ArevaEPRDCPEm Resource

From: WILLIFORD Dennis (AREVA) [Dennis.Williford@areva.com]
Sent: Friday, August 17, 2012 3:59 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (AREVA); DELANO Karen (AREVA); LEIGHLITER John (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA); TOLLEY Tracey (AREVA); VANCE Brian (AREVA); WELLS Russell (AREVA); Darrell.Gardner@areva.com
Subject: DRAFT Response to U.S. EPR Design Certification Application RAI No. 547 (6499, 6359), FSAR Ch. 3 - NEW PHASE 4 RAI, Question 03.06.01-14
Attachments: RAI 547 Question 03.06.01-14 Draft Response US EPR DC.pdf

Getachew,

Attached is a DRAFT response for RAI No. RAI No. 547 (6499, 6359), FSAR Ch., Question 03.06.01-14 as shown below in advance of the October 17, 2012 final date. Please note that due the large number of changes to COL information items associated with this response and the potential that some of these may change as a result of the NRC review of the attached response, the FSAR changes that are attached to this response have not yet been formally incorporated into the U.S. EPR FSAR. Once it has been determined that this RAI response can be sent final, the FSAR changes will be formally made and transmitted as part of the final RAI response.

To keep our commitment to send a final response to this question by October 17th, we need to receive all NRC staff feedback and comments no later than **October 3rd**.

Thanks,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
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From: WILLIFORD Dennis (RS/NB)
Sent: Wednesday, July 11, 2012 2:52 PM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); Michael.Miernicki@nrc.gov; WELLS Russell (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 547 (6499, 6359), FSAR Ch. 3 - NEW PHASE 4 RAI

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 547 Response US EPR DC.pdf," provides a schedule since a technically correct and complete response to the four questions cannot be provided at this time.

The following table indicates the respective pages in the response document, "RAI 547 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 547 — 03.06.01-14	2	2
RAI 547 — 03.07.02-76	3	4
RAI 547 — 03.07.02-77	5	5
RAI 547 — 03.07.02-78	6	12

The schedule for a technically correct and complete response to these 4 questions is provided below.

Question #	Response Date
RAI 547 — 03.06.01-14	**October 17, 2012**
RAI 547 — 03.07.02-76	**November 29, 2012**
RAI 547 — 03.07.02-77	**November 14, 2012**
RAI 547 — 03.07.02-78	**April 30, 2013**

Sincerely,

Dennis Williford, P.E.
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, June 15, 2012 2:45 AM
To: ZZ-DL-A-USEPR-DL
Cc: Xu, Jim; Thomas, Brian; Miernicki, Michael; Clark, Phyllis; Segala, John; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 547 (6499, 6359), FSAR Ch. 3 - NEW PHASE 4 RAI

Attached please find the subject request for additional information (RAI). A draft of the RAI was provided to you on May 17, 2012, and June 12, 2012, 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/LB1
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 3991

Mail Envelope Properties (2FBE1051AEB2E748A0F98DF9EEE5A5D4DB6DB1)

Subject: DRAFT Response to U.S. EPR Design Certification Application RAI No. 547 (6499, 6359), FSAR Ch. 3 - NEW PHASE 4 RAI, Question 03.06.01-14
Sent Date: 8/17/2012 3:58:45 PM
Received Date: 8/17/2012 3:58:56 PM
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Files	**Size**	**Date & Time**
MESSAGE	4021	8/17/2012 3:58:56 PM
RAI 547 Question 03.06.01-14 Draft Response US EPR DC.pdf	856501	

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

Response to

Request for Additional Information No. 547(6499, 6359), Revision 0
Question 03.06.01-14:

6/15/2012

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.06.01 - Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment
SRP Section: 03.07.02 - Seismic System Analysis

Application Section: Tier 2 Table 1.8-2

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

Question 03.06.01-14:

Open Item

Follow-up RAI to RAI 533, Question 3.6.1-13

Following the issuance of RAI 533, Question 3.6.1-13 on COL Information Items (I/Is) 3.6-1 and 3.6-2, it was identified by the staff that there are a number of similar COL I/Is in U.S. FSAR Tier 2, Table 1.8-2, that cannot theoretically be completed by the COL applicants prior to issuance of a COL license. This issue was discussed with the AREVA and COL applicants in an EPR DCWG public meeting. In their response to RAI 533 Question 3.6.1-13, AREVA chose to only respond to address that specific instance, versus the generic problem.

Generally, the proposed FSAR Tier 2 Table 1.8-2 COL I/Is are technically appropriate, however, as currently worded some present a design certification legal issue. As written, they cannot be completed prior to the issuance of a COLA. For example, the COL I/I may require: 1) as-built information to be provided, 2) completion of examinations, or 3) other information that has to be provided prior to fuel load. These COL I/Is may be revised in several different ways depending on how they are currently worded as follows:

A. COL I/Is that can be reworded in an acceptable manner so they can be completed by the COL applicant.

B. COL I/Is that duplicate, to some extent, an existing ITAAC, can be reworded to limit the scope of the COL I/I while retaining the ITAAC.

C. COL I/Is that entirely duplicate an existing ITAAC can be deleted

D. COL I/Is that can be deleted, and a new ITAAC be created, or the scope of an existing ITAAC be expanded.

The applicant is requested to review the entire COL I/Is and any associated ITAAC with the above concepts and situations in mind, and make the appropriate changes to both the FSAR Tier 2 Table 1.8-2 COL I/Is, and to the various Tier 1 ITAAC tables.

Response to Question 03.06.01-14:

AREVA NP has reviewed each of the COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2. Table 03.06.01-14-1 lists those COL I/IIs that will be deleted or modified based on the criteria in the NRC Question. The results of this review are summarized below:

Category	Number of Applicable COL I/Is	Affected U.S. EPR FSAR Tier 2 Sections
A	14	Table 1.8-2, 3.5.1.2.3, 3.9.3, 3.12, 7.7.2.3.5, 8.3.1.1.5, 10.2.3, 19.1.2, 19.2.5, 15.0.0.3.9
B	3	Table 1.8-2, 3.6.2.5.1, 3.9.3
C	9	Table 1.8-2, 3.4.1, 3.6.3, 3.9.3.1, 3.9.5.2, 3.10.4, 3.11, 9.5.1.2.1, 9.5.1.3
D	0	N/A

FSAR Impact:

U.S. EPR FSAR Tier 2, Sections 3.4.1, 3.5.1.2.3, 3.6.2.5.1, 3.6.3, 3.9.3, 3.9.5.2, 3.10.4, 3.11, 3.12, 7.7.2.3.5, 8.3.1.1.5, 9.5.1, 10.2.3, 15.0.0.3.9, 19.1.2, and 19.2.5; 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.

Table 03.06.01-14-1
Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
3.4-4	A COL applicant that references the U.S. EPR design certification will perform internal flooding analyses prior to fuel load for the Safeguard Buildings and Fuel Building to demonstrate that the impact of internal flooding is contained within the Safeguard Building or Fuel Building division of origin.	3.4.1	C	Delete COL item, this is redundant to ITAAC Tier 1 Table 2.1.1-10, Item 2.2, and Table 2.1.1-11, acceptance criteria f and g. The internal flooding analysis for the safeguard buildings and fuel buildings are described in U.S. EPR FSAR Tier 2, Section 3.4, and verified by ITAAC.
3.4-5	A COL applicant that references the U.S. EPR design certification will perform an internal flooding analysis prior to fuel load for the Reactor Building and Reactor Building Annulus to demonstrate that the essential equipment required for safe shutdown is located above the	3.4.1	C	Delete COL item, this is redundant to ITAAC Tier 1 Table 2.1.1-8, Item 2.10. The internal flooding analysis for the reactor building and reactor building annulus are described in U.S. EPR FSAR Tier 2, Section 3.4, and verified by ITAAC.

Table 03.06.01-14-1

Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
3.5-1	A COL applicant that references the U.S. EPR design certification will describe controls to confirm that unsecured maintenance equipment, including that required for maintenance and that are undergoing maintenance, will be removed from containment prior to operation, moved to a location where it is not a potential hazard to SSC important to safety, or seismically restrained to prevent it from becoming a missile.	3.5.1.2.3	A	Reword COL item to delete “prior to operation.”
3.6-3	A COL applicant that references the U.S. EPR design certification will confirm that the design LBB analysis remains bounding for each piping system and provide a summary of the results of the actual as-built plant specific LBB analysis, including material properties of piping and welds, stress analyses, leakage detection capability, and degradation mechanisms.	3.6.3	C	U.S. EPR FSAR Tier 1, Table 2.2.1-5, Item 3.7, includes an ITAAC on LBB. The design report that will be prepared to close out this ITAAC will include the information in this COL item. The COL item will be deleted and U.S. EPR FSAR Tier 2, Section 3.6.3, will be revised to state “A design report will confirm that the design LBB analysis remains bounding for each piping system and provide a summary of the results of the actual as-built, plant-specific LBB analysis, including material properties of piping and welds, stress analyses, leakage detection capability, and degradation mechanisms.”

Table 03.06.01-14-1

Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
3.6-4	A COL applicant that references the U.S. design certification will provide diagrams showing the final as-designed configurations, locations, and orientations of the pipe whip restraints in relation to break locations in each piping system.	3.6.2.5.1	B	Revise COL item to delete “final as-designed.” U.S. EPR FSAR Tier 1, Table 3.8-1, Item 2.1 requires that a pipe break hazards analysis report demonstrates that pipe whip restraints and jet shield designs for protection of the essential systems and components can mitigate pipe break loads.

Table 03.06.01-14-1

Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
3.9-2	A COL applicant that references the U.S. EPR design certification will prepare the design specifications and design reports for ASME Class 1, 2, and 3 components, piping, supports and core support structures that comply with and are certified to the requirements of Section III of the ASME Code. The COL applicant will address the results and conclusions from the reactor internals material reliability programs applicable to the U.S. EPR reactor internals with regard to known aging degradation mechanisms such as irradiation-assisted stress corrosion cracking and void swelling.	3.9.3	B	Design reports (including design specifications) for ASME Class 1, 2, and 3 components, piping, supports and core support structures are covered under existing ITAAC (e.g., U.S. EPR FSAR Tier 1, Table 2.2.1-5, Items 3.16, 3.20, 3.21, 3.25, 3.26). Thus, this COL item will be revised to apply to site-specific ASME Code Class 1, 2 and 3 components. Additionally, the last sentence of this COL information will item will be revised to state that the COLA applicant will implement the augmented ISI program to verify that IASCC and void swelling does not impact the safety function of the reactor internals. As NRC notes in RAI 339, "AREVA plans on participating in the industry EPRI/MRP programs to manage IASCC and void swelling to screen the heavy reflector for IASCC and void swelling. To verify that IASCC and void swelling does not impact the safety function of the heavy reflector or create loose parts, an augmented ASME Code, Section XI inspection program will be developed." The change to the last sentence of this COL item is also consistent with COL information item 3.6-5

Table 03.06.01-14-1
Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
3.9-3	A COL applicant that references the U.S. EPR design certification will examine the feedwater line welds after hot functional testing prior to fuel loading and at the first refueling outage, in accordance with NRC Bulletin 79-13. A COL applicant that references the U.S. EPR design certification will report the results of inspections to the NRC, in accordance with NRC Bulletin 79-13.	3.9.3.1.1	B	ITAAC exist for the verification that the feedwater welds will conform to the non-destructive examination requirements of ASME Code Section III (Tier 1, Table 2.2.1-5, items 3.22 and 3.27. Thus, this COL item will be revised as follows: "A COL applicant that references the U.S. EPR design certification will ***develop a program to*** examine the feedwater line welds ***during*** ~~after hot functional testing prior to fuel loading and at~~ the first refueling outage, in accordance with NRC Bulletin 79-13. A COL applicant that references the U.S. EPR design certification will report the results of inspections to the NRC, in accordance with NRC Bulletin 79-13."
3.9-4	As noted in ANP-10264NP-A, a COL applicant that references the U.S. EPR design certification will confirm that thermal deflections do not create adverse conditions during hot functional testing.	3.9.3.1.1	A	Reword COL item as follows: A COL applicant that references the U.S. EPR design certification will ***develop a program to*** confirm that thermal deflections do not create adverse conditions during hot functional testing.

