ArevaEPRDCPEm Resource

From: WILLIFORD Dennis (AREVA) [Dennis.Williford@areva.com]
Sent: Friday, February 22, 2013 6:31 PM
To: Snyder, Amy
Cc: Clark, Phyllis; DELANO Karen (AREVA); LEIGHLITER John (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA); TOLLEY Tracey (AREVA); VANCE Brian (AREVA); WELLS Russell (AREVA); WILLS Tiffany (AREVA); BALLARD Bob (AREVA); NOXON David (AREVA)
Subject: Advanced Response to U.S. EPR Design Certification Application RAI No. 554 (6572), FSAR Ch. 11, Question 11.02-27
Attachments: RAI 554 Advanced Response Question 11.02-27 - US EPR DC.pdf

Amy,

Attached is an Advanced Response to RAI No.554, Question 11.02-27 in advance of the final response date of April 19, 2013.

To keep our commitment to send a final response to this question by the commitment date, we need to receive all NRC staff feedback and comments no later than **April 5, 2013**.

Please let me know if NRC staff has any questions or if this response can be sent as final.

Sincerely,

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

From: RYAN Tom (RS/NB)
Sent: Friday, September 28, 2012 10:37 AM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); LEIGHLITER John (RS/NB); ROMINE Judy (RS/NB); WELLS Russell (RS/NB); WILLIFORD Dennis (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 554 (6572), FSAR Ch. 11, 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 554 Response US EPR DC.pdf," provides a schedule since a technically correct and complete response to the 1 question cannot be provided at this time.

The following table indicates the respective pages in the response document, "RAI 554 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 554 — 11.02-27	2	6

A complete answer is not provided for the 1 question. The schedule for a technically correct and complete response to this question is provided below.

Question #	Response Date
RAI 554 — 11.02-27	April 19, 2013

Sincerely,

Tom Ryan for
Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, August 29, 2012 2:49 PM
To: ZZ-DL-A-USEPR-DL
Cc: Dehmel, Jean-Claude; McCoppin, Michael; Clark, Phyllis; Segala, John; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 554 (6572), FSAR Ch. 11, NEW PHASE 4 RAI

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on August 1, 2012, and discussed with your staff on August 29, 2012. No change is made to the draft RAI as a result of that discussion. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,

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

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 4233

Mail Envelope Properties (554210743EFE354B8D5741BEB695E6560E57D2)

Subject: Advanced Response to U.S. EPR Design Certification Application RAI No. 554 (6572), FSAR Ch. 11, Question 11.02-27
Sent Date: 2/22/2013 6:30:50 PM
Received Date: 2/22/2013 6:31:07 PM
From: WILLIFORD Dennis (AREVA)

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Files	**Size**	**Date & Time**
MESSAGE	3245	2/22/2013 6:31:07 PM
RAI 554 Advanced Response Question 11.02-27 - US EPR DC.pdf	958494	

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

Advanced Response to

Request for Additional Information 554 (6572), Question 11.02-27

8/29/2012

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket Number 52-020

Review Section: 11.02 - Liquid Waste Management System
Application Section: 11.2 with supporting data from 10.4.8, 9.3.4, 3.7.2, 3.2.2, and 12.2

Question 11.02-27:

OPEN ITEM

NEW PHASE 4 RAI

In FSAR Tier 2, Rev. 3, Table 1.9-2, the applicant has endorsed the use of Regulatory Guide (RG) 1.143, Rev. 2, with no exceptions (heretofore simply referred as RG 1.143 for brevity). FSAR Table 1.9-2 states that the guidance of RG 1.143 applies to structures, systems, and components (SSCs) described in FSAR Tier 2, Rev. 3, Sections 3.2.1, 3.7.2, 3.10, 10.4.8, 11.2, 11.3, and 11.4.

RG 1.143 lists applicable codes and standards that are acceptable to the NRC. The codes and standards address specifications on design and construction, materials, welding, and inspection and testing. The regulatory guide identifies natural and man-induced hazards, design loads, and design criteria and associated safety classifications. The safety classifications are RW-IIa (high hazard), RW-IIb (hazardous), and RW-IIc (non-safety), with radiological criteria assigned to each one. The evaluation process of SSCs is described in Regulatory Position C.5, which focuses on acceptable radiological criteria, while Regulatory Position C.6 addresses natural phenomena and man-induced events and combination of design loads and their applicability to the safety classification system.

The assignment of the safety classification is based on the amount of radioactivity contained in systems and components housed within structures, and the resulting dose or dose rate from unmitigated radiological releases at the unprotected area boundary, and a maximum unmitigated exposure within the protected area boundary. The radiological criteria for unmitigated radiological releases (considering the maximum inventory) at the boundary of the unprotected area should not exceed 100 millirem, and the maximum unmitigated exposure to site personnel within the protected area should not exceed 5 rem. Note that the staff has indicated that the 500 mrem dose limit at the boundary of the unprotected area is not correct in the RG and a dose of 100 millirem is applied instead to be consistent with current Part 20 requirements and Part 50, Appendix A for SSCs that are important to safety functions. As an aside, the staff notes that this issue will be addressed as part of the next revision of RG 1.143.

As part of the review of the FSAR Tier 2, Rev. 3, Sections 3.2.1, 3.7.2, 3.10, 10.4.8, 11.2, 11.3, and 11.4, the staff (**Health Physics and Structural**) has identified a number of inconsistencies that warrant clarification to ensure that RG 1.143 guidance is properly applied in Tier 2 and provide the necessary technical basis to support the related FSAR Tier 1 commitments. The staff will issue a separate RAI on FSAR Tier 1, Rev. 3, sections on ITAAC commitments for the related SSCs.

The applicant is requested to review the following items and confirm and revise all appropriate FSAR sections, tables, and figures, accordingly. The applicant should use these as examples of the staff's concern and review the FSAR beyond those sections identified by the staff in this RAI to ensure a consistent approach in applying the guidance of RG 1.143 and demonstrate compliance with GDC 2, 60 and 61 and Part 20 requirements. While this RAI is issued on FSAR Tier 2, Rev. 3, Section 11.2, it should be noted that its applicability extends to other SSCs (as noted below). The staff deems it more effective to issue a single RAI in avoiding unnecessary duplication and facilitate an integrated review and resolution of the staff's concerns across all relevant FSAR sections since RG 1.143 applies to the LWMS, GWMS, SWMS, and

SG Blowdown systems with associated wastes being addressed in FSAR Tier 2, Sections 11.2 to 11.4.

1. Liquid Waste Management Systems and Process Related Systems

   A review of the FSAR Tier 2, Rev. 3, Section 11.2.1 indicates that the design of the LWMS is stated to comply with RG 1.143, under a RW-IIa classification. Specifically, FSAR Tier 2, Rev. 3, Section 11.2.1.2.2 states that design criteria pertinent to systems classified as RG 1.143 classification RW-IIa, given RG 1.143, Tables 2, 3 and 4 are used in design analyses of the liquid waste storage and processing systems. FSAR Tier 2, Table 3.2.2-1 (sheet 134) assigns the seismic design and other design classifications for components of the liquid waste management system. The liquid waste storage and liquid waste processing systems are classified as Radwaste Seismic (RS). Structures, systems, and components making up the liquid waste storage and processing systems that are classified as RG 1.143 classification RW-IIa are designed to withstand a seismic loading equivalent to one-half SSE. Similar design commitments are made for the GWMS and SWMS in FSAR Tier 2, Rev. 3, Sections 11.3 and 11.4.

   With respect to information presented in FSAR, Tier 2, Rev. 3, Sections 3.2.1 and 11.2, it is noted that the information presented in FSAR Tier 2, Table 3.2.2-1 (sheet 134) is not consistent in its description of the seismic category. For example, while the seismic category refers to “RS, radwaste seismic,” the entries (see Comments/Commercial Code) refer only to RG 1.143 and do not specify the safety classification in a manner that is consistent with other listed systems. See corresponding entries for the GWMS (sheet 135). Moreover, the definition of “RS” in Footnote 16 of FSAR Table 3.2.2-1 (p.3.2-199) should match the technical definitions provided in FSAR Tier 2, Sections 3.2.1 and 11.2. FSAR Tier 2, Table 3.2.2-1, Footnote 16 should be clarified for consistency and refer to RW-IIa per RG 1.143 for seismic loads up to ½ SSE. The same observation applies for SWMS system (sheet 133) and for the classification of the Radioactive Waste Processing Building (RWPB) (sheet 157). Finally, the applicant should ensure that once corrected, the notations for the assigned safety classifications for all three systems (LWMS, SWMS, and GWMS) and RWPB are internally consistent among all entries and SSC descriptions in FSAR Tier 2, Table 3.2.2-1 and FSAR Tier 2, Sections 3.2.1, 11.2, 11.3, and 11.4.

   In claiming that the LWMS is designed to a RW-IIa classification, the FSAR does not provide any information for the staff to confirm that the projected inventories of radioactive materials in LWMS tanks and processing equipment would be sufficient large to qualify as such. A review of FSAR Tier 2, Rev. 3, Section 12.2.1 indicates that there is no information on radionuclide concentrations expected to be contained in LWMS processing components. Similarly, the parallel information is not provided for the GWMS and SWMS. Some information is presented only as photon spectra flux rates (MeV/sec or MeV/sec-m3) for a limited number of components, with the exception of N-16 for the coolant loop which is not relevant here. The applicant is requested to provide a listing of the expected inventories of radioactive materials (listings of radionuclides and their respective concentrations or curies, and the volume of components on which the inventories are based) for the major components of the LWMS, GWMS, and SWMS for the staff to confirm that such inventories are consistent with an assignment of a RW-IIa classification.

