, Section 3A.3.6.3.

System fundamental frequencies for a cable tray system tested in the Bechtel-ANCO test program qualitatively show the effect of degraded rotation stiffness on system fundamental frequency. Using a single degree-of-freedom (SDOF) model approximation, it is demonstrated that the change in rotational stiffness for support connections from the initial value to degraded value provides a lower bound estimate of the transverse system fundamental frequency, as compared with test results.

Transverse system fundamental frequencies for cable tray systems using fully loaded Metal Products Corporation (MPC) ladder trays are plotted with respect to base motion input zero-period acceleration (ZPA) in Figure 03.07.01-28-5. Test results shown in Figure 03.07.01-28-5 are solely for MPC ladder trays. Test results are not all from the same test sequence. Therefore, some variation exists between test results. In the Response to RAI 215, Question 03.07.01-23, a linear least squares regression was performed on test data for various tray types and manufacturers with 100 percent cable loading, and with consistent support configurations. A trend line for degraded system fundamental frequency was developed and plotted in the Response to RAI 215, Figure 03.07.01-23-1. As noted in the Response to RAI 215, Question 03.07.01-23, a reduction in system fundamental frequency with increasing base motion input ZPA was observed in the Bechtel-ANCO test results. This trend line is plotted in Figure 03.07.01-28-5. The black horizontal line in Figure 03.07.01-28-5 represents an estimate of the transverse system fundamental frequency that might be expected from an SDOF model approximation that is characterized by a fully loaded cable tray system and support connections, with degraded rotational stiffness associated with $\theta_{ult}/2$ (from the strength curve shown in Figure 03.07.01-28-2). As shown in Figure 03.07.01-28-5, the system fundamental frequency calculated using the degraded rotational stiffness associated with $\theta_{ult}/2$ provides a lower bound estimate of the system fundamental frequency (approximately 2.5 Hz), as compared with the MPC ladder tray test data and the trend line for other tray manufacturers for base motion input ZPA up to approximately 0.9 g.

The reduced system fundamental frequencies shown in Figure 03.07.01-28-5 are associated with softening of the connections (degraded rotational stiffness), and the results are from sine-sweep testing. While sine-sweep tests are effective for system identification, the periodic motion can introduce a large amount of energy near resonant frequencies and can cause more damage than may be experienced by random vibration, such as seismic motion). When earthquake excitation was used for base motion input in the Bechtel-ANCO test program and system fundamental frequencies were identified, less reduction in system frequencies, or more specifically, less softening of connections, was observed for seismic base input ZPAs up to approximately 2.4 g. Using a lower bound system frequency, which is shown as the black horizontal line in Figure 03.07.01-28-5, based on a strength curve of the representative connection associated with $\theta_{ult}/2$, provides a conservative estimate for design purposes.

In addition to modeling considerations for support connections, an additional requirement for a low-cycle fatigue check is applied in accordance with U.S. EPR FSAR Tier 2, Section 3.7.3.2 to confirm structural integrity of the softened support connections for a sufficient number of cycles under seismic loading. Consistent with U.S. EPR FSAR Tier 2, Section 3.7.3.2, cable tray systems are qualified to withstand the effects of seismic induced fatigue associated with five one-half SSE events, followed by one full SSE event (with 10 maximum stress cycles per event). This type of cyclic loading induces levels of stresses in the support connection in excess of the material yield limit and is often referred to as low-cycle fatigue. During the Bechtel-ANCO test program, it was concluded that since support connections are cycled beyond the strain associated with the material yield limit, reference to cyclic stress is not suitable for fatigue evaluation and cycles to failure are more appropriately defined in terms of strain levels (for support connections in terms of angular rotation). Connection fatigue checks are evaluated after seismic analysis of the cable tray system is completed and maximum rotation of support connections are computed. The maximum rotation of the support connections are then compared with corresponding number of cycles to failure obtained from strut connection fatigue tests.

Fatigue evaluation of a typical strut support connection with bolted clip angles is shown in Figure 03.07.01-28-6. The figure shows test data from a strut support connection fatigue test conducted during the Bechtel-ANCO test program. The cycles to connection failure, N, are plotted for various set values of connection angular rotation applied during testing. A mean trend line of the test data that represents the expected cycles to failure is shown in Figure 03.07.01-28-6. For design purposes, an appropriate factor of safety, with respect to the mean trend line, is selected so that the curve used for design provides a lower bound of the test data. An example of a design curve is shown in Figure 03.07.01-28-6. Further information regarding the strut support connection fatigue tests is provided in Reference 3.

To evaluate the fatigue life of a strut connection, an SSE event is applied to the cable tray system to determine the maximum rotation of the support connection. The rotation is used in conjunction with the process shown in Figure 03.07.01-28-6 to determine the allowable number of cycles that the connection can sustain at that rotation. In a similar manner, the allowable number of cycles is determined for the maximum rotation obtained from seismic analysis based on one-half of the SSE event. When the allowable number of cycles for each seismic event is determined, fatigue life of the strut connection is evaluated using the cumulative usage factor shown in Figure 03.07.01-28-6 consistent with fatigue requirements provided in U.S. EPR FSAR Tier 2, Section 3.7.3.2.

The cumulative usage factor for evaluating fatigue life is comparable to the linear damage accumulation theory in Reference 4. According to this theory, the material uses different fractions of its fatigue life during each cyclic event (e.g., five one-half SSE events and one full SSE event). The fractional damage at a rotation level is added to the corresponding fractional damage of another rotation level to obtain the total cumulative damage experienced. The strut connection will undergo fatigue failure when the total cumulative damage reaches a value of unity.

Part E2:

Hand calculations, based upon verified assumptions, can be used in conjunction with the equivalent static load method. When a more refined analysis method, (e.g., response spectrum method) is used, cable tray systems are modeled as three-dimensional frame structures for seismic analysis in each of the three orthogonal directions. Attention is given to the proper modeling of joints and members. The model is constructed using the following criteria:

- The cable trays are modeled as continuous beam elements using the tray section properties provided by the vendor as input for the equivalent beam element properties. The beams are discretized into approximately 1 foot elements to accurately model the mass distribution and capture the response contribution of the higher modes.
- Vertical and horizontal support struts are modeled as continuous beam elements using strut section properties provided by the vendor. The beams are discretized into approximately one foot elements, with a minimum of three elements per beam, to accurately model the mass distribution and capture the response contribution of the higher modes.
- Transverse and longitudinal braces of the cable tray supports are modeled as single truss elements. Truss behavior is achieved by using beam elements and releasing end moments (releasing moments of the members transfer only axial and shear loads).

- Appropriate cable loading is considered by applying additional uniform loads to the beam element representing the tray.
- Strut hangers exhibit a moderate amount of moment-resisting frame action between members and joints. Connections are modeled to reflect flexural behavior of the strut-to-clip angle connections. In transverse direction degraded rotational spring constants are incorporated into the model. Determining degraded rotational spring constants is described in Part A of this response (i.e., rotational spring constants are obtained from strut connection load tests).
- Appropriate in-structure response spectrum (ISRS) curves are applied to the model in each orthogonal direction.

Criteria for the seismic model used for cable tray systems will be added to U.S. EPR FSAR Tier 2, Section 3A.3.6.3.

Part E3:

Hand calculations based on verified assumptions, are sometimes used in conjunction with the equivalent static load method. When a more refined analysis, such as the response spectrum method is used, modal analysis is also performed. The cable tray system is modeled as linear. The methodology described in U.S. EPR FSAR Tier 2, Section 3.7.3.1.1 is used for modal analysis (response spectrum method) and the methodology described in U.S. EPR FSAR Tier 2, Section 3.7.3.1.4 is used for the equivalent static load method.

For either modal analysis or the equivalent static load method, damping values exceeding those in RG 1.61, Revision 1 of up to 15 percent may be used for evaluating the cable tray system in the transverse direction (perpendicular to the direction of the tray run). For the longitudinal and vertical directions, damping values in accordance with Table 4 of RG 1.61, Revision 1 and U.S. EPR FSAR Tier 2, Table 3.7.1-1 are used for seismic analysis. Linear methods of analysis are adequate for seismic analysis of cable tray systems if appropriate measures are considered in the seismic model and in defining the characteristics of the strut support connections. Part E1 of this response provide details on determining degraded rotational stiffness, modeling of cable tray system, and fatigue evaluation of the softening effects of strut support connections under cyclic loading.

Part E4:

When modal analysis is performed, the modal frequencies are determined using the same standard methods described in U.S. EPR FSAR Tier 2, Section 3.7.3.1.

The same modal damping value used for the fundamental mode is also used for the higher modes. Therefore, the same damping values are applied for low and high frequencies. Damping values used for the longitudinal and vertical directions are in accordance with Table 4 of RG 1.61, Rev. 1 and U.S. EPR FSAR Tier 2, Table 3.7.1-1. In the transverse direction, damping values up to 15 percent may be used for seismic analysis in accordance with U.S. EPR FSAR Tier 2, Figure 3.7.1-16.

Use of the same modal damping value for higher modes and fundamental mode is justified based on a number of considerations. The Bechtel-ANCO test program concluded that higher modes, which typically involve tray bending, exhibit more damping (e.g., bracing induces tray bending that results in increased damping) than modes that do not. For the same reason, higher modes of vibration generally have higher damping than the fundamental modes. Since the fundamental mode dominates the response, the modal participation of higher modes is small in comparison. The influence of higher modes on system response is further reduced when higher modes are combined using modal combination methods, such as square root of the sum of the squares (SRSS). Higher modes are associated with higher frequencies, where the spectral acceleration for various damping values tends to converge, reducing the importance of the actual damping value.