Table 03.06.01-14-1
Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
3.9-11	A COL applicant that references the U.S. EPR design certification will provide a summary of the maximum total stress, deformation (where applicable), and cumulative usage factor values for each of the component operating conditions for ASME Code Class 1 components. For those values that differ from the allowable limits by less than 10 percent, the COL applicant will provide the contribution of each of the loading categories (e.g., seismic, pipe rupture, dead weight, pressure, and thermal) to the total stress for each maximum stress value identified in this range. The COL applicant will also provide the maximum total stress and deformation values for each operating condition for Class 2 & 3 components required for safe shutdown of the reactor, or mitigation of consequences of a postulated piping failure without offsite power. Identification of those values that differ from the allowable limits by less than 10 percent will also be provided.	3.9.3.1	C	As NRC noted in RAI 386, Suppl 10, "In EPR FSAR Tier 2, Section 3.9.3.1, Areva indicated that a COL applicant referencing the US EPR design certification will provide summary of the maximum total stress, deformation, and cumulative usage factor value for each ASME Code Class I components. Corresponding ITAAC is provided in Tier 1, Table 2.2.1-5, item 3.11, to address a) fatigue analysis and b) for components identified as ASME Code Class I, operating modes where peak stress are within 10 percent of allowable have been identified." AREVA NP Response to 386, Suppl 10 stated: "The U.S. EPR FSAR Tier 1, Table 2.2.1-5, Item 3.11, ITAAC referenced in the question was replaced in the same table by Items 3.25, 3.26, 3.27, and 3.28 in response to RAI 210, Question 14.3.3-33. These ITAAC specify ASME code requirements and delete the redundant fatigue ITAAC. Compliance with the ASME Code Section III design requirements is explicitly required by these revised ITAAC which, therefore, includes fatigue analysis requirements.

Table 03.06.01-14-1

Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
3.9-11 cont'd				The information required by this COL item will be included in stress reports which follow the ASME guidelines for design reports (Section III Division 1 Appendix C). These stress reports are included as part of the "associated referenced documents" in the ITAAC for U.S. EPR FSAR Tier 1 Table 2.2.1-5, item 3.25. Therefore, the COL item will be deleted and U.S. EPR FSAR Tier 2, Section 3.9.3.1 will be revised to state that design reports provide a summary of the maximum total stress, deformation (where applicable), and cumulative usage factor values for each of the component operating conditions for ASME Code Class 1 components.

Table 03.06.01-14-1
Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
3.9-11 cont'd				For those values that differ from the allowable limits by less than 10 percent, the design reports provide the contribution of each of the loading categories (e.g., seismic, pipe rupture, dead weight, pressure, and thermal) to the total stress for each maximum stress value identified in this range. The design reports also provide the maximum total stress and deformation values for each operating condition for Class 2 & 3 components required for safe shutdown of the reactor, or mitigation of consequences of a postulated piping failure without offsite power. Identification of those values that differ from the allowable limits by less than 10 percent will also be provided.

Table 03.06.01-14-1
Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
3.9-14	A COL applicant that references the U.S. EPR design certification will provide a summary of reactor core support structure maximum total stress, deformation, and cumulative usage factor values for each component and each operating condition in conformance with ASME Section III, Subsection NG.	3.9.5.2	C	The information in this COL item is required by ASME Section III Subsection NG. The ITAAC for U.S. EPR FSAR Tier 1, Table 2.2.1-5, Item 3.16 verifies that the RPV internals are designed in accordance with ASME Code Section III, Subsection NG requirements. It is also noteworthy, that the information in COL Item 3.9-14 was originally intended to be provided as part of the information in COL item 3.9-11 (see the Response to RAI 149, Question 03.09.05-11. Therefore, similar to the disposition for COL Item 3.9-11, the COL item will be deleted and U.S. EPR FSAR Tier 2, Section 3.9.5.2, will be revised to state that design reports provide a summary of reactor core support structure maximum total stress, deformation, and cumulative usage factor values for each component and each operating condition in conformance with ASME Section III, Subsection NG.

Table 03.06.01-14-1
Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
3.10-1	A COL applicant that references the U.S. EPR design certification will create and maintain the SQDP file during the equipment selection and procurement phase.	3.10.4	C	ITAAC acceptance criteria exist (e.g., U.S. EPR FSAR Tier 1, Table 2.2.1-5, Item 3.3, Table 2.2.3-3, Item 3.4) which require the development of SQDPs. Thus, this COL item can be deleted. U.S. EPR FSAR Tier 2, Section 3.10.4, will be revised to state that SQDP files are created and maintained during the equipment selection and procurement phase.
3.11-1	A COL applicant that references the U.S. EPR design certification will maintain the equipment qualification test results and qualification status file during the equipment selection, procurement phase and throughout the installed life in the plant.	3.11	C	ITAAC acceptance criteria exist (e.g., U.S. EPR FSAR Tier 1, Table 2.2.1-5, Item 6.1, Table 2.2.3-3, Item 6.1) which require the development of EQDPs which contain the equipment qualification test results and qualification status. Thus, this COL item can be deleted. U.S. EPR FSAR Tier 2, Section 3.10.4, will be revised to state that equipment qualification test results and qualification status file are maintained during the equipment selection, procurement phase and throughout the installed life in the plant.

Table 03.06.01-14-1

Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
3.12-3	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	A	Reword COL item as follows: A COL applicant that references the U.S. EPR design certification ***will develop a program to*** 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.
3.12-4	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	A	Reword COL item as follows: A COL applicant that references the U.S. EPR design certification ***will develop a program to*** 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.

Table 03.06.01-14-1

Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
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	A	Reword COL item as follows: A COL applicant that references the U.S. EPR design certification ***will develop a program to*** 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.
3.12-6	A COL applicant that references the U.S. EPR 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	A	Reword COL item as follows: A COL applicant that references the U.S. EPR design certification ***will develop a program to*** 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.

Table 03.06.01-14-1

Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
7.1-2	A COL applicant that references the U.S. EPR design certification will, following selection of the actual plant operating instrumentation and calculation of the instrumentation uncertainties of the operating plant parameters, prior to fuel load, calculate the primary power calorimetric uncertainty. The calculations will be completed using an NRC acceptable method and confirm that the safety analysis primary power calorimetric uncertainty bounds the calculated values.	7.7.2.3.5	A	Reword COL item to delete "prior to fuel load."
8.3-1	A COL applicant that references the U.S. EPR design certification will monitor and maintain EDG reliability during plant operations to verify the selected reliability level target is being achieved as intended by RG 1.155.	8.3.1.1.5	A	Reword COL item as follows: A COL applicant that references the U.S. EPR design certification will ***establish procedures to*** monitor and maintain EDG reliability during plant operations to verify the selected reliability level target is being achieved as intended by RG 1.155.

Table 03.06.01-14-1

Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
9.5-16	A COL applicant that references the U.S. EPR design certification will perform an as-built, post-fire Safe Shutdown Analysis, which includes final plant cable routing, fire barrier ratings, purchased equipment, equipment arrangement and includes a review against the assumptions and requirements contained in the Fire Protection Analysis. The post-fire Safe Shutdown Analysis will demonstrate that safe shutdown performance objectives are met prior to fuel loading and will include a post-fire safe shutdown circuit analysis based on the methodology described in NEI 00-01, “Guidance for Post-Fire Safe-Shutdown Circuit Analysis.”	9.5.1.2.1	C	ITAAC exist for performance of the post-fire safe shutdown analysis (Tier 1 Table 2.1.1-8, items 2.7, 2.24, 2.25, Table 2.1.1-10, item 2.2, Table 2.1.1-11, item 2.2). The acceptance criteria for these ITAAC reflect the information in the COL item and the COL item can be deleted. U.S. EPR FSAR Tier 2, Section 9.5.1.2.1 will be revised to state that the post-fire Safe Shutdown Analysis includes final plant cable routing, fire barrier ratings, purchased equipment, equipment arrangement, and includes a review against the assumptions and requirements contained in the Fire Protection Analysis. The post-fire Safe Shutdown Analysis demonstrates that safe shutdown performance objectives are met prior to fuel loading and includes a post-fire safe shutdown circuit analysis based on the methodology described in NEI 00-01, “Guidance for Post-Fire Safe-Shutdown Circuit Analysis.”

Table 03.06.01-14-1
Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
9.5.17	A COL applicant that references the U.S. EPR design certification will evaluate the differences between the as-designed and as-built plant configuration to confirm the Fire Protection Analysis remains bounding. This evaluation will be performed prior to fuel loading and will consider the final plant cable routing, fire barrier ratings, combustible loading, ignition sources, purchased equipment, equipment arrangement and includes a review against the assumptions and requirements contained in the Fire Protection Analysis. The applicant will describe how this as-built evaluation will be performed and documented, and how the NRC will be made aware of deviations from the FSAR, if any.	9.5.1.3	C	ITAAC exist for performance of the Fire Protection Analysis (Tier 1 Table 2.1.1-8, items 2.7, 2.24, 2.25, Table 2.1.1-10, item 2.2, Table 2.1.1-11, item 2.2). Therefore, the COL item can be deleted. U.S. EPR FSAR Tier 2, Section 9.5.1.2.1 will be revised to state that the Fire Protection Analysis includes an evaluation of the final plant cable routing, fire barrier ratings, purchased equipment, and equipment arrangement.
10.2-2	A COL applicant that references the U.S. EPR design certification will provide applicable material properties of the turbine rotor, including the method of calculating the fracture toughness properties, after the site-specific turbine has been procured.	10.2.3.1	A	Revise COL item to delete "after the site-specific turbine has been procured."

Table 03.06.01-14-1

Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
10.2-3	A COL applicant that references the U.S. EPR design certification will provide applicable turbine disk rotor specimen test data, load- displacement data from the compact tension specimens and the fracture toughness properties after the site-specific turbine has been procured.	10.2.3.2	A	Revise COL item to delete "after the site-specific turbine has been procured."

Table 03.06.01-14-1

Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
15.0-1	A COL applicant that references the U.S. EPR design certification will provide for staff review, prior to the first cycle of operation, a report that demonstrates compliance with the following items: • Examine fuel assembly characteristics to verify that they are hydraulically compatible based on the criterion that a single package of assembly specific critical heat flux (CHF) correlations can be used to evaluate the assembly performance. • Verify that uncertainties used in the setpoint analyses are appropriate for the plant and cycle being analyzed. • Verify that the DNBR and LPD satisfy SAFDL with a 95/95 assurance. • Review the U.S. EPR FSAR Tier 2 analysis results for the first cycle to confirm that the static setpoint value provides adequate protection for at least three limiting AOO.	15.0.0.3.9	A	Reword COL item as follows: A COL applicant that references the U.S. EPR design certification will provide for staff review a report that demonstrates compliance with the following items ***applicable to the first cycle of operation***: • Examine fuel assembly characteristics to verify that they are hydraulically compatible based on the criterion that a single package of assembly specific critical heat flux (CHF) correlations can be used to evaluate the assembly performance. • Verify that uncertainties used in the setpoint analyses are appropriate for the plant and cycle being analyzed. • Verify that the DNBR and LPD satisfy SAFDL with a 95/95 assurance. • Review the U.S. EPR FSAR Tier 2 analysis results for the first cycle to confirm that the static setpoint value provides adequate protection for at least three limiting AOO.

Table 03.06.01-14-1
Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
19.1-4	A COL applicant that references the U.S. EPR design certification will conduct a peer review of the PRA relative to the ASME PRA Standard prior to use of the PRA to support risk-informed applications or before fuel load.	19.1.2.3	A	Revise COL item to delete "or before fuel load."
19.1-9	A COL applicant that references the U.S. EPR design certification will review as-designed and as-built information and conduct walk-downs as necessary to confirm that the assumptions used in the PRA (including PRA inputs to RAP and SAMDA) remain valid with respect to internal events, internal flood and fire events (routings and locations of pipe, cable and conduit), and HRA analyses (development of operating procedures, emergency operating procedures and severe accident management guidelines and training), external events including PRA-based seismic margins HCLPF fragilities, and LPSD procedures.	19.1.2.2	A	Reword COL item as follows: A COL applicant that references the U.S. EPR design certification will ***describe the process to*** review as-designed and as-built information and conduct walk-downs as necessary to confirm that the assumptions used in the PRA (including PRA inputs to RAP and SAMDA) remain valid with respect to internal events, internal flood and fire events (routings and locations of pipe, cable and conduit), and HRA analyses (development of operating procedures, emergency operating procedures and severe accident management guidelines and training), external events including PRA-based seismic margins HCLPF fragilities, and LPSD procedures.

