ArevaEPRDCPEm Resource

From: BRYAN Martin (EXT) [Martin.Bryan.ext@areva.com]
Sent: Wednesday, June 02, 2010 11:56 AM
To: Tesfaye, Getachew
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); HAMMOND Philip R (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 306, FSAR Ch. 3, Supplement 3
Attachments: RAI 306 Supplement 3 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 306 on December 4, 2009. AREVA NP provided responses to 8 of the 10 questions of RAI No. 306 on March 11, 2010. The schedule for technically correct and complete responses to the remaining 2 questions was changed May 12, 2010 to allow time to address items raised during the May 10, 2010 phone call and to interact with the NRC on the revised response. The attached file, "RAI 306 Supplement 3 Response US EPR DC" provides technically correct and complete responses to the remaining 2 questions, as committed.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 306 Questions 3.12-19 and 3.12-20.

The following table indicates the respective pages in the response document, "RAI 306 Supplement 3 Response US EPR DC" that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 306 — 03.12-19	2	2
RAI 306 — 03.12-20	3	6

This concludes the formal AREVA NP response to RAI 306, and there are no questions from this RAI for which AREVA NP has not provided responses.

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 (EXT)
Sent: Wednesday, May 12, 2010 4:26 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); HAMMOND Philip R (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 306, FSAR Ch. 3, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 306 on December 4, 2009. On March 11, 2010, AREVA NP provided responses to 8 of the 10 questions for RAI No. 306.

The schedule for technically correct and complete responses to the remaining 2 questions has been changed and is provided below. This change is to allow time to address items raised during the May 10, 2010 phone call and to interact with the NRC on the revised response.

Question #	Response Date
RAI 306 — 03.12-19	June 10, 2010
RAI 306 — 03.12-20	June 10, 2010

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 (EXT)
Sent: Thursday, March 11, 2010 3:02 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); HAMMOND Philip R (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 306, FSAR Ch. 3, Supplement 1

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 306 on December 4, 2009. The attached file, “RAI 306 Supplement 1 Response US EPR DC” provides technically correct and complete responses to 8 of the remaining 10 questions, as committed.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 306 Questions 03.08.01-42 and 3.12-18.

The following table indicates the respective pages in the response document, “RAI 306 Supplement 1 Response US EPR DC,” that contain AREVA NP’s response to the subject questions. Please note that AREVA NP requests an opportunity for interaction with the staff regarding environmentally-assisted fatigue as it relates to the response to question 03.12-18.

Question #	Start Page	End Page
RAI 306 — 03.03.01-4	2	2
RAI 306 — 03.08.01-39	3	8
RAI 306 — 03.08.01-40	9	11
RAI 306 — 03.08.01-41	12	13
RAI 306 — 03.08.01-42	14	14

RAI 306 — 03.08.01-43	15	16
RAI 306 — 03.12-18	17	18
RAI 306 — 03.12-19	19	19
RAI 306 — 03.12-20	20	20
RAI 306 — 03.12-21	21	21

The schedule for technically correct and complete responses to the remaining 2 questions has been changed due to administrative reasons and is provided below:

Question #	Response Date
RAI 306 — 03.12-19	May 12, 2010
RAI 306 — 03.12-20	May 12, 2010

Sincerely,

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

From: Pederson Ronda M (AREVA NP INC)
Sent: Friday, December 04, 2009 4:08 PM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); HAMMOND Philip R (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 306, FSAR Ch. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 306 Response US EPR DC.pdf," provides the schedule for technically correct and complete responses to these questions.