   A review of the FSAR Tier 2, Rev. 3, Section 11.2.3.8 indicates that the QA program for the LWMS is stated to comply with RG 1.143 and notes that the quality assurance program governing the design of the liquid waste storage and processing systems conforms to ANSI/ANS 55.6-1993, Section 4.3, as described in RG1.143, Section 7. FSAR Tier 2, Table 3.2.2-1 (sheet 134) reiterates this commitment. FSAR Tier 2, Rev. 3, Section 11.2.1.2.4 indicates that the connection and operation of mobile systems connected to permanently installed LWMS equipment will comply with RG 1.143 using plant specific information. Similar design commitments are made for the GWMS and SWMS in FSAR Tier 2, Rev. 3, Sections 11.3 and 11.4. A review of FSAR Tier 2, Rev. 3, Section 3.2.2 indicates that for Quality Group D, the commitment refers to a commitment to RG 1.26 for non-safety related systems, but the applicability of RG 1.143 to only specific radwaste processing systems is not stated. The applicant is requested to revise FSAR Tier 2, Section 3.2.2.4 and indicate that the guidance of RG 1.143 is used in assigning the quality group classifications only for SSCs that fall under the guidance of RG 1.143 and list such systems or refer to the applicable FSAR sections where such systems are described.

2. Steam Generator Blowdown and Blowdown Treatment Systems

While the SG Blowdown treatment system is not described in Chapter 11, it is a system that falls under the guidance of RG 1.143, Rev. 2, with its resulting radwaste processed by the LWMS and SWMS. This part of the SG blowdown system is located in the NAB, which is classified as Seismic Cat II and Radwaste Seismic. The NAB is classified as Seismic Category II because of its potential to interact with a Seismic Category I structure during an SSE event. FSAR Tier 2, Rev. 3, Section 10.4.8.1 indicates that the safety-related portions of the SG blowdown system are designed to Seismic Category I and Quality Group B. These portions of the system are located in the RB and SGB, and protected from natural phenomena, such as earthquakes, tornadoes, hurricanes, floods, and external missiles. A review of FSAR Tier 2, Rev. 3, Section 10.4.8.1 indicates that the design basis refers to RG 1.143, Regulatory Position C.1.1 for those non-safety related portions of the system, as it relates to quality standards and codes of RG 1.143, Table 1, as supplemented by Regulatory Positions C.1.1.1 and C.1.1.3. FSAR Tier 2, Rev. 3, Section 10.4.8.2.2 refers to FSAR Tier 2, Rev. 3, Table 3.2.2-1 (sheets 143 to 155) for applicable seismic and other design classifications for component descriptions, and FSAR Tier 2, Rev. 3, Section 3.2 on how RG 1.26 and 1.29 are implemented.

As part of the applicant's safety evaluation, FSAR Tier 2, Rev. 3, Section 10.4.8.4 reiterates most of the above information and compliance with RG 1.26 and 1.29 for safety related portions of the SG blowdown system. For the non-safety related portions of the SG blowdown system, the applicant's evaluation commits to RG 1.143 with respect to quality standards, and states that the foundations and walls that house SCs are consistent with the natural phenomena and internal and external man-induced hazards criteria of RG 1.143, Regulatory Positions C.1.1.3 and C.6.

A review of FSAR Tier 2, Rev. 3, Section 10.4.8.4 indicates that it does not specifically commit to the Regulatory Position C.5 in addressing the safety classifications (as RW-IIa, RW-IIb, or RW-IIc) for those portions of the system expected to contain radioactive materials. A review of FSAR Tier 2, Rev. 3, Section 3.2 and Table 3.2.2-1 (sheet 143 to 155) indicates that the some components of the SG blowdown system and its treatment system are classified as ‘Conventional Seismic” and RW-IIc under RG 1.143. FSAR Tier 2, Rev. 3, Section 3.2.1.3 defines Radwaste Seismic as compliant with RW-IIa classification and ½ SSE.

With respect to information presented in FSAR, Tier 2, Rev. 3, Sections 3.2.1 and 10.4.8, it is noted that the information presented in FSAR Tier 2, Table 3.2.2-1 is not consistent in its description of the seismic category. The proposed RW-IIc classification for these SG Blowdown components, under RG 1.143, Regulatory Position C.5, is not supported by technical information in FSAR Tier 2, Rev. 3, Section 10.4.8.4. FSAR Tier 2, Rev. 3, Section 3.2.1.4 defines Conventional Seismic as compliant with RW-IIb or RW-IIc classification and less demanding than full or ½ SSE. For example, while the seismic category refers to Category II and RG 1.143 for piping and valves, “CS, Conventional Seismic” and RG 1.143 RW-IIc are assigned to the second stage blowdown coolers, and “CS,” and RG 1.143 RW-IIc are applied to components of the SG blowdown demineralizer treatment system. Moreover, the definition of “CS” in Footnote 16 of FSAR Table 3.2.2-1 (p.3.2-199) should match the technical definitions provided in FSAR Tier 2, Sections 3.2.1 and 10.4.8. FSAR Tier 2, Table 3.2.2-1, Footnote 16 should be clarified for consistency and refer to RW-IIb or RW-IIc per RG 1.143 for seismic loads less than ½ SSE. The same observation applies for SWMS system and for the classification of the Radioactive Waste Processing Building (RWPB). Finally, the applicant should ensure that once corrected, the notations of the assigned safety classification for the SG blowdown system and SG blowdown treatment system are internally consistent among all entries in FSAR Tier 2, Table 3.2.2-1 and FSAR Tier 2, Sections 3.2.1, 10.4.8.1 and 10.4.8.4.

FSAR Tier 2, Section 3.2.1.4 indicates that SSCs classified as CS, based in commercial or industry codes are not considered part of the licensing basis. However, it should be noted that the “CS” classification is used for SSCs that fall within the guidance of RG 1.143. As such, SSCs classified as “CS” are part of the licensing basis given that the applicant has endorsed the guidance of RG 1.143 without exceptions to systems and components containing radioactive materials. The applicant is requested to review and clarify this statement in FSAR Tier 2, Section 3.2.1.4 to confirm the licensing basis of RG 1.143 for SSCs described in FSAR Tier 2, Sections 3.2 and 10.4.8 and FSAR Tier 2, Table 3.2.2-1.

In claiming that the SG blowdown system and SG blowdown treatment system are designed to a RW-IIc classification, the FSAR does not provide any information for the staff to confirm that the projected inventories of radioactive materials in components and processing equipment would qualify as such. Similarly, FSAR Tier 2, Rev. 3, Section 12.2.1 does not present information on radionuclide concentrations expected to be contained in SG Blowdown process equipment. The information is presented only as photon spectra flux rate (MeV/sec or MeV/sec-m3) for a limited number of components, with the exception of N-16 for the coolant loop which is not relevant here. The applicant is requested to provide a listing of the expected inventories of radioactive materials (listings of radionuclides and their respective concentrations or curies, and the volume of components on which the inventories are based) in the major components of SG blowdown system and SG blowdown treatment system for the staff to confirm that such inventories are consistent with an assignment of a RW-IIc classification.

3. CVCS and GWP Systems Interface and Use of RG 1.143 Classification

FSAR Tier 2, Rev. 3, Table 3.2.2-1 (sheet 69) indicates that some aspects of the guidance of RG 1.143 have been assigned to the boric acid storage tank design. While the CVCS is excluded from RG 1.143 requirements, an entry is noted for that system’s storage tank connections to the GWPS and assigns the applicability of RG 1.143 without noting its safety classification or stating where those portions of the systems and system interfaces are located, e.g., NAB or RWB. A review of FSAR Tier 2, Rev. 3, Section 9.3.4 indicates that the design of the CVCS applies the guidance of RG 1.29, Position C.1, for safety-related portions of the system, and Position C.2 for non-safety-related portions. As result, the relevance and design criteria of RG 1.143 are not clear for this part of the system. The applicant should review this aspect of the design commitment and clarify that entry in FSAR Tier 2, Table 3.2.2-1, add a specific footnote for details in assigning design commitments based on RG 1.143, and make the corresponding revisions in FSAR Tier 2, Sections 9.3.4.1 and 9.3.4.3.

Response to Question 11.02-27:

To address this question the U.S. EPR FSAR was reviewed for how RG 1.143 is referenced throughout the U.S. EPR FSAR, to ensure a consistent approach in applying the guidance of RG 1.143 and demonstrate compliance with GDC 2, 60 and 61 and Part 20 requirements. Changes to the U.S. EPR FSAR as a result of this review are described below.

1. Liquid Waste Management Systems and Process Related Systems

   U.S. EPR FSAR Tier 2, Table 3.2.2-1, will be updated to clarify the radioactive waste classifications for the components of the liquid waste management system (LWMS), solid waste management system (SWMS), and for the radioactive waste processing building. Liquid waste storage and processing system tanks and pumps have been added to U.S. EPR FSAR Tier 2, Table 3.2.2-1, as required to clarify radwaste classifications.

   U.S. EPR FSAR Tier 2, Table 3.2.2-1, Footnote 16, refers to U.S. EPR FSAR Tier 2, Section 3.2.1 for detailed definitions of the seismic classifications. U.S. EPR FSAR Tier 2, Section 3.2.1.3, “Radwaste Seismic,” states that systems that are classified as RW-IIa per RG 1.143 are able to withstand loads up to ½ SSE.

   U.S. EPR FSAR Tier 2, Section 3.2.1.4, will be updated to provide clarification of the applicability of RG 1.143 for conventional seismic components.

   U.S. EPR FSAR Tier 2, Figure 11.2-1, will be updated to reflect the changes to the seismic classification.

   U.S. EPR FSAR Tier 2, Section 12.2, will be revised to clarify that radiation source information is used to determine radwaste classifications in accordance with RG 1.143.