Table 03.06.01-14-1

Review of COL I/Is in U.S. EPR FSAR Tier 2, Table 1.8-2

Item No.	Description	Section	Classification (see key at end of table)	Disposition
19.2-1	A COL applicant that references the U.S. EPR design certification will develop and implement severe accident management guidelines prior to fuel loading using the Operating Strategies for Severe Accidents (OSSA) methodology described in U.S. EPR FSAR Section 19.2.5.	19.2.5	A	Revise COL item to delete “prior to fuel loading.”

Key:

A COL I/Is that can be reworded in an acceptable manner so they can be completed by the COL applicant.

B COL I/Is that duplicate, to some extent, an existing ITAAC, can be reworded to limit the scope of the COL I/I while retaining the ITAAC.

C COL I/Is that entirely duplicate an existing ITAAC can be deleted

D COL I/Is that can be deleted, and a new ITAAC be created, or the scope of an existing ITAAC be expanded.

U.S. EPR Final Safety Analysis Report Markups

Table 1.8-2—U.S. EPR Combined License Information Items
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Item No.	Description	Section
3.3-3	A COL applicant that references the U.S. EPR design certification will demonstrate that failure of site-specific structures or components not included in the U.S. EPR standard plant design, and not designed for tornado loads, will not affect the ability of other structures to perform their intended safety functions.	3.3.2
3.4-1	A COL applicant that references the U.S. EPR design certification will confirm the potential site specific external flooding events are bounded by the U.S. EPR design basis flood values or otherwise demonstrate that the design is acceptable.	3.4.3.2
3.4-2	A COL applicant that references the U.S. EPR design certification will perform a flooding analysis for the ultimate heat sink makeup water intake structure based on the site-specific design of the structur Deleted ion concepts provided herein.	3.4.3.10
3.4-3	A COL applicant that references the U.S. EPR design certification will define the need for a site-specific permanent dewatering system.	3.4.3.11
3.4-4	~~A COL applicant that references the U.S. EPR design certification will perform internal flooding analyses prior to fuel load for the Safeguard Buildings and Fuel Building to demonstrate that the impact of internal flooding is contained within the Safeguard Building or Fuel Building division of origin.~~	~~3.4.1~~
3.4-5	~~A COL applicant that references the U.S. EPR design certification will perform an internal flooding analysis prior to fuel load for the Reactor Building and Reactor Building Annulus to demonstrate that the essential equipment required for safe shutdown is located above the internal flood level.~~	~~3.4.1~~
3.4-6	A COL applicant that references the U.S. EPR design certification will include in its maintenance program appropriate watertight door preventive maintenance in accordance with manufacturer recommendations so that each Safeguards Building and Fuel Building watertight door above elevation +0 feet remains capable of performing its intended function.	3.4.1
3.4-7	A COL applicant that references the U.S. EPR design certification will design the watertight seal between the Access Building and the adjacent Category I access path to the Reactor Building Tendon Gallery. Watertight seal design will account for hydrostatic loads, lateral earth pressure loads, and other applicable loads.	3.4.2

Delete

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Item No.	Description	Section
3.5-1	A COL applicant that references the U.S. EPR design certification will describe controls to confirm that unsecured maintenance equipment, including that required for maintenance and that are undergoing maintenance, will be removed from containment ~~prior to operation~~, moved to a location where it is not a potential hazard to safety-related SSC ~~important to safety~~, or seismically restrained to prevent it from becoming a missile.	3.5.1.2.3
3.5-2	A COL applicant that references the U.S. EPR design certification will confirm the evaluation of the probability of turbine missile generation for the selected turbine generator, P1, is less than 1 x 10^{-4} for turbine-generators favorably oriented with respect to containment.	3.5.1.3
3.5-3	A COL applicant that references the U.S. EPR design certification will assess the effect of potential turbine missiles from turbine generators within other nearby or co-located facilities.	3.5.1.3
3.5-4	A COL applicant that references the U.S. EPR design certification will evaluate the potential for other missiles generated by natural phenomena, such as hurricanes and extreme winds, and their potential impact on the missile protection design features of the U.S. EPR.	3.5.1.4
3.5-5	A COL applicant that references the U.S. EPR design certification will evaluate the potential for site proximity explosions and missiles generated by these explosions for their potential impact on missile protection design features.	3.5.1.5
3.5-6	A COL applicant that references the U.S. EPR design certification will evaluate site-specific aircraft hazards and their potential impact on plant SSC.	3.5.1.6
3.5-7	For sites with surrounding ground elevations higher than plant grade, a COL applicant that references the U.S. EPR design certification will confirm that automobile missiles cannot be generated within a 0.5 mile radius of safety-related SSC that would lead to impact higher than 30 ft above plant grade.	3.5.1.4
3.5-8	A COL applicant that references the U.S. EPR design certification will describe controls to confirm that unsecured compressed gas cylinders will be either removed or seismically supported when not in use to prevent them from becoming missiles.	3.5.1.1.3
3.5-9	A COL applicant that references the U.S. EPR design certification will describe controls to confirm that unsecured maintenance equipment, including that required for maintenance and that are undergoing maintenance, will be either removed or seismically supported when not in use to prevent it from becoming a missile.	3.5.1.1.3

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Deleted

Item No.	Description	Section
3.6-1	Deleted.A COL applicant that references the U.S. EPR design certification will perform the pipe break hazards analysis and reconcile deviations in the as-built configuration to the as-designed analysis.	3.6.1
	Deleted.A COL applicant that references the U.S. EPR design certification will perform the pipe break hazards analysis and reconcile deviations in the as-built configuration to the as-designed analysis.	3.6.2.1
3.6-3	A COL applicant that references the U.S. EPR design certification will confirm that the design LBB analysis remains bounding for each piping system and provide a summary of the results of the actual as-built plant specific LBB analysis, including material properties of piping and welds, stress analyses, leakage detection capability, and degradation mechanisms.	3.6.3
3.6-4	A COL applicant that references the U.S. design certification will provide diagrams showing the final as-designed configurations, locations, and orientations of the pipe whip restraints in relation to break locations in each piping system.	3.6.2.5.1
3.6-5	A COL applicant that references the U.S. EPR design certification will implement the ISI program as augmented with NRC approved ASME Code cases that are developed and approved for augmented inspections of Alloy 690/152/52 material to address PWSCC concerns.	3.6.3.3.4.1
3.7-1	A COL applicant that references the U.S. EPR design certification will confirm that the site-specific seismic response is within the parameters of section 3.7 of the U.S. EPR standard design.	3.7.2
3.7-2	A COL applicant that references the US EPR design certification will provide the site-specific separation distances for the access building and turbine building.	3.7.2.8
3.7-3	A COL applicant that references the U.S. EPR design certification will provide a description of methods used for seismic analysis of site-specific Category I concrete dams, if applicable.	3.7.3.13
3.7-4	A COL applicant that references the U.S. EPR design certification will determine whether essentially the same seismic response from a given earthquake is expected at each of the units in a multi-unit site or instrument each unit. In the event that only one unit is instrumented, annunciation shall be provided to each control room.	3.7.4.2

Delete

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Item No.	Description	Section
3.8-20	A COL applicant that references the U.S. EPR design certification will compare the ESWB site-specific predicted angular distortion to the angular distortion in the total differential settlement contours in Figure 3.8-136, using methods described in U.S. Army Engineering Manual 1110-1-1904, The comparison is made throughout the basemat in both the east-west and north-south directions. If the predicted angular distortion of the basemat of ESWB structures is less than the angular distortion shown, the site is considered acceptable. Otherwise, further analysis will be required to demonstrate that the structural design is adequate.	3.8.5.5.3
3.9-1	A COL applicant that references the U.S. EPR design certification will submit the results from the [site specific] vibration assessment program for the U.S. EPR RPV internals ~~and piping systems specified in U.S. EPR FSAR Tier 2, Section 3.9.2.1~~, in accordance with RG 1.20.	3.9.2.4
3.9-2	A COL applicant that references the U.S. EPR design certification will prepare the design specifications and design reports for ASME Class 1, 2, and 3 components, piping, supports and core support structures that comply with and are certified to the requirements of Section III of the ASME Code. The COL applicant will ~~address~~ [implement the ISI program as augmented with NRC approved ASME Code cases to verify that the safety function of the U.S. EPR reactor internals are not impacted] ~~the results and conclusions from the reactor internals material reliability programs applicable to the U.S. EPR reactor internals with regard to known aging degradation mechanisms such as irradiation assisted stress corrosion cracking and void swelling.~~	3.9.3
3.9-3	A COL applicant that references the U.S. EPR design certification will [develop a program to] examine the feedwater line welds ~~after hot functional testing prior to fuel loading and at~~ [during] the first refueling outage, in accordance with NRC Bulletin 79-13. A COL applicant that ~~references the U.S. EPR design~~ certification will [develop a program to] report the results of ~~inspections to the NRC, in~~ accordance with NRC Bulletin 79-13.	
3.9-4	As noted in ANP-10264NP-A, a COL applicant that references the U.S. EPR design certification will confirm that thermal deflections do not create adverse conditions during hot functional testing.	3.9.3.1.1
3.9-5	As noted in ANP-10264NP-A, should a COL applicant that references the U.S. EPR design certification find it necessary to route Class 1, 2, and 3 piping not included in the U.S. EPR design certification so that it is exposed to wind and tornadoes, the design must withstand the plant design-basis loads for this event.	3.9.3.1.1
3.9-6	A COL applicant that references the US EPR design certification will identify any additional site-specific valves in Table 3.9.6-2 to be included within the scope of the IST program.	3.9.6.3

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Item No.	Description	Section
3.9-7	A COL applicant that references the U.S. EPR design certification will submit the preservice testing (PST) program and IST program for pumps, valves, and snubbers as required by 10 CFR 50.55a.	3.9.6
3.9-8	A COL applicant that references the US EPR design certification will identify any additional site-specific pumps in Table 3.9.6-1 to be included within the scope of the IST program.	3.9.6.2
3.9-9	COL applicant that references the U.S. EPR design certification will either use a piping analysis program based on the computer codes described in Section 3.9.1 and Appendix 3C or will implement a U.S. EPR benchmark program using models specifically selected for the U.S. EPR.	3.9.1.2
3.9-10	Pipe stress and support analysis will be performed by a COL applicant that references the U.S. EPR design certification.	3.9.1.2
3.9-11 Deleted	~~A COL applicant that references the U.S. EPR design certification will provide a summary of the maximum total stress, deformation (where applicable), and cumulative usage factor values for each of the component operating conditions for ASME Code Class 1 components. For those values that differ from the allowable limits by less than 10 percent, the COL applicant will provide the contribution of each of the loading categories (e.g., seismic, pipe rupture, dead weight, pressure, and thermal) to the total stress for each maximum stress value identified in this range.~~ ~~The COL applicant will also provide the maximum total stress and deformation values for each operating condition for Class 2 & 3 components required for safe shutdown of the reactor, or mitigation of consequences of a postulated piping failure without offsite power. Identification of those values that differ from the allowable limits by less than 10 percent will also be provided.~~	~~3.9.3.1~~
3.9-12	A COL applicant that references the U.S.EPR design certification will provide a table identifying the safety-related systems and components that use snubbers in their support systems, including the number of snubbers, type (hydraulic or mechanical), applicable standard, and function (shock, vibration, or dual-purpose snubber). For snubbers identified as either a dual-purpose or vibration arrester type, the COL applicant shall indicate whether the snubber or component was evaluated for fatigue strength.	3.9.6.4

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Item No.	Description	Section
3.9-13	A COL applicant that references the U.S. EPR design certification will identify the implementation milestones and applicable ASME OM Code for the preservice and inservice examination and testing Deleted hese programs will be consistent with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a on the date 12 months before the date for initial fuel load.	3.9.6
3.9-14	~~A COL applicant that references the U.S. EPR design certification will provide a summary of reactor core support structure maximum total stress, deformation, and cumulative usage factor values for each component and each operating condition in conformance with ASME Section III Subsection NG.~~	~~3.9.5.2~~
3.10-1	~~A COL applicant that references the U.S. EPR design certification will create and maintain the SQDP file during the equipment selection and procurement phase.~~	~~3.10.4~~
3.10-2	A COL applicant that references the U.S. EPR design certification will identify any additional site specific components that need to be added to the equipment list in Table 3.10-1.	3.10.1.1
3.10-3	If the seismic and dynamic qualification testing is incomplete at the time of the COL application, a COL applicant that references Deleted gn certification will submit an implementation program, including milestones and completion dates, for NRC review and approval prior to installation of the applicable equipment.	3.10.4
3.11-1	~~A COL applicant that references the U.S. EPR design certification will maintain the equipment qualification test results and qualification status file during the equipment selection, procurement phase and throughout the installed life in the plant.~~	~~3.11~~
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 3.11-1.	3.11.1.1.3
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