The following table indicates the respective pages in the response document, "RAI 306 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 306 — 03.03.01-4	2	2
RAI 306 — 03.08.01-39	3	3
RAI 306 — 03.08.01-40	4	4
RAI 306 — 03.08.01-41	5	5
RAI 306 — 03.08.01-42	6	6
RAI 306 — 03.08.01-43	7	7
RAI 306 — 03.12-18	8	8
RAI 306 — 03.12-19	9	9
RAI 306 — 03.12-20	10	10
RAI 306 — 03.12-21	11	11

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

Question #	Response Date
RAI 306 — 03.03.01-4	March 12, 2010
RAI 306 — 03.08.01-39	March 12, 2010
RAI 306 — 03.08.01-40	March 12, 2010
RAI 306 — 03.08.01-41	March 12, 2010
RAI 306 — 03.08.01-42	March 12, 2010
RAI 306 — 03.08.01-43	March 12, 2010
RAI 306 — 03.12-18	March 12, 2010
RAI 306 — 03.12-19	March 12, 2010
RAI 306 — 03.12-20	March 12, 2010
RAI 306 — 03.12-21	March 12, 2010

Sincerely,

Ronda Pederson

ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
AREVA NP Inc.
An AREVA and Siemens company
3315 Old Forest Road
Lynchburg, VA 24506-0935
Phone: 434-832-3694
Cell: 434-841-8788

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, November 04, 2009 12:14 PM
To: ZZ-DL-A-USEPR-DL
Cc: Patel, Jay; Xu, Jim; Hawkins, Kimberly; Hsu, Kaihwa; Dixon-Herrity, Jennifer; Miernicki, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 306(3642,3787,3755), FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on October 9, 2009, and discussed with your staff on November 4, 2009. No changes were made to the draft RAI as a result of that discussion. 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: 1492

Mail Envelope Properties (BC417D9255991046A37DD56CF597DB71065B6FE4)

Subject: Response to U.S. EPR Design Certification Application RAI No. 306, FSAR Ch. 3, Supplement 3
Sent Date: 6/2/2010 11:56:00 AM
Received Date: 6/2/2010 11:56:03 AM
From: BRYAN Martin (EXT)

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

Recipients:
"DELANO Karen V (AREVA NP INC)" <Karen.Delano@areva.com>
Tracking Status: None
"ROMINE Judy (AREVA NP INC)" <Judy.Romine@areva.com>
Tracking Status: None
"BENNETT Kathy A (OFR) (AREVA NP INC)" <Kathy.Bennett@areva.com>
Tracking Status: None
"HAMMOND Philip R (AREVA NP INC)" <Philip.Hammond@areva.com>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

Post Office: AUSLYNCMX02.adom.ad.corp

Files	Size	Date & Time
MESSAGE	7996	6/2/2010 11:56:03 AM
RAI 306 Supplement 3 Response US EPR DC.pdf		206468

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

Response to

Request for Additional Information No. 306, Supplement 3

11/04/2009

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.03.01 - Wind Loading
SRP Section: 03.08.01 - Concrete Containment
SRP Section: 03.12 - ASME Code Class 1, 2, and 3 Piping Systems and Piping Components and Their Associated Supports

Application Section: FSAR Ch 3

QUESTIONS for EPR Projects Branch (NARP)
QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)
QUESTIONS for Engineering Mechanics Branch 1 (AP1000/EPR Projects) (EMB1)

Question 03.12-19:

Follow-up to RAI Question No. 03.12-17

In response to Question 03.12-17, AREVA indicated that heatup/cooldown procedures are plant-specific. In order to use the first US EPR initial plant operation to verify the design transients for the surge line are representative, AREVA has to assure that all U.S. EPR plants will use the same heatup/cooldown methods. The staff asks AREVA to address this item and explain why only first plant surge line transients are monitored without standard heatup/cooldown procedures.

Response to Question 03.12-19:

The COL information item in U.S. EPR Tier 2, Section 3.12.5.10.1 and U.S. EPR Tier 2, Table 1.8-2 will be revised to clarify that pressurizer surge line temperatures will be monitored during the first cycle of initial plant operation for each plant.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.12.5.10.1 and U.S. EPR FSAR Tier 2, Table 1.8-2 will be revised as described in the response and indicated on the enclosed markup.