Part E5:

The use of higher damping does not affect the application of co-directional response combination methodologies described in U.S. EPR FSAR Tier 2, Section 3.7.3.6. These methods for spatial combination are consistent with RG 1.92, Revision 2, and used when damping values higher than those in RG 1.61, Revision 1 (i.e., a damping value of up to 15 percent) are selected for the transverse direction (horizontal direction perpendicular to tray run).

Because the methods of seismic analysis for cable tray systems using higher damping transversely are consistent with methods currently defined in the U.S. EPR FSAR Tier 2, Section 3.7.3, no further descriptions of the analysis process for co-directional response combination will be added to the U.S. EPR FSAR.

Part F:

U.S. EPR FSAR Tier 2, Table 3.7.1-1 and Figure 3.7.1-16 will be revised to modify the damping value discrepancies. U.S. EPR FSAR Tier 2, Sections 3.7.1.2 and 3A.3.5 will also be revised to maintain consistency with U.S. EPR FSAR Tier 2, Table 3.7.1-1 and Figure 3.7.1-16.

References

1. “Plastic Capacity of Raceway Supports - Experimental Evidence,” *Proceedings of Second ASCE Conference on Civil Engineering and Nuclear Power,* Keowen et al, Knoxville, Tennessee, 1980.
2. “Dynamics of Structures: Theory and Applications to Earthquake Engineering,” Chopra, A.K., 2nd Edition, Prentice Hall.
3. “Plastic Capacity of Raceway Supports – Engineering Analysis” *Proceedings of Second ASCE Conference on Civil Engineering and Nuclear Power*, Hamilton, C. W. and Hadjian, A. H., Knoxville, Tennessee, September 15-17, 1980.
4. "Random Vibrations in Mechanical Systems," Crandall, S. H. and Mark, W. D., 1963.

FSAR Impact:

U.S. EPR FSAR Tier 2, Sections 3.7.1.2, 3.7.1.4, 3A.3.5 and 3A.3.6.3, Table 3.7.1-1 and Figure 3.7.1-16 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR Tier 2, Table 3.7.1-7 and Figures 3A-1, 3A-2, 3A-3, and 3A-4 will be added as described in the response and indicated on the enclosed markup.

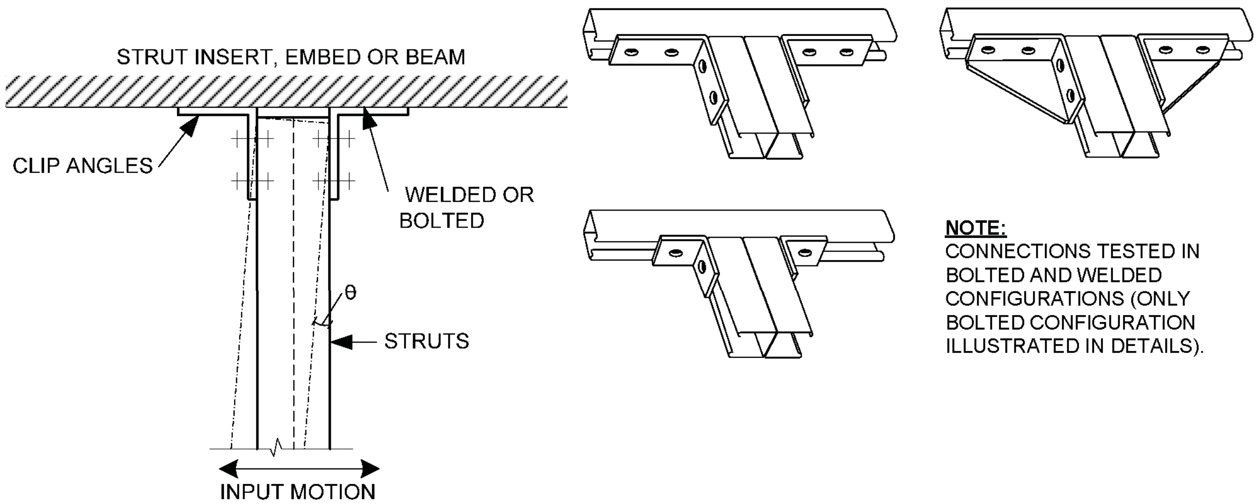
Table 03.07.01-28-1—Criteria for Cable Tray System Similarity with Bechtel-ANCO Test Program

Criteria	Similarity Characteristic
Support Members (See Note 1)	
• Type	Strut Type Trapeze and Strut Type Cantilever (See Note 2)
• Length	2'-0" to 11'-6"
• Width	2'-0" to 4'-0"
• Spacing	Maximum 8'-0" (See Note 3)
• Section	Channel without Holes or Slots
• Material	Cold-Formed from 12 gauge Strip Steel
Fittings	
• Support Anchor and Framing Connections	Single and Double Clip Angles using Bolted or Welded Construction Type (See Note 4)
Tray	
• Type	(See Note 5)
• System	1 to 5 Tiers (Trapeze Type) 1 to 3 Tiers (Cantilever Type)
• Width	1'-0" to 3'-0"
• Span	(See Support Spacing)
• Material	Steel
• Cable Ties	Cable Tie Spacing of No Closer than 2'-0" on Center (see Note 6)
• Hold Down Anchor	Friction Clamp or Bolt-through Clamp
• Covers	Min. 1/2" Spacing Between Cables and Tray Covers
Bracing	
• Transverse	Cantilever – Brace at Every Support (Note 2) Trapeze - Min. of 1 Brace Every 2 Consecutive Supports
• Longitudinal	(See Note 7)
Fireproofing	Fire Retardant Spray Not Allowed Cerablankets Are Allowed

NOTES:

1. Struts by all manufacturers are allowed provided criteria for Support Members are satisfied.
2. Applicable strut cantilever support systems are constructed of a vertical strut suspended from a strut insert, embed or beam with horizontal cantilever struts carrying the trays and transverse bracing provided at every support.
3. Typical nominal spacing of cable tray supports is 8'-0". Spans less than 8'-0" are allowed for locating supports near obstructions.
4. B-Line Systems, Inc. clip angle models B101, B104 and B144L were tested and rotational stiffness for various strut configurations can be obtained from the Bechtel-ANCO test report (Reference 3 of 3.7.1.4). Other clip angle models and manufacturers may be used provided new connection load tests are performed using testing methodology provided in U.S. EPR FSAR Tier 2, Section 3.7.1.4, References 3 and 10. The rotational spring constant for a particular strut and clip angle configuration shall be taken from moment versus rotation strength plots, where the rotational spring constant is obtained from the slope of the line from the origin to the point on the strength curve corresponding to one-half the rotation at failure of the connection.
5. All industry standard tray types (e.g., Ladder, Punch Bottom or Trough) are applicable.
6. Cables shall not be bundled in groups. When used, cable ties shall be tied to the tray no closer than 2'-0" on center and not tied to other cables.
7. X-bracing (or two diagonal braces) shall be provided on both sides of the tray. The spacing between bracing on each side of the tray shall not exceed 48'-0".

Figure 03.07.01-28-1—Typical Tested Connection Types: (a) Test Configuration (b) Connection Details



(a) (b)

Figure 03.07.01-28-2—Example Strength Curve in Strong Axis for B-Line Systems Model B-104 Clip Angle with B-Line Systems B-22A Strut

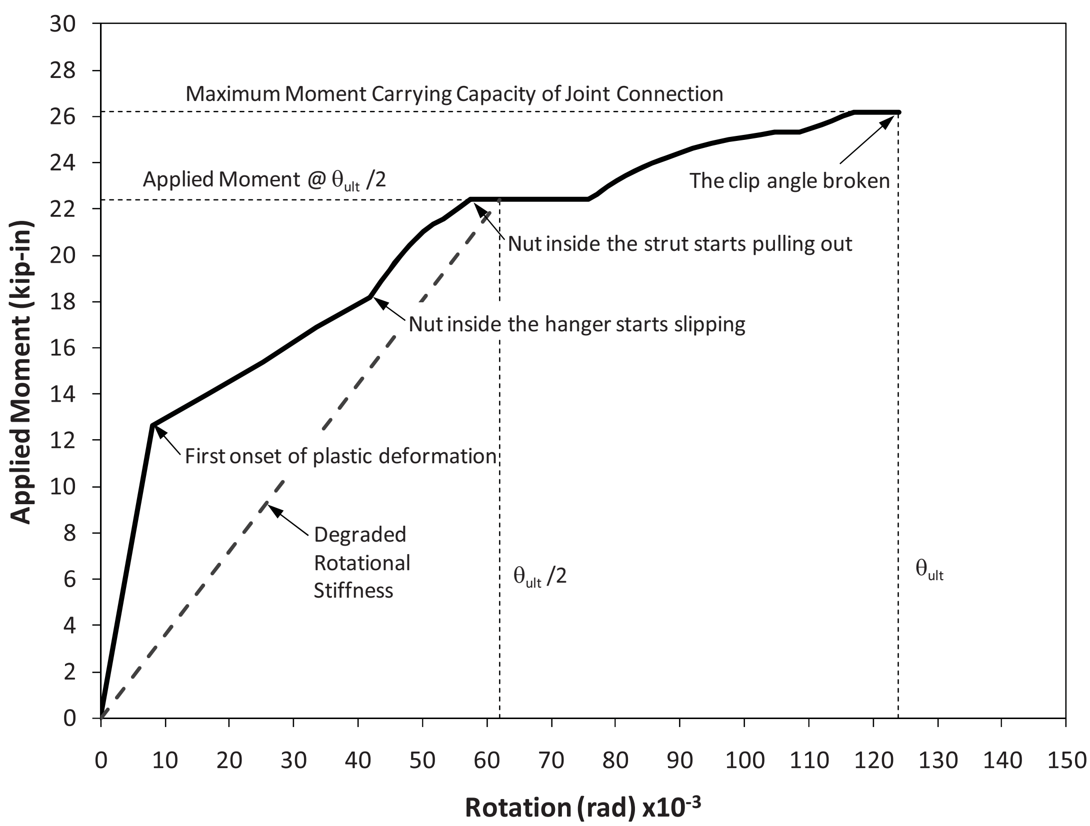


Figure 03.07.01-28-3—First Hysteresis Plots of a Typical Bolted Clip Angle and Strut Connection at Various Prescribed Maximum Rotations (Adapted from Bechtel-ANCO Report)

