ArevaEPRDCPEm Resource

From: Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
Sent: Tuesday, August 18, 2009 3:23 PM
To: Tesfaye, Getachew
Cc: WELLS Russell D (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 218, FSARCh. 3, Supplement 2
Attachments: RAI 218 Supplement 2 Response US EPR DC.pdf

Getachew,

AREVA NP Inc.'s (AREVA NP) provided a response to 2 of the 5 questions of RAI 218 on June 12, 2009 and provided a schedule for the remaining questions. On July 7, 2009, AREVA NP provided a revised schedule for responding to the remaining questions. The attached file, "RAI 218 Response US EPR DC.pdf" provides a technically correct and complete response to the remaining 3 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 218 Questions 03.04.01-8, 03.04.01-9, and 03.04.01-11.

The following table indicates the respective pages in the response document, "RAI 218 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 218 — 03.04.01-8	2	5
RAI 218 — 03.04.01-9	6	7
RAI 218 — 03.04.01-11	8	11

This concludes the formal AREVA NP response to RAI 218, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Ronda Pederson
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From: Pederson Ronda M (AREVA NP INC)
Sent: Tuesday, July 07, 2009 4:59 PM
To: 'Tesfaye, Getachew'
Cc: WELLS Russell D (AREVA NP INC); DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 218, FSARCh. 3, Supplement 1

Getachew,

AREVA NP Inc.'s (AREVA NP) provided a response to 2 of the 5 questions of RAI 218 on June 12, 2009 and indicated that the responses to the remaining questions would be provided by July 9, 2009.

AREVA NP is unable to provide a technically correct and complete response to the remaining questions as scheduled.

The schedule for technically correct and complete responses to the remaining 3 questions has been revised as provided below:

Question #	Response Date
RAI 218 — 03.04.01-8	August 21, 2009
RAI 218 — 03.04.01-9	August 21, 2009
RAI 218 — 03.04.01-11	August 21, 2009

Sincerely,

Ronda Pederson
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From: Pederson Ronda M (AREVA NP INC)
Sent: Friday, June 12, 2009 2:38 PM
To: 'Getachew Tesfaye'
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); WELLS Russell D (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 218, FSARCh. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 218 Response US EPR DC.pdf" provides a technically correct and complete response to 2 of the 5 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 218 Questions 03.04.01-10 and 03.04.01-12.

The following table indicates the respective pages in the response document, "RAI 218 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 218 — 03.04.01-8	2	2
RAI 218 — 03.04.01-9	3	3

RAI 218 — 03.04.01-10	4	4
RAI 218 — 03.04.01-11	5	5
RAI 218 — 03.04.01-12	6	6

A complete answer is not provided for 3 of the 5 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 218 — 03.04.01-8	July 9, 2009
RAI 218 — 03.04.01-9	July 9, 2009
RAI 218 — 03.04.01-11	July 9, 2009

Sincerely,

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From: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, May 15, 2009 8:57 AM
To: ZZ-DL-A-USEPR-DL
Cc: Chang Li; John Segala; Michael Miernicki; Joseph Colaccino; ArevaEPRDCPEm Resource; Jay Patel
Subject: U.S. EPR Design Certification Application RAI No. 218 (2613), FSARCh. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on April 22, 2009, and discussed with your staff on May 12, 2009. No change was to the draft RAI questions as a result of that discussion. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 741

Mail Envelope Properties (5CEC4184E98FFE49A383961FAD402D3101291363)

Subject: Response to U.S. EPR Design Certification Application RAI No. 218, FSARCh. 3, Supplement 2
Sent Date: 8/18/2009 3:23:25 PM
Received Date: 8/18/2009 3:23:29 PM
From: Pederson Ronda M (AREVA NP INC)

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Files	Size	Date & Time
MESSAGE	5583	8/18/2009 3:23:29 PM
RAI 218 Supplement 2 Response US EPR DC.pdf		620703

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

Response to

Request for Additional Information No. 218 (2613), Revision 0

05/15/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.04.01 - Internal Flood Protection for Onsite Equipment Failures
Application Section: 3.4.1

QUESTIONS for Balance of Plant Branch 2 (ESBWR/ABWR) (SBPB)

Question 03.04.01-8:

This is a follow-up of RAI 03.04.01-1, -4, and -7.

The staff in RAI 03.04.01-1 requested the applicant to:

> "…Clarify whether the U.S. EPR flood protection design intends to include the option of submerged SSCs operation in the design certification stage or in the COL application stage. If it is in the DC stage, provide the information about the submerged SSCs and the qualification program for those SSCs in the FSAR for the DC. However, if it is in the COL stage, identify a COL information item that requires the applicant to provide the above information, if the applicant will locate safety-related SSCs below the flood level. …"

The applicant responded as follows:

a. In Response to eRAI No. 109, Question 03.04.01-1, the applicant stated, "There are no safety-related structures, systems, and components (SSC) required to perform a safety-related function while being completely or partially flooded. The U.S. EPR flood protection design does not include an option of submerged SSC operation."

b. In Response to eRAI No. 118, Question 03.04.01-4, the applicant responded by stating that the safety-related SSCs for structures without physical separation between divisions (containment and annulus) have the safe shutdown systems and components located above the flood level.

c. In Response to eRAI No. 118, Supplement 1, Response to Question 03.04.01-7, the applicant responded with Tier 1 (ITAAC) and Tier 2 FSAR changes that state the U.S. EPR flood protection design includes the option of SSCs withstanding flooding. It states that a flood analysis will be performed prior to fuel load by the COL applicant, and COL Information Items (U.S. FSAR Tier 2, Table 1.8-2, Items 3.4-4 and 3.4-5) were created.

These RAI responses are inconsistent as related to the operation of submerged SSCs. The staff finds the response to RAI 03.04.01-7 with Tier 1 and Tier 2 FSAR changes acceptable in providing COL information items and ITAAC inspections. However, the details of the COL information items and the ITAAC inspection need to be revised; this is discussed in RAI 03.04.01-9.

To be consistent with this change in the response to RAI 03.04.01-7, the applicant needs to revise the FSAR Tier 2, Section 3.4.3.3, Page 3.4-6 changes associated with RAI 03.04.01-1. In addition, the applicant is requested to clarify this inconsistency among the responses to RAI 03.04.01-1, -4 and -07 with respect to the operation of submerged SSCs.

Response to Question 03.04.01-8:

The bounding internal flooding case for the Reactor Building (RB) in containment has been revised from a postulated pipe break in the fire water distribution system (FWDS) to a large break loss of coolant accident (LBLOCA) inside containment. The maximum credible flood level from a LBLOCA is conservatively estimated using a volume of released water equal to the contents of the reactor coolant system (RCS), the volume of water in the pressurizer (PZR), and the water volume of the accumulators. This is a conservative estimate because the portion of the RCS inventory in the vessel below the large break, remains in the vessel. There are no safety-related SSC inside containment needed to achieve safe shutdown or mitigate the consequences of accidents that are below the LBLOCA flood level.

The FWDS has been removed as the bounding flood source by isolating the FWDS piping inside containment, including the spray deluge system, by normally closed containment isolation valves. The FWDS and spray deluge piping inside containment are dry, containing no water which could cause flooding from any postulated pipe rupture.