Question 03.12-20:

In FSAR Section 3.12.5.9, AREVA stated that the EPRI generic methodology indicated that thermal stratification will occur in RHR/SIS/EBS injection, RHR/SIS suction piping**.** AREVA also stated that specific measurements taken at AREVA NP designed foreign plants on piping configurations that are representative of U.S.EPR piping system indicate small range and shorter vortex penetration than the EPRI methodology. Thus, testing information shows that thermal stratification does not occur in any horizontal segment of the aforementioned (RHR/SIS/EBS injection, RHR/SIS suction) RCS attached piping.

The staff noted that the cyclic thermal stratification occurring within such RCS attached piping is affected by the line orientation and geometry. The staff requests AREVA to provide detailed line geometry information (e.g. L/Di, DH/H/LH configuration) for each of the above mentioned lines in order to determine that the thermal stratification does not occur in any horizontal segment of the RCS attached piping.

If AREVA uses its specific test information to justify that thermal stratification does not occur in any RCS attached piping for EPR design. The staff requests AREVA to provide detailed test information for review and approval.

AREVA stated that the U.S. EPR design incorporates lessons learned from operating experience in that the injection line (SIS/RHRS) continually rises in elevation from the check valve; therefore, it is not susceptible to valve leakage-induced cyclic thermal stratification. The staff requests AREVA to explain why the piping is not susceptible to valve leakage-induced cyclic thermal stratification with continual rises in elevation from the check valve and rise to what kind of level/elevation will not be susceptible to cyclic thermal stratification.

Response to Question 03.12-20:

1. RHR/SIS/EBS injection and RHR/SIS suction RCS attached piping are both located in a downward-horizontal (DH) configuration from the RCS. The requested detailed piping information for the RCS attached RHR/SIS/EBS injection lines of trains 1 to 4 is shown in Figure 03.12-20-1 and Figure 03.12-20-2, and the RCS attached SIS/RHR suction lines of trains 1 to 4 is shown in Figure 03.12-20-3 and Figure 03.12-20-4. The cumulative pipe lengths, with respect of the pipe inner diameter (Di), are indicated within parentheses.