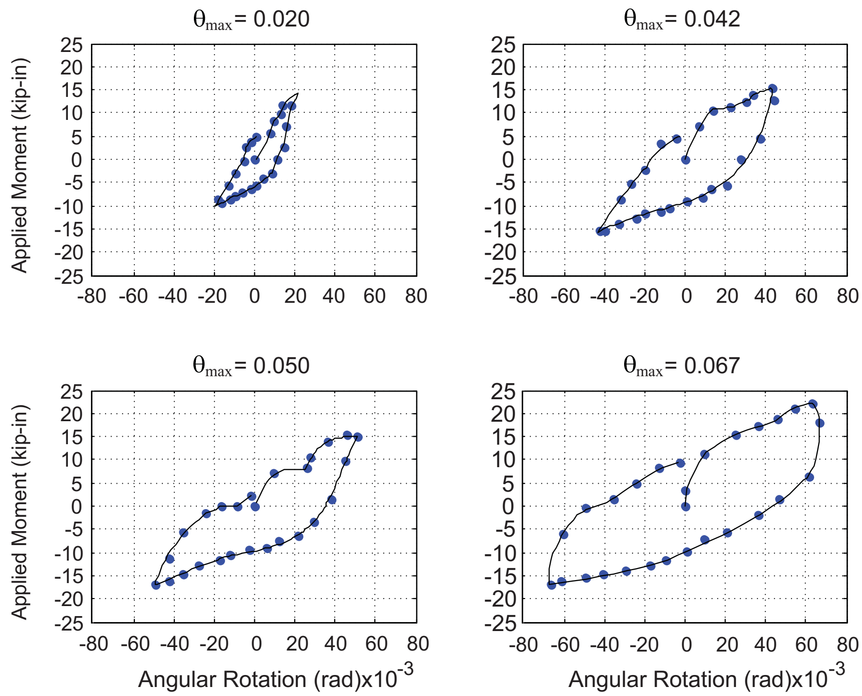
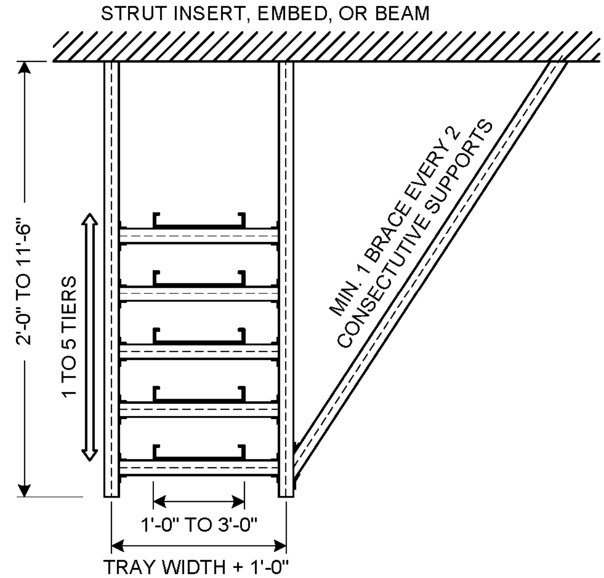
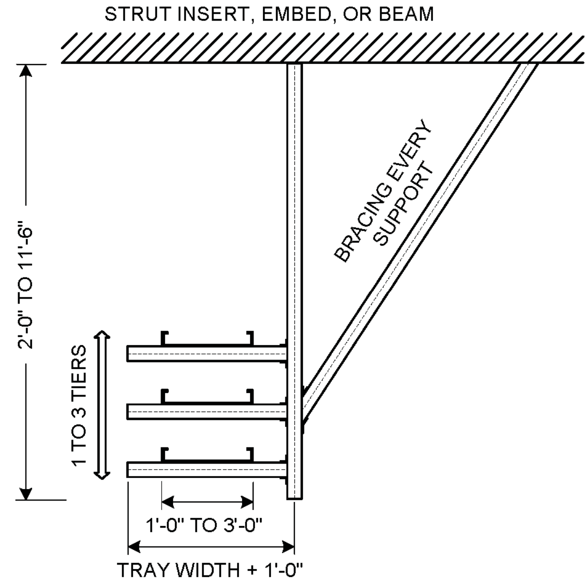


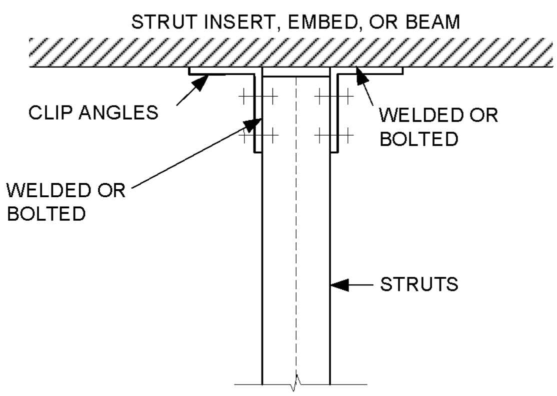
Figure 03.07.01-28-4—Typical Cable Tray Hardware