Table 1.8-2—U.S. EPR Combined License Information Items
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Item No.	Description	Section
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. If the impact review determines the existing piping analysis does not bound the additional mass of the pipe support, the COL applicant will perform reanalysis of the piping to include the additional mass.	3.12.4.2
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
3.12-3	A COL applicant that references the U.S. EPR design certification will develop a program to 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
3.12-4	A COL applicant that references the U.S. EPR design certification will develop a program to 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 develop a program to 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. EPR design certification will develop a program to 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

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Item No.	Description	Section
6.4-3	A COL applicant that references the U.S. EPR design certification will evaluate the results of the toxic chemical accidents from Section 2.2.3, address their impact on control room habitability in accordance with RG 1.78, and if necessary, identify the types of sensors and automatic control functions required for control room operator protection.	6.4.1
6.4-4	A COL applicant that references the U.S. EPR design certification will confirm that the radiation exposure of main control room occupants resulting from a design basis accident at a nearby unit on a multi-unit site is bounded by the radiation exposure from the postulated design basis accidents analyzed for the U.S. EPR; or confirm that the limits of GDC-19 are met.	6.4.4
6.6-1	A COL applicant that references the U.S. EPR design certification will identify the implementation milestones for the site-specific ASME Section XI preservice and inservice inspection program for the Class 2 and Class 3 components, consistent with the requirements of 10 CFR 50.55a (g). The program will identify the applicable edition and addenda of the ASME Code Section XI, and will identify additional relief requests and alternatives to Code requirements.	6.6
7.1-1	Deleted.~~A COL applicant that references the U.S. EPR design certification will confirm the inventory list of PAM variables in Table 7.5-1—Inventory of Post-Accident Monitoring Variables upon completion of the emergency operating and abnormal operating procedures prior to fuel loading.~~	Deleted.~~7.5.2.2.1~~
7.1-2	A COL applicant that references the U.S. EPR design certification will, following selection of the actual plant operating instrumentation and calculation of the instrumentation uncertainties of the operating plant parameters, ~~prior to fuel load,~~ calculate the primary power calorimetric uncertainty. The calculations will be completed using an NRC acceptable method and confirm that the safety analysis primary power calorimetric uncertainty bounds the calculated values.	7.7.2.3.5
7.1-3	A COL applicant that references the U.S. EPR design certification will identify the need for any site-specific PAM variables.	7.5.2.2.1
7.1-4	A COL applicant that references the U.S. EPR design certification will establish a plan to address the site-specific implementation of the limitations and conditions identified in Section 4 of the NRC Safety Evaluation for Topical Report ANP-10272A, "Software Program Manual for TELEPERM XS Safety Systems."	7.1.1.2.2

delete

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Item No.	Description	Section
8.3-1	A COL applicant that references the U.S. EPR design certification will monitor and maintain EDG reliability during plant operations to verify the selected reliability level target is being achieved as intended by RG 1.155.	8.3.1.1.5
8.3-2	A COL applicant that references the U.S. EPR design certification will describe inspection, testing and monitoring programs to detect the degradation of inaccessible or underground power cables that support EDGs, offsite power, ESW and other systems that are within the scope of 10 CFR 50.65.	8.3.1.1.8
8.4-1	A COL applicant that references the U.S. EPR design certification will provide site-specific information that identifies any additional local power sources and transmission paths that could be made available to resupply the power plant following a loss of offsite power (LOOP).	8.4.1.3
8.4-2	A COL applicant that references the U.S. EPR design certification will address the RG 1.155 guidance related to procedures and training to cope with SBO.	8.4.2.6.4
9.1-1	A COL applicant that references the U.S. EPR design certification will provide site-specific information on the heavy load handling program, including a commitment to procedures for heavy load lifts in the vicinity of irradiated fuel or safe shutdown equipment, and crane operator training and qualification.	9.1.5.2.5
9.1-2	A COL applicant that references the U.S. EPR design certification will perform appropriate tests and analyses, which demonstrate that an identified NRC-approved cask can be safely connected to the spent fuel cask transfer facility (SFCTF), and the cask and its adapter meet the criteria specified in Table 9.1.4-1, prior to initial fuel loading into the reactor.~~provide a cask design acceptable for interfacing with the SFCTF prior to initial cask loading operations. The design of the spent fuel cask must meet the following interface requirements:~~ • ~~The mating surface of the cask maintains a leak-tight connection with the penetration assembly when the cask is connected to the penetration.~~ • ~~The dose rates from a loaded cask during cask handling operations does not exceed those identified in Section 12.3.~~ • ~~A structural and seismic analysis of the SFCTM and cask demonstrates that the fluid boundary between the penetration assembly and connected cask is maintained to preclude the loss of significant inventory in the spent fuel pool during cask loading operations, including safe shutdown earthquake (SSE), and the postulated drop of a fuel assembly from the maximum handling height in the cask loading pit onto a connected cask.~~	9.1.4

All indicated changes are in response to RAI 547 Question 03.06.01-14

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Item No.	Description	Section
9.5-13	A COL applicant that references the U.S. EPR design certification will submit site specific information to address the Regulatory Guide 1.189, Regulatory Position C.6.2.4, Independent Spent Fuel Storage Areas.	Table 9.5.1-1, C.6.2.4
9.5-14	A COL applicant that references the U.S. EPR design certification will submit site specific information to address the Regulatory Deleted gulatory Position C.6.2.6, Cooling Towers.	Table 9.5.1-1, C.6.2.6 9.5.1.2.1
9.5-15	A COL applicant that references the U.S. EPR design certification will submit site specific information to address Regulatory Guide 1.189, Regulatory Position C.7.6, Nearby Facilities.	Table 9.5.1-1, C.7.6
9.5-16	~~A COL applicant that references the U.S. EPR design certification will perform an as-built, post-fire Safe Shutdown Analysis, which includes final plant cable routing, fire barrier ratings, purchased equipment, equipment arrangement and includes a review against the assumptions and requirements contained in the Fire Protection Analysis. The post-fire Safe Shutdown Analysis will demonstrate that safe shutdown performance objectives are met prior to fuel loading and will include a post-fire safe shutdown circuit analysis based on the methodology described in NEI 00-01, "Guidance for Post-Fire Safe Shutdown Circuit Analysis."~~	~~9.5.1.2.1~~
9.5.17	~~A COL applicant that references the U.S. EPR design certification will evaluate the differences between the as-designed and as-built plant configuration to confirm the Fire Protection Analysis remains bounding. This evaluation will be performed prior to fuel loading and will consider the final plant cable routing, fire barrier ratings, combustible loading, ignition sources, purchased equipment, equipment arrangement and includes a review against the assumptions and requirements contained in the Fire Protection Analysis. The applicant will describe how this as-built evaluation will be performed and documented, and how the NRC will be made aware of deviations from the FSAR, if any.~~	~~9.5.1.3~~
9.5-18	A COL applicant that references the U.S. EPR design certification will perform a supplemental Fire Protection Analysis for site-specific areas of the plant not analyzed by the FSAR.	9.5.1.3
9.5-19	A COL applicant that references the U.S. EPR design certification will provide a description and simplified Fire Protection System piping and instrumentation diagrams for site-specific systems.	9.5.1.2.1
9.5-20	A COL applicant that references the U.S. EPR design certification will describe the program used to monitor and maintain an acceptable level of quality in the fire protection system freshwater storage tanks.	9.5.1.2.1

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Item No.	Description	Section
9.5-21	A COL applicant that references the U.S. EPR design certification will provide a description of the offsite communication system that interfaces with the onsite communication system, including type of connectivity, radio frequency, normal and backup power supplies and plant security system interface.	9.5.2.1.1
9.5-22	A COL applicant that references the U.S. EPR design certification will describe the site-specific sources of acceptable fuel oil available for refilling the EDG fuel oil storage tanks within seven days, including the means of transporting and refilling the fuel storage tanks, following a design basis event to enable each diesel generator system to supply uninterrupted emergency power.	9.5.4.4
10.0-1	Deleted.	Deleted
10.2-1	Delete	Deleted
10.2-2	A COL applicant that references the U.S. EPR design certification will provide applicable material properties of the turbine rotor, including the method of calculating the fracture toughness properties~~, after the site-specific turbine has been procured~~.	10.2.3.1
10.2-3	A COL applicant that references the U.S. EPR design certification will provide applicable turbine disk rotor specimen test data, load-displacement data from the compact tension specimens and the fracture toughness properties ~~after the site-specific turbine has been procured~~.	10.2.3.2
10.2.4	Deleted.	Deleted
10.2-5	A COL applicant that references the U.S. EPR design certification will provide the site-specific turbine rotor inservice inspection program and inspection interval consistent with the manufacturer's turbine missile analysis.	10.2.3.6
10.2-6	A COL applicant that references the U.S. EPR design certification will include ultrasonic examination of the turbine rotor welds or provide an analysis which demonstrates defects in the root of the rotor welds will not grow to critical size for the life of the rotor.	10.2.3.6
10.2-7	A COL applicant that references the U.S. EPR design certification will provide the site-specific inservice inspection program, inspection intervals, and exercise intervals consistent with the turbine manufacturer's recommendations for the main steam stop and control valves, the reheat stop and intercept valves, and the extraction non-return valves.	10.2.2.12

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applicable to the first cycle of operation

Item No.	Description	Section
15.0-1	A COL applicant that references the U.S. EPR design certification will provide for staff review, ~~prior to the first cycle of operation~~, a report that demonstrates compliance with the following items: ● Examine fuel assembly characteristics to verify that they are hydraulically compatible based on the criterion that a single package of assembly specific critical heat flux (CHF) correlations can be used to evaluate the assembly performance. ● Verify that uncertainties used in the setpoint analyses are appropriate for the plant and cycle being analyzed. ● Verify that the DNBR and LPD satisfy SAFDL with a 95/95 assurance. ● Review the U.S. EPR FSAR Tier 2 analysis results for the first cycle to confirm that the static setpoint value provides adequate protection for at least three limiting AOO.	15.0.0.3.9
16.0-1	Reviewer's Notes and brackets are used to identify information or characteristics that are plant specific or are based on preliminary design information. A COL applicant that references the U.S. EPR design certification will provide the necessary information in response to the Reviewer's Notes and replace preliminary information provided in brackets of the Technical Specifications and Technical Specification Bases with plant specific values.	16.0
17.2-1	A COL applicant that references the U.S. EPR design certification will provide the Quality Assurance Programs associated with the construction and operations phases.	17.2
17.4-1	A COL applicant that references the U.S. EPR design certification will identify the site-specific SSC within the scope of the RAP.	17.4.2
17.4-2	A COL applicant that references the U.S. EPR design certification will provide the information requested in Regulatory Guide 1.206, Section C.I.17.4.4.	17.4.4
17.6-1	A COL applicant that references the U.S. EPR design certification will describe the process for determining which plant structures, systems, and components (SSC) will be included in the scope of the Maintenance Rule Program in accordance with 10 CFR 50.65(b). The program description will identify that additional SSC functions may be added to or subtracted from the Maintenance Rule scope prior to fuel load, when additional information is developed (e.g., emergency operating procedures, or EOP), and after the license is issued.	17.6.1

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Item No.	Description	Section
18.1-1	A COL applicant that references the U.S. EPR design certification will execute the NRC approved HFE program as described in this section	~~1.8~~18.1
18.1-2	A COL applicant that references the U.S. EPR design certification will be responsible for HFE design implementation for a new Emergency Operations Facility (EOF) or changes resulting from the addition of the U.S. EPR to an existing EOF.	18.1.1.3
18.5-1	A COL applicant that references the U.S. EPR design will confirm that actual staffing levels and qualifications of plant personnel specified in Section 13.1 of the COL application remain bounded by regulatory requirements and results of the staffing and qualifications analysis.	18.5
18.8-1	A COL applicant that references the U.S. EPR design certification will describe how HFE principles and criteria are incorporated into the development program for site procedures.	18.8
18.9-1	A COL applicant that references the U.S. EPR design certification will describe how HFE principles and criteria are incorporated into the development of training program scope, structure, and methodology.	18.9
19.0-1	A COL applicant that references the U.S. EPR design certification will either confirm that the PRA in the design certification bounds the site-specific design information and any design changes or departures, or update the PRA to reflect the site-specific design information and any design changes or departures.	19.0
19.1-1	A COL applicant that references the U.S. EPR design certification will describe the uses of PRA in support of licensee programs and identify and describe risk-informed applications being implemented during the combined license application phase.	19.1.1.2
19.1-2	A COL applicant that references the U.S. EPR design certification will describe the uses of PRA in support of licensee programs and identify and describe risk-informed applications being implemented during the construction phase.	19.1.1.3
19.1-3	A COL applicant that references the U.S. EPR design certification will describe the uses of PRA in support of licensee programs and identify and describe any risk-informed applications being Delete uring the operational phase.	19.1.1.4
19.1-4	A COL applicant that references the U.S. EPR design certification will conduct a peer review of the PRA relative to the ASME PRA Standard prior to use of the PRA to support risk-informed applications ~~or before fuel load~~.	19.1.2.3