   Eight tables (U.S. EPR FSAR Tier 2, Tables 12.2-24 through 12.2-31) have been added to U.S. EPR FSAR Tier 2, Section 12.2. These tables provide a listing of the expected inventories of radioactive materials for the major components of the LWMS, gaseous waste management system (GWMS), and SWMS. The tables provide the radionuclides and their respective curies, as well as the volumes of components on which the inventories are based. The photon spectrum in U.S. EPR FSAR Tier 2, Table 12.2-15, which corresponds to the radioactivity content in U.S. EPR FSAR Tier 2, Table 12.2-24, and the photon spectrum in U.S. EPR FSAR Tier 2, Table 12.2-16, which corresponds to the radioactivity content in U.S. EPR FSAR Tier 2, Tables 12.2-25 and 12.2-26, have also been updated and are enclosed for completeness as replacements of the corresponding tables in the U.S. EPR FSAR. Radionuclide inventories and photon spectra for additional source terms used in shielding analyses will be provided in Response to RAI 539, Questions 12.03-12.04-29 (c) and (d).

2. Steam Generator Blowdown and Blowdown Treatment Systems

   The steam generator blowdown system description in U.S. EPR FSAR Tier 2, Sections 10.4.8.1 and 10.4.8.4, will be updated to reference compliance with Regulatory Guide 1.143, Regulatory Position C.5, as it relates to radwaste classifications.

   U.S. EPR FSAR Tier 2, Figure 10.4.8-2 Sheets 1, 2 and 3, shall be updated as shown in the attached mark-up to reflect the changes to the seismic classification.

   U.S. EPR FSAR Tier 2, Table 3.2.2-1, will be updated to clarify the radwaste classifications for the components of the steam generator blowdown and blowdown treatment systems.

   U.S. EPR FSAR Tier 2, Table 3.2.2-1, Footnote 16, refers to U.S. EPR FSAR Tier 2, Section 3.2.1 for detailed definitions of the seismic classifications. U.S. EPR FSAR Tier 2, Section 3.2.1.4, "Conventional Seismic," states that systems that are classified as RW-IIb or RW-IIc per RG 1.143 have seismic requirement less than ½ SSE.

   U.S. EPR FSAR Tier 2, Section 3.2.1.4, will be updated to clarify that SSCs that are classified as conventional seismic are considered as part of the licensing basis as it relates to RG 1.143.

   A new table (U.S. EPR FSAR Tier 2, Table 12.2-32) has been added to U.S. EPR FSAR Tier 2, Section 12.2, to provide a listing of the expected inventories of radioactive materials for the steam generator blowdown demineralizer. This table provides the radionuclides and their respective curies, as well as the volume of the steam generator blowdown demineralizer.

3. CVCS and GWP Systems Interface and Use of RG 1.143 Classification

   The reactor boron recovery system description in U.S. EPR FSAR Tier 2, Section 9.3.4, will be updated to reference compliance with Regulatory Guide 1.143, Regulatory Position C.5 as it relates to radwaste classifications.

   U.S. EPR FSAR Tier 2, Table 3.2.2-1, will be updated to clarify the radioactive waste classifications for the components of the reactor boron recovery system. As shown in U.S. EPR FSAR Tier 2, Table 3.2.2-1 and Figure 9.3.4-4; the valves, KBC21/22 AA003, are located in the Fuel Building.

FSAR Impact:

U.S. EPR FSAR Tier 2, Table 3.2.2-1, will be revised as described in the response and indicated in the enclosed markup.

U.S. EPR FSAR Tier 2, Figure 11.2-1, will be revised as described in the response and indicated in the enclosed markup.

U.S. EPR FSAR Tier 2, Section 3.2.1.4, will be revised as described in the response and indicated in the enclosed markup.

U.S. EPR FSAR Tier 2, Figure 10.4.8-2, will be revised as described in the response and indicated in the enclosed markup.

U.S. EPR FSAR Tier 2, Sections 10.4.8.1 and 10.4.8.4, will be revised as described in the response and indicated in the enclosed markup.

U.S. EPR FSAR Tier 2, Section 9.3.4, will be revised as described in the response and indicated in the enclosed markup.

U.S. EPR FSAR Tier 2, Section 12.2, will be revised as described in the response and indicated in the enclosed markup.

U.S. EPR FSAR Tier 2, Tables 12.2-15 and 12.2-16, will be revised as described in the response and indicated in the enclosed markup.

U.S. EPR FSAR Tier 2, Tables 12.2-24 through 12.2-32, will be added, as described in the response and indicated in the enclosed markup.

U.S. EPR
Final Safety Analysis Report

MARKUPS

storage racks in the spent fuel storage structure and Class 1E electrical systems, are classified as Seismic Category I.

Seismic Category I SSC are designed to withstand the seismic loads associated with the SSE, in combination with other designated loads, without loss of function or pressure integrity. SSE seismic design loads are addressed in Section 3.7. The design of Seismic Category I structures is addressed in Section 3.8. The seismic design of mechanical systems and components is addressed in Section 3.9. The seismic qualification of mechanical and electrical equipment, including their supports, is addressed in Section 3.10.

Seismic Category I SSC are subject to the quality assurance program requirements of 10 CFR 50, Appendix B.

3.2.1.2 Seismic Category II

Per RG 1.29, some U.S. EPR SSC that perform no safety-related function could, if they failed under seismic loading, prevent or reduce the functional capability of a Seismic Category I SSC, or cause incapacitating injury to main control room occupants during or following an SSE. These non-safety-related SSC are classified as Seismic Category II.

U.S. EPR SSC classified as Seismic Category II are designed to withstand SSE seismic loads without incurring a structural failure that permits deleterious interaction with any Seismic Category I SSC or that could result in injury to main control room occupants. The seismic design criteria that apply to Seismic Category II SSC are addressed in Section 3.7.

Seismic Category II SSC are subject to the pertinent quality assurance program requirements of 10 CFR 50, Appendix B.

3.2.1.3 Radwaste Seismic

Radioactive waste management SSC that are classified as RW-IIa per RG 1.143 are subject to the relevant seismic design requirements tabulated in that RG. These SSC are designed to withstand seismic loads up to ½ SSE and are seismically categorized as radwaste seismic (RS).

3.2.1.4 Conventional Seismic

Some non-safety-related U.S. EPR SSC do not fall within the criteria for classification as Seismic Category I or II, but may still be subject to seismic design criteria that are incorporated in, or invoked by, an applicable commercial or industry code. These SSC are classified as conventional seismic (CS). ~~SSC that are classified as CS, based solely on applicable commercial or industry codes, are not considered part of the licensing~~

~~basis for the U.S. EPR since this classification is not prescribed in NRC regulations or guidance documents.~~

Some supplemented grade U.S. EPR SSC do not fall within the criteria for classification as Seismic Category I or II, but may be subject to "significant licensing requirements or commitments" that specify consideration of seismic design criteria that are less demanding than either a full or ½ SSE. Those SSC that are classified as RW-IIb or RW-IIc per RG 1.143 are included in this group. These SSC are also seismically categorized as CS.

3.2.1.5 Non-Seismic

The U.S. EPR SSC that do not fall within the RG 1.29 criteria for classification as Seismic Category I or II, do not fall within the RG 1.143 criteria for RW-IIa, RW-IIb, or RW-IIc, and are not subject to any seismic design criteria invoked by the applicable commercial or industrial codes and standards, are classified as non-seismic (NSC).

Next File

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
KBB	**Coolant Supply & Storage System**						
30KBB11/12/13/14/ 15/16 BB001	Storage Tanks	NS	D	NSC	No	UKA	ASME VIII[8]
KBB	All KBB System Piping	NS	D	NSC	No	UKA	ANSI/ASME B31.1[6]
KBC	**Reactor Boron & Water Makeup System**						
KBC	Boric Acid Mixing Tank, Feed Pump and their Connected Pipe and Valves	NS	E	NSC	No	UFA	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7], ASME VIII[8]
KBC	Boric Acid Storage Pumps and their Connected Pipe and Valves	NS	D	NSC	No	UFA	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7], ASME VIII[8]
KBC	Boric Acid Storage Tanks and their Connected Pipe and Valves except 30KBC21/22 AA191	NS	D	NSC	No	UFA	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7], ASME VIII[8]
30KBC21/22 AA003	Boric Acid Storage Tanks to GWPS Isolation Valves	NS-AQ	D	RS	No	UFA	ANSI/ASME B31.3[9], ANSI/ASME B16.34[7], RG 1.143, RW-IIa

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
30XJA50/80 AV100	Diesel Engine (Excluding Engine-Driven Cooling, Lubrication, and Fuel Pumps)	NS-AQ	N/A	NSC	No	UBA	
30XJA50/80 AP100	Engine Governor	NS-AQ	N/A	NSC	No	UBA	
30XJQ50/80	Exhaust Gas and Air Intake System	NS-AQ	N/A	NSC	No	UBA	ANSI/ASME B31.1[6]
30XJN50/80	Fuel Oil System	NS-AQ	N/A	NSC	No	UBA	ANSI/ASME B31.1[6]
30XKA50/80 AH	Generator Space Heaters	NS	N/A	NSC	No	UBA	
30XKA50/80 CT	Generator Thermal Sensors	NS	N/A	NSC	No	UBA	
30XJV50/80	Lube Oil System	NS-AQ	N/A	NSC	No	UBA	ANSI/ASME B31.1[6]
30XJX50/80	Starting Air System	NS-AQ	N/A	NSC	No	UBA	ANSI/ASME B31.1[6]
30XJA50/80 AN100A/B	Turbochargers	NS-AQ	N/A	NSC	No	UBA	
KPC	**Solid Waste System**						
KPC	All Other Equipment	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPC20 BB001	Concentrate Buffer Tank	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPC20 AP001	Concentrate Recirculation Pump	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa