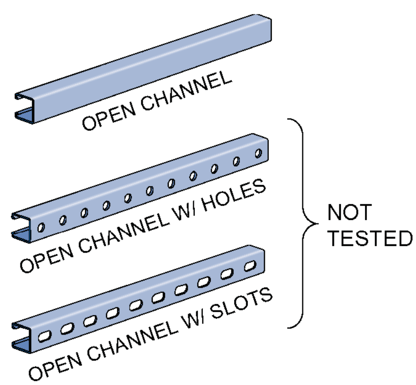
(a) Strut Type Trapeze



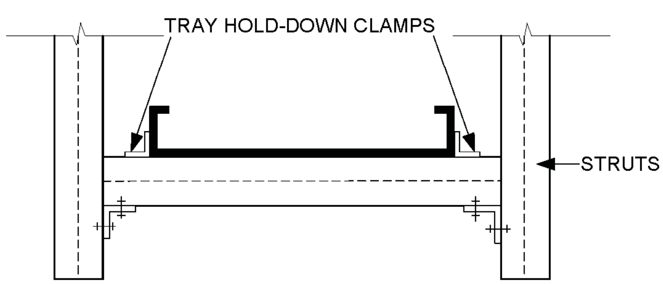
(b) Strut Type Cantilever



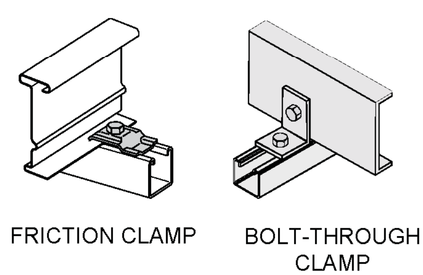
(c) Double Clip Angle Connection



(d) Strut Types

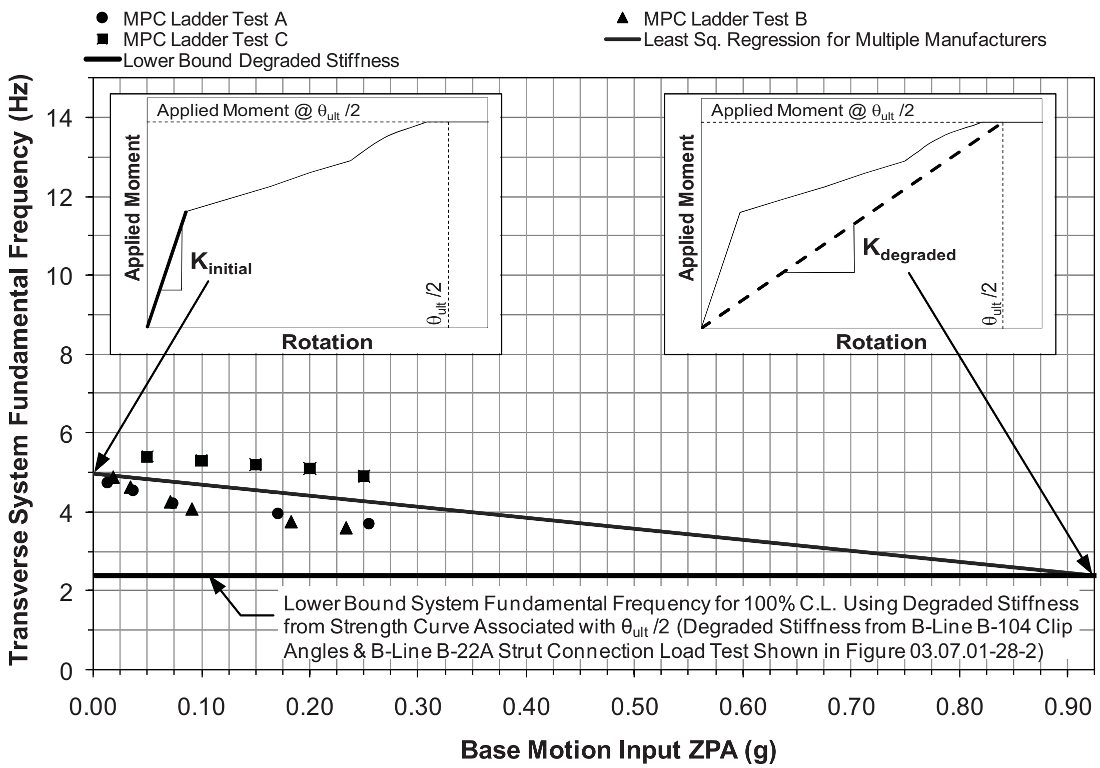


(e) Single Clip Angle Connection



(f) Tray Hold-Down Clamps

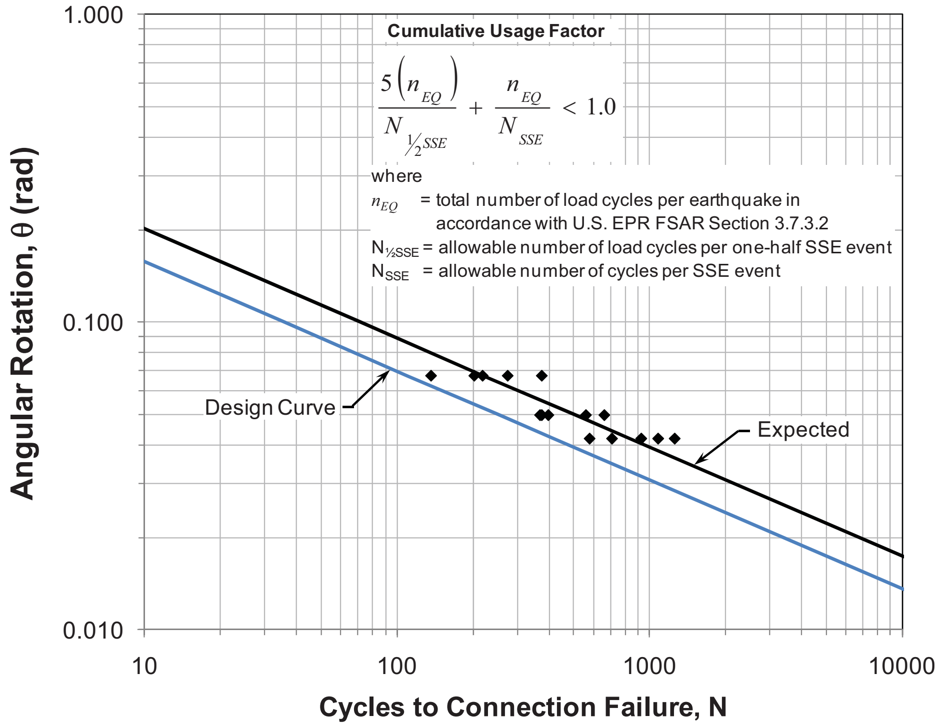
Figure 03.07.01-28-5—Transverse System Fundamental Frequency Based on Bechtel-ANCO Report Test Results for Various Manufacturers[1]



Note:

1. General trends based on least squares regression, and lower bound system fundamental frequency based on degraded stiffness from strength curve.

Figure 03.07.01-28-6—Bechtel-ANCO Test Results for Fatigue Tests of B-Line Systems B-22A (Unistrut N1001 Equivalent) Support Struts with B-Line Systems B104 Bolted Clip Angles



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The damping values for conduits and cable tray systems are presented in Table 3.7.1-1. Several test programs and studies have demonstrated that higher damping values may be utilized for certain cable tray systems (References 3 through 5). For cable tray

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systems that are similar to those tested by Bechtel-ANCO Engineers, Inc. (Reference 3) meet the criteria in Table 3.7.1-7 for similarity to the Bechtel-ANCO test program and satisfy tray loading criteria of RG 1.61, the damping values in Figure 3.7.1-16—Damping Values for Cable Tray Systems, may be used on a case-by-case basis. These systems and are limited to a maximum damping value of 15 percent dampingin the transverse direction (horizontal direction perpendicular to direction of of tray run) and limited to damping values of RG 1.61 in the other directions. For cable tray systems that are significantly different than those tested by Reference 3, do not meet the criteria in Table 3.7.1-7 for similarity to the Bechtel-ANCO test program, the damping values of RG 1.61 shall be used for each of the three orthogonal directions. See Appendix 3A for additional discussion on cable tray and conduit system damping.

Heating, ventilation, and air conditioning duct systems use damping values of 10 percent for pocket-lock construction, seven percent for companion-angle construction, and four percent for welded construction. The damping values provided in Table 3.7.1-1 are applicable to time history, response spectra and equivalent static analysis procedures for structural qualification as discussed in regulatory position C.4 of RG 1.61.

The seismic qualification of passive electrical and mechanical equipment by analysis is performed using the damping values listed in Table 3.7.1-1, which are in conformance with regulatory position C.5 of RG 1.61. The seismic qualification of active electrical and mechanical equipment is performed by testing as described in Section 3.10.

Modes of vibration of a structure, component, or subsystem composed of the same material are assigned the appropriate damping value. Damping values for structures, components, and systems composed of materials of different properties are determined using the procedures in Table 3.7.1-1 (Note 1) and Section 3.7.2.15 and Section 3.7.3.5.

Material damping values for soils are presented below in Section 3.7.1.3.

3.7.1.3 Supporting Media for Seismic Category I Structures

Chapter 3.8 provides a detailed description of the NI Common Basemat Structures and other Seismic Category I structures. Figure 3B-1—Dimensional Arrangement Reference Plant Building Location, illustrates the general arrangement of the standard plant and provide key dimensions and separation distances between the NI Common Basemat Structures and other Seismic Category I and non-Seismic Category I structures. The NI Common Basemat provides common support for the shield structure, Safeguard Buildings 1 through 4, the Fuel Building, the Reactor Building,

9. NUREG/CR-6728, "Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk- Consistent Ground Motion Spectra Guidelines," Nuclear Regulatory Commission, October 2001.

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10. Keowen, R.S., Stoessel, J., Sires-Yifat, C., and Ibanez, P., "Plastic Capacity of Raceway Supports - Experimental Evidence," Proceedings of Second ASCE Conference on Civil Engineering and Nuclear Power, Knoxville, Tennessee, September 15-17, 1980.

Table 3.7.1-1—Damping Values for Safe Shutdown Earthquake
Sheet 1 of 2

Item	Percent Critical Damping, SSE [4]
Reinforced concrete structures	7
Prestressed Concrete Structures	5
Welded Steel or Bolted Steel with Friction Connections [1]	4
Bolted Steel with Bearing Connections [1]	7
Motor, Fan, and Compressor Housings	3
Pressure Vessels, Heat Exchangers, and Pump and Valve Bodies	3
Welded Instrument Racks	3
Electrical Cabinets, Panels, and Motor Control Centers (MCC)	3
Piping Systems	
• Time history and ISM response spectrum analysis	
• USM response spectrum analysis	See Note 2
• Systems susceptible to Stress Corrosion Cracking (SSC)	
• Systems with supports designed to dissipate energy by yielding	
Reactor Coolant System [6]	
• Component Shells	3
• Component Internals	4
• RPV Closure Head Equipment Tie Rods	7
• RCS Component Supports	4
• RCS Piping (including Surge Line)	4
• Fuel Assemblies [5]	30 max
Cable trays and supports [3]	See Note 3
• ~~Maximum Cable~~ Fully Loaded~~ing~~ [~~A, D~~3D]	~~10~~
• Empty [~~B~~3B, 3D]	~~7~~
• Sprayed-on Fire Retardant or other cable-restraining mechanism [~~C~~3D]	~~7~~
• Cable Tray Systems meeting the criteria for similarity in Table 3.7.1-7[3E] ~~Represented by Reference 3~~[~~E~~]	~~15 max~~
Conduits [3]	See Note 3
• ~~Maximum Cable fill~~Fully Loaded [~~A~~3D]	~~7~~
• Empty [~~B~~3B, 3D]	~~5~~

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Table 3.7.1-1—Damping Values for Safe Shutdown Earthquake
Sheet 2 of 2

Item	Percent Critical Damping, SSE [4]
HVAC Duct Systems	
• Pocket lock	10
• Companion angle	7
• Welded	4
Metal Atmospheric Storage Tanks	
• Impulsive Mode	3
• Sloshing mode	0.5

Notes:

1. For steel structures with a combination of different connection types, use the lowest specified damping value, or as an alternative, use a "weighted average" damping value based on the number of each type present in the structure.

2. As specified in RG 1.61, Revision 1 and ANP-10264NP-A.

3. The following clarifications are applicable.

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A. DeletedMaximum cable loadings, in accordance with the plant design specification, are to be utilized in conjunction with these damping values.

B. Spare and initially empty cable trays and conduits, may beare analyzed with zero cable load and these a maximum of seven percent damping for cable trays and five percent damping for conduitsvalues. (Note: Reanalysis is performed when put into service.)