The bounding internal flooding case for the RB annulus (RBA) has also been revised from a postulated pipe break in the FWDS to operation of the fire protection system, which occurs during manual fire fighting by hose streams in the RBA. In order to decrease the risk posed by a flood in the RBA as addressed in the internal flooding probabilistic risk assessment (PRA), the position of the FWDS annulus isolation valves have been changed to normally closed, and a normally open bypass line has been added around each valve to reduce the amount of flooding in the event of a line rupture.

The FWDS piping inside the RBA is seismically designed so that a pipe break would not adversely affect safety-related SSC required for safe shutdown. Specifically, the FWDS piping for safe shutdown equipment protection is Seismic Category II. ANP-10264NP-A, "U.S. EPR Piping Analysis and Pipe Support Design Topical Report," Section 3.1 states in order "to prevent adverse impact to Seismic Category I SSCs, Seismic Category II piping will be designed to the same requirements as Seismic Category I piping." The internal flooding sources inside the RBA are the moderate-energy, water-carrying piping systems, including the FWDS piping. Because these piping systems are seismically designed inside the annulus, AREVA NP postulates flooding due to through-wall leakage cracks. The released water from these pipe failures is limited by either operator action to isolate the source or by the limited volume of water contained in a closed system. These systems do not release an amount of water that would flood safety-related SSC, and the resulting flood level is below elevation +0 feet.

Therefore, for RB and RBA flooding there are no submerged SSC that are required to perform a safety-related function for safe shutdown of the plant or to mitigate the consequences of an accident. U.S. EPR FSAR, Tier 2, Section 3.4.3.3 will be revised to reflect these revised flooding analyses.

The basis for postulating through-wall leakage cracks in the seismically designed moderate-energy FWDS piping inside the RBA is described below:

- BTP 3-3, Appendix A defines postulated piping failures as:

  > "Longitudinal and circumferential breaks in high energy fluid system piping and through-wall leakage cracks in seismically-designed moderate energy fluid system piping postulated according to the provisions BTP 3-4. Also, full circumferential breaks in nonseismic moderate energy piping should be considered (since these breaks are not considered in BTP 3-4 because it only applies during normal operation, not seismic events)."

  Therefore, for seismically designed moderate-energy piping, only through-wall leakage cracks must be postulated.

- NUREG-1793, Section 3.4.1.2 identifies two internal flooding sources: “through-wall cracks in seismically supported, moderate-energy piping and breaks and through-wall cracks in nonseismically supported, moderate-energy piping.”
- SRP 3.6.1, Technical Rationale Section, Item 1 regarding compliance with GDC 2, notes that full-circumferential ruptures are only considered for non-seismic moderate-energy piping. This implies that full-circumferential ruptures do not need to be considered in seismically designed moderate-energy piping.
- SRP 3.4, Section III.3 states:

  > “Moderate energy piping that is not seismically supported should be considered for full circumferential ruptures, not just cracks.” Section IV of SRP 3.4 states “Identifying all possible sources of internal flooding, including all pipe breaks postulated in SRP Sections 3.6.1 and 3.6.2, full circumferential breaks of non-seismic moderate energy piping, failures of non-seismic internal and external tanks and vessels, backflow through drains, and operation of the fire protection system.”

  This excerpt implies that full-circumferential ruptures do not need to be considered in seismically designed moderate energy piping.
- SRP 3.6.1, Section III.3 states:

  > “The reviewer evaluates for adequacy the system descriptions of the high and moderate energy piping runs and by reviewing the appropriate system arrangement and piping drawings, examines plant arrangement measures that were taken to ensure protection from the effects of postulated pipe breaks of high energy systems and non-seismic moderate energy systems, or of leakage cracks for seismically-designed moderate energy systems.”

  This statement shows that only leakage cracks need to be evaluated in seismically designed moderate energy piping.

The following U.S. EPR FSAR sections will be revised to include the information in this response as described below:

- For U.S. EPR FSAR, Tier 1, Section 2.1.1.1, Item 2.10 and Item 2.10 in Table 2.1.1-8, will be revised to delete the phrase “or is designed to withstand flooding.” Similarly, this phrase will also be deleted from the COL information item in U.S. EPR FSAR, Tier 2, Table 1.8-2 and Section 3.4.1.

- U.S. EPR FSAR, Tier 2, Table 3 2 2-1 will be revised to add the Reactor Building annulus (KKS code UJB) to the locations of the fire water distribution system.

- U.S. EPR FSAR, Tier 2, Sections 3.4.1 and Section 3.4.3.3 will be revised to reflect the revised internal flooding analysis described in this response.

- A new Table 3.4-1 will be added to U.S. EPR FSAR Tier 2 to identify the internal flooding sources inside the RB.

- U.S. EPR FSAR, Tier 2, Table 6.2.4-1 will be revised to show the position of the FWDS containment isolation valves as normally closed.
- U.S. EPR FSAR, Tier 2, Section 9.5.1 will be revised to change FWDS annulus isolation valves SGB30AA021 and SGB30AA022 to normally closed motor operated valves.
- U.S. EPR FSAR, Tier 2, Figure 9.5.1-1 (Sheets 4 and 7) will be revised to add a normally open bypass line around the FWDS annulus isolation valves.

FSAR Impact:

U.S. EPR FSAR, Tier 1, Section 2.1.1.1 and Table 2.1.1-8 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR, Tier 2, Table 1.8-2, Table 3 2 2-1, Section 3.4.1, Table 3.4-1, Section 3.4.3.3, Table 6.2.4-1, Section 9.5.1, and Figure 9.5.1-1 will be revised as described in the response and indicated on the enclosed markup.

Question 03.04.01-9:

This is a follow-up of the responses to RAI 04.03.01-1, -4, and -7.

a. The staff noted that in the responses to the above RAIs and FSAR Tier 1 and Tier 2, the applicant identified the components to be protected from internal flooding being limited to safe shutdown equipment. SRP Section 3.4.1, Subsection I, “Areas of Review,” and Subsection III, “Review Procedures,” indicate that the review of the plant internal flood protection includes all safety-related SSCs. Based on SRP Section 3.4.1, the staff believes that the components to be protected from internal flooding should include all safety-related components, not just being limited to safe shutdown equipment. The applicant is requested to clarify and revise the FSAR accordingly.

b. In the response to RAI 03.04.01-7, the applicant proposed a COL Information Items 3.4-5. It states that “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 or is designed to withstand flooding.”

   In accordance with SRP Section 3.4.1, Review Procedure No. 5, the safety-related SSCs being located below the flood level should be identified in the FSAR, and the qualification program should be described in the FSAR for the staff review. Exceptions, if any, should be justified in the FSAR. Clarification is needed that if the operation of submerged SSCs is allowed, the COL applicant should identify the submerged components and describe the qualification program for the staff review in accordance with SRP Section 3.4.1.