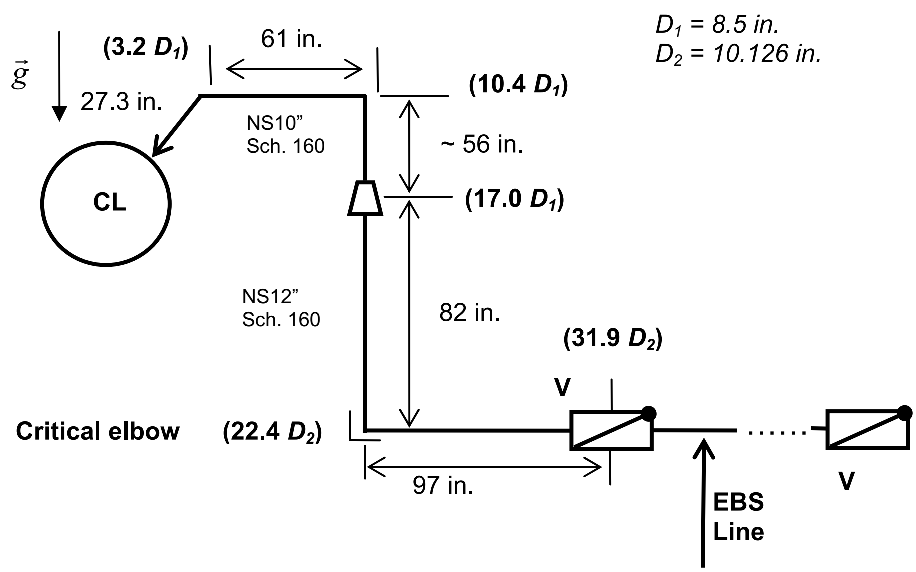

Figure 03.12-20-1—Branch of SIS/RHRS/EBS Injection Lines – Trains 1 & 4

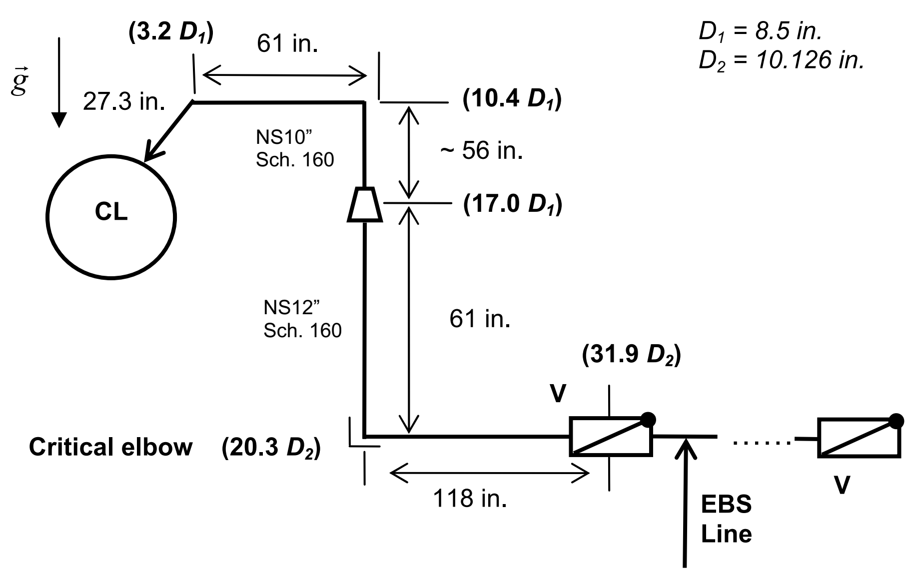

Figure 03.12-20-2—Branch of SIS/RHRS/EBS Injection Lines – Trains 2 & 3

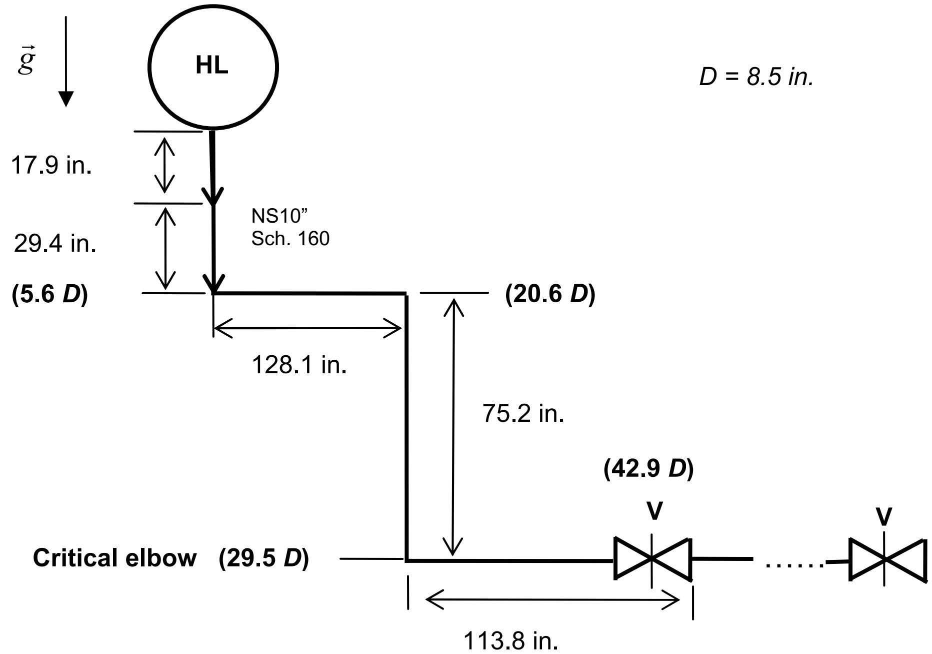

Figure 03.12-20-3—Branch of SIS/RHRS Suction Lines – Trains 1 & 4

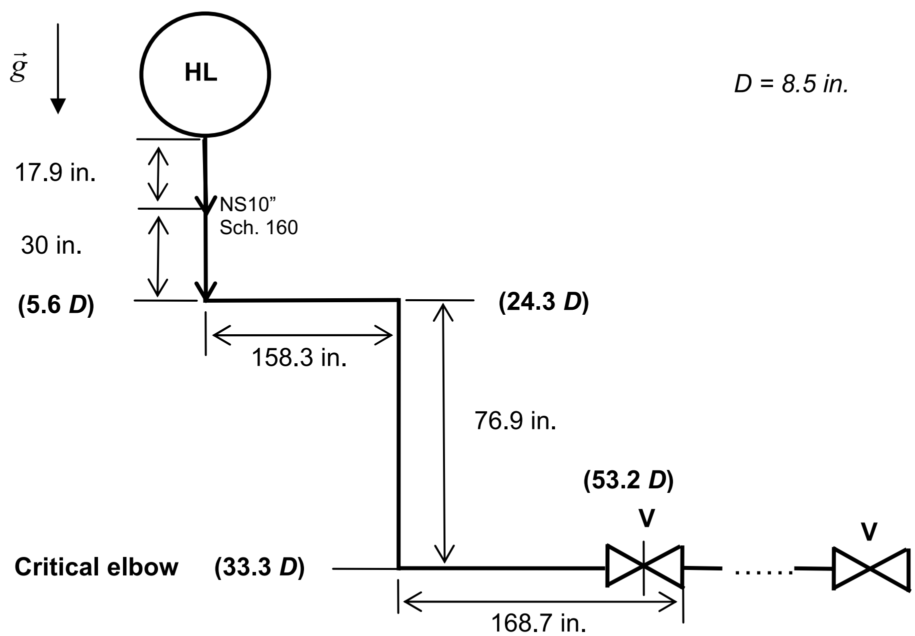

Figure 03.12-20-4—Branch of SIS/RHRS Suction Lines – Trains 2 & 3

2. AREVA did not use specific test information to justify that thermal stratification does not occur in any RCS attached piping for the U.S. EPR design. Instead, AREVA followed the EPRI thermal stratification guidelines (Reference 4 of U.S. EPR FSAR Tier 2, Section 3.12.7). When the EPRI thermal stratification guidelines predict the occurrence of thermal stratification, the branch lines of concern are monitored. U.S. EPR FSAR Tier 2, Section 3.12.5.9 will be revised to clarify that the assessment of thermal oscillations in piping connected to the RCS was based on the EPRI thermal stratification guidelines and EPRI thermal fatigue guidelines (Reference 3 and Reference 4 of U.S.EPR FSAR Tier 2, Section 3.12.7). The COL information item in U.S. EPR FSAR Tier 2, Section 3.12.5.9 and U.S. EPR FSAR Tier 2, Table 1.8-2 will be revised to clarify that the RCS attached piping branch lines of concern are monitored.

3. Valve in-leakage in the SIS/RHR injection lines is not a factor in regards to thermal stratification because:

   – The SIS/RHRS injection lines of each train have a DH configuration. According to EPRI guidelines (Reference 3 of U.S.EPR FSAR Tier 2, Section 3.12.7), Section 2.2.3 and Appendix B, turbulent/swirl penetration from the RCS to the DH attached line is considered as the primary physical mechanism causing thermal stratification. The lesson learned was to incorporate a DH configuration of the SIS/RHRS injection lines instead of an upward-horizontal configuration.

   – The SIS/RHRS pressure (for injection and suction lines) is always less than the RCS pressure when the system is in stand-by condition. There is no high head injection in the U.S. EPR design.