C. DeletedRestraint of the free relative movement of the cables inside a tray reduces the system damping.

D. The selected damping value shall be in accordance with Figure 3.7.1-16. Selected damping value is to be justified and documented on an individual basis when cable loadings less than 50 percent of the maximum rated loading are specified for design calculations.

E. Higher dDamping values beyond RG 1.61 and as shown in Figure 3.7.1-16 limited apply solely to the transverse direction (horizontal direction perpendicular to direction of tray run) of cable tray systems representative of systems tested in meeting the criteria in Table 3.7.1-7 for similarity to Bechtel-ANCO test program (Reference 3) and having loaded to greater than 50 percent to fully loaded trayof the maximum rated loading.

Table 3.7.1-7—Criteria for Cable Tray System Similarity with Bechtel-ANCO Test Program

Criteria	Similarity Characteristic
Support Members (See Note 1)	
• Type	Strut Type Trapeze and Strut Type Cantilever (See Note 2)
• Length	2'-0" to 11'-6"
• Width	2'-0" to 4'-0"
• Spacing	Maximum 8'-0" (See Note 3)
• Section	Channel without Holes or Slots
• Material	Cold-Formed from 12 gauge Strip Steel
Fittings	
• Support Anchor and Framing Connections	Single and Double Clip Angles using Bolted or Welded Construction Type (See Note 4)
Tray	
• Type	(See Note 5)
• System	1 to 5 Tiers (Trapeze Type) 1 to 3 Tiers (Cantilever Type)
• Width	1'-0" to 3'-0"
• Span	(See Support Spacing)
• Material	Steel
• Cable Ties	Cable Tie Spacing of No Closer than 2'-0" on Center (see Note 6)
• Hold Down Anchor	Friction Clamp or Bolt-through Clamp
• Covers	Min. 1/2" Spacing Between Cables and Tray Covers
Bracing	
• Transverse	Cantilever - Brace at Every Support (See Note 2) Trapeze - Min. of 1 Brace Every 2 Consecutive Supports
• Longitudinal	(See Note 7)
Fireproofing	Fire Retardant Spray Not Allowed Cerablankets Are Allowed

Notes:

1. Struts by all manufacturers are allowed provided criteria for Support Members are satisfied.

2. Applicable strut cantilever support systems are constructed of a vertical strut suspended from a strut insert, embed or beam with horizontal cantilever struts carrying the trays and transverse bracing provided at every support.

3. Typical nominal spacing of cable tray supports is 8'-0". Spans less than 8'-0" are allowed for locating supports near obstructions.

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4. B-Line Systems, Inc. clip angle models B101, B104 and B144L were tested and rotational stiffness for various strut configurations can be obtained from the Bechtel-ANCO test report (Reference 3). Other clip angle models and manufacturers may be used provided new connection load tests are performed using testing methodology provided in References 3 and 10. The rotational spring constant for a particular strut and clip angle configuration shall be taken from moment versus rotation strength plots, where the rotational spring constant is obtained from the slope of the line from the origin to the point on the strength curve corresponding to one-half the rotation at failure of the connection.

5. All industry standard tray types (e.g., Ladder, Punch Bottom or Trough) are applicable.

6. Cables shall not be bundled in groups. When used, cable ties shall be tied to the tray no closer than 2'-0" on center and not tied to other cables.

7. X-bracing (or two diagonal braces) shall be provided on both sides of the tray. The spacing between bracing on each side of the tray shall not exceed 48'-0".

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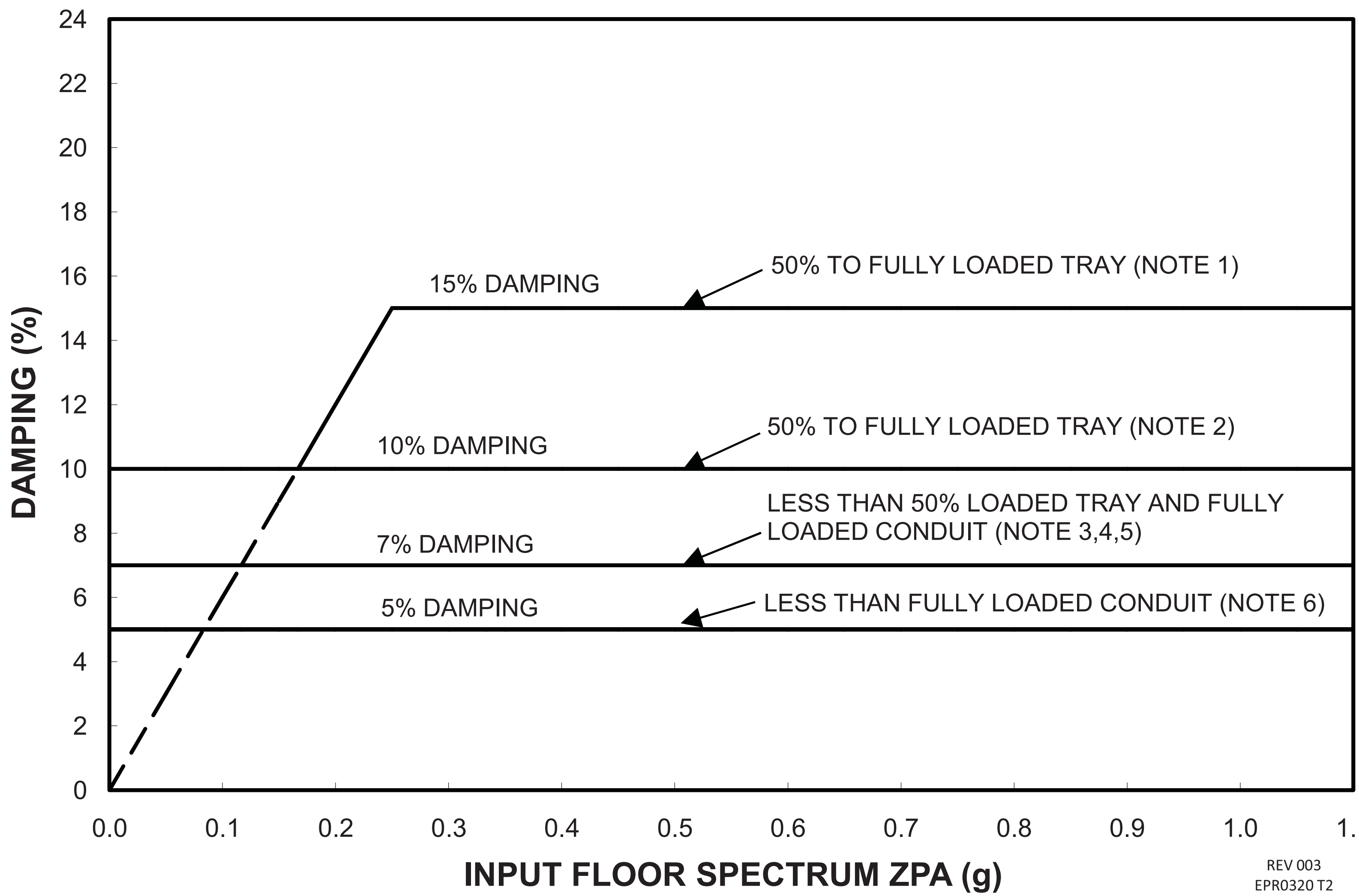
Figure 3.7.1-16—Damping Values for Cable Tray Systems



Notes:

1. For cable tray systems meeting the cable tray system similarity criteria in Table 3.7.1-7, a damping value of up to 15 percent in the transverse direction may only be used for a 50 percent to fully loaded tray, subject to the following limitations:

    a. ZPA greater than 0.25g, use a damping value of 15 percent.
    b. ZPA between 0.17g and 0.25g, use a damping value consistent with the linearly varying line between 15 percent and 10 percent.
    c. ZPA less than 0.17g, use a damping value of 10 percent.

2. For cable tray systems that do not meet the cable tray similarity criteria in Table 3.7.1-7, use 10 percent damping for a fully loaded tray. In accordance with RG 1.61, when the tray is at least 50 percent loaded, but not fully loaded, a damping value of up to 10 percent may be used provided it is justified and documented.

3. For cable tray systems that are unloaded or loaded less than 50 percent, use seven percent damping.

4. For cable tray systems with rigid fireproofing, or other cable-restraining mechanisms, such as bundled cables, use seven percent damping.

5. For fully loaded conduit systems, use seven percent damping.

6. For conduit systems not fully loaded, use five percent damping.

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The ISRS are developed as described and are applied to the subsystem at locations of structural attachment, such as support or equipment locations (see Section 3.7.2.5). The response spectra analysis is performed using either enveloped uniform response spectra or independent support motion (ISM) using multiple spectra input.

ISRS for each of the three directional components of earthquake motions are applied separately to the subsystem. Modal responses are determined by accelerating each mode with the spectral acceleration corresponding to the frequency of that mode. The modal and co-directional responses are then combined by the methods described in Sections 3.7.3.7 and 3.7.3.6, respectively.

Peak Broadening Method

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ISRS are generated from the seismic structural analysis using the methods provided in Section 3.7.2 and following guidance from RG 1.122. ISRS are peak broadened by a minimum of ±15 percent to account for uncertainties in the structural response, as described in Section 3.7.2.5. Additional ISRS broadening considerations specific to cable tray systems are provided in Section 3A.3.6.3.

Peak Shifting Method

Peak shifting as described in ASCE 4-98 (Reference 4) and ASME BPV Code, Section III, Division 1, Appendix N (Reference 12) may be used in place of peak broadening to obtain a more realistic design. However, the peak shifting method described by these codes is applicable only to piping systems. Similar to broadening, peak shifting considers a minimum of ±15 percent uncertainty in the peak structural frequencies. However, spectral shifting refines the analysis by considering only one mode of the distribution subsystem to respond at the peak acceleration.