Next File

Table 1.8-2—U.S. EPR Combined License Information Items
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Item No.	Description	Section
19.1-5	A COL applicant that references the U.S. EPR design certification will describe the applicant's PRA maintenance and upgrade program.	19.1.2.4.1
19.1-6	A COL applicant that references the U.S. EPR design certification will confirm that the U.S. EPR PRA-based seismic margin assessment is bounding for their specific site, and will update it to include site-specific SSC and soil effects (including sliding, overturning liquefaction and slope failure).	19.1.5.1.2.4
19.1-7	A COL applicant that references the U.S. EPR design certification will perform the site-specific screening analysis and the site-specific risk analysis for external events applicable to their site.	19.1.5.4
19.1-8	A COL applicant that references the U.S. EPR design certification will describe the uses of PRA in support of site-specific design programs and processes during the design phase.	19.1.1.1
19.1-9	A COL applicant that references the U.S. EPR design certification will [describe the process to] review as-designed and as-built information and conduct walk-downs as necessary to confirm that the assumptions used in the PRA (including PRA inputs to RAP and SAMDA) remain valid with respect to internal events, internal flood and fire events (routings and locations of pipe, cable and conduit), and HRA analyses (development of operating procedures, emergency operating procedures and severe accident management guidelines [Delete]), external events including PRA-based seismic margins HCLPF fragilities, and LPSD procedures.	19.1.2.2
19.2-1	A COL applicant that references the U.S. EPR design certification will develop and implement severe accident management guidelines ~~prior to fuel loading~~ using the Operating Strategies for Severe Accidents (OSSA) methodology described in U.S. EPR FSAR Section 19.2.5.	19.2.5

contained within the division of hazard origin and are not allowed to propagate to other divisions. Consequently, in a large internal flooding event in buildings with divisional separation safety-related SSC within the affected division are assumed to be flooded. The plant arrangement provides divisional separation walls to physically separate the redundant trains of safe shutdown systems and components. A combination of fluid diversion flow paths and passive features contain the water within the affected division.

Features credited in the analysis will be verified by walk-down.

Div[illegible]ion +0 feet, 0 inches (hereinafter +0 feet) provide sep[illegible]d barriers to prevent flood waters spreading to adjacent divi[illegible]alls are watertight, have no doors, and a minimal number of p[illegible] are watertight up to elevation +0 feet. Water is directed within one division to the building elevations below +0 feet, where it is stored. Above elevation +0 feet, a combination of watertight doors and openings for water flow to the lower building levels prevent water ingress into adjacent divisions. Watertight doors have position indicators for control of the closed position and are periodically inspected and maintained so that they remain capable of performing their intended function. Existing openings (e.g., stair cases, elevator shafts, and equipment openings) are credited as water flow paths. Watertight doors are designed to functional requirements such as leak-rate limits, door-closure indication, door-seal aging-degradation characteristics, and maintainability. Maintenance requirements are based on manufacturer recommendations and maintenance procedures are written by COL applicants in accordance with their respective regulatory approved maintenance programs.

A COL applicant that references the U.S. EPR design certification will include in its maintenance program appropriate watertight door preventive maintenance in accordance with manufacturer recommendations so that each Safeguards Building and Fuel Building watertight door above elevation +0 feet remains capable of performing its intended function.

Flooding pits with burst openings collect and direct water flow to lower building levels. Rooms within divisions have interconnections so that the maximum released water volume can be distributed and stored in the lower building levels of the affected division. Interconnections include doors with flaps, wall openings, and other wall penetrations that are not required to be sealed. Elevated thresholds, curbs, and pedestals are provided as necessary.

In Seismic Category I buildings that are not designed with divisional separation, e.g., the Reactor Building (RB), the layout allows water released inside the building to flow to the lower level of the building. In containment, water flows down to the in-containment refueling water storage tank (IRWST). In the annulus, water flows to the bottom level where it is stored. Safety-related SSC in these buildings, required to

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achieve safe shutdown or mitigate the consequences of an accident, are located above the maximum water level, protecting them from the effects of flooding.

Leak detection and isolation measures mitigate the consequences of postulated pipe ruptures. Water level instrumentation and other leak detection measures detect pipe ruptures that could result in internal flooding. These leak detection systems provide a signal to automatically isolate the affected system or to provide indication to the main control room (MCR) to initiate operator action from within the MCR or locally. Section 3.6 provides further information on protection mechanisms associated with the postulated rupture of piping.

move highlighted text to end of this paragraph

The nuclear island drain and vent system (NIDVS) prevents backflow of water from affected areas of the plant that contain safety-related equipment. The NIDVS is conservatively considered not available for reducing water volume by the respective sump pumps, and floor drains are assumed to be plugged.

Deleted

~~A COL applicant that references the U.S. EPR design certification will perform internal flooding analyses prior to fuel load for the Safeguard Buildings and Fuel Building to demonstrate that the impact of internal flooding is contained within the Safeguard Building or Fuel Building division of origin. Features credited in the analysis will be verified by walk-down.~~

~~A COL applicant that references the U.S. EPR design certification will perform an internal flooding analysis prior to fuel load for the Reactor Building and Reactor Building Annulus to demonstrate that the essential equipment required for safe shutdown is located above the internal flood level.~~ Locations of essential SSC and features provided to withstand flooding will be verified by walk-down.

the last sentence in this paragraph was moved to page 3.4-2

3.4.2 External Flood Protection

The Seismic Category I SSC listed ... withstand the effects of external flooding due to natural phenomena ... component failures. Seismic Category I structures, provide protection from external floods and groundwater by incorporating the following external flood protection measures:

- The PMF elevation of the U.S. EPR generic design is one foot below finished yard grade (as noted in Section 2.4).
- The maximum groundwater elevation for the U.S. EPR generic design is 3.3 ft below finished yard grade (as noted in Section 2.4).
- The finished yard grade slopes away from Seismic Category I structures so that external flood water flows away from these structures.
- No access openings or tunnels penetrate the exterior walls of the Nuclear Island or any other Seismic Category I structures below grade.

Delete

e, SSC inside containment are designed to withstand a postulated CRDM missile, even though this event is deemed non-credible.

A COL applicant that references the U.S. EPR design certification will describe controls to confirm that unsecured maintenance equipment, including that required for maintenance and that are undergoing maintenance, will be removed from containment ~~prior to operation,~~ moved to a location where it is not a potential hazard to safety-related SSC, or seismically restrained to prevent it from becoming a missile.

3.5.1.3 Turbine Missiles

The plant layout, as shown in Figure 1.2-1 in Section 1.2, is a longitudinal arrangement for the turbine generators. The axis of the turbine rotor shafts is positioned such that safety-related structures, except for two of the four ESWBs and two of the four EPGBs, are located outside the turbine low-trajectory hazard zone, as defined by RG 1.115. Redundancy of the UHS and ESW systems and the EDGs provides adequate protection for U.S. EPR safety-related systems. Therefore, the turbine generator is favorably positioned, as defined by NUREG-0800 (Reference 10) SRP Section 3.5.1.3, because the containment and most of the safety-related SSC are located outside the low-trajectory hazard zone defined by RG 1.115.

Section 10.2 describes the design of the turbine generator. The probability of turbine failure resulting in ejection of the turbine rotor (or internal structure) fragments through the turbine casing, P_1, will be less than 1×10^{-4}. In accordance with guidance provided by Reference 10, SRP Section 3.5.1.3, Table 3.5.1.3-1, an overall turbine missile safety objective for the probability of unacceptable damage resulting from turbine missiles, P_4, of less than 1×10^{-7} is satisfied with P_1 less than 1×10^{-4} for favorably oriented turbine-generators. Therefore, given the redundancy and the low probability of a turbine missile being generated, the impact of turbine-generated missiles on safety-related SSC is not safety significant. A COL applicant that references the U.S. EPR design certification will confirm the evaluation of the probability of turbine missile generation for the selected turbine generator, P_1, is less than 1×10^{-4} for turbine-generators favorably oriented with respect to containment.

Section 10.2 describes requirements for disk and rotor integrity, rotor material fracture toughness, overspeed protection, inspection, testing, examination, startup procedures, operation procedures, and maintenance of the turbine generator equipment. A COL applicant that references the U.S. EPR design certification will assess the effect of potential turbine missiles from turbine generators within other nearby or co-located facilities.

S_y = yield stress of the pipe.

Using one of the above methods, the whipping pipe problem is characterized to determine the appropriate pipe movements, pipe impact loads, and pipe whip restraint design forces.

3.6.2.5 Implementation of Criteria Dealing with Special Features

3.6.2.5.1 Pipe Whip Restraints

The pipe whip restraints are a gapped, crushable, bumper-type support near an elbow and provide clearance to access welds. Additional information on the crushable material is described in Section 3.6.2.3. The restraint consists of a structural member and a bracket mounted to the structural member, with clearance around the subject piping to allow for thermal movement and the installation of pipe insulation. A COL applicant that references the U.S. design certification will provide diagrams showing the ~~final as-designed~~ configurations, locations, and orientations of the pipe whip restraints in relation to break locations in each piping system.

Delete

3.6.2.5.1.1 Location of Whip Restraints

The ideal location for a pipe whip restraint is near the first elbow upstream of the circumferential break location (or near the longitudinal break location), as close to the first elbow (or longitudinal break) as practical. This location prevents the whipping motion, while preventing a plastic hinge from developing in the pipe between the elbow and the restraint. If the placement cannot be close to the elbow (or longitudinal break) due to physical constraints, a potential hinge location is calculated using a simplified static analysis approach so that the whip restraint is properly placed. Pipe whip restraints are located so that they do not cover piping welds that require inservice inspections.

With the pipe break jets and whips characterized per the sections above, there is still a need to design pipe whip restraints which have been assumed in the rupture analysis, or to design structural barriers between the break and potential essential system targets. Both of these types of structural designs are for essential system protection purposes.

3.6.2.5.1.2 Pipe Whip Support Design

Pipe whip supports are typically only designed for the restraint of a whipping pipe following a postulated high-energy line break, and are typically separate from the other system pipe supports which are designed for other design basis loadings. Whip restraints are typically designed for a one-time accident event; so they are designed to undergo deformation as long as the whipping pipe is fully restrained for the entire time of the blowdown event. Similarly, the whip restraint has gaps to allow for the

3.6.3 Leak-Before-Break Evaluation Procedures

This section describes the analyses used to eliminate from the design basis the dynamic effects of certain pipe ruptures for high-energy piping systems and demonstrate that the probability of pipe rupture is extremely low under conditions consistent with the design basis for the piping.

GDC 4 requires structures, systems, and components important to safety to be designed to accommodate the effects from loss-of-coolant accidents. However, dynamic effects associated with postulated pipe ruptures may be excluded from the design basis when analyses reviewed and approved by the NRC demonstrate that the probability of fluid system piping rupture is extremely low under conditions consistent with the design basis for the piping. Accordingly, this section addresses the piping systems that are qualified to be considered for the leak-before-break (LBB) application, the potential for piping failure mechanisms, the fracture mechanics analyses of postulated pipe cracks, and the leak detection system capability, which collectively demonstrate that the probability of pipe rupture is extremely low. This section also provides a description of the applicable piping and the analysis techniques used to eliminate from the structural design basis for the identified piping systems the dynamic effects of double-ended guillotine and equivalent longitudinal breaks.

design report

A ~~COL applicant that references the U.S. EPR design certification~~ will confirm that the design LBB analysis remains bounding for each piping system and provide a summary of the results of the actual as-built, plant-specific LBB analysis, including material properties of piping and welds, stress analyses, leakage detection capability, and degradation mechanisms. The results of the bounding analyses are provided in the form of LBB allowable range of loadings or "LBB allowable load window."