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
30KPC50 AP001	Condensate Collection Pump	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPC50 BB001	Condensate Collection Tank	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPC30/40/50 BB001	Drum Drying Stations	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPC60 AP001	High Pressure Cleaning Device	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPC10 BB001	Resin Proportioning Tank	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPC50 BB002	Scrubber Tank	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPC60 BZ001	Vacuum Unit	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
KPK, KPF	**Liquid Waste Storage & Processing System**						
KPF, KPK	All Pumps (excluding 30KPK26/27 AP001)	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
KPF, KPK	All Tanks (excluding 30KPK21/22 BB001)	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPK21/22 BB001	Monitoring Tanks	NS-AQ	D	CS	No	UKS	RG 1.143, RW-IIc
30KPK26/27 AP001	Recirculation and Discharge Pumps	NS-AQ	D	CS	No	UKS	RG 1.143, RW-IIc
30KPK41/42/43/44 AM001	Chemical Tank Agitators	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa

**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
30KPK31/32/33 AM001	Concentrate Tank Agitators	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPF51 AT001	Decanter with Filling Station (Centrifuge Plant)	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPF11 AC002	Evaporator	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPF11 AT001	Evaporator Column	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPF52 AT001	Separator (Centrifuge Plant)	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPF53 AM001	Sludge Tank Agitator	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPK11/12/13/14/ 15 AM001	Storage Tank Agitators	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
30KPF11 AN001	Vapor Compressor	NS-AQ	D	RS	No	UKS	RG 1.143, RW-IIa
KPF	Vendor Supplied Demineralizer System	NS-AQ	N/A	RS	No	UKS	RG 1.143, RW-IIa
KPL	**Gaseous Waste Processing System**						
30KPL30 BB001	Condensate Collecting Tank	NS-AQ	D	RS	No	UKA	RG 1.143, RW-IIa
30KPL84 BR004/005	Containment Isolation Piping	S	B	I	Yes	UFA, UJA	ASME Class 2[2]
30KPL85 BR006/007	Containment Isolation Piping	S	B	I	Yes	UFA, UJA	ASME Class 2[2]

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
30GDA14 AT010	Backwash Air Vessel	NS	E	NSC	No	UKA	ASME VIII[8]
GDA	Balance of GDA Piping and Valves	NS	D	NSC	No	UKA	ANSI/ASME B31.3[9], RG 1.143
30GDA20 AT010	Buffer Tank for Pneumatic Valves	NS	E	NSC	No	UKA	ASME VIII[8]
30GDA10 AT010	Cartridge Filter	NS-AQ	D	CRS	No	UKA	ASME VIII[8], RG 1.143, RW-IIae
30GDA10 AT001	Cation Exchanger	NS-AQ	D	CRS	No	UKA	ASME VIII[8], RG 1.143, RW-IIae
30GDA13 AT012	Drain Buffer Tank	NS-AQ	D	CRS	No	UKA	ASME VIII[8], RG 1.143, RW-IIae
30GDA10 AT002	Mixed Bed Exchanger	NS-AQ	D	CRS	No	UKA	ASME VIII[8], RG 1.143, RW-IIae
30GDA10 AT011	Resin Trap	NS-AQ	D	CRS	No	UKA	ASME VIII[8], RG 1.143, RW-IIae
30GDA13 AP001	Waste Water Pump	NS-AQ	D	CRS	No	UKA	ASME VIII[8], RG 1.143, RW-IIae
PA	**Circulating Water Supply System**	NS	N/A	NSC	No	UMA, UZT	
PG	**Turbine Building Closed Cooling Water System**	NS	N/A	NSC	No	UMA, UZT	ASME B31.1[6], ASME VIII[8]

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
UBP	**Emergency Power Generating Buildings**	S	N/A	I	Yes	UBP	
URB	**Essential Service Water Cooling Tower Structures**	S	N/A	I	Yes	URB	
UQB	**Essential Service Water Pump Buildings**	S	N/A	I	Yes	UQB	
UKA	**Nuclear Auxiliary Building**	NS-AQ	N/A	RS, II	Yes	UKA	RG 1.143, RW-IIa
UKS	**Radioactive Waste Processing Building**	NS-AQ	N/A	RS	No	UKS	RG 1.143, RW-IIa
UKH	**Vent Stack**	S	N/A	I	Yes	UKH	
[[UMA, UBA	Turbine Building (Switchgear Building)	NS-AQ	N/A	II	Yes	UMA, UBA]]	
[[UKE	Access Building	NS-AQ	N/A	II	Yes	UKE]]	
SM, SN	**Cranes, Hoists, and Elevators**						
SMJ06	Assembly Crane	NS-AQ	N/A	II	Yes	UJA	ASME NUM-1
SM	Balance of Cranes and Hoists	NS	N/A	NSC	No	All	ASME NOG-1, ASME NUM-1

- Safety-related portions of the CVCS are designed to reliably provide negative reactivity to the reactor by supplying borated water to the RCS in the event of anticipated operational occurrences (AOO); if the plant design relies on the CVCS to perform the safety function of boration for mitigation of design basis events (DBE) (GDC 29).

- Safety-related portions of the CVCS are designed to supply reactor coolant makeup in the event of small breaks or leaks in the RCPB and to function as part of the emergency core cooling system (ECCS) assuming a single active failure coincident with a loss of offsite power (LOOP); if the plant design relies on the CVCS to perform the safety function of safety injection as part of the ECCS (GDC 33 and GDC 35). CVCS valves are designed to fail to a position (i.e., closed, open, or as-is) upon loss of motive power that meets safety analysis assumptions.

- Safety-related portions of the CVCS are designed to have provisions for venting and draining through closed systems (GDC 60 and GDC 61).

- Safety-related portions of the CVCS are designed to have provisions for a leakage detection and control program to minimize the leakage from those portions of the CVCS outside of the containment that contain or may contain radioactive material following an accident (10 CFR 50.34(f)(2)(xxvi)).

- Safety-related portions of the CVCS are designed to provide sufficient capacity and capability to make sure that the core is cooled in the event of a station blackout (SBO) (10 CFR 50.63(a)(2)).

- The portions of the boron recovery system downstream of the outer containment isolation valves (CIVs), that interface with the gaseous waste processing system, meet the radwaste classifications defined in RG 1.143, Regulatory Position C.5.

The CVCS is designed to meet the following functional criteria:

- Maintain and adjust the RCS boron concentration to control reactor power level variations resulting from expected reactivity changes due to the effects of xenon build-in or burn-out, and compensate for core burn-up to provide assurance that operating fuel limits are not exceeded.

- Maintain RCS water inventory by maintaining a constant charging flow and adjusting the letdown flow to account for volume changes due to RCS temperature variations.

- Provide cooled, purified and filtered water to the RCP seal water system to maintain cooling and leak tightness of the RCP seals and return seal leakage back to the CVCS.

- Provide cooled reactor coolant for chemical and radiological control of the primary coolant in combination with the coolant purification, treatment, degasification and storage systems.

- The CVCS is designed to supply reactor coolant makeup in the event of small breaks or leaks in the reactor coolant pressure boundary. The CVCS is designed with both on-site and off-site electric power and meets GDC 33.

- The CVCS is not designed to perform the safety function of the ECCS during a DBA. Therefore, GDC 35 is not applicable to the CVCS.

The design of safety-related portions of the CVCS satisfies GDC 60 regarding vents and drains containing gaseous and liquid radioactive material through closed systems.

- The CVCS component vents and drains are piped to the nuclear island vent and drain system (NIDVS), which allows storage and processing of the discharged liquids. The gases discharged from the CVCS are collected and processed in the gaseous waste processing system.

The design of safety-related portions of the CVCS satisfies GDC 61 regarding the assurance of adequate safety under normal and postulated accident conditions.

- The CVCS design permits periodic inspections with suitable shielding for radiation protection and with appropriate containment, confinement and filtering systems. To allow personnel access to different system components while maintaining exposure low, radioactive components are separated from non-radioactive components.

The design of safety-related portions of the CVCS satisfies 10 CFR 50.34(f)(2)(xxvi) regarding detection of reactor coolant leakage outside containment by providing leakage control and detection systems in the CVCS and implementation of appropriate leakage control program.

- The CVCS isolates components or piping so that the CVCS safety function is not compromised. Design provisions include the capability to identify and isolate the leakage or malfunction, and to isolate the non-safety-related portions of the system.

10 CFR 50.63 identifies the requirements for withstanding or coping with, and recovering from an SBO event.

- The CVCS provides automatic isolation of the letdown line at the onset of an SBO event.

- The interface between the reactor boron system and the gaseous waste processing system includes two isolation valves. The design of these two isolation valves satisfies RG 1.143, Regulatory Position C.5, as it relates to radwaste classifications so that the radiological release/quantity criterion is met.

9.3.4.4 Inspection and Testing Requirements

The CVCS components are inspected and tested as part of the initial test program. Refer to Section 14.2 (test abstracts #002, #003, #004, #005, #006, #007, #008, #009,

10.4.8 Steam Generator Blowdown System (PWR)

The Steam Generator Blowdown System (SGBS) assists in maintaining the chemical characteristics of the secondary water within permissible limits. The SGBS provides the capability for continuous hot blowdown of the secondary side of the steam generators (SG). The SGBS includes equipment for heat recovery, purification and reuse of SG blowdown.

10.4.8.1 Design Bases

The following safety-related isolation functions are performed by the SGBS and are required to function following a design basis accident (DBA):

- Provide blowdown system isolation.
- Provide containment isolation.

The SGBS has the following design basis requirements and criteria:

- The design of the safety-related portions of the SGBS is Seismic Category I and Quality Group B from its connection to the SG inside primary containment up to and including the first isolation valve outside containment (GDC 1).
- The non-safety-related portion of the SGBS, downstream of the outer containment isolation valves (CIV), meets the quality standards of RG 1.143, regulatory position C.1.1 (GDC 1).
- The non-safety portions of the SGBS downstream of the outer containment isolation valves (CIVs), meets the radwaste classifications defined in Regulatory Guide 1.143, Regulatory Position C.5.
- The safety-related portion of the SGBS is designed to function and is protected from the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods and external missiles (GDC 2).
- The blowdown system is sampled continuously to monitor its demineralization and clean up performance (GDC 13).
- The SGBS is designed to blow down up to one percent of the main steam flow rate of all four SGs or up to two percent of a single SG main steam flow rate to maintain water chemistry (GDC 14).