Response to Question 03.04.01-9:

a) The U.S. EPR flood protection design does not preclude flooding of safety-related structures, systems, and components (SSC) in buildings designed with divisional separation (i.e., the Safeguard Buildings (SBs), Emergency Power Generating Buildings (EPGBs), Essential Service Water Pump Buildings (ESWPBs), and the Fuel Building (FB) (below level 0 feet 0 inches)). These buildings are designed so that the consequences of an internal hazard are contained within the division and are not allowed to propagate to other divisions. In the event of an internal flood, it is assumed the affected division is lost and at least one remaining division is available and sufficient to perform the necessary safety functions. Consequently, in an internal flooding event in buildings with divisional separation, safety-related SSC within the affected division are assumed to be flooded. In buildings without complete divisional separation, including the Reactor Building (RB) and the RB annulus, the flood protection design locates safety-related SSC required for safe shutdown or accident mitigation above the flood level. See the U.S. EPR FSAR changes associated with the Response to Question 03.04.01-8.

   Protection from flooding of safety-related SSC needed to achieve safe shutdown or mitigate the consequences of an accident is consistent with NRC guidance and final safety evaluation reports (FSERs) for other design certifications. For example, RG 1.206, Section C.I.3.4.1 states:

> "The applicant should describe the internal flood protection measures for all SSCs whose failure could prevent safe shutdown of the plant or result in uncontrolled release of significant radioactivity."

SRP 3.1 states:

> "The review of the plant internal flood protection includes all structures, systems, and components (SSCs) whose failure could prevent safe shutdown of the plant or result in uncontrolled release of significant radioactivity."

NUREG-1503, Section 3.4.1 states:

> "From this review of the applicant's design criteria, design bases, and safety classification for safety-related SSCs necessary for a safe plant shutdown during and following the flood condition from either external or internal causes, the staff concludes that the design of the facility for flood protection conforms to the Commission's regulations as set forth in GDC 2 and 10 CFR Part 100 Appendix A with respect to protection of SSCs important to safety from the effects of floods, tsunamis, and seiches."

NUREG-1793, Section 3.4.1.2 states:

> "The staff's review of the flood protection design included systems and components whose failure could prevent safe shutdown of the plant *and* maintenance thereof, or result in significant uncontrolled release of radioactivity. Based on its review of the proposed flood protection criteria for safety-related SSCs necessary for safe shutdown during and following flood conditions resulting from external or internal causes, the staff determined for the reasons set forth above that the capability of the design to protect safety-related SSCs from the effects of floods are in accordance with the following criteria:
>
> - Position C.1 of RG 1.59 regarding the design of safety-related SSCs to withstand the worst-probable, site-related flood
> - Position C.1 of RG 1.102 regarding the type of flood protection provided
> - Therefore, the staff concludes that the AP1000 design meets the applicable guidelines of Section 3.4.1 of the SRP."

b) The Response to Question 03.04.01-8 revised U.S. EPR FSAR, Tier 2, Table 1.8-2, COL Information Item 3.4-5, U.S. EPR FSAR, Tier 2, Section 3.4.1, U.S. EPR FSAR, Tier 1, Section 2.1.1.1, and U.S. EPR FSAR, Tier 1, Table 2.1.1 to delete "or is designed to withstand flooding."

FSAR Impact:

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

b) The U.S. EPR FSAR will be revised as described in the Response to Question 03.04.01-8.

Question 03.04.01-11:

This is a follow-up of the response to RAI 03.04.01-6. The staff found that the response to RAI 03.04.01-6 did not address the questions.

a) In RAI 118 Question 04.03.01-6 (a), the staff asked the applicant to provide a list of potential flood sources in the containment and reactor building annulus. In the response, the applicant stated that "all" of the water-carrying systems inside each building including high and moderate energy lines were considered for the potential flood sources. The staff found the response using "all of the water systems" without explicit system names to be nonresponsive to the question. In an audit of February 19, 2009, the staff found in the audit documentation that there was a list of systems being considered as potential flood sources. The applicant is requested to provide such list in the FSAR.

b) In Question 04.03.01-6 (b), the staff asked the applicant to explain how the bounding pipe breaks for the flood analysis in the containment and in reactor building annulus were determined. In the responses, the applicant restated what the bounding cases are, but did not respond the staff's question as how the bounding cases were determined. The staff found that the response did not address the question. In the audit review, the applicant explained verbally how the bounding cases were determined, but that was not documented in the FSAR or in the audit documentation. The applicant is requested to document how the bounding cases were determined in the RAI responses.

c) In Question 04.03.01-6 part (c), the applicant was requested to provide details of the analysis outlined in FSAR Tier 2 Section 3.4.3.1, "Internal Flooding Events," for the containment and reactor building annulus, including flood water volumes, flow rates, building floor elevation, free areas, free volumes, and assumptions used for obtaining these volumes and flood levels. The applicant referred the response to an audit. The staff reviewed the audit documentation regarding the details of the analysis and found the analysis acceptable. However, the staff believes that the key parameters that were used in the analysis determining the flood levels in the design should be documented in the RAI responses. Such parameters include flood water volumes and flow rates, building bottom floor elevation, free areas, free volumes, % of area occupied by equipments.

Response to Question 03.04.01-11:

a) As indicated in the Response to Question 03.04.01-8, U.S. EPR FSAR, Tier 2, Table 3.4-1 will be added to list the water-carrying piping systems located in the Reactor Building (RB) and the Reactor Building annulus (RBA), which are considered potential internal flooding sources in the flooding analysis of the respective buildings.

b) Bounding pipe ruptures (breaks and through-wall cracks) and internal flood sources for the RB containment and RBA are determined using the following methodology:

   - A list identifying the piping systems located within these buildings is prepared.
   - Gaseous piping systems and high-energy lines located within guard pipes are eliminated as potential flooding sources.
   - Fluid flow rates from high- and moderate-energy piping ruptures are determined based on the criteria provided in U.S. EPR FSAR, Tier 2, Section 3.6.1 and Section 3.6.2. In addition, any non-seismic moderate-energy piping is evaluated as a full circumferential break.

- The maximum operational pressure is used to estimate leakage flow rates.
- Released steam is considered to be completely condensed.
- Floor drains are assumed to be plugged and sump pumps are assumed to be unavailable for reducing flood water volume.
- The volumes of released water resulting from the postulated pipe ruptures are determined using the flow rates and assumptions regarding flooding duration described in U.S. EPR FSAR, Tier 2, Section 3.4.3.1:
  - For closed systems and storage tanks, the complete system or tank content is assumed to be released.
  - For leaks and breaks that are detected by instrumentation and controls (I&C) where an automatic isolation is provided, the flooding duration spans the time it is detected through the duration of the automatic isolation.
  - For leaks and breaks that can be detected by signals in the Main Control Room (MCR) where isolation by operator action is provided, the flooding duration spans the time from when the first alarm in the MCR is received through a thirty-minute operator action time from the MCR.
  - For leaks and breaks that can be detected by signals in the MCR and for which isolation by local actions is provided, the flooding duration spans the time from when the first alarm in the MCR is received through a one hour local action time (e.g., the time for personnel to perform manual valve isolation).
  - Leaks and breaks that cannot be detected or isolated are assumed to release the entire water inventory if the discharge is not otherwise limited.
    - The bounding pipe rupture is based on the largest total released water volume.
    - The volume of water released from operation of the fire protection system is determined based on 500 gpm for two hours.

c) The flooding analyses for the RB and the RBA calculates flood levels using the following methodology:

- The floor area is determined using the building general arrangement drawings.
- In containment, the flood is conservatively assumed to begin rising in the annular area of containment at elevation -7 feet 6½ inches (building bottom floor elevation). This is conservative because the calculation does not include the freeboard volume of the in-containment refueling water storage tank (IRWST) above the normal operation maximum water level.
- In the RBA, the flood level rises from the building bottom floor at elevation -14 feet 1¼ inches.
- The net floor area (or free area) is determined by subtracting the area occupied by walls and equipment.