In the peak shifting method, the structural frequencies of the distribution subsystem within the maximum peak acceleration, broadened spectral frequency range are determined. If no distribution subsystem natural frequencies exist within this frequency range, successively lower acceleration peaks are broadened until the first range containing at least one natural frequency of the subsystem is found.

Considering that the peak structural frequency may lie at any one frequency within the broadened range, N+3 separate response spectra analyses are then performed, where N is the number of subsystem modes within the broadened frequency range. The first analysis uses the unbroadened response spectrum. The second and third analyses use the unbroadened spectrum modified by shifting the frequencies associated with each spectral value by $-\Delta f_j$ and $+\Delta f_j$, where Δf_j is the amount of peak shifting required to account for the uncertainties of the structural response. The remaining N analyses also use the unbroadened spectrum modified by shifting the frequencies associated with each spectral value by a factor of:

subsystem components as lumped masses at their center of gravity locations. The seismic response forces from these masses are then statically determined by multiplying the contributing mass by an appropriate seismic acceleration coefficient. The seismic acceleration coefficient is determined from response spectrum based on the system natural frequency. When the equivalent static load method is used, justification is provided that the use of a simplified model is realistic and the results are conservative. Additionally, relative motion between all points of support, where determined to be significant, are considered in the analysis. Maximum relative support displacements may be determined using conventional static analysis methods and then imposed in the most unfavorable combination. Every support is considered active in the analysis.

In general, many subsystems, and especially distribution subsystems, are multiple degree-of-freedom systems and have a number of significant modal frequencies in the amplified region of the response spectrum curve below the zero period acceleration (ZPA). For these systems, the peak response system may be conservatively used. When the subsystem frequency is not determined analytically, or is determined to be equal to or less than the peak frequency of the appropriate ISRS, the seismic acceleration coefficient is taken as the peak acceleration of the ISRS.

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Alternatively, the frequency determination method may be used when the subsystem frequency is greater than the peak frequency of the appropriate ISRS. In the frequency determination method, the subsystem frequency is greater than the peak frequency and the corresponding seismic acceleration is less than the ISRS peak acceleration. For ISRS with multiple peaks, the seismic acceleration coefficient shall not be less than the accelerations corresponding to subsequent ISRS peaks at frequencies higher than the subsystem frequency, as all subsequent modes will have higher frequencies and lower seismic acceleration coefficients. Additional frequency determination method considerations specific to cable tray systems are provided in Section 3A.3.6.3.

The seismic acceleration coefficient, from both the peak response method and the frequency determination method is multiplied by a multi-mode factor of 1.5 to account for multi-modal participation. Single-degree-of-freedom (SDOF) systems with a known fundamental frequency or rigid systems with fundamental frequency beyond the cutoff frequency may use a factor of 1.0 with the highest spectral acceleration at that frequency or any subsequent higher frequency (as may be the case for multiple peak input spectra).

This analysis is performed for the three directions of seismic input motion. The results of these three analyses are combined as described in Section 3.7.3.6.

3A.3.3 Load Combinations

Table 3A-4 lists the raceway and support loading combinations for the design of cable trays, conduits and supports.

3A.3.4 Allowable Stress Criteria

The basic stress allowables for carbon steel cold formed sections are in accordance with the AISI cold-formed structural design specification (Reference 4). The basic stress allowables for support structural steel, welds, and bolts are in accordance with Reference 8.

3A.3.5 Damping

The damping values for the design of cable tray and conduit systems and their associated supports are addressed in Section 3.7.1.2, and are provided in Table 3.7.1-1.

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Cable tray systems meeting the criteria in Table 3.7.1-7 for similarity to the Bechtel-ANCO test program may use ~~higher~~ damping values up to 15 percent in accordance with Figure 3.7.1-16 for the transverse direction (horizontal direction perpendicular to direction of tray run).~~based on testing, which includes the proposed installed configuration, loading, and support system.~~ Historic tests have demonstrated that a substantial amount of energy is dissipated by friction between cables and through movement and bouncing of cables within the tray. While damping values beyond 15 percent were identified in historic tests~~The increase in damping is more pronounced~~ for loaded trays with higher input excitation, ~~but~~ the maximum ~~critical~~ damping value in the transverse direction is limited to 15 percent for ~~cable trays with a minimum loading of~~ 50 percent to fully loaded tray~~of the trays full rated loading~~ (for input ground motion ZPA exceeding 0.25 g). For the other two directions, damping values are in accordance with RG 1.61 and is shown in Figure 3.7.1-16.

~~Other c~~Cable tray systems not meeting the criteria in Table 3.7.1-17 for similarity to the Bechtel-ANCO test program are limited to ~~a maximum critical~~ damping values that are~~of 10 percent for cable tray systems with more than 50 percent loading and 7 percent with less than 50 percent loading~~ in accordance with RG 1.61 and as shown in Figure 3.7.1-16. The damping value is to be reduced to the values indicated in Table 3.7.1-1 for conduit, cable trays loaded to less than 50 percent of the cable tray rated capacity, cable trays loaded primarily with conduit, or when rigid fire proofing materials are used causing the cables to become effectively bundled together.

3A.3.6 Seismic Analysis

This section describes the seismic analysis criteria for cable trays, conduits and their supports.

3A.3.6.1 Seismic Analysis Methods

Refer to Section 3.7.3.1.

3A.3.6.2 Determination of Number of Earthquake Cycles

Section 3.7.3.2 discusses the required number of earthquake cycles to be considered for seismic-induced fatigue. Rolled structural steel members for cable tray and conduit supports may be qualified for fatigue by evaluation in accordance with the provisions of ANSI/AISC N690 (Reference 8). Cold-formed members for cable tray and conduit supports may be qualified for fatigue by evaluation in accordance with the provisions of American Iron and Steel Institute (AISI), North American Specification for the Design of Cold-Formed Steel Structural Members (Reference 4). Connections for structural steel members are qualified by cyclic testing for the number of earthquake cycles specified in Section 3.7.3.2. Similarly, hardware components used to connect cold-formed members are also qualified by cyclic testing for the number of earthquake cycles specified in Section 3.7.3.2.

3A.3.6.3 Analytical Modeling Procedures

Refer to Section 3.7.3.3.

For seismic analysis of cable tray systems using refined analysis methods (e.g., the Response Spectrum Method), and using damping values in excess of RG 1.61 in accordance with Figure 3.7.1-16, seismic models are constructed using the following criteria:

- The cable trays are modeled as continuous beam elements using the tray section properties provided by the vendor as input for the equivalent beam element properties. The beams are discretized into approximately one foot elements to accurately model the mass distribution and capture the response contribution of the higher modes.
- Vertical and horizontal support struts are modeled as continuous beam elements using strut section properties provided by the vendor. The beams are discretized into approximately one foot elements, with a minimum of three elements per beam, to accurately model the mass distribution and capture the response contribution of the higher modes.
- Transverse and longitudinal braces of the cable tray supports are modeled as single truss elements. Truss behavior is achieved by using beam elements and releasing end moments (releasing moments of the members transfer only axial and shear loads).
- Cable loading consistent with Section 3A.3.2 is considered by applying uniform loads to the beam element representing the tray.

- Strut support connections are modeled to reflect the flexural behavior of the strut-to-clip angle connections. In the transverse direction (horizontal direction perpendicular to direction of tray run), degraded rotational spring constants are used. The spring constants are obtained from moment versus rotation curves of strut connection load tests, and are defined as the slope of the line from the origin to the point on the strength curve corresponding to one-half the maximum tested rotation of the connection. In the longitudinal direction (horizontal direction parallel to direction of tray run), rotational spring constants are taken as one-half the value of the degraded rotational spring constants in the transverse direction. No reduction in stiffness is required in the vertical direction.

The Frequency Determination Approach to the equivalent static load method considers the response from an in-structure response spectra (ISRS) curve at the corresponding fundamental frequency of the cable tray system in each of the three orthogonal directions to determine the seismic loads. Because the seismic demands are calculated on a frequency dependent basis, softening effects of the support connections need to be addressed in determining the system fundamental frequency in the transverse direction (horizontal direction perpendicular to direction of tray run). If the system fundamental frequency in one seismic direction is determined to be equal to or less than the frequency associated with the peak spectral acceleration from the appropriate ISRS curve, the peak spectral acceleration is used in accordance with Section 3.7.3.1.4. The fundamental frequency for a given cable tray system can be calculated using analytical approaches or computational methods through eigen value analysis. Accounting for uncertainties in the calculation of system fundamental frequencies is conservatively mitigated by considering a frequency band extending from ±20 percent of the calculated fundamental frequencies in each of the three directions. Within the ±20 percent frequency band for each direction, the appropriate ISRS curve is inspected for maximum spectral acceleration, and corresponding equivalent static forces are evaluated.