Note: the last sentence of this paragraph is repeated in the last paragraph of section 3.6.3.5.1

3.6.3.1 Application of Leak-Before-Break to the U.S. EPR

The application of LBB is limited to the following high energy piping systems:

- Main coolant loop (MCL) piping, (hot legs, crossover legs, and cold legs).
- Pressurizer surge line (
- Main steam line (MSL) ment (i.e., from the steam generators to the first a he Containment Building penetration).

3.6.3.2 Methods and Criteria

The methods and criteria to evaluate LBB are consistent with the guidance in NUREG-1061, Volume 3 (Reference 1), and the Standard Review Plan (SRP) 3.6.3 (Reference 2) and are described in the following sections. The following steps are used to perform the LBB analyses:

All indicated changes are in response to RAI 547 Question 03.06.01-14

components are designed to have an extremely low probability of abnormal leakage, rapidly propagating failure, and gross rupture.

This section refers to U.S. EPR Piping Analysis and Pipe Support Design Topical Report (References 2 and 7) for information related to the design and analysis of safety-related piping. This topical report presents the U.S. EPR code requirements, acceptance criteria, analysis methods, and modeling techniques for ASME Class 1, 2, and 3 piping and pipe supports. Applicable COL action items in the topical report are identified in the applicable portions of this section. The U.S. EPR design is based on the 2004 ASME Code, Section III, Division 1, with no addenda subject to the limitations and modification identified in 10 CFR 50.55a(b)(1) and the piping analysis criteria and methods, modeling techniques, and pipe support criteria described in References 2 and 7.

A design specification is required by Section III of the ASME Code for Class 1, 2, and 3 components, piping, supports, and core support structures. In addition, the ASME Code requires design reports for all Class 1, 2, and 3 components, piping, supports and

site specific

[...]uctures documenting that the as-designed and as-built configurations adhere to the requirements of the design specification. A COL applicant that references the U.S. EPR design certification will prepare the design specifications and design reports for ASME Class 1, 2, and 3 components, piping, supports and core support structures that comply with and are certified to the requirements of Section III of the ASME Code. The COL applicant will ~~address the results and conclusions from the reactor internals material reliability programs applicable to the U.S. EPR reactor internals~~ with regard to known aging degradation mechanisms such as irradiation-assisted stress corrosion cracking and void swelling addressed in Se[...]

implement the ISI program as augmented with NRC approved ASME Code cases to verify that the safety function of the U.S. EPR reactor internals are not impacted

Other sections that relate to this section are described below:

- Section 3.9.6 describes the snubber inspection and test program[...]
- Section 3.10 describes the methods and criteria for seismic qual[...] Seismic Category I mechanical equipment and a description of [...] operability criteria.
- Section 3.12 describes the design of systems and components th[...] the RCS with regard to intersystem LOCAs.
- Section 3.13 describes bolting and threaded fastener adequacy and integrity.
- Section 5.2.2 describes the pressure-relieving capacity of the valves specified for RCPB.
- Section 10.3 describes the pressure-relieving capacity of the valves specified for the steam and feedwater systems.

All indicated changes are in response to RAI 547 Question 03.06.01-14

3.9.3.1 Loading Combinations, System Operating Transients, and Stress Limits

Section 3.9.3.1.1 describes the design and service level loadings used for the design of ASME Class 1, 2, and 3 components, piping, supports, and core support structures, including the appropriate system operating transients. Sections 3.9.3.1.2 through 3.9.3.1.8 define the loading combinations for the ASME Code Class 1, 2, and 3 components, piping, supports, and core support structures; these sections also define the stress limits applicable to the various load combinations. The loading combinations and corresponding stress limits for ASME Code design are defined for the Design Condition, Service Levels A, B, C and D (also known as normal, upset, emergency, and faulted conditions), and test conditions.

Internal parts of components, such as valve discs, seats, and pump shafts, comply with the applicable ASME Code or Code Case criteria. In those instances where no ASME Code criteria exist, these components are designed so that no safety-related functions are impaired.

Calculation methods used to evaluate RCS components and their supports for faulted loading are provided in Appen[illegible]ethods used to evaluate piping and supports are described in Sections 4 and 6 of Reference 2.

~~A COL applicant that references the U.S. EPR design certification will~~ Design reports provide a summary of the maximum total stress, deformation (where applicable), and cumulative usage factor values for each of the component operating conditions for ASME Code Class 1 components. For those values that differ from the allowable limits by less than 10 percent, ~~the COL applicant will~~ the design reports provide the contribution of each of the loading categories (e.g., seismic, pipe rupture, dead weight, pressure, and thermal) to the total stress for each maximum stress value identified in this range.

The ~~COL applicant will~~ design reports also provide the maximum total stress and deformation values for each operating condition for Class 2 & 3 components required for safe shutdown of the reactor, or mitigation of consequences of a postulated piping failure without offsite power. Identification of those values that differ from the allowable limits by less than 10 percent will also be provided.

3.9.3.1.1 Loads for Components, Component Supports, and Core Support Structures

The following sections describe the loadings considered in the design of the components, piping, and support structures. Piping analysis methods are described in Appendix 3C and the Piping Analysis Topical Report (Reference 2). Section 3.9.1 lists the design transients and number of events used in fatigue analyses.

Thermal Stratification, Cycling, and Striping

Thermal stratification, cycling, and striping (including applicable NRC Bulletins 79-13, described in Section 3.7 of Reference 2. The pressurizer surge line is analyzed with the main coolant loop piping and supports as described in Appendix 3C. As noted in ANP-10264NP-A, a COL applicant that references the U.S. EPR design certification will develop a program to confirm that thermal deflections do not create adverse conditions during hot functional testing.

A COL applicant that references the U.S. EPR design certification will develop a program to examine the feedwater line welds ~~after hot functional testing prior to fuel loading and at~~ during the first refueling outage, in accordance with NRC Bulletin 79-13. A COL applicant that references the U.S. EPR design certification will report the results of inspections to the NRC, in accordance with NRC Bulletin 79-13.

Environmental Fatigue

The effects of the environment on fatigue for Class 1 piping and components are addressed in FSAR Section 3.12 and in Section 3.4 of Reference 2.

3.9.3.1.2 Load Combinations and Stress Limits for Class 1 Components

Table 3.9.3-1—Load Combinations and Acceptance Criteria for ASME Class 1 Components provides the loading combinations and corresponding stress design criteria per ASME Service Level for ASME Class 1 components.

3.9.3.1.3 Load Combinations and Stress Limits for Class 2 and 3 Components

Table 3.9.3-2—Load Combinations and Acceptance Criteria for ASME Class 2 and 3 Components provides the loading combinations and corresponding stress design criteria per ASME Service Level for ASME Class 2 and 3 components.

3.9.3.1.4 Load Combinations and Stress Limits for Class 1 Piping

Table 3-1 of Reference 2 provides the loading combinations and corresponding stress design criteria per ASME Service Level for ASME Class 1 piping.

3.9.3.1.5 Load Combinations and Stress Limits for Class 2 and 3 Piping

Table 3-2 of Reference 2 provides the loading combinations and corresponding stress design criteria per ASME Service Level for ASME Class 2 and 3 piping.

3.9.3.1.6 Load Combinations and Stress Limits for Core Support Structures

Table 3.9.3-3—Load Combinations and Acceptance Criteria for ASME Core Support Structures provides the loading combinations and corresponding stress design criteria per ASME Service Level for ASME core support structures.

Component Classification lists the core support structures (CS) and internal structures (IS) for the RPV internals.

Evaluations of rupture locations, rupture loads, and dynamic effects of postulated rupture of piping are provided in Section 3.6.2. Evaluation of the adequacy of analysis methods for Seismic Category I RPV internals is provided in Section 3.9.1. The plant and system operating conditions and design-basis events that provide the basis for the design of the RPV internals are addressed in Section 3.9.3. The preoperational vibration test program for the RPV internals is consistent with the guidelines of RG 1.20 and is addressed in Section 3.9.2.

Design reports

~~A COL applicant that references the U.S. EPR design certification will~~ provide a summary of reactor core support structure maximum total stress, deformation, and cumulative usage factor values for each component and each operating condition in conformance with ASME Section III Subsection NG.

3.9.5.3 Design Bases

Pursuant to GDC 10, the reactor internals are designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

The combinations of design and service loadings accounted for in the design of the RPV internals, and the method of combining loads for normal, upset, emergency, and faulted service conditions, are addressed in Section 3.9.3. The allowable design or service limits to be applied to the RPV internals and the effects of service environments, deflection, cycling, and fatigue limits are addressed in Section 3.9.3.1.

Evaluation of the adequacy of dynamic analyses under steady-state and operational flow transient conditions, and the proposed program for pre-operational and startup testing of flow-induced vibration and acoustic resonance for RPV internals, is addressed in Section 3.9.2. Evaluation of the adequacy of the structural integrity design of the RPV internals is provided in Section 3.9.3. Section 3.6.3 provides a description of the LBB methodology used to eliminate from the design basis the dynamic effects of the pipe ruptures postulated in Section 3.6.2.

3.9.5.3.1 Interface Cold Gaps

The design of the RPV internals involves interface cold gaps between the internals and the RPV and between the main parts of the internals. The types of cold gaps are defined below:

- Functional cold gaps that are relative to the alignments of the equipment and to the limitation of core bypass flows under normal and upset operating conditions.

described above. The Test Response Spectra (TRS) closely resembles and envelops the RRS.

Equipment functionality adequacy will be demonstrated by testing. The equipment support will be included in the test using the representative ISRS input motion at the equipment support mounting location. If the equipment is installed in a non-operational mode for the support testing, the response in the test at the equipment mounting locations should be monitored and characterized in a manner consistent with SRP 3.10, Acceptance Criteria (II) (1) (A) (iii). In such a case, equipment should be tested separately for functionality, and the actual input motion to the equipment in this test should be more conservative in amplitude and frequency content than the monitored response from the support test.

The seismic qualification of equipment requires consideration of actual or installed equipment mounting. The mounting conditions and methods for the tested or analyzed equipment simulate the expected or installed conditions. The equipment mounting considered in the analysis or testing is identified in the SQDP.

3.10.4 Test and Analysis Results and Experience Database

The results of seismic qualification testing and analysis, per the criteria in Section 3.10.1, Section 3.10.2, Section 3.10.3, are included in the corresponding SQDP (see Appendix 3D, Attachment F). ~~A COL applicant that references the U.S. EPR design certification will create and maintain the~~ SQDP file[s are created and maintained] during the equipment selection and procurement phase. If the seismic and dynamic 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.

Complete and auditable plant-specific records and reports are available and are maintained at a central location for the life of the plant. The reports describe the qualification methods used for the equipment in sufficient detail to document compliance with the specified criteria. These records are updated and maintained current as equipment is replaced, modified, further tested, or requalified.

The equipment seismic qualification file contains a list of the systems' equipment and the equipment support structures. The equipment list identifies which equipment is NSSS supplied and which equipment is balance-of-plant supplied. The equipment qualification file includes qualification summary data sheets for each mechanical and electrical component of each system which summarizes the component's qualification. See Appendix 3D, Attachment F for a sample SQDP and Appendix 3D, Attachment A for a sample equipment qualification data package.

are maintained

The seismic qualification of mechanical and electrical equipment is presented in Section 3.10. The portions of post-accident monitoring equipment required to be environmentally qualified are discussed in Section 3.11.2.1.

~~A COL applicant that references the U.S. EPR design certification will maintain~~ the equipment qualification test results and qualification status file during the equipment selection, procurement phase and throughout the installed life in the plant.

3.11.1 Equipment Identification and Environmental Conditions

Mechanical and electrical equipment covered by this section includes equipment associated with systems that are essential to emergency reactor shutdown, containment isolation, core cooling, and containment and reactor heat removal, or are otherwise essential to preventing significant release of radioactive material to the environment.

Included in this equipment scope is:

- Equipment that performs these functions automatically.
- Equipment that is used by the operators to perform these functions manually.
- Equipment whose failure can prevent the satisfactory accomplishment of one or more of the above safety functions.
- Safety-related and important to safety electrical equipment (including I&C) as described in 10 CFR 50.49 (b)(1) and (b)(2).
- Certain post-accident monitoring (PAM) equipment as described in 10 CFR 50.49(b)(3).

3.11.1.1 Equipment Identification

The list of components to be screened for qualification has been developed with consideration of systems, structures and components (SSC) located in three plant areas: the Nuclear Island (NI), Turbine Island (TI), and the balance of plant (BOP).