- The area occupied by equipment is estimated by inspecting the 3D plant model and general arrangement drawings. For the RB, the area used by equipment is assumed to be ten percent of the gross floor area. For the RBA, the area taken up by equipment is assumed to be 15 percent of the gross floor area.
- The flood height is calculated by dividing the volume of released flood water, calculated using the methodology outlined in Item b) above, by the net floor area.

For example for an annular area:

$A_{gross} = \pi(R_1^2 - R_2^2)$, where:

R_1 = radius of outer annulus wall

R_2 = radius of inner annulus wall

$A_{gross} = \pi[(87\ ft)^2 - (81\ ft)^2]$

$A_{gross} = 3{,}167\ ft^2$

$A_{net} = A_{gross} - A_{walls} - A_{equipment}$, where:

$A_{equipment} = A_{gross} * 15\%$

Substituting, $A_{net} = 3{,}167 - [2* ½(3\ ft * 6\ ft)] - [4* ½(3\ ft * 9.5\ ft)] - [3{,}167 * 0.15]$

$A_{net} = 3{,}167\ ft^2 - 75\ ft^2 - 475\ ft^2$

$A_{net} = 2{,}617\ ft^2$

The flood water height (H) is determined by dividing the volume of released flood water (V_{water}) by the net floor area (A_{net}):

$H = V_{water} / A_{net}$

For the bounding case, the volume of released flood water (V_{water}) is determined from the design flow rate and design duration for the fire protection system operation (two hose streams @ 250 gpm for 2 hours per Regulatory Guide 1.189), or:

500 gpm x 2 hours = $8{,}022\ ft^3$

Substituting, $H = 8{,}022\ ft^3 / 2{,}617\ ft^2$

H = 3 ft 1 inch

FSAR Impact:

a) U.S. EPR FSAR, Tier 2, Table 3.4-1 will be added as described in the Response to Question 03.04.01-8 and indicated on the enclosed markup.

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

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

U.S. EPR Final Safety Analysis Report Markups

2.2 As shown on Figure 2.1.1-4, a flooding barrier ~~consisting of several walls~~ is provided to prevent ingress of water into the core melt spreading area. ~~This barrier includes a watertight door that provides entry to the venting shaft of the spreading area.~~

2.3 Core melt cannot relocate to the upper containment due to the existence of concrete barriers, as shown on Figure 2.1.1-9.

2.4 The RB structures are Seismic Category I and are designed and constructed to withstand design basis loads without loss of structural integrity and safety-related functions. The design basis loads are those loads associated with:

- Normal plant operation (including dead loads, live loads, lateral earth pressure loads, equipment loads, hydrostatic, hydrodynamic, and temperature loads).
- Internal events (including internal flood loads, accident pressure loads, accident thermal loads, accident pipe reactions, and pipe break loads, including reaction loads, jet impingement loads, and missile impact loads).
- External events (including rain, snow, flood, tornado, tornado-generated missiles and earthquake).

2.5 The RCB, including the liner plate, maintains its pressure boundary integrity at the design pressure.

2.6 The RCB is post-tensioned, pre-stressed concrete structure.

2.7 The RBA is separated from the SBs and the FB by an internal hazard protection barrier~~barriers, doors, dampers, and penetrations~~ that ~~have~~ has a minimum 3-hour fire rating, as ~~shown~~ indicated on Figure 2.1.1-20.

2.8 The following are provided for water flow to the in-containment refueling water storage tank (IRWST):

- As shown on Figure 2.1.1-4, RCB rooms which are adjacent to the IRWST contain wall openings slightly above the floor to allow water flow into the IRWST.
- As shown on Figure 2.1.1-5, RCB rooms which are directly above the IRWST, contain trapezoidal-shaped openings in the floor to allow water flow into the IRWST. The floor openings are protected by weirs and trash racks to provide a barrier against material transport into the IRWST.

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RBA penetrations that contain high-energy pipelines, as described in Table 2.1.1 7, have guard pipes.

2.10 Essential equipment required for plant shutdown located in the RB and RBA is located above the internal flood level~~or is designed to withstand flooding~~.

2.11 The reactor pressure vessel, reactor coolant pumps, pressurizer, steam generators, and interconnecting RCS piping are insulated with reflective metallic insulation.

2.12 The RB structures have key design dimensions that are confirmed after construction.

Table 2.1.1-8—Reactor Building ITAAC (~~5~~ 6 Sheets)

	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
2.10	Essential equipment required for plant shutdown located in the RB and RBA is located above the internal flood level ~~or is designed to withstand flooding~~. 03.04.01-8 and 03.04.01-9	a. An internal flood analysis for the RB and RBA will be performed. b. A walkdown of the essential equipment in the RB and RBA required for plant shutdown will be performed.	a. Completion of the internal flood analysis for the RB and RBA indicates essential equipment required for plant shutdown is located above the internal flood level ~~or is designed to withstand flooding~~. b. Essential equipment in the RB and RBA required for plant shutdown is located above the internal flood level ~~or is designed to withstand flooding~~.
2.11	The reactor pressure vessel, reactor coolant pumps, pressurizer, steam generators, and interconnecting RCS piping are insulated with reflective metallic insulation.	An inspection will be performed.	The reactor pressure vessel, reactor coolant pumps, pressurizer, steam generators, and interconnecting RCS piping are insulated with reflective metallic insulation.
2.12	The RB structures have key design dimensions that are confirmed after construction.	An inspection of key dimensions of the as-installed RB structures will be performed. During construction, deviations from the approved design will be analyzed for design basis loads.	Deviations from the key dimensions and tolerances specified in Table 2.1.1-5 are reconciled and the as-installed RB structures will withstand the design basis loads without loss of structural integrity and safety related functions.
2.13	The RCB has a minimum containment free volume that is confirmed after construction.	During construction, dimensional deviations from the RCB and RB internal structures concrete outline drawings will be analyzed for impact on the minimum containment free volume value.	The final RCB minimum containment free volume is greater than or equal to 2.755 x 10^6 ft^3 after all volumetric changes resulting from dimensional deviations to the RCB and RB internal structures concrete outline drawings have been reconciled.