10.4.8.2 System Description

10.4.8.2.1 General Description

Figure 10.4.8-1—Steam Generator Blowdown System Discharge and Cooling and Figure 10.4.8-2—Steam Generator Blowdown Demineralizing System Flow Diagram provide schematic diagrams of the SGBS. Each SG is equipped with its own blowdown

10.4.8.3.3 Accident Conditions

The blowdown isolation valves isolate on a containment isolation signal or emergency feedwater (EFW) actuation signal, or mainsteam isolation signal with low SG pressure or high SG pressure drop. For steam generator tube rupture, the blowdown isolation valves on the affected SG close on a partial cooldown signal with high mainsteam activity or high SG level above the narrow range.

10.4.8.4 Safety Evaluation

The design of the SGBS satisfies GDC 1 as it relates to system components being designed, fabricated, erected, and tested for quality standards.

- The safety-related portion of the SGBS is designed and fabricated to codes consistent with the quality group classification assigned by RG 1.26 and the seismic category assigned by RG 1.29. The design of the SGBS is Seismic Category I and Quality Group B from its connection to the SG inside primary containment up to and including the first isolation valve outside containment. Table 3.2.2-1 provides the seismic design and other design classifications for components in the SGBS.

- The power supplies and control function necessary for the safety functions of the system are Class IE, as described in Chapter 7 and Chapter 8.

- The non-safety-related portion of the SGBS, downstream of the outer containment isolation valves (CIV), meets the quality standards of RG 1.143, regulatory position C.1.1.

The SGBS design satisfies RG 1.143, Regulatory Position C.5, as it relates to radwaste classifications so that the radiological release/quantity is met.

The design of the SGBS satisfies GDC 2 regarding protection from the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods and external missiles per general design criterion.

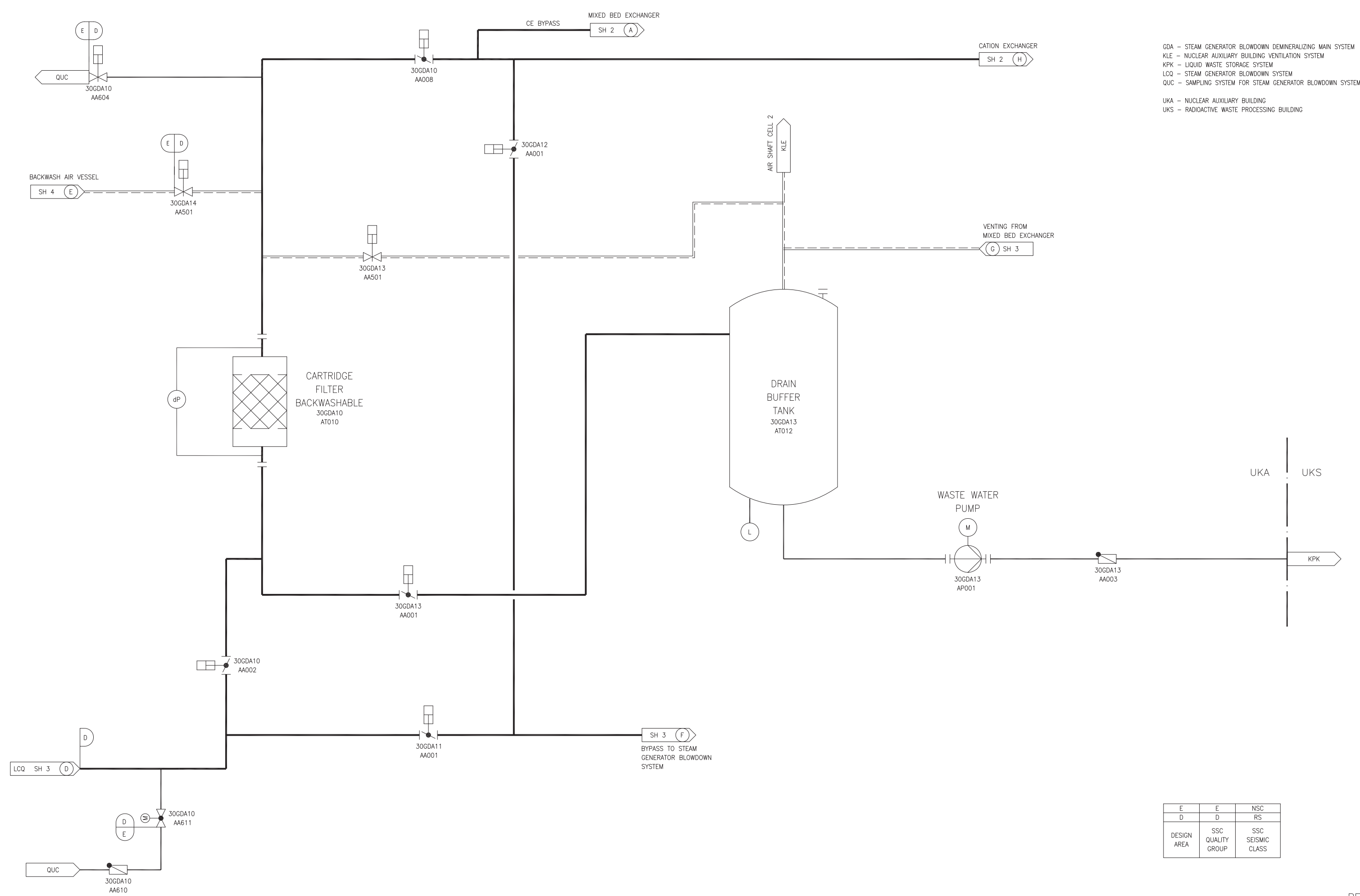
- The safety-related portions of the SGBS are located in the Reactor Building and the Safeguard Buildings. These buildings are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles and other similar natural phenomena. Sections 3.3, 3.4, 3.5, 3.7, and 3.8 provide the bases for the adequacy of the structural design of these buildings.

- The safety-related portions of the SGBS are designed to remain functional after an SSE. Sections 3.7 and 3.9 discuss the design loading conditions considered.

- The foundations and walls of structures that house the SGBS, downstream of the outer CIV, are consistent with the natural phenomena and internal and external man-induced hazards criteria in RG 1.143, positions 1.1.3 and 6.

All indicated changes are in response to RAI #554, Question 11.02-27

Figure 10.4.8-2—Steam Generator Blowdown Demineralizing System Flow Diagram Sheet 1 of 4



All indicated changes are in response to RAI #554, Question 11.02-27

Figure 10.4.8-2—Steam Generator Blowdown Demineralizing System Flow Diagram Sheet 2 of 4

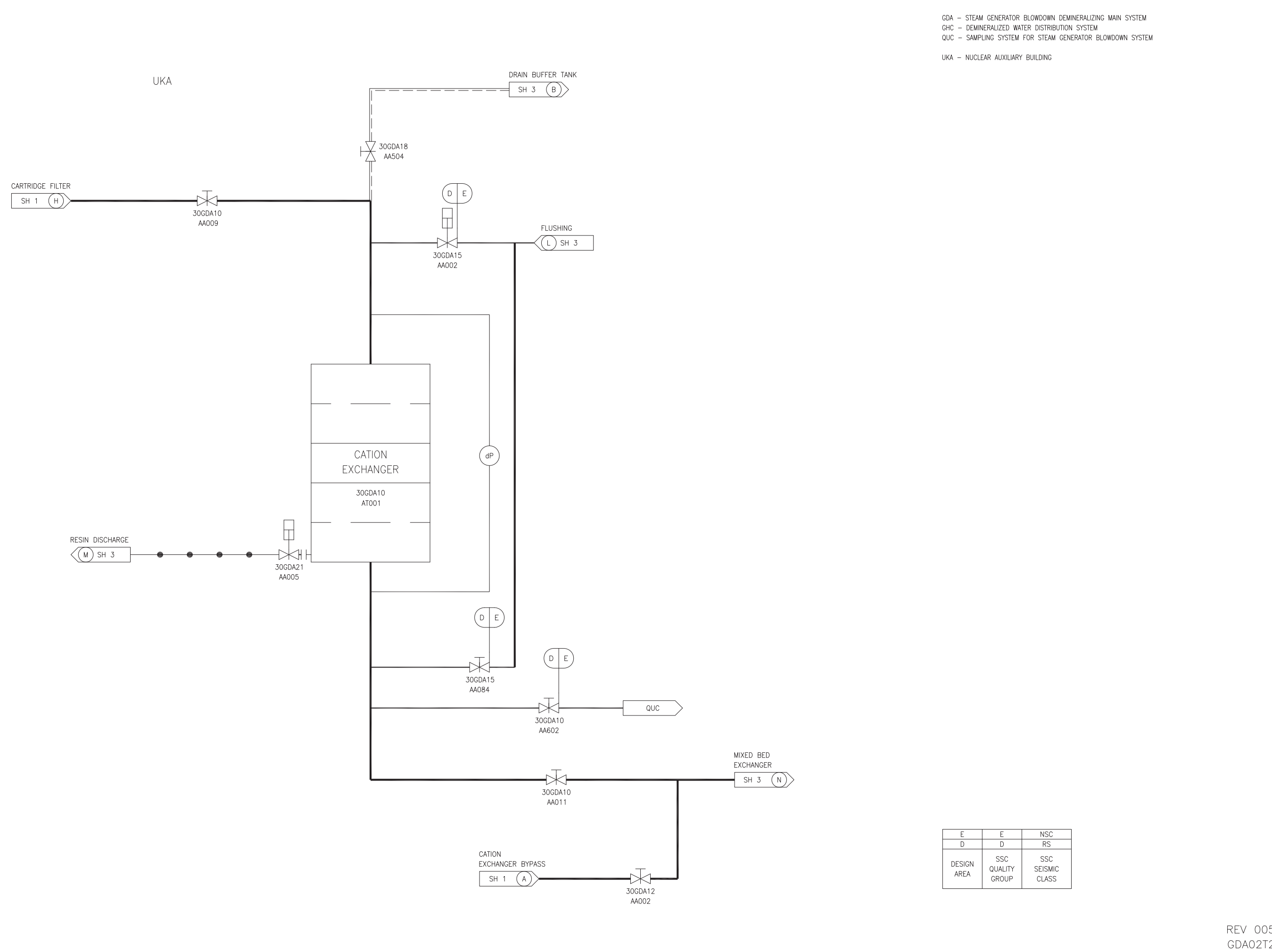


Figure 10.4.8-2—Steam Generator Blowdown Demineralizing System Flow Diagram
Sheet 3 of 4