A demonstration of how design basis ISRS are modified and ±20 percent frequency bands are implemented for the Frequency Determination Approach is illustrated in Figure 3A-1 and Figure 3A-2. Two possible scenarios are presented, with Figure 3A-1 showing the scenario of a design basis ISRS where the high frequency peak has the highest spectral acceleration and Figure 3A-2 showing the scenario of a design basis ISRS where the low frequency peak has the highest spectral acceleration. For both scenarios, three calculated system fundamental frequencies are plotted at different locations on the design basis ISRS to illustrate how design accelerations are picked within the corresponding ±20 percent frequency bands. The modified ISRS in Figure 3A-1 and Figure 3A-2 show the peak spectral acceleration extended left of the peak in accordance with Section 3.7.3.1.4. This extension of the peak spectral acceleration accounts for multimode effects and is applicable in each of the three orthogonal directions. Multimode response factors are derived based on a uniform acceleration spectrum. Implementation therefore requires that spectral accelerations at the frequencies of higher modes must be less than or equal to the acceleration at the fundamental frequency. In addition, for the manual determination of transverse system fundamental frequencies, selecting boundary conditions whose frequency approximation underestimates the actual system frequency as required by the seismic modeling procedures in 3A.3.6.3, together with extending the peak spectral acceleration to lower frequencies, verifies conservative acceleration values for the fundamental mode.

For the response spectrum method, a computational model is developed to perform eigen value analysis of the system. Softening effects of support connections in the transverse direction and characteristics of cable tray system computer models are addressed similar to the Frequency Determination Approach. However, accounting for uncertainties in calculation of system fundamental frequencies resulting from modeling is different. The appropriate ISRS for the transverse direction is smoothed and broadened consistent with Section 3.7.3.1.1, and is modified so that the peak is extended from a frequency of zero Hz to a frequency that extends 20 percent beyond the maximum frequency associated with the peak spectral acceleration. This approach is applied in the transverse direction to verify conservatism when using degraded rotational stiffness values for support connections. In the vertical and longitudinal directions, it is sufficient to broaden the peaks of the appropriate ISRS curves by ±20 percent. The ISRS curves are also smoothed and broadened in accordance with Section 3.7.3.1.1.

A demonstration of how design basis ISRS are modified when using the response spectrum method is illustrated in Figure 3A-3 and Figure 3A-4. Two possible scenarios are presented, with Figure 3A-3 showing the scenario of design basis ISRS where the high frequency peak has the highest spectral acceleration, and Figure 3A-4 showing the scenario of design basis ISRS where the low frequency peak has the highest spectral acceleration. In both scenarios, the peaks of the design basis ISRS are broadened by 20 percent for the vertical and longitudinal directions to account for uncertainties in fundamental frequency estimates resulting from modeling. For the transverse direction in both scenarios, the design basis ISRS is modified so that the peak spectral acceleration is extended left of the peak frequency to either the next modified ISRS peak or to a frequency of zero Hz as shown in Figure 3A-3 and Figure 3A-4. This extension of the peak spectral acceleration accounts for support connection softening effects in the transverse direction. For the transverse direction in both scenarios, the peak of the design basis ISRS is also extended to the right of the peak by 20 percent as shown in Figure 3A-3 and Figure 3A-4 to account for uncertainties in fundamental frequency estimates resulting from modeling.

3A.3.6.4 Basis for Selection of Frequencies

Refer to Section 3.7.3.4.

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Figure 3A-1—Demonstration of Modified ISRS for Frequency Determination Approach to Equivalent Static Load Method: High Frequency Peak Has Highest Spectral Acceleration

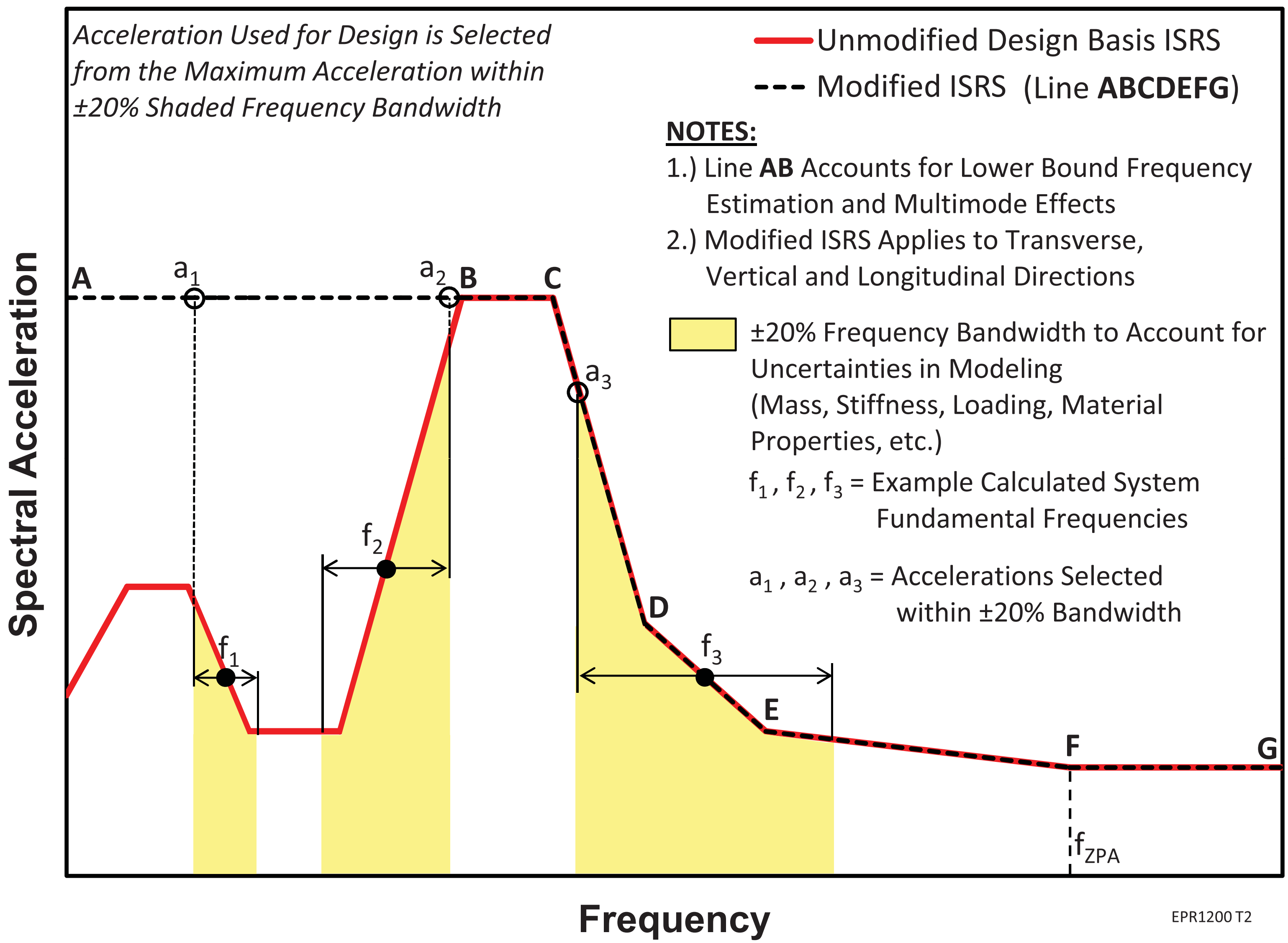

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Figure 3A-2—Demonstration of Modified ISRS for Frequency Determination Approach to Equivalent Static Load Method: Low Frequency Peak Has Highest Spectral Acceleration