Table 1.8-2—U.S. EPR Combined License Information Items
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Item No.	Description	Section	Action Required by COL Applicant	Action Required by COL Holder
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 ~~or is designed to withstand flooding~~.	3.4.1		Y
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	Y	
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	Y	
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	Y	
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	Y	
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	Y	

Table 3.2.2-1—Classification Summary
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KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
SGB	Fire Water Distribution System, SGB Subsystem (Safe Shutdown Equipment Protection)	NS-AQ	D	II	Yes	UBP, UFA, UJA, UJH, UJK, URB, UJB	NFPA 14, 2007 Ed. NFPA 25, 2002 Ed. NFPA 804, 2006 Ed. ANSI/ASME B31.1[6]; Required for safe shutdown earthquake protection
SGB	Fire water distribution system, SGB Subsystem Containment Isolation	S	B	I	Yes	UFA, UJA, UJB	ASME Class 2[2]
SGC	**Spray Deluge Systems**	NS-AQ	D	NSC	No	UJA, UBP	NFPA 13, 2007 Ed. NFPA 15, 2007 Ed. NFPA 25, 2002 Ed. NPFA 804, 2006 Ed.
SGE	**Sprinkler Systems**	NS-AQ	D	NSC	No	UBP	NFPA 13, 2007 Ed. NFPA 25, 2002 Ed. NFPA 804, 2006 Ed.
SGJ	**Gaseous Fire Extinguishing Systems**	NS-AQ	D	NSC	No	2UJH	NFPA 2001, 2004 Ed. NFPA 804, 2006 Ed.

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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 principal protective measure for Seismic Category I buildings is physical separation of the redundant safe shutdown systems and components.~~ 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. ~~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.~~

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Division walls below elevation +0 feet, 0 inches (hereinafter +0 feet) provide separation and serve as flood barriers to prevent flood waters spreading to adjacent divisions. These division walls are watertight, have no doors, and a minimal number of penetrations. 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 tested to verify proper functionality. Existing openings (e.g., stair cases, elevator shafts, and ~~building drains~~equipment openings) are credited as water flow paths ~~when available~~. 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.

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In Seismic Category I ~~structures~~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 ~~the RB~~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 ~~systems and components~~SSC in these ~~structures~~ buildings, required to achieve safe shutdown or mitigate the consequences of an accident, are located above the maximum water level, protecting them from the effects of flooding. ~~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 or is designed to withstand flooding. Locations of essential SSC and features provided to withstand flooding will be verified by walk-down.~~

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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.

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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.

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.

3.4.2 External Flood Protection

The Seismic Category I SSC listed in Section 3.2 can withstand the effects of external flooding due to natural phenomena and postulated 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 ~~n~~Nuclear ~~i~~Island or any other Seismic Category I structures below grade.

- Portions of Seismic Category I structures located below grade elevation incorporate the use of waterstops and waterproofing to mitigate environmental deterioration of exposed surfaces and thereby minimize long term maintenance. ~~are protected from external flooding by waterstops and waterproofing. Below grade exterior construction joints have waterstops to prevent in-leakage.~~

- Exterior wall or floor penetrations of Seismic Category I structures below grade have watertight seals.

- The roofs of Seismic Category I structures prevent the undesirable buildup of standing water in conformance with RG 1.102. The roofs of the structures do not have parapets that could collect water.

- The maximum rainfall rate for roof design is 19.4 inches per hour and the maximum static roof load because of snow and ice is 100 pounds per square foot.

- Seismic Category I structures can withstand hydrostatic loads resulting from groundwater pressure and external flooding.

The reinforced concrete Seismic Category I structures, together with the waterproofing and sealing features described above, provide hardened protection from the effects of external flooding for safety-related SSC as defined in RG 1.59. Additionally, the external flood protection measures described above protect against flooding from postulated failures of onsite storage tanks. Further information on the potential causes of external flooding from natural phenomena is provided in Sections 2.4.1 through 2.4.14.

3.4.3 Analysis of Flooding Events

3.4.3.1 Internal Flooding Events

An internal flooding analysis was performed for Seismic Category I structures to determine the adequacy of the design to protect safety-related SSC from the effects of internal flooding caused by postulated component failures. The internal flooding analysis demonstrates that internal flooding resulting from a postulated initiating event does not cause the loss of equipment required to achieve and maintain safe shutdown of the plant, emergency core cooling capability, or equipment whose failure could result in unacceptable offsite radiological consequences. Section 7.4 describes the safety-related systems and components required for safe shutdown of the plant. The internal flooding analysis also describes the flooding protection measures that mitigate the consequences of flooding in areas that contain safety-related systems and components.

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Sources of flooding ~~considered~~ in the internal flooding ~~analysis~~analyses include ~~high and moderate-energy line ruptures, improper system valve alignments, tanks, fire protection systems, and water from adjacent buildings.~~:

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- High-energy piping (breaks and cracks).
- Through-wall cracks in seismically supported moderate-energy piping.
- Breaks and cracks in non-seismically supported moderate-energy piping.
- Improper system valve alignments.
- Tanks.
- Fire protection systems.
- Water from adjacent buildings.

The internal flooding analysis is conducted on a level-by-level and room-by-room basis for the Seismic Category I structures for the postulated flooding events. The analysis consists of the following:

- Identification of safety-related equipment.
- Identification of potential flooding sources.
- Determination and comparison of flood water volumes and building volumes.
- Evaluation of effects on required equipment.
- Determination of the need for protection and mitigation measures.

The following criteria and assumptions are used to determine flood water volumes and flow rates:

- For closed systems and storage tanks, the complete system or tank content is assumed to be released.
- If isolation of the pipe leak or break is assumed, only the released water volume within the operator action time is considered.
- The maximum operational pressure is used to estimate leakage flow rates.
- Released steam is considered to be completely condensed.
- Criteria and assumptions described in Section 3.6 are used to determine break configurations, locations, and flow rates for postulated high- and moderate-energy pipe ruptures.

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- Floor drains are assumed to be plugged and sump pumps are assumed to be not available for reducing flood water volume.
- Volume of water released from operation of the fire protection system is determined based on 500 gpm for 2 hours.

Equipment and components of these systems that are sensitive to flooding are generally located above ~~elevation -4 feet, 3 inches~~the maximum internal flood level. This arrangement provides a margin between the normal operation maximum water level of the IRWST and these components, in order to store water released from postulated pipe failures and avoid a consequential failure by flooding.

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In the event of piping failures, water flows directly to the IRWST while steam condenses on structures (e.g., concrete walls, containment walls, ceilings, and floors) and flows to the IRWST.

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The analysis is focused on postulated piping failures that ~~lead to~~result in the largest volume of released water inside containment. Table 3.4-1 is a compilation of water-carrying piping systems located in the RB containment and RB annulus which were considered as potential internal flooding sources in the flooding analysis of these buildings. The following cases are enveloping scenarios for released water volume in containment:

- Water from a large break loss-of-coolant-accident (LOCA) in the reactor coolant pressure boundary (i.e., release of reactor coolant system inventory, pressurizer water volume, and the inventory of accumulators).

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- ~~Postulated pipe break in a main steam line.~~
- ~~Postulated pipe break in a main feedwater line.~~
- ~~Postulated pipe break in the fire water distribution system ring header.~~Operation of the fire protection system.