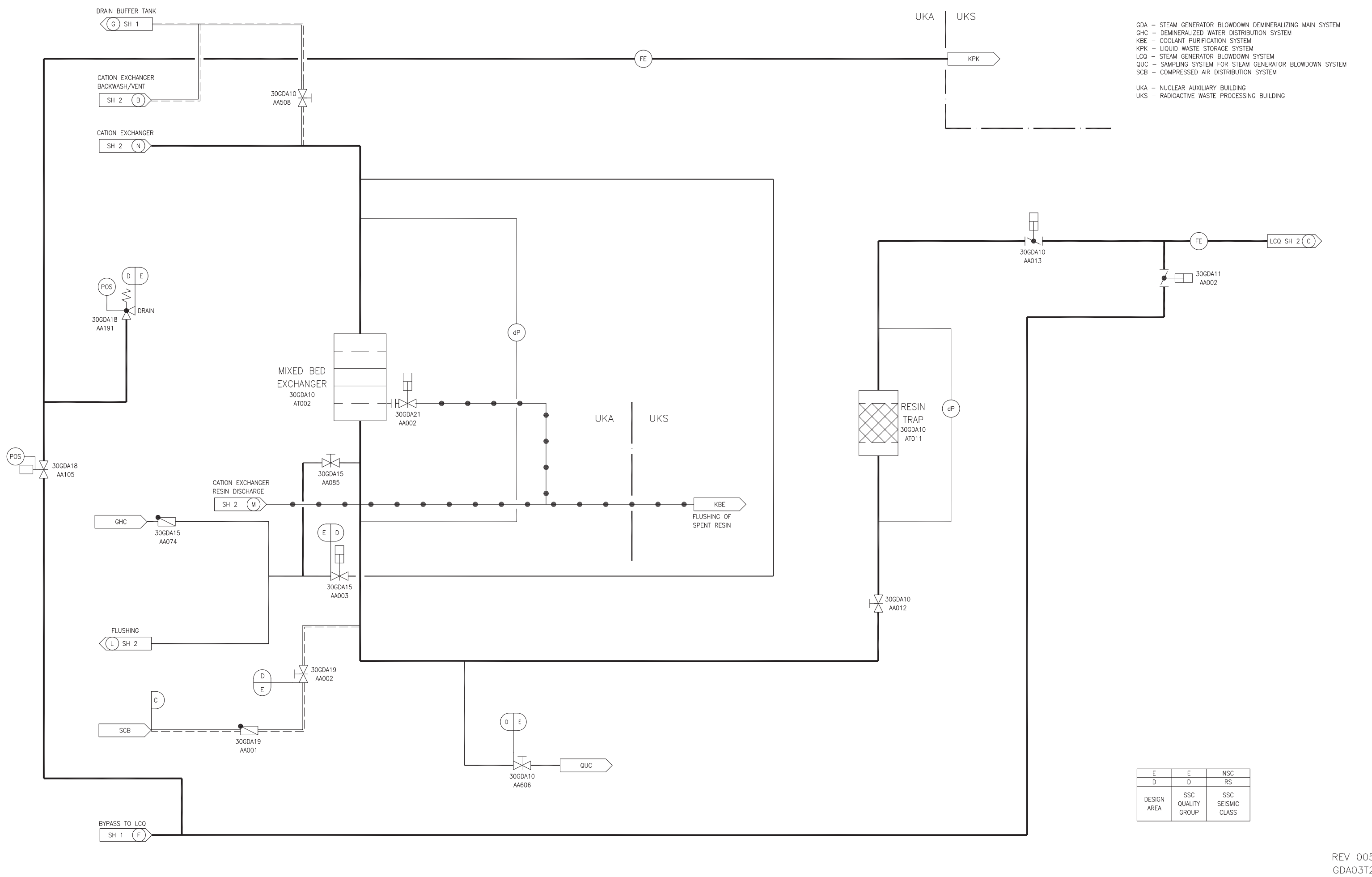
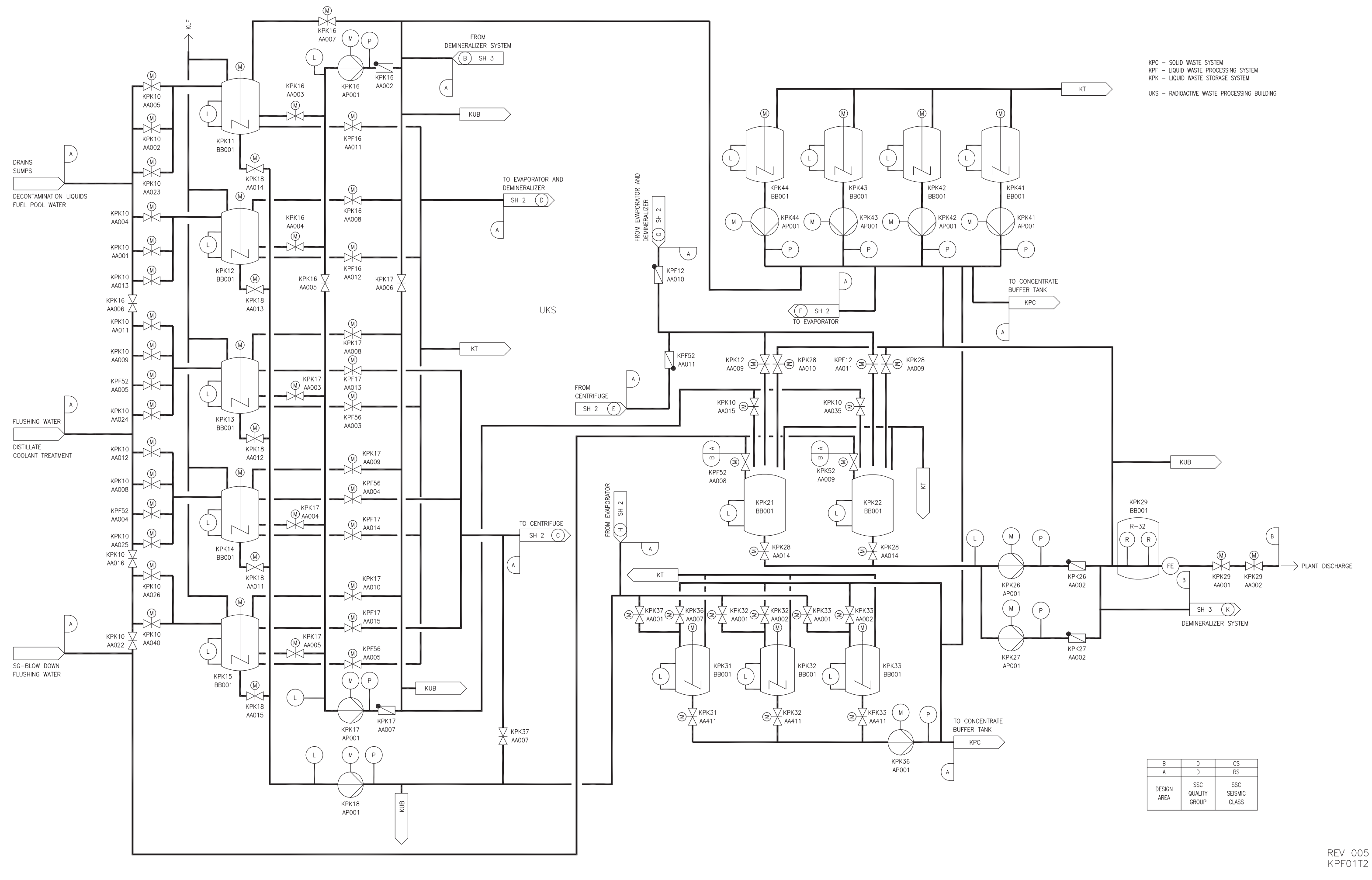


Figure 11.2-1—Liquid Waste Storage System



12.2 Radiation Sources

This section describes the key component sources of radioactivity present in the U.S. EPR, in accordance with Section 12 of the NUREG-0800 SRP (Reference 1), that are used as input to:

- Perform shield design calculations (see Section 12.3.2).
- Design the ventilation systems.
- Determine radwaste classifications for systems and components in accordance with Regulatory Guide 1.143.

Source terms are presented here for both contained and airborne sources of radioactivity.

12.2.1 Contained Sources

The U.S. EPR component source terms for contained sources are based on the shielding design basis primary coolant source term described in Section 11.1.2, Table 11.1-2, which is based on U.S. EPR specific design inputs and a conservative 0.25 percent failed fuel fraction. Plan scale drawings of each floor of the plant, showing the location of these contained sources, are included in the radiation zone maps (see Section 12.3.2.3).

12.2.1.1 Reactor Core

During normal operation, radiation within the containment consists of neutrons and gamma radiation emanating from the reactor core. The model dimensions for the reactor vessel are shown in Table 12.2-1—Reactor Vessel Model Dimensions (cm). Table 12.2-2—Neutron and Gamma Fluxes at Primary Shield Concrete lists neutron and gamma multigroup fluxes at the inside surface of the primary shield concrete, core midplane elevation. These fluxes are further reduced by shielding provided by the reactor vessel and reactor internals. See Section 12.3.1.1 for features that reduce neutron and gamma streaming in the service area of the Containment Building.