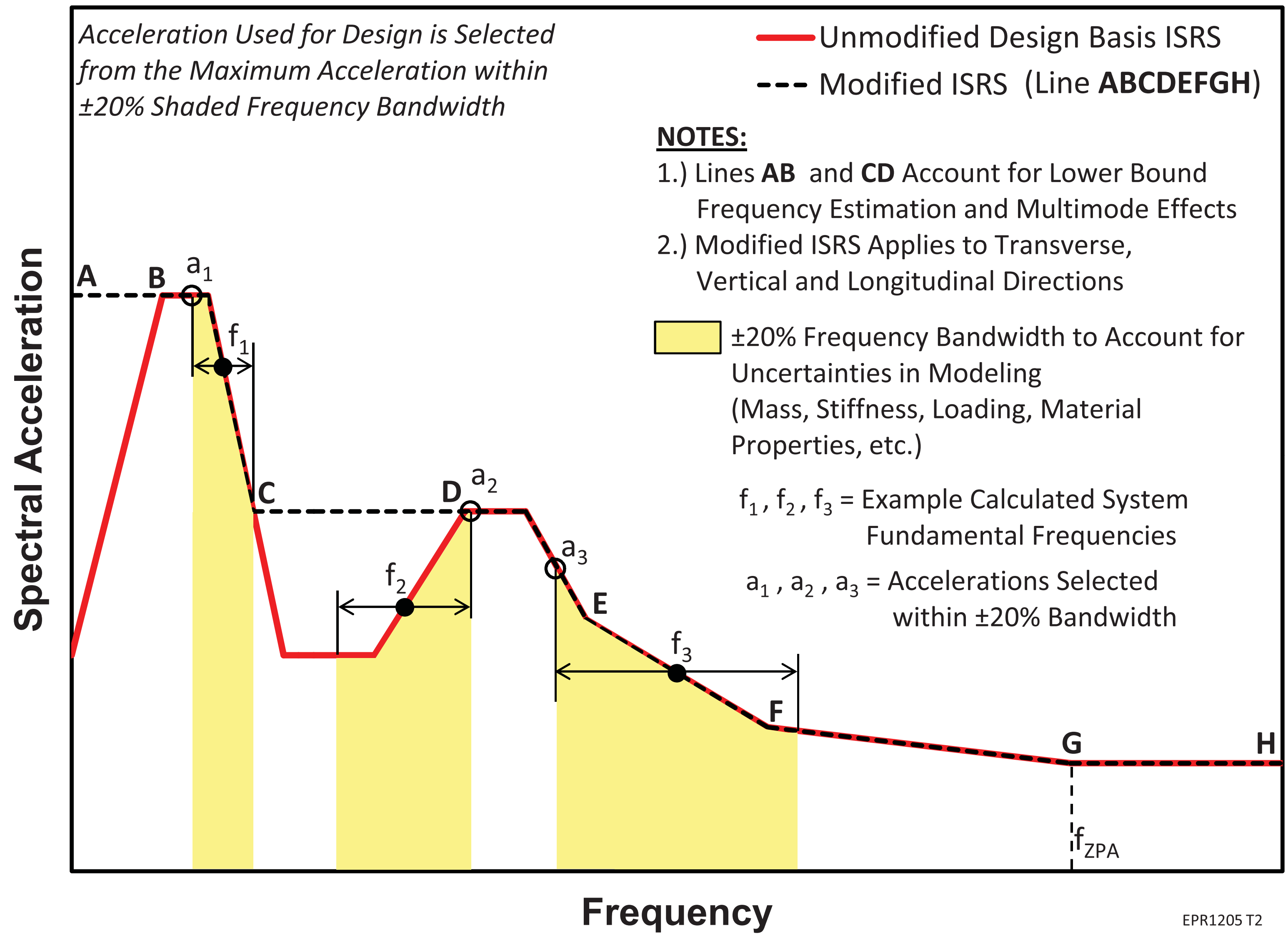

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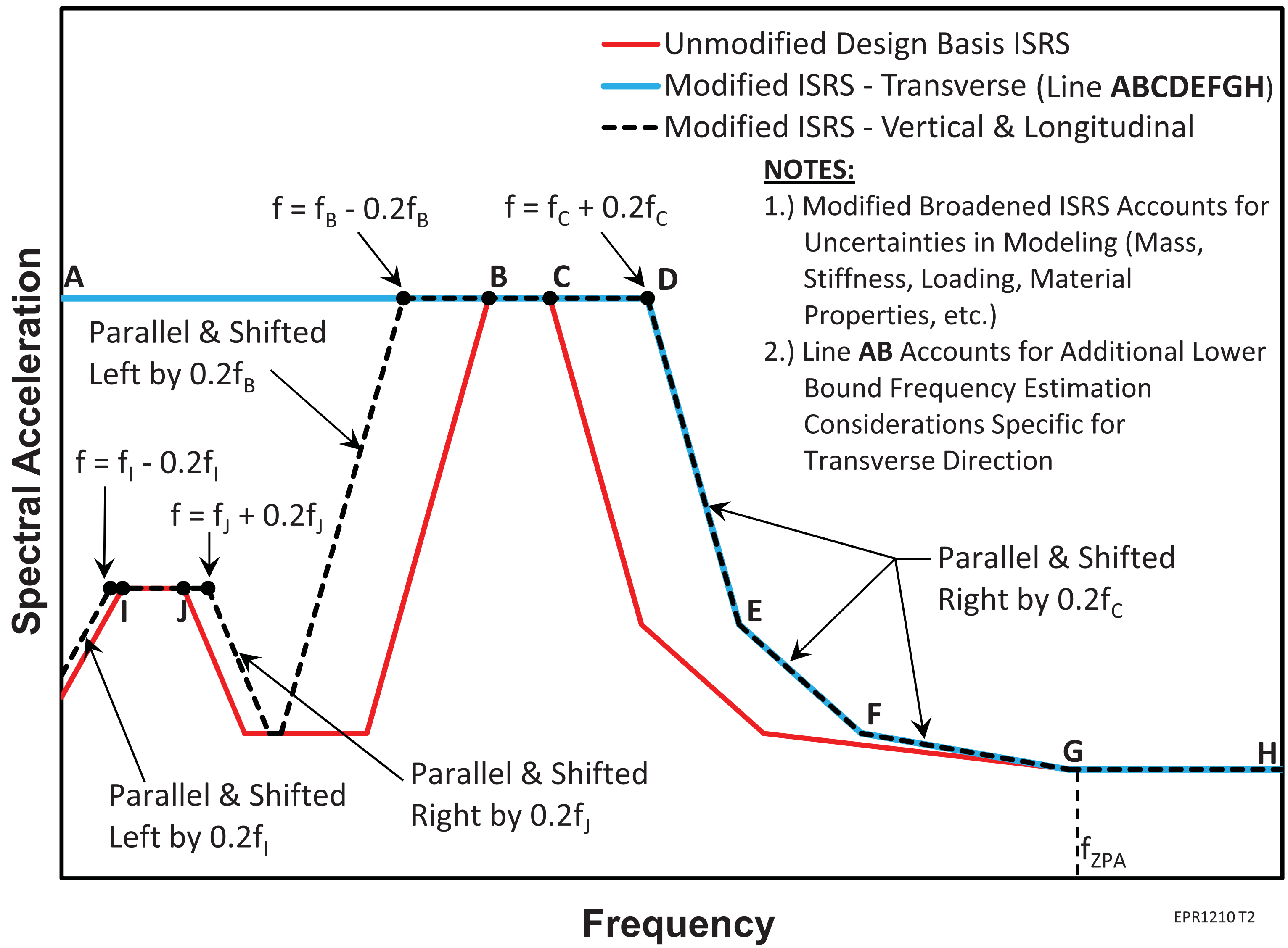
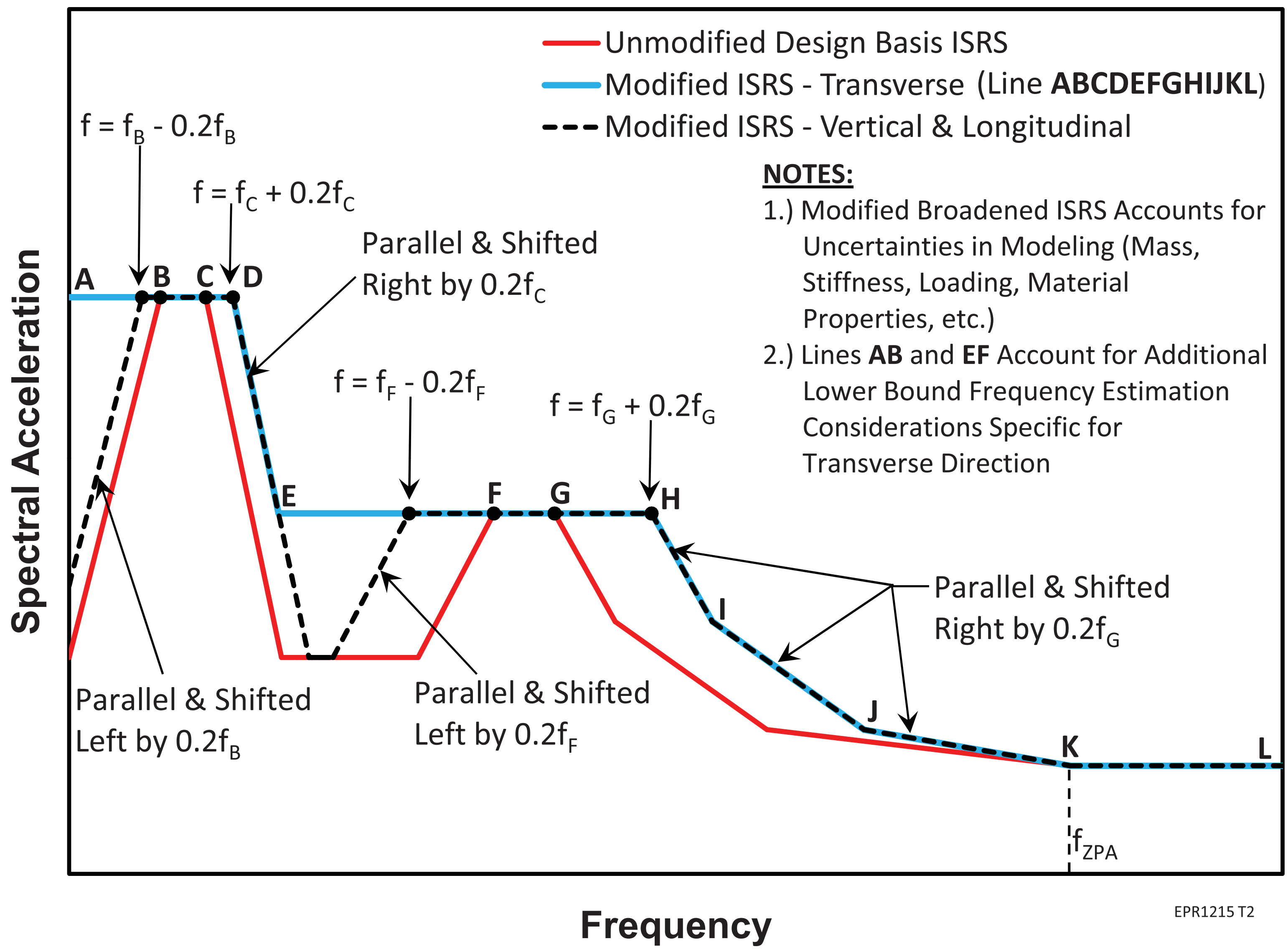
Figure 3A-3—Demonstration of Modified ISRS for Response Spectrum Method: High Frequency Peak Has Highest Spectral Acceleration



03.07.01-28

Figure 3A-4—Demonstration of Modified ISRS for Response Spectrum Method: Low Frequency Peak Has Highest Spectral Acceleration



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