3.11.1.1.1 Nuclear Island

The NI consists of the following structures:

- Reactor Building (RB).
- Safeguards Buildings (SB).
- Fuel Building.
- Nuclear Auxiliary Building.

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.

A COL applicant that references the U.S. EPR design certification will develop a program to 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.

3.12.5.10 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.

- During normal at-power operation, a continuous bypass spray flow of sufficient magnitude is maintained to further suppress turbulent penetration from the hot leg flow.

- 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 insurge/outsurge cycles between pressurizer and hot leg temperature.

A COL applicant that references the U.S. EPR design certification will develop a program to 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. The monitoring program 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. A COL applicant that references the U.S. EPR design certification will develop a program to 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 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.

corresponding pressures and/or temperatures. The continuous secondary calorimetric calculation of reactor thermal power is performed according to methodology outlined in Reference 3, which has been accepted by the NRC, per Reference 4. As an analytical requirement, 0.48 percent uncertainty on core thermal power was assumed in the safety analysis. However, the measurement requirements for the U.S. EPR allow the secondary side calorimetric to calculate reactor thermal power within a ± 0.40 percent uncertainty. To achieve the required uncertainty in the secondary side calorimetric algorithm, the elemental uncertainties of the instrument strings and parameters, previously mentioned, are verified to comply with requirements provided in Table 7.7-2—Elemental Uncertainties for Secondary Side Calorimetric.

The control logic compares the mismatch between main turbine and generator load and the highest of the previously listed power signals and takes actions when reactor power exceeds 100 percent. There are two thresholds. The intent of the first is to alert the operator and take action to prevent further power increase. The intent of the second threshold is to reduce power to 100 percent.

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A COL applicant that references the U.S. EPR design certification will, following selection of the actual plant operating instrumentation and calculation of the instrumentation uncertainties of the operating plant parameters, ~~prior to fuel load~~, calculate the primary power calorimetric uncertainty. The calculations will be completed using an NRC acceptable method and confirm that the safety analysis primary power calorimetric uncertainty bounds the calculated values.

7.7.2.3.6 Rod Drop Limitation

The objective of this limitation function is to detect the spurious drop of RCCAs and to reduce the turbine generator power level to match the reactor power reduction due to the dropped RCCAs.

This limitation function is designed to avoid reactivity compensation by core control functions after the RCCAs drop and to avoid the low departure from nucleate boiling (DNBR) and high linear power density (HLPD) protective actuations after one or more RCCAs drop into the core.

Rod drop is detected in the RCSL system based on the RCCA position measurements. In each RCSL division, a quarter of the RCCAs are monitored and the four RCCA drop detection logic signals (i.e., one per RCSL division) are voted one out of four.

The other criterion indicating an RCCA drop is derived from the decrease of the reactor power level (i.e., neutron flux from power range detectors). The derivative of the four nuclear power signals are compared with a low threshold and voted one out of four.

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.

The U.S. EPR main feedwater lines are designed to minimize thermal stratification. The main feedwater nozzle (located in the conical shell of the steam generator) and the adjacent feedwater line is angled downward from the horizontal to minimize the potential for thermal stratification. During steady-state operations, thermal stratification is prevented because of a continuous flow in the feedwater lines. During low flow actuation and flow shutdown, thermal stratification in the main feedwater line near the steam generator occurs. A COL applicant that references the U.S. EPR design certification will develop a program to 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.

The emergency feedwater system (EFWS) is not actuated during normal operations. The EFWS actuation occurs only during reactor trip at full power with a subsequent return to full power (i.e., Upset Transient 1A, see Section 3.9.1.1.2), and during emergency and faulted plant operations (see Sections 3.9.1.1.3 and 3.9.1.1.4). The low frequency of occurrence of EFWS and the EFWS piping layout minimize thermal stratification during upset, emergency, and faulted plant operations.

3.12.5.11 Safety Relief Valve Design, Installation, and Testing

Section 3.8 of Reference 1 addresses the design and installation of pressure relief devices. Additional information is provided in Section 3.9.3.

3.12.5.12 Functional Capability

Section 3.5 of Reference 1 addresses conformance with NUREG-1367, "Functional Capability of Piping Systems" (Reference 5).

3.12.5.13 Combination of Inertial and Seismic Anchor Motion Effects

As noted in Section 3.3.1.4 of Reference 1, the design of Seismic Category I piping and supports includes analysis of the inertial and anchor movement effects of the safe shutdown earthquake (SSE) event. Additional information is provided in Table 3-1 and Table 3-2 of Reference 1. Discussion of seismic anchor motion effects is provided corresponding pressures and/or temperatures. The continuous secondary calorimetric calculation of reactor thermal power is performed according to methodology outlined in Reference 3, which has been accepted by the NRC, per Reference 4. As an analytical requirement, 0.48 percent uncertainty on core thermal power was assumed in the safety analysis. However, the measurement requirements for the U.S. EPR allow the secondary side calorimetric to calculate reactor thermal power within a ± 0.40 percent uncertainty. To achieve the required uncertainty in the secondary side calorimetric algorithm, the elemental uncertainties of the instrument strings and parameters, previously mentioned, are verified to comply with requirements provided in Table 7.7-2—Elemental Uncertainties for Secondary Side Calorimetric.

The control logic compares the mismatch between main turbine and generator load and the highest of the previously listed power signals and takes actions when reactor power exceeds 100 percent. There are two thresholds. The intent of the first is to alert the operator and take action to prevent further power increase. The intent of the second threshold is to reduce power to 100 percent.

delete

A COL applicant that references the U.S. EPR design certification will, following selection of the actual plant operating instrumentation and calculation of the instrumentation uncertainties of the operating plant parameters, ~~prior to fuel load~~, calculate the primary power calorimetric uncertainty. The calculations will be completed using an NRC acceptable method and confirm that the safety analysis primary power calorimetric uncertainty bounds the calculated values.

7.7.2.3.6 Rod Drop Limitation

The objective of this limitation function is to detect the spurious drop of RCCAs and to reduce the turbine generator power level to match the reactor power reduction due to the dropped RCCAs.

This limitation function is designed to avoid reactivity compensation by core control functions after the RCCAs drop and to avoid the low departure from nucleate boiling (DNBR) and high linear power density (HLPD) protective actuations after one or more RCCAs drop into the core.

Rod drop is detected in the RCSL system based on the RCCA position measurements. In each RCSL division, a quarter of the RCCAs are monitored and the four RCCA drop detection logic signals (i.e., one per RCSL division) are voted one out of four.

The other criterion indicating an RCCA drop is derived from the decrease of the reactor power level (i.e., neutron flux from power range detectors). The derivative of the four nuclear power signals are compared with a low threshold and voted one out of four.

The load acceptance test demonstrates the ability of the load sequencer to properly sequence loads listed in Table 8.3-4, Table 8.3-5, Table 8.3-6 and Table 8.3-7 onto the EDGs within the specified time, while the EDG maintains and restores voltage and frequency within specifications.

Load tests are performed to verify an EDG output of 9500 kW or greater while maintaining steady-state frequency at 60 Hz ± 2 percent and steady-state output voltage between 6555 VAC and 7260 VAC. The EDG continuous rating is sufficient to supply the safety-related and non-safety-related loads assigned to each EDG per Table 8.3-4, Table 8.3-5, Table 8.3-6 and Table 8.3-7 for the respective EDG when derated for ambient air temperatures and essential service water temperatures. Additionally, periodic load tests are performed at a load of [illegible] demonstrate capability to operate at the short term rating of 110 percent for a period of two hours.

Emergency Diesel Generator Reliability Program

EDG minimum reliability targets are described in Section 8.4.2.6.1. A COL applicant that references the U.S. EPR design certification will establish procedures to monitor and maintain EDG reliability during plant operations to verify the selected reliability level target is being achieved as intended by RG 1.155. Surveillance testing of the EDGs is in accordance with the availability testing described in RG 1.9, and is detailed in Chapter 16.

The EDGs are procured from a diesel generator manufacturer which meets the requirements of RG 1.9 and considers the recommendations of NUREG/CR-0660 (Reference 9). Specific included design recommendations of Reference 9 are:

- The starting air system air dryer minimizes moisture, as described in Section 9.5.6.2.2.
- The lube oil preheat system performs a non-safety-related function to continuously maintain the lube oil at a set temperature using a preheating unit when the diesel generator is in standby. A motor-driven pump circulates the lube oil through the engine and the standby heater unit to maintain the engine in a prelubricated condition to reduce wear during engine starts.
- The EPGB ventilation system includes particulate air filters in addition to maintaining the building at a positive pressure which limits dust and other contaminates entering the building.
- Combustion air and ventilation system intakes are a minimum of 20 ft above adjacent ground elevation. Diesel engine exhaust gases are released from the exhaust stack on the building roof on the opposite side of the building from the ventilation and combustion air intakes that are located on the building side.

- Reactor heat removal: The reactor heat removal function shall be capable of achieving and maintaining decay heat removal.
- Process monitoring: The process monitoring function shall be capable of providing direct readings of the process variables necessary to perform and control the previously listed functions.
- Support: The supporting functions shall be capable of providing the process cooling, lubrication, and other activities necessary to permit operation of equipment used for safe shutdown functions.

The diverse design of the U.S. EPR plant makes sure that systems and equipment are available to accomplish the previously listed performance goals.

The ~~A COL applicant that references the U.S. EPR design certification will perform an as built,~~ post-fire Safe Shutdown Analysis~~, which~~ includes final plant cable routing, fire barrier ratings, purchased equipment, equipment arrangement and includes a review against the assumptions and requirements contained in the Fire Protection Analysis. The post-fire Safe Shutdown Analysis ~~will~~ demonstrates that safe shutdown performance objectives are met prior to fuel loading and ~~will~~ includes a post-fire safe shutdown circuit analysis based on the methodology described in NEI 00-01, "Guidance for Post-Fire Safe-Shutdown Circuit Analysis" (Reference 39).

Cold Shutdown and Allowable Repairs

RG 1.189~~, Revision 1~~ allows fire damage to redundant systems necessary to achieve CSD provided that at least one success path can be repaired or otherwise made operable within 72 hours using onsite capability, or within the time period required to achieve CSD conditions, if less than 72 hours. Although repairs to equipment necessary to achieve and maintain CSD may be permitted per the RG, the U.S. EPR design provides the capability to achieve cold shutdown conditions within 72 hours without the need for repairs to facilitate the use of one success path. This is the case whether CSD is achieved from the MCR or RSS. In addition, when shutdown is accomplished from either operating location, systems and equipment necessary to achieve CSD have the capability of being powered from onsite sources.

Spurious Operation of Components

The U.S. EPR plant digital control system design makes extensive use of fiber optic cable. The inherent design features of the digital control system and its associated fiber optic wiring eliminate fire-induced spurious actuations as a concern for the U.S. EPR plant. In support of this position, the Standard Review Plan (Reference 37), Section 9.5.1, Appendix A, Subsection 6.2, Item f, recognizes that on a macroscopic level the use of fiber optic cable reduces the overall likelihood of hot shorts and spurious actuations. Therefore, fire-induced failures of fiber optic wiring leading to spurious component actuations are not considered credible for the U.S. EPR Plant.

- The emergency lighting and plant communication systems and the adequacy of these systems to support fire suppression and safe shutdown activities.

The fire protection analysis includes a set of fire area drawings and a summary of the analysis methodology for each fire area and

The

A COL applicant that references the U.S. EPR design certification will evaluate the differences between the as-designed and as-built plant configuration to confirm the Fire Protection Analysis remains bounding. This evaluation will be performed prior to fuel loading and will consider the final plant cable routing, fire barrier ratings, combustible loading, ignition sources, purchased equipment, equipment arrangement and includes a review against the assumptions and requirements contained in the Fire Protection Analysis. The applicant will describe how this as-built evaluation will be performed and documented, and how the NRC will be made aware of deviations from the FSAR, if any.

includes an evaluation of

A COL applicant that references the U.S. EPR design certification will perform a supplemental Fire Protection Analysis for site-specific areas of the plant not analyzed by the FSAR.

9.5.1.4 Inspection and Testing Requirements

The FPP addresses the inspection, testing, and maintenance of FPS and features. Disabled or impaired FPS and features are controlled by a permit system. Procedures and practices also establish appropriate compensatory actions for FPS or features out-of-service or impaired.