~~The postulated pipe break in the fire water distribution system ring header is considered the bounding case for the maximum released water volume in containment. This water volume results from an assumed complete separation of piping ends, a flow rate limited by the maximum possible pump capacity, and an MCR operator action time of thirty minutes before closing the containment isolation valves and the fire water distribution system isolation valves at the entrance to Safeguard Buildings (SB) 1 and 4. The resulting water level is estimated to be at elevation -4 feet, 7 inches. There are no safety-related SSC required to perform a safety-related function while being completely or partially submerged.~~A large break LOCA is determined to be the bounding case for the maximum released water volume in containment. There are no submerged SSC required to achieve safe shutdown or mitigate the consequences of an accident. No other postulated pipe breaks, through-wall cracks, or operation of the fire protection system inside containment release a volume of water which could cause flooding of safety-related SSC required for safe shutdown or to mitigate the consequence of accidents.

Inside containment, leakages are integrally detected by measuring humidity, temperature, condensate flow, and water levels in drain and vent collection tanks or sumps. Depending on the leak and break size and the affected system, the protection system initiates automatic measures as required to cope with the event (e.g., LOCA, main steam line break, or main feedwater line break). A NIDVS sump located at level -7 feet, 6-1/2 inches is equipped with safety-related Seismic Category I level instrumentation to initiate alarms in the MCR for a filled sump and large flooding event. These alarms notify the MCR operator to begin action to isolate the flooding sources.

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To avoid water ingress into the corium spreading area, which could produce a steam explosion in case of an accident, the venting area from the spreading compartment has a watertight door.

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~~The released water from fire fighting by hose streams or a deluge system is enveloped by the higher flow rates and released water volumes from the relevant postulated pipe failures.~~

Reactor Building Annulus

03,04.01-8

Below elevation +0 feet, the annulus between the Shield Building and the Containment Building is a single volume; therefore, it is considered one room for flooding protection purposes. Water released from a specific location flows down in the annulus and collects on the bottom level. Because high-energy piping (e.g., main steam lines and main feedwater lines) is routed inside guard pipes, there is no water accumulation in the annulus due to their failure. Therefore, the analysis is focused on water-carrying systems without guard pipes. ~~The case that results in the largest water volume released in the annulus is a postulated pipe break in the fire water distribution system. The volume of released water is based on an assumed full break in the piping, a flow rate limited by the maximum pump capacity, and an operator action time of thirty minutes to isolate the system after receiving the first alarm in the MCR. The fire water distribution system is isolated by manually closing the isolation valves at the entrances to SB-1 and SB-4. Two motor-operated isolation valves, powered from different electrical divisions, are provided in series for isolation. The resulting flood level in the annulus is below elevation +0 feet.~~Table 3.4-1 lists the water-carrying piping systems in the annulus evaluated in the flooding analysis. The internal flooding sources inside the reactor building annulus are the moderate-energy water-carrying piping systems. Since these piping systems are seismically designed inside the annulus, through-wall leakage cracks were postulated. The released water from these pipe failures is limited by either operator action to isolate the source or by the limited volume of water contained in a closed system. The systems listed in Table 3.4-1 do not release an amount of water which would flood safety-related SSC and the resulting flood level is below elevation +0 feet. The bounding internal flooding source becomes operation of the fire protection system which occurs during manual fire fighting by hose stream. The released water during fire fighting does not flood safety-related SSC and the resulting flood level is below +0 feet.

Inside the annulus, only the plug boxes of cable penetrations for electrical and instrumentation and control equipment located above elevation +16 feet, 10-3/4 inches could be affected by flooding. In the event of ~~a postulated break in~~operation of the fire water distribution system, the annulus ventilation system supply is lost because the annulus ventilation duct is flooded through the grids. Furthermore, the normal operating mode of the SB controlled area ventilation system could be lost because of water entering through the inspection openings. These consequences are acceptable because the safety-related functions are fulfilled by the annulus ventilation system exhaust trains which maintain sub-pressure in the annulus, the accident mode of the SB controlled area ventilation system which maintains sub-pressure in the SBs, and the recirculation mode of the SB controlled area ventilation system which maintains ambient conditions in the SBs.

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Leak detection inside the annulus consists of ~~two~~ safety-related Seismic Category I level measurements in the NIDVS sump located on elevation -14 feet, 1-1/4 inches. These level measurements initiate an alarm in the MCR for a filled sump (considered as the first alarm for initiating the operator action time for isolation) and an alarm for a flooding event above floor level -14 feet, 1-1/4 inches.

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The hydrostatic water loads corresponding to an elevation of +0 feet are taken into account in the structural design of the annulus walls and for the watertight design of cable and piping penetrations below this elevation. ~~The water released during fire fighting by hose streams is enveloped by the higher flow rates and released water volumes of the relevant postulated pipe failures.~~

The annulus is not divisionally separated; however, redundant divisions are separated in fire zones. In case of fire fighting or a postulated piping failure ~~break in the fire water distribution system~~, overlapping areas exist where redundancies belonging to another division could be indirectly impacted by water flow through the horizontally arranged fire separation structures on the inner and outer walls of the annulus. In these cases, the plug boxes of cable penetrations for electrical and instrumentation and control equipment are designed to withstand this water flow.

3.4.3.4 Safeguard Buildings Flooding Analysis

The arrangement of the SBs provides physical separation of the redundant safe shutdown systems and components using structural barriers. The building layout directs released water within one SB to building levels below elevation +0 feet.

Below Elevation +0 Feet, 0 Inches

Division walls below elevation +0 feet, 0 inches provide separation and serve as flood barriers to prevent the spread of flood water to the adjacent SB. Below elevation +0 feet, SB-1 and SB-4 are connected to the Fuel Building (FB) via passageways. Postulated piping failures below elevation +0 feet could lead to consequential failures door is opened to connect the hose to the hydrant inside the SB, the threshold will prevent backflow of extinguishing water into the SBs through the open door.

3.4.3.5 Fuel Building Flooding Analysis

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~~The FB is divisionally separated with regard to the building levels below elevation +0 feet to protect the fuel pool cooling system and the extra borating system (EBS). This~~The divisional separation of the FB (see Section 3.4.1) is denoted by referring to the two divisions as FB-1 and FB-2. The upper building levels are not separated for flood protection because of the layout of the fuel pools. The flooding analysis for the FB follows the separation for fire protection, which separates the building into two main fire areas. This principle is followed so that only one division of the building is flooded in the event of postulated pipe failures.

The FB flooding analysis considers the elevation inside FB-1, FB-2, or the area between the shield wall (the structure that protects the FB, RB, and SBs 2 and 3) and the inner decoupled structure of the FB, up to elevation +0 feet. The design of the enclosing walls of these building areas takes this elevation into account. The piping and cable penetrations in these enclosing walls up to elevation +0 feet are designed for water tightness. There are no ventilation penetrations in these walls. The NIDVS is interconnected between the different FB divisions and with the SBs and the Nuclear Auxiliary Building (NAB). Ingress of water by backflow in the system from one area to the others is prevented by redundant check valves in series. Piping penetrations from FB-2 toward the NAB are watertight for an elevation corresponding to building level of +0 feet in the NAB.