The spent fuel gamma ray source strengths, as a function of time after shutdown, are presented in Table 12.2-3. The spectra are based on the radionuclide mix containing the bounding core inventory for each individual radionuclide of importance for the following core parameters:

- Power level: 4612 MW_t.
- U-235 fuel enrichment: 2 to 5 $^{w}/_{o}$.
- Fuel burn-up: 5 to 62 GWD/MTU.

12.2.1.8 Fuel Pool Cooling and Purification System

Radioactive impurities in the fuel pool water or in the fuel pool cooling system result from:

- Release of fission products from breaches in fuel rod cladding.
- Release of activated corrosion products located on the surfaces of fuel rods stored in the fuel pool.
- Intermixing of minimal amounts of reactor coolant with fuel pool water via the transfer channel during fuel assembly transfer.

The fuel pool cooling and purification system (FPCPS) uses mechanical filters and mixed-bed demineralizers, which are operated continuously to remove impurities. The mechanical prefilters, upstream of the mixed bed demineralizer, are used to trap undissolved corrosion products, preventing them from entering the mixed bed demineralizer. The activity on the mechanical pre-filter and post-filters is bounded by the activity on the mixed bed demineralizer. The source term for the FPCPS mixed bed demineralizer is presented in Table 12.2-14—Photon Spectra for FPCPS Mixed-Bed Demineralizer after Operation Period of 1 Year. A one-year operation period was selected for determining shielding adequacy.

12.2.1.9 Liquid Waste Management System

The radiation sources in the liquid waste storage system (LWSS) and in the liquid waste processing system (LWPS) include fission and activation products present in the reactor coolant. Table 12.2-15—Photon Spectra for Liquid Waste Storage System Group I Waste Tank and Table 12.2-16—Photon Spectra for Liquid Waste Processing System Evaporator and Concentrate Tanks for Batch Operations provide the source terms for the components of the LWSS and LWPS. Table 12.2-24—Radioactivity Content of Group I Liquid Waste Storage Tank, Table 12.2-25—Radioactivity Content of KPF Evaporator, Table 12.2-26—Radioactivity Content of Liquid Waste Concentrate Tank, and Table 12.2-27—Radioactivity Content of Liquid Waste Monitoring Tanks provide design basis normal operations radioactivity contents for these components of the LWSS and LWPS.

12.2.1.10 Gaseous Waste Processing System

Radioactive fission product gases that are generated in the reactor core are released into the reactor coolant through the fuel rod cladding and are transported to auxiliary systems within the plant. These gases are collected and processed by the gaseous waste processing system (GWPS). The radiation shielding source terms for the components of the GWPS are listed in Table 12.2-17—Photon Spectra for Gaseous Waste Processing System. Table 12.2-28—Radioactivity Content of Purge Gas Circuit and Table 12.2-29—Radioactivity Content of Charcoal Holdup Beds provide design basis normal operations radioactivity contents for these components of the GWPS.

12.2.1.11 Solid Waste Management System

During operation, solid radioactive waste is generated from processes such as maintenance, repair, exchange of components, decontamination, and cleaning. The U.S. EPR layout physically separates radioactive waste collection, processing, handling, and storage. This arrangement minimizes the dose contribution from activities in which the operator is not immediately involved. To further minimize exposure, operators use remote control equipment to move solid radioactive wastes into and out of storage.

The wastes associated with this system range in activity from relatively low activity materials to high activity spent resins and filter cartridges. Tables 11.4-2 through 11.4-10 provide the shielding source terms for the components of the solid waste management system. Table 12.2-30—Radioactivity Content of KPC Concentrate Buffer Tank and Table 12.2-31—Radioactivity Content of Waste Resin Tank provide curie contents of the major components that are part of, or constitute inputs to, the Solid Waste Management System. Table 12.2-32—Radioactivity Content of Steam Generator Blowdown Demineralizer provides curie contents of the Steam Generator Blowdown Demineralizer.

12.2.1.12 Post-LOCA ESF Filters

The radiation shielding source terms for the ESF filters post-LOCA are listed in Table 12.2-18—Photon Spectra for ESF Filters Post-LOCA.

12.2.1.13 Miscellaneous Sources

A combined license (COL) applicant that references the U.S. EPR design certification will provide site-specific information for required radiation sources containing byproduct, source, and special nuclear material that may warrant shielding design considerations. This site-specific information will include a listing of isotope, quantity, form, and use of all sources in this latter category that exceed 100 millicuries.

12.2.1.14 Safety Injection System

The U.S. EPR safety injection system (SIS) source strengths at various times following a loss of coolant accident (LOCA) are presented in Table 12.2-21. The tabulated spectra are based on the following:

1. A radionuclide mix at the time of the postulated LOCA containing the bounding core inventory for each individual radionuclide of importance for the following core parameters:

   Power level: 4612 MW_t

All indicated changes are in response to RAI #554, Question 11.02-27

Table 12.2-15—Photon Spectra for Liquid Waste Storage System Group I Waste Tank

Photon Energy (MeV)	Photon Spectra (MeV/sec-m³)	
	Without Noble Gas Radionuclides	With Noble-Gas Radionuclides as Decay Products
0.01	5.47E+06	6.85E+06 ~~9.23E+06~~
0.025	4.30E+07	4.77E+07 ~~6.89E+07~~
0.0375	3.25E+07	1.02E+08 ~~7.02E+07~~
0.0575	2.12E+07	2.12E+07 ~~2.75E+07~~
0.085	5.65E+07	1.88E+08 ~~1.03E+08~~
0.125	2.76E+08	2.76E+08 ~~3.51E+08~~
0.225	8.08E+08	1.34E+09 ~~2.91E+09~~
0.375	7.02E+09	7.03E+09 ~~9.15E+09~~
0.575	1.50E+10	1.52E+10 ~~3.48E+10~~
0.85	9.32E+09	9.32E+09 ~~1.66E+10~~
1.25	6.05E+09	6.05E+09 ~~2.39E+10~~
1.75	1.14E+09	1.14E+09 ~~7.53E+09~~
2.25	2.14E+08	2.14E+08 ~~1.20E+09~~
2.75	7.01E+08	7.01E+08 ~~3.00E+09~~
3.5	6.63E+06	6.63E+06 ~~3.35E+06~~
5	1.30E+06	1.30E+06 ~~6.06E+04~~
7	9.53E-04	9.53E-04 ~~9.68E-04~~
9.5	1.49E-04	1.49E-04 ~~1.51E-04~~
Total	4.07E+10	4.17E+10 ~~9.98E+10~~

Source volume = 70 cubic meters

Table 12.2-16—Photon Spectra for Liquid Waste Processing System Evaporator and Concentrate Tanks for Batch Operations

Photon Energy (MeV)	Photon -Spectra (MeV/s)	
	Evaporator (1)	Concentrate Tank (2)
0.01	9.79E+08	1.85E+09
0.025	5.88E+09	5.95E+09
0.0375	1.69E+10	5.45E+10
0.0575	3.70E+09	3.70E+09
0.085	9.38E+09	9.39E+09
0.125	2.36E+10	2.36E+10
0.225	1.13E+11	1.14E+11
0.375	1.10E+12	1.10E+12
0.575	8.63E+12	2.87E+13
0.85	6.08E+12	1.84E+13
1.25	1.07E+12	2.37E+12
1.75	2.38E+10	2.39E+10
2.25	5.34E+09	5.41E+09
2.75	2.21E+10	2.21E+10
3.5	2.31E+07	2.33E+07
5	2.80E+05	2.80E+05
7	1.05E+00	3.22E+00
9.5	1.64E-01	5.03E-01
TOTAL	**1.71E+13**	**5.07E+13**
~~1.00E-02~~	~~2.42E+08~~	~~9.58E+08~~
~~2.50E-02~~	~~2.11E+09~~	~~8.89E+09~~
~~3.75E-02~~	~~1.90E+09~~	~~8.82E+09~~
~~5.75E-02~~	~~1.12E+09~~	~~4.96E+09~~
~~8.50E-02~~	~~3.10E+09~~	~~1.38E+10~~
~~1.25E-01~~	~~1.09E+10~~	~~3.93E+10~~
~~2.25E-01~~	~~3.90E+10~~	~~1.67E+11~~
~~3.75E-01~~	~~3.77E+11~~	~~1.67E+12~~
~~5.75E-01~~	~~6.87E+11~~	~~3.02E+12~~
~~8.50E-01~~	~~5.00E+11~~	~~2.34E+12~~
~~1.25E+00~~	~~1.89E+11~~	~~7.81E+11~~
~~1.75E+00~~	~~9.69E+09~~	~~2.26E+10~~

All indicated changes are in response to RAI #554, Question 11.02-27

Table 12.2-16—Photon Spectra for Liquid Waste Processing System Evaporator and Concentrate Tanks for Batch Operations

~~2.25E+00~~	~~2.47E+09~~	~~6.98E+09~~
~~2.75E+00~~	~~1.10E+10~~	~~1.98E+10~~
~~3.50E+00~~	~~1.05E+07~~	~~2.20E+07~~
~~5.00E+00~~	~~1.40E+05~~	~~2.47E+05~~
~~7.00E+00~~	~~6.64E-02~~	~~3.31E-01~~
~~9.50E+00~~	~~1.04E-02~~	~~5.17E-02~~
~~**Total**~~	~~**1.84E+12**~~	~~**8.10E+12**~~

Notes:

1. Liquid waste processing system evaporator photon spectr<u>um</u>~~a~~ for ~~one~~<u>18</u> batch<u>es</u> of Group I waste <u>processed within 160 days. Combined volume for evaporator and evaporator column is 9 cubic meters</u>~~based on a processing time of approximately 18 hours/batch~~.