Test plans are established that provide routine functional testing of FPS and components. NFPA 25 (Reference 8) is considered in the development of the maintenance procedures. Fire barriers and installed assemblies and penetrations are periodically inspected and active components such as fire dampers and doors are functionally tested.

The FPP provides reasonable assurance that qualified personnel perform inspection, testing and maintenance of FPS.

9.5.1.5 Fire Probabilistic Risk Assessment

In accordance with 10 CFR 52.47(a)(v), as part of the design certification process, a fire probabilistic risk assessment (PRA), specific to the U.S. EPR design is performed (refer to Section 19.1.2.3.4 and Section 19.1.5.3). The fire PRA is performed using state-of-the-art methods, tools, and data. Guidance from NUREG/CR-6850 (Reference 40) is used, as judged applicable to the bounding assessment.

Curves of Charpy V-notch absorbed energy and percentage crystallinity versus test temperature are plotted for FATT determination. The method of measurement of crystallinity conforms to the requirements of ASTM A370. The FATT is determined as the temperature corresponding to 50 percent crystallinity using a minimum of ten test pieces.

Table 10.2-2—Turbine-Generator Material Data, provides a list of material specifications for turbine-gene[illegible] Delete [illegible]al material properties of turbine rotors are obtained through precise destructive tests of actual samples from each turbine rotor. A COL applicant that references the U.S. EPR design certification will provide applicable material properties of the turbine rotor, including the method of calculating the fracture toughness properties~~, after the site-specific turbine has been procured~~.

10.2.3.2 Fracture Toughness

As noted in Section 10.2.3.1, a suitable material toughness is obtained through the use of selected materials to produce a balance of adequate material strength and toughness and maintain a reasonable level of safety, while simultaneously providing high reliability, availability and efficiency during operation.

Stress calculations are performed taking into account centrifugal loads and thermal gradients, wherever applicable, on all major components (e.g., rotors, casings, blades). Fracture mechanics calculations are performed on the rotors taking into account the maximum acceptable size defect for U.S. standards. Calculations verify that the initial defect, after increasing due to fatigue during the equipment lifetime, does not propagate and remains non critical by a large margin as regards to brittle fracture.

The ratio of the fracture toughness, K_{Ic} (as calculated from the material tests performed on the rotor) to the maximum tangential stress at speeds from normal to 120 percent of the rated speed, is at least 2 $\sqrt{in}$, at minimum operating temperature. Adequate fracture toughness to prevent brittle fracture during startup is verified by calculating startup curves specifying appropriate startup temperature and sufficient warm-up time.

The acceptance criteria for UT inspections are:

- 3 mm maximum for discs (depending on the areas).
- 5 mm maximum for shaft ends (depending on the areas).

Fracture toughness properties are calculated from material tests and can be obtained by any of the following methods:

- Testing of the actual material of the turbine rotor to establish the Klc value at normal operating temperature.

- Testing of the actual material of the turbine rotor with an instrumented Charpy machine and a fatigue precracked specimen to establish the Klc (dynamic) value at normal operating temperature. If this method is used, Klc (dynamic) is used in lieu of Klc (static) in meeting the toughness criteria.

- Estimating of K_{Ic} values at various temperatures from conventional Charpy and tensile data on the rotor material using methods are presented in J. A. Begley and W. A. Logsdon, Scientific Paper 71-1E7-MSLRF-P1 (Reference 5). This method of obtaining K_{Ic} is used only on materials which exhibit a well-defined Charpy energy and fracture appearance transition curve and are strain-rate insensitive.

- Estimating "lower bound" values of Klc at various temperatures using the equivalent energy concept developed by F. J. Witt and T. R. Mager, ORNL-TM-3894 (Reference 6).

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A COL applicant that references the U.S. EPR design certification will provide applicable turbine disk rotor specimen test data, load-displacement data from the compact tension specimens and fracture toughness properties ~~after the site-specific turbine has been procured~~.

10.2.3.3 High Temperature Properties

There is no influence on stress rupture properties because the maximum operating temperature, the basis for determining the design temperature of rotors, is below the re-crystallization and creep temperatures.

10.2.3.4 Turbine Rotor Design

The high pressure (HP) part of the high/intermediate pressure (HIP) rotor assembly is one forged section. The intermediate pressure (IP) part of the HIP rotor assembly consists of three forged sections. The HIP rotor assembly is a welded rotor consisting of four forgings. The rotors of the LP turbines are a welded rotor design.

The turbine assembly is designed to withstand normal operating conditions, anticipated transients, and accidents resulting in a turbine trip without loss of structural integrity. The design of the turbine assembly meets the following criteria:

- The design overspeed of the turbine is 120 percent of rated speed, which is higher than the highest anticipated speed resulting from a loss of load. The primary overspeed trip system fully closes the valves at about 110 percent of rated speed. An independent and redundant backup electrical overspeed trip circuit is provided to fully close these valves at about 111 percent of rated speed.

- The combined stresses in the low-pressure turbine rotor at design overspeed due to centrifugal forces and thermal gradients do not exceed 75 percent of the minimum

- Uncontrolled Control Rod Assembly Withdrawal from a Subcritical or Low Power Startup Condition.
- Uncontrolled Control Rod Assembly Withdrawal at Power.
- Spectrum of Rod Ejection Accidents.
- Loss-of-Coolant Accidents Resulting from Spectrum of Postulated Piping Breaks within the Reactor Coolant Pressure Boundary.

Transient Analysis with Incore Trips

The transient analysis is performed with incore trip models decoupled from the system simulation code, S-RELAP5. The incore trip models are generically referred to as the "algorithm" or separately as the Low DNB Channel algorithm and High LPD Channel algorithm. The core boundary conditions for the algorithm are generated in S-RELAP5 and power distributions are generated in the nodal neutronics code, PRISM.

The Low DNB Channel and High LPD Channel algorithms are simulated to predict times at which the incore trip setpoints are reached, and to demonstrate the adequacy of the dynamic compensation on the trips. Table 15.0-7 lists the incore trip setpoints used in the accident analyses. The methodology for confirming the dynamic compensation is described in Section 9.4 of Reference 2.

The Low DNB Channel and High LPD Channel algorithms use the following measurements:

- The reactor power distributions derived from the SPNDs, which are part of the nuclear incore instrumentation.
- The primary system pressure derived from the primary pressure sensors.
- The core flow derived from the reactor coolant pump (RCP) speed sensors and the calibrated volumetric flow from a surveillance measurement.
- The reactor inlet temperature derived from the cold leg temperature sensors.

A COL applicant that references the U.S. EPR design certification will provide~~, prior to the first cycle of operation,~~ a report that demonstrates compliance with the following items: applicable to the first cycle of operation

- Examine fuel assembly characteristics to verify that they are hydraulically compatible based on the criterion that a single package of assembly specific critical heat flux (CHF) correlations can be used to evaluate the assembly performance.
- Verify that uncertainties used in the setpoint analyses are appropriate for the plant and cycle being analyzed.

19.1.2.2 PRA Level of Detail

To be effective in supporting the design process and to provide meaningful results with regard to judging the overall risk posed by the design, the PRA reflects a level of detail limited only by the following:

- The availability of certain design details, operating procedures, and other information.
- The level at which useful reliability data are available.

At the present time, elements of the detailed design that are not available to support the PRA include the following:

- The specific routing of piping. This information is particularly useful in the assessment of internal flooding events.
- The routing of control and power cables, which is relevant to a detailed assessment of internal fire events.
- The specific location of some equipment within plant buildings.
- Emergency and other operating procedures that would define the manner in which operating crews would respond to upset conditions and the specific actions they would be expected to take.

Analysis has been performed that is consistent with the level of detail available. For example, calculations of the frequencies of internal flooding events due to pipe failures account for the expected number of pipe segments in relevant systems (which are available), rather than the length of piping (which is not). In the case of internal fire events, the frequencies and the evaluation of equipment that could be affected reflect bounding assumptions. These assumptions have been refined, within the context of the available information, to avoid masking risk contributors from other sources due to overly conservative treatment.

A COL applicant that references the U.S. EPR design certification will describe the process to review as-designed and as-built information and conduct walk-downs as necessary to confirm that the assumptions used in the PRA, including PRA inputs to RAP and severe accident mitigation design alternatives (SAMDA), remain valid with respect to internal events, internal flooding and fire events (routings and locations of pipe, cable and conduit), and human reliability analyses (HRA) (i.e., development of operating procedures, emergency operating procedures and severe accident management guidelines and training), external events including PRA-based seismic margins, high confidence, low probability of failure (HCLPF) fragilities, and low power shutdown (LPSD) procedures.

The PRA reflects the details of system design configurations consistent with the design submitted to the NRC for design certification. However, some design change features have not been specifically included in the PRA model. Refer to Section 19.1.2.4 for information on design changes.

19.1.2.3 PRA Technical Adequacy

The content of the PRA and the steps taken to provide for its technical quality are consistent with the guidance in the PRA Standard (Reference 3, Reference 4, and Reference 5). The ASME PRA Standard presents high-level requirements and, for each of these, a set of more detailed supporting requirements. The supporting requirements are related to the three capability categories addressed in the standard. These requirements were generally formulated for application to operating nuclear power plants, and in some cases cannot be explicitly satisfied for a PRA performed in the design phase. Table 19.1-1—Characterization of U.S. EPR PRA Relative to Supporting Requirements in ASME PRA Standard provides a summary of the degree to which the U.S. EPR PRA relates to the capability categories for the nine technical elements addres Delete d.

A COL applicant that references the U.S. EPR design certification will conduct a peer review of the PRA relative to the ASME PRA Standard prior to use of the PRA to support risk-informed applications ~~or before fuel load~~.

The U.S. EPR design development and probabilistic evaluation of its design features have benefited from the international cooperation between the U.S. and European divisions of AREVA NP. This cooperation includes sharing of PRA experience and technology through technical review meetings, independent reviews, and collaborative work assignments. This interaction has helped development of the U.S. EPR PRA models and provides added assurance that the U.S. EPR PRA approach is technically adequate, uses mature PRA techniques, and is sufficient to meet the PRA objectives for design certification.

The ASME PRA Standard does not address external events, low power shutdown or internal fire events. For these types of analyses where the ASME PRA Standard does not apply, AREVA NP has employed the latest NRC guidance available to perform assessments commensurate with the uses of the PRA. This additional guidance includes the following:

- Internal fire analysis. NRC has not yet endorsed a fire-PRA standard. The internal fire analysis for the U.S. EPR PRA employs the guidance provided in NUREG/CR-6850 (Reference 6) as practical. This report documents the most up-to-date methodology available for practical assessment of internal fires in nuclear power plants. Limitations in applying this methodology because some design details are not yet available are addressed below and in Section 19.1.5.2.

Severe accident management encompasses those actions taken during the course of an accident by the plant operating and technical staff to:

- Prevent core damage.
- Terminate the progress of core damage if it begins and retain the core within the reactor vessel.
- Maintain containment integrity as long as possible.
- Minimize offsite releases.

In principle, severe accident management extends the defense-in-depth philosophy to the plant operating staff by extending the operating procedures well beyond the plant design basis into severe fuel damage regimes, using existing plant equipment, operator skills, and personnel creativity to terminate severe accidents and limit potential offsite consequences.

The SAMGs address the recognized need to provide nuclear power plant technical staff with structured guidance for response to a potential severe accident condition involving core damage and potential release of fission products to the environment. AREVA NP has developed a new approach to SAMGs in a project called Operating Strategies for Severe Accidents (OSSA). The OSSA framework makes maximum use of the lessons learned to date in the field of severe accidents and incorporates a number of new features which simplify and streamline the guidance material while maintaining comprehensive guidance for response to any severe accident. The OSSA framework is described in ANP-10314, "The Operating Strategies for Severe Accidents Methodology for the U.S. EPR Technical Report" (Reference 23).

The purpose of this section is to describe the OSSA framework for the U.S. EPR SAMGs. The high-level actions that would need to be taken to mitigate severe accidents are described in the context of the unique severe accident design features of the U.S. EPR. The potential challenges that need to be addressed by the technical support center team and the OSSA diagr Delete te these challenges are described.

A COL applicant that references the U.S. EPR design certification will develop and implement severe accident management guidelines ~~prior to fuel loading~~ using the Operating Strategies for Severe Accidents (OSSA) methodology described in this section and in Reference 23.

As stated in Section 19.1.2.2, the COL applicant will review final plant-specific EOPs and SAMGs to confirm that the assumptions used in the PRA and severe accident analyses remain valid.