The building is designed for the water mass corresponding to one completely filled building area up to elevation +0 feet. The building layout is designed to direct released water within one FB division to the building levels below elevation +0 feet where physical separation exists. FB-1 and FB-2 are connected to SB-1 and SB-4, respectively, via passageways. To avoid water ingress into the adjacent division and in and out of adjacent buildings at elevation +0 feet and above, a combination of watertight doors and openings for water flow to the lower building levels are provided. The doors from the FB to SB-1 and SB-4 at elevations -31 feet, -20 feet, and -11 feet are physical protection doors. These doors are not watertight because the adjacent SB belongs to the same division. Failures in piping systems below elevation +0 feet would lead to consequential failures in only one division, SB-1 and FB-1 or SB-4 and FB-2. Below elevation +0 feet, the rooms within one division have interconnections so that the maximum released water volume can be stored within the division. Interconnections include doors with flaps, burst openings, and other wall penetrations that are not required to be sealed.

Excessive water losses from the fuel pool are avoided by locating piping connections near the top of the fuel pool and by the use of siphon breakers. Any released water is

Table 3.4-1—Water-Carrying Piping in the Reactor Building

Description	Reactor Building	
	Containment	Annulus
Fuel pool purification system	X	X
Demineralized water system	X	X
Extra borating system	X	X
Reactor coolant system	X	
Reactor coolant pump seal injection and leak-off system	X	X
Containment heat removal system	X	X
Residual heat removal system	X	X
Medium head safety injection system	X	X
Low head safety injection system	X	X
In-containment refueling water storage tank	X	X
Component cooling water system	X	X
Chemical and volume control system	X	X
Nuclear island drain and vent systems	X	X
Nuclear sampling system	X	X
Feedwater system	X	X
Emergency feedwater system	X	X
Main steam system	X	X
Condensate system	X	X
Steam generator blowdown system	X	X
Operational chilled water system	X	X
Secondary sampling system	X	X
Fire water distribution system	X	X
Spray deluge system	X	

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Table 6.2.4-1—Containment Isolation Valve and Actuator Data
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Pent-ration No. (JMK)	GDC Req.	System Name	Fluid	Line Size (in)	Essent System	Potent Bypass Path	Valve Number	Valve Location	Type C Leak Test	Valve Type and Operator	Pri- mary Act-uation	Secon-dary Act-uation	Normal Position	Shut-down Position	Post Accident Position	Power Failure Position	Cont. Isolation Signal	Valve Closure Time	Power Source
10BQ030	56/57	CADS to IA	air	2.0	no	no	SCB01 AA002	inside	yes	globe/ MOV	PS	RM	open	open	close	as-is	stage 1	≤ 15 sec	31BRA
10BQ030	56/57	CADS to IA	air	2.0	no	no	SCB01 AA001	outside	yes	globe/ MOV	PS	RM	open	open	close	as-is	stage 1	≤ 15 sec	34BNB03
01BQ031	56/57	CADS to SA	air	2.0	no	no	SCB02 AA002	inside	yes	globe/ manual	n/a	n/a	close	open	close	n/a	admin close	n/a	n/a
01BQ031	56/57	CADS to SA	air	2.0	no	no	SCB02 AA001	outside	yes	globe/ manual	n/a	n/a	close	open	close	n/a	admin close	n/a	n/a
30BQ033	56/57	FWDS inside NI	water	8.0	no	no	SGB30 AA032	inside	yes	gate/ MOV	PS	RM	~~open~~close	open	close	as-is	stage 1	≤ 40 sec	31BRA
30BQ033	56/57	FWDS inside NI	water	8.0	no	no	SGB30 AA031	outside	yes	gate/ MOV	PS	RM	~~open~~close	open	close	as-is	stage 1	≤ 40 sec	34BNB03

Next File

system installed in the MCR sub-floor area is of manual-only actuation. While NFPA 2001 (Reference 28) requires clean agent fire extinguishing systems to be automatically actuated via a signal from the fire detection system, the standard does allow such systems to be of manual-only actuation if acceptable to the authority having jurisdiction.

The boundary of the MCR cable sub-floor area is adequately sealed to prevent a loss of clean agent, or the clean agent quantity is designed to compensate for loss of agent. The operational requirements of the ventilation system, including agent distribution, maintenance of agent concentration during the soak time, and overpressure protection are integrated into the clean agent system design. The toxicity of the clean agent, including potential corrosive characteristics or effects of thermal decomposition products was considered. Measures are provided to verify the agent quantity of the storage cylinders and containers.

Manual Fire Suppression Systems

Manual firefighting capability is provided throughout the plant to limit the extent of fire damage. Standpipe systems, hydrants and portable equipment consisting of hoses, nozzles, and extinguishers are provided for use by fire brigade personnel. Manual fire suppression systems and equipment are designed and installed in accordance with the guidance from SRP 9.5.1 (Reference 37), RG 1.189, and applicable NFPA standards.

Interior manual hose installations are provided so that each plant location that contains, or could present a fire exposure hazard to, equipment important to safety can be reached with at least one effective hose stream. For all plant power block buildings on all floors, Class III standpipe systems, designed and installed in accordance with NFPA 14 (Reference 3) are provided with hose connections equipped with a maximum of 100 feet of 1.5 inch diameter woven-jacket, lined fire hose, and suitable nozzles. Hose stations are located to facilitate access and use for firefighting operations. Alternative hose stations are provided if a fire hazard could block access to a single hose station serving a plant area.

Supply water distribution capability is provided for reasonable assurance of an adequate water flowrate and nozzle pressure for all hose stations. Hose station pressure reducers are provided where necessary for the safety of plant fire brigade members and offsite fire department personnel.

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Automatic standpipe systems are provided throughout except in the Reactor Building and including the Reactor Annulus. Automatic standpipe systems are attached to a water supply capable of supplying the system demand at all times and requiring no action other than opening a hose valve to provide water at hose connections. The Reactor Building, including the Reactor Annulus, have semiautomatic standpipe systems that are attached to a water supply capable of supplying the system demand at all times, but requiring activation of motor-operated control valves to provide full water supply to hose connections. In the inner Reactor Containment Building the inboard and outboard containment isolation, motor-operated control valves are normally kept closed and are only opened during a fire emergency requiring the use of the standpipe system in the Reactor Containment Building. In the Reactor Annulus there are two supply connections to the annulus standpipe system with a motor-operated control valve in each connection. These are normally kept closed and only opened during a fire emergency requiring the use of the standpipe system in the Reactor Annulus. In addition, each of the control valves for the Reactor Annulus standpipe system has a 1 inch by-pass line which will keep the standpipe filled and pressurized.

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The proper type of hose nozzle provided for each hose station is based on the fire hazards in the area. Combination spray or straight-stream nozzles are not used in plant areas where a straight stream could cause unacceptable damage or present an electrical hazard to firefighting personnel. UL listed electrically safe fixed fog nozzles are provided in areas where high-voltage shock hazards exist. All nozzles have full shutoff capability.

Fire hose meets the applicable criteria of NFPA 1961 (Reference 26) and is hydrostatically tested in accordance with the applicable guidance of NFPA 1962 (Reference 27).