   Therefore, the extent of rise is irrelevant in the piping evaluation that has a DH configuration.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.12.5.9 and U.S. EPR FSAR Tier 2, Table 1.8-2 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

Table 1.8-2—U.S. EPR Combined License Information Items
Sheet 22 of 49

Item No.	Description	Section	Action Required by COL Applicant	Action Required by COL Holder
3.11-2	A COL applicant that references the U.S. EPR design certification will identify additional site specific components that need to be added to the environmental qualification list in Table 3.11-5.	3.11.1.1.3	Y	
3.11-3	If the equipment qualification testing is incomplete at the time of the COL application, a COL applicant that references the U.S. EPR design certification will submit an implementation program, including milestones and completion dates, for NRC review and approval prior to installation of the applicable equipment.	3.11.3	Y	
3.12-1	A COL applicant that references the U.S. EPR design certification will perform a review of the impact of contributing mass of supports on the piping analysis following the final support design to confirm that the mass of the support is no more than ten percent of the mass of the adjacent pipe span.	3.12.4.2		Y
3.12-2	As indicated in Section 5.3 of topical report ANP-10264NP-A, pipe and support stress analysis will be performed by the COL applicant that references the U.S. EPR design certification. If the COL applicant that references the U.S. EPR design certification chooses to use a piping analysis program other than those listed in Section 5.1 of the topical report, the COL applicant will implement a benchmark program using models specifically selected for the U.S. EPR.	3.12.4.3		Y
3.12-3	03.12-20 → A COL applicant that references the U.S. EPR design certification will monitor the RHR/SIS/EBS injection piping from the RCS to the first isolation valve (all four trains), and RHR/SIS suction piping from the RCS to the first isolation valve (trains 1 and 4) during the first cycle of the first U.S. EPR initial plant operation to verify that operating conditions have been considered in the design unless data from a similar plant's operation demonstrates that thermal oscillation is not a concern for piping connected to the RCS.	3.12.5.9		

Table 1.8-2—U.S. EPR Combined License Information Items
Sheet 23 of 49

Item No.	Description	Section	~~Action Required by COL Applicant~~	~~Action Required by COL Holder~~
3.12-4	A COL applicant that references the U.S. EPR design certification will monitor pressurizer surge line temperatures during the first fuel cycle of initial plant operation to verify that the design transients for the surge line are representative of actual plant operations.	3.12.5.10.1		
3.12-5	A COL applicant that references the U.S. EPR design certification will monitor the normal spray line temperatures during the first cycle of the first U.S. EPR initial plant operation to verify that the design transients for the normal spray are representative of actual plan operations unless data from a similar plant's operation determines that monitoring is not warranted.	3.12.5.10.3		
3.12-6	A COL applicant that references the U.S. EOR design certification will monitor the temperature of the main feedwater lines during the first cycle of the first U.S. EPR initial plant operation to verify that the design transients for the main feedwater lines are representative of actual plant operations unless data from a similar plant's operation determines that monitoring is not warranted.	3.12.5.10.4		
3.13-1	A COL applicant referencing the U.S. EPR design certification will submit the inservice inspection program for ASME Code Class 1, Class 2, and Class 3 threaded fasteners, to the NRC prior to performing the first inspection. The program will identify the applicable edition and addenda of ASME Section XI and ensure compliance with the requirements of 10CFR50.55a(b)(2)(xxvii).	3.13.2		~~Y~~
3E-1	A COL applicant that references the U.S. EPR design certification will address critical sections relevant to site-specific Seismic Category I structures.	3E	~~Y~~	
5.2-1	Deleted			
5.2-2	A COL applicant that references the U.S. EPR design certification will identify additional ASME code cases to be used.	5.2.1.2	~~Y~~	

03.12-19

3.12.5.8 Fatigue Evaluation of ASME Code Class 2 and 3 Piping

Section 3.4.2 of Reference 1 addresses fatigue evaluation methods used for ASME Code Class 2 and Code Class 3 piping.

3.12.5.9 Thermal Oscillations in Piping Connected to the Reactor Coolant System

Piping connected to the reactor coolant system (RCS) can experience temperature oscillations resulting from a swirling turbulent flow that has a varying range of axial penetration distance into the attached piping. The axial movement of the vortex penetration may introduce hot water into an otherwise cooler stagnant horizontal line. If the swirling penetration periodically enters a horizontal section and then retreats, the piping conditions will cycle between stratified and non-stratified. Thermal oscillations have caused cracks in non-isolable piping connected to the RCS for several nuclear plants. As a result, NRC Bulletin 88-08 and Supplements 1 through 3 were issued.

03.12-20 → ~~A two-step approach was~~Electric Power Research Institute (EPRI) guidelines were used for the assessment of thermal oscillations in piping connected to the RCS. ~~The first step~~ This approach consisted of following the ~~generic Electric Power Research Institute (EPRI)~~ thermal management guidelines provided in EPRI Reports TR-1011955 (Reference 3) and TR-103581 (Reference 4). The identification, screening, and evaluation of thermal cycling were performed for normally stagnant non-isolable lines attached to the RCS. ~~The second step considered measurements on similar piping arrangements to determine if thermal stratification could occur.~~

For thermal oscillations to occur in piping connected to the RCS, the following conditions are required:

- For piping that extends vertically upward from the RCS that is followed by a horizontal section, a cold water source must exist in order to have the potential for thermal oscillations.
  - There must be a pressure differential capable of forcing leakage through the pressure retaining component (e.g., valve) into the RCS.
  - There must be a temperature difference between the fluid in the non-isolable piping section and the fluid from the leakage source.
- For piping that extends vertically downward from the RCS that is followed by a horizontal section, vortex penetration distance must reach the horizontal section in order for stratification to occur.
  - Thermal cycling primarily occurs due to cyclic penetration, break down, and retreat of a thermal stratification interface that is formed by the interaction between the swirl penetration and the cooler fluid in the horizontal branch line.

  - A leaking cold water source is not required for this configuration.

- Sections of piping that are less than or equal to one inch nominal pipe size are not susceptible to these thermal fatigue phenomena.

- If a sufficient continuous flow rate exists within the RCS attached piping, thermal oscillations will not occur.

The following piping systems connected to the RCS were identified and evaluated:

- Residual heat removal discharge/safety injection piping/extra borating system (RHR/SIS/EBS).

- Residual heat removal suction/safety injection piping (RHR/SIS).

- Chemical volume control system (CVCS) letdown piping.

- CVCS injection piping.

- Normal and auxiliary pressurizer spray lines.

  - The pressurizer, surge line, and spray lines are evaluated in Section 3.12.5.10.

- Pressurizer surge line.

  - The pressurizer, surge line, and spray lines are evaluated in Section 3.12.5.10.

The EPRI generic methodology indicates that thermal stratification will not occur in these systems with the exception of the following lines:

03.12-20

- RHR/SIS/EBS injection piping from the RCS to the first isolation valve (for all four trains).

- RHR/SIS suction piping from the RCS to the first isolation valve (trains 1 and 4)~~(for two of four trains)~~.

~~However, specific measurements taken at AREVA NP designed foreign plants on piping configurations that are representative of U.S. EPR piping systems indicate smaller range and shorter vortex penetrations than the EPRI methodology. Thus, testing information shows that thermal stratification does not occur in any horizontal segment of the aforementioned RCS attached piping.~~ This conclusion is based on turbulent or vortex penetration, which is considered a fundamental mechanism for thermal cycling in DH oriented piping, according to Reference 3. Operating plant experiences presented in Reference 3 support this finding and indicate that DH piping does not require valve leakage for thermal cycling to occur, but instead thermal stratification in DH lines was governed by the cyclic penetration and retreat of the thermal front due to turbulent penetration. The U.S. EPR design incorporates lessons learned from this operating experience in that the injection line (SIS/RHRS) continually rises in elevation from the check valve; therefore, it is not susceptible to valve leakage-induced cyclic thermal stratification.

03.12-20

The differences in swirling penetration distances between the generic EPRI methodology and AREVA NP measurements indicate the inherent uncertainty in predicting detailed thermal phenomena for piping systems and the need to instrument/monitor conditions during initial plant operation. The A COL applicant that references the U.S. EPR design certification will monitor the RCS attached pipingRHR/SIS/EBS injection piping from the RCS to the first isolation valve (all four trains) and RHR/SIS suction piping from the RCS to the first isolation valve (trains 1 and 4)will be instrumented and monitored during the first cycle of the first U.S. EPR initial plant operation to verify that operating conditions have been considered in the design unless data from a similar plant's operation demonstrates that thermal oscillation is not a concern for piping connected to the RCS.