Standpipe and hose systems in areas containing equipment required for safe plant shutdown following an SSE are designed to be functional following an SSE and capable of providing flow to at least two hose stations (approximately 75 gpm per hose stream). The standpipe and hose stations in these areas, the water supply and distribution piping, and the supports and valves, as a minimum, satisfy ASME B31.1 (Reference 32). This is accomplished by manually realigning valves to isolate non-seismically qualified portions of the FPS from the seismic portions of the system and manually starting the diesel fire pumps.

To comply with this requirement, portions of the fire protection water supply and water distribution system are designed to satisfy, as a minimum, the following requirements ~~of ASME B31.1 as follows~~:

- Seismic design of the fire water storage tanks is in accordance with AWWA D100-2005 (Reference 45), referenced by NFPA 22 (Reference 6), "Standard for Water Tanks for Private Fire Protection," (refer to RG 1.189).~~The two fire water storage tanks (Part of USG) and their associated piping, supports and valves are designed to remain functional following an SSE.~~

- The fire pump house (Part of USG) is designed in accordance with ASCE 43-05 (Reference 44), with the seismic demand on the structure calculated for the site SSE.~~to satisfy the requirements of a seismically qualified structure.~~

Figure 9.5.1-1—Fire Water Distribution System
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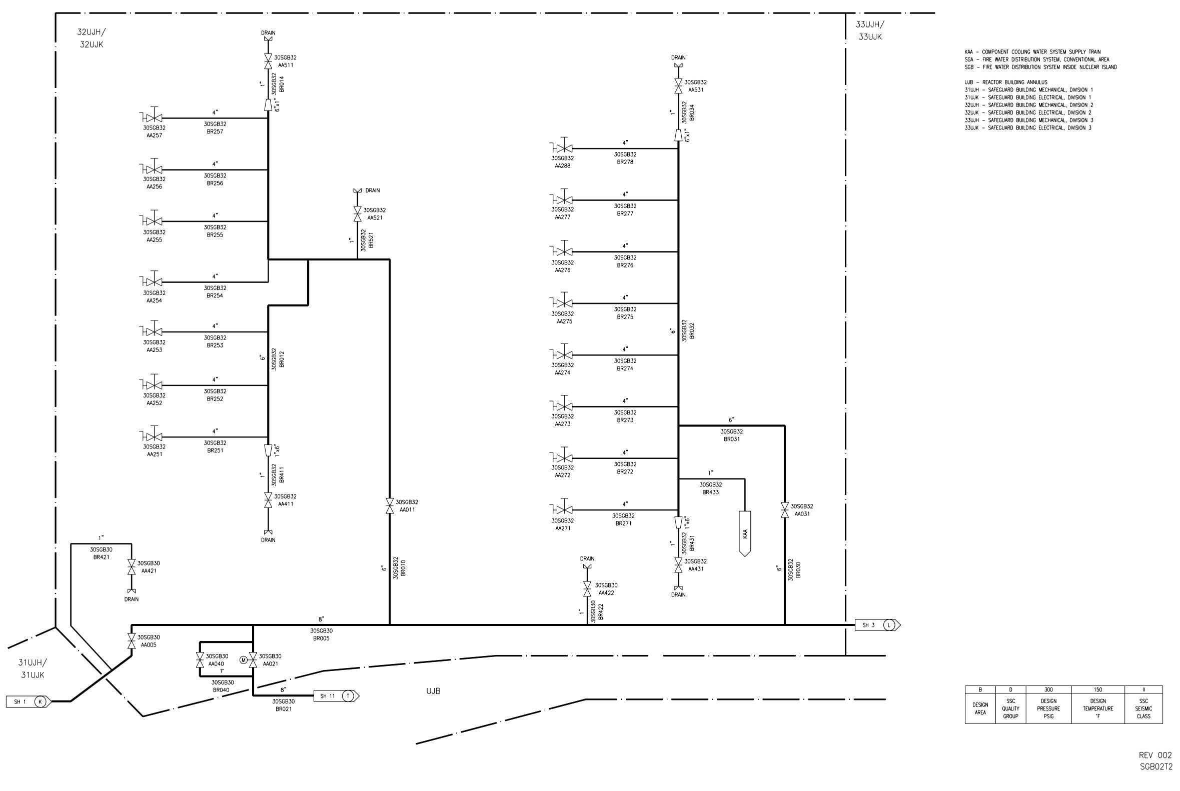
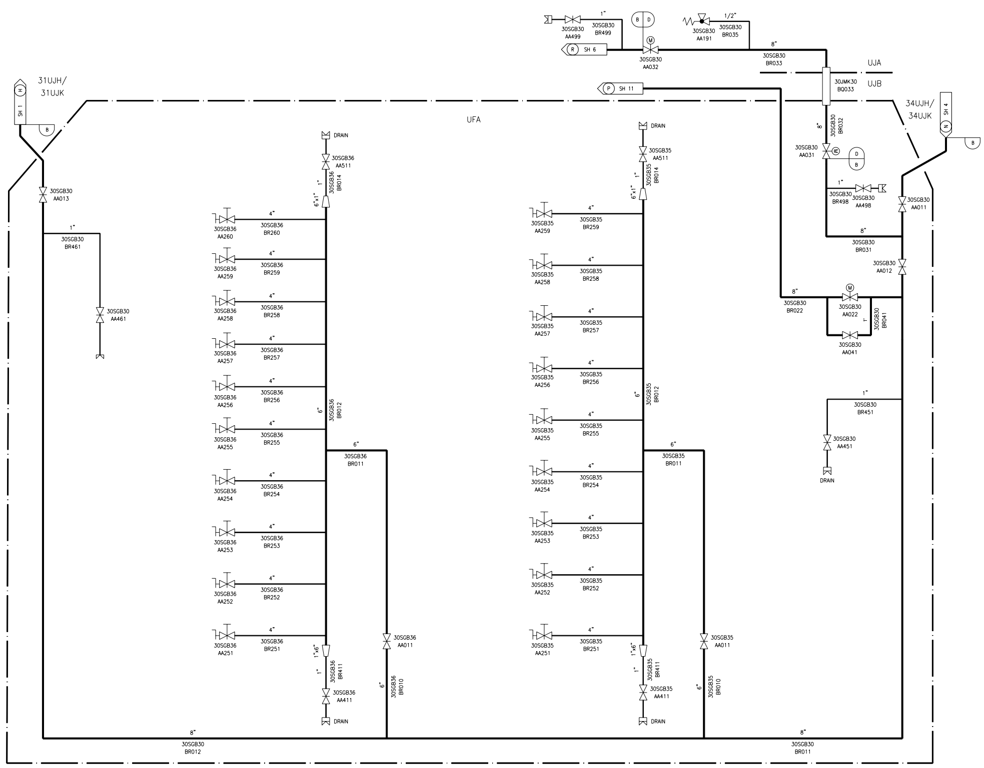


Figure 9.5.1-1—Fire Water Distribution System
Sheet 7 of 13



D	B	300	150	I
B	D	300	150	II
DESIGN AREA	SSC QUALITY GROUP	DESIGN PRESSURE PSIG	DESIGN TEMPERATURE °F	SSC SEISMIC CLASS

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