3.12.5.10 Thermal Stratification

The term "thermal stratification" applies to any condition where fluid is thermally layered due to buoyancy differences between the layers. Thermal stratification occurs in horizontal piping when flow and boundary conditions result in two layers of fluid at different temperatures without appreciable mixing. In cases where the top of pipe temperature is higher than the bottom of pipe temperature, pipe stresses occur due to pipe deflection and changes in support loads.

3.12.5.10.1 Pressurizer Surge Line Stratification (NRC Bulletin 88-11)

NRC Bulletin 88-11 recommended that pressurized water reactors (PWR) establish and implement a program to verify the structural integrity of the pressurizer surge line when subjected to thermal stratification.

The U.S. EPR design addresses the concerns of NRC Bulletin 88-11 with several features and operational procedures that minimize surge line stratification:

- The pressurizer surge line piping layout minimizes stratification. The pressurizer surge line has a continuous centerline elevation decrease from the pressurizer to the hot leg. Also, the pressurizer surge line connects to the top of the hot leg with a vertical take-off. The surge line is sloped at approximately five degrees between the vertical take-off at the hot leg and the vertical leg at the pressurizer which promotes mixing of the colder and hotter fluid layered in the line. There are no horizontal sections of pressurizer surge line piping.

- The take-off from the hot leg is upward vertical and of sufficient length such that when coupled with continuous bypass spray flow it will prevent the cooler hot leg fluid from entering the surge line beyond the take-off.

- The pressurizer versus RCS temperature differential is controlled during heatup to limit the pressurizer-to-hot leg temperature difference. Also, the pressurizer on/off heaters are energized during initial RCS heatup to maintain a constant outsurge of fluid from the pressurizer reducing the number of insurges and the thermal cycles between pressurizer and hot leg temperature.

03.12-19

~~The~~ A COL applicant that references the U.S. EPR design certification will monitor pressurizer surge line temperatures ~~will be monitored~~ during the first fuel cycle of ~~the first U.S. EPR~~ initial plant operation to verify that the design transients for the surge line are representative of actual plant operations ~~unless data from a similar plant's operation determines that monitoring is not warranted.~~ The monitoring program~~, if required,~~ includes temperature measurements at several locations along the pressurizer surge line and plant parameters including pressurizer temperature, pressurizer level, hot leg temperature, and reactor coolant pump status.

3.12.5.10.2 Pressurizer Stratification

Insurges due to momentary fluctuations in RCS inventory occur during normal operation. These fluctuations result in a stratified thermal front of cooler fluid (near hot leg temperature) being moved up into the lower section of the pressurizer. These insurges result in a step change in the pressurizer bottom fluid temperature. Consideration of these temperature changes is included in the design basis of the pressurizer.

3.12.5.10.3 Spray Line Stratification

The normal spray lines contain stratified liquid and steam during the initial part of the heatup as the horizontal sections in each of the two lines are filled from the cold leg at the same time that the pressurizer is being filled. ~~The~~ A COL applicant that references the U.S. EPR design certification will monitor the normal spray line temperatures ~~will be monitored~~ during the first cycle of the first U.S. EPR initial plant operation to verify that the design transients for the normal spray are representative of actual plant operations unless data from a similar plant's operation determines that monitoring is not warranted.

The auxiliary spray line is not used during normal or upset operations. The potential for stratification exists only during initiation for emergency and faulted transients where auxiliary spray is used.

3.12.5.10.4 Feedwater Line Stratification (NRC Bulletin 79-13)

NRC Bulletin 79-13 was issued as a result of a feedwater line cracking incident and the subsequent inspections resulting in discovery of cracks in the feedwater lines of several nuclear power plants. The primary cause of the cracking was determined to be thermal fatigue loading due to thermal stratification during low flow emergency feedwater and main feedwater injections.