2. Liquid Waste Storage System concentrate tank photon spectr<u>um</u>~~a~~ for ~~five~~<u>72</u> batches of liquid waste processing system~~ with no decay time credit during the first batch~~.<u> Tank volume is 36 cubic meters.</u>

Table 12.2-24—Radioactivity Content of Group I Liquid Waste Storage Tank

Nuclide	Activity (Ci)	Nuclide	Activity (Ci)	Nuclide	Activity (Ci)
Kr-83m	6.36E-02	Te-127	4.33E-02	Np-239	3.18E-02
Kr-85m	8.09E-05	Te-129m	9.54E-02	Y-90	1.28E-03
Kr-85	1.41E-08	Te-129	6.36E-02	Y-91m	5.11E-03
Xe-131m	6.50E-02	Te-131m	8.84E-02	Y-91	5.87E-03
Xe-133m	4.20E-01	Te-131	2.05E-02	Y-92	8.15E-04
Xe-133	8.19E+00	Te-132	1.75E+00	Y-93	5.52E-04
Xe-135m	6.77E-01	Te-133m	2.87E-03	Y-95	4.10E-07
Xe-135	4.40E+00	Te-133	6.82E-04	Zr-95	6.27E-03
Br-83	6.36E-02	Te-134	3.91E-03	Zr-97	9.43E-04
Br-84	7.45E-03	Sr-89	4.32E-02	Nb-95	6.46E-03
Br-85	8.09E-05	Sr-90	2.25E-03	Ag-110m	1.36E-05
I-129	3.18E-06	Sr-91	8.18E-03	Ag-110	1.81E-07
I-130	5.17E-01	Sr-92	3.95E-04	La-140	2.70E-02
I-131	4.19E+01	Ba-137m	7.07E+00	La-141	1.82E-04
I-132	2.44E+00	Ba-139	2.86E-02	La-142	4.33E-05
I-133	2.15E+01	Ba-140	3.76E-02	Pr-143	5.69E-03
I-134	1.81E-01	Mo-99	4.23E+00	Pr-144	4.77E-03
I-135	4.40E+00	Tc-99m	3.79E+00	Nd-147	2.04E-03
Rb-86m	4.27E-09	Ru-103	5.14E-03	Am-241	5.46E-07
Rb-86	1.22E-01	Ru-105	3.70E-04	Cm-242	1.29E-04
Rb-88	2.55E-01	Ru-106	1.85E-03	Cm-244	7.06E-06
Rb-89	1.01E-02	Rh-103m	4.63E-03	Na-24	4.65E-01
Cs-134	1.18E+01	Rh-105	1.49E-03	Cr-51	1.30E-01
Cs-136	3.23E+00	Rh-106	1.85E-03	Mn-54	6.88E-02
Cs-137	7.47E+00	Ce-141	5.84E-03	Fe-55	5.25E-02
Cs-138	9.94E-02	Ce-143	1.93E-03	Fe-59	1.27E-02
Sb-125	5.51E-05	Ce-144	4.77E-03	Co-58	1.96E-01
Sb-127	2.31E-04	Pu-238	1.38E-05	Co-60	2.35E-02
Sb-129	2.49E-05	Pu-239	1.41E-06	Zn-65	2.20E-02
Sb-131	8.37E-07	Pu-240	1.94E-06	W-187	3.51E-02
Te-127m	3.00E-02	Pu-241	4.77E-04	H-3	6.92E+01

Source Volume: 70 cubic meters

Table 12.2-25—Radioactivity Content of KPF Evaporator

Nuclide	Activity (Ci)	Nuclide	Activity (Ci)	Nuclide	Activity (Ci)
Br-83	9.61E-04	Sr-89	3.43E-01	Y-93	1.75E-04
Br-84	3.21E-09	Sr-90	4.03E-02	Zr-95	5.72E-02
I-129	5.71E-05	Sr-91	2.42E-03	Zr-97	4.71E-04
I-130	2.00E-01	Sr-92	9.10E-06	Nb-95	8.03E-02
I-131	9.42E+01	Ba-137m	1.27E+02	Ag-110m	2.00E-04
I-132	2.30E+00	Ba-139	3.90E-05	Ag-110	2.66E-06
I-133	1.23E+01	Ba-140	1.15E-01	La-140	1.18E-01
I-134	1.32E-05	Mo-99	4.85E+00	La-141	1.18E-05
I-135	7.96E-01	Tc-99m	4.63E+00	La-142	1.06E-07
Rb-86	4.84E-01	Ru-103	3.47E-02	Pr-143	1.86E-02
Cs-134	1.98E+02	Ru-105	3.19E-05	Pr-144	7.18E-02
Cs-136	1.00E+01	Ru-106	2.89E-02	Nd-147	5.63E-03
Cs-137	1.34E+02	Rh-103m	3.13E-02	Am-241	1.26E-05
Cs-138	5.00E-08	Rh-105	1.21E-03	Cm-242	1.72E-03
Sb-125	9.46E-04	Rh-106	2.89E-02	Cm-244	1.26E-04
Sb-127	3.26E-04	Ce-141	3.46E-02	Na-24	2.13E-01
Sb-129	2.01E-06	Ce-143	1.46E-03	Cr-51	6.87E-01
Te-127m	3.50E-01	Ce-144	7.18E-02	Mn-54	1.05E+00
Te-127	3.47E-01	Pu-238	2.52E-04	Fe-55	8.94E-01
Te-129m	5.78E-01	Pu-239	2.54E-05	Fe-59	9.35E-02
Te-129	3.76E-01	Pu-240	3.48E-05	Co-58	1.89E+00
Te-131m	6.32E-02	Pu-241	8.50E-03	Co-60	4.11E-01
Te-131	1.42E-02	Np-239	3.32E-02	Zn-65	3.22E-01
Te-132	2.23E+00	Y-90	3.92E-02	W-187	2.19E-02
Te-133m	2.91E-07	Y-91m	1.54E-03	H-3	8.89E+00
Te-133	4.88E-08	Y-91	5.14E-02		
Te-134	3.48E-08	Y-92	7.54E-05		

Source Volume: 9 cubic meters (evaporator and evaporator column).

Note: Activity is based on the processing of 18 liquid waste tank volumes within 160 days.

Next File

Table 12.2-26—Radioactivity Content of Liquid Waste Concentrate Tank

Nuclide	Activity (Ci)	Nuclide	Activity (Ci)	Nuclide	Activity (Ci)
Br-83	9.61E-04	Sr-89	3.81E-01	Y-93	1.75E-04
Br-84	3.21E-09	Sr-90	1.50E-01	Zr-95	6.82E-02
I-129	2.16E-04	Sr-91	2.42E-03	Zr-97	4.71E-04
I-130	2.00E-01	Sr-92	9.10E-06	Nb-95	1.03E-01
I-131	9.42E+01	Ba-137m	4.71E+02	Ag-110m	4.43E-04
I-132	2.30E+00	Ba-139	3.90E-05	Ag-110	5.90E-06
I-133	1.23E+01	Ba-140	1.15E-01	La-140	1.18E-01
I-134	1.32E-05	Mo-99	4.85E+00	La-141	1.18E-05
I-135	7.96E-01	Tc-99m	4.63E+00	La-142	1.06E-07
Rb-86	4.85E-01	Ru-103	3.65E-02	Pr-143	1.86E-02
Cs-134	6.10E+02	Ru-105	3.19E-05	Pr-144	1.68E-01
Cs-136	1.00E+01	Ru-106	7.40E-02	Nd-147	5.63E-03
Cs-137	4.98E+02	Rh-103m	3.30E-02	Am-241	8.03E-05
Cs-138	5.00E-08	Rh-105	1.21E-03	Cm-242	3.13E-03
Sb-125	3.06E-03	Rh-106	7.40E-02	Cm-244	4.64E-04
Sb-127	3.26E-04	Ce-141	3.56E-02	Na-24	2.13E-01
Sb-129	2.01E-06	Ce-143	1.46E-03	Cr-51	6.97E-01
Te-127m	5.23E-01	Ce-144	1.68E-01	Mn-54	2.55E+00
Te-127	5.16E-01	Pu-238	9.66E-04	Fe-55	2.87E+00
Te-129m	5.96E-01	Pu-239	9.60E-05	Fe-59	1.01E-01
Te-129	3.88E-01	Pu-240	1.32E-04	Co-58	2.33E+00
Te-131m	6.32E-02	Pu-241	3.11E-02	Co-60	1.43E+00
Te-131	1.42E-02	Np-239	3.32E-02	Zn-65	7.06E-01
Te-132	2.23E+00	Y-90	1.49E-01	W-187	2.19E-02
Te-133m	2.91E-07	Y-91m	1.54E-03	H-3	3.40E+01
Te-133	4.88E-08	Y-91	5.95E-02		
Te-134	3.48E-08	Y-92	7.54E-05		

Source Volume: 34 cubic meters.

Note: Activity is based on the processing of 72 liquid waste tank volumes in four batches.

Table 12.2-27—Radioactivity Content of Liquid Waste Monitoring Tanks

Nuclide	Activity (Ci)	Nuclide	Activity (Ci)	Nuclide	Activity (Ci)
Br-83	9.61E-08	Sr-90	2.25E-10	La-140	2.95E-09
I-129	3.18E-10	Sr-91	2.42E-10	Pr-143	5.54E-10
I-130	2.00E-05	Ba-137m	7.07E-07	Pr-144	4.76E-10
I-131	3.93E-03	Ba-140	3.61E-09	Nd-147	1.94E-10
I-132	3.22E-05	Mo-99	3.52E-07	Na-24	2.12E-08
I-133	1.21E-03	Tc-99m	3.35E-07	Cr-51	1.28E-08
I-134	1.31E-09	Ru-103	5.07E-10	Mn-54	6.87E-09
I-135	7.96E-05	Ru-106	1.84E-10	Fe-55	5.25E-09
Rb-86	1.19E-08	Rh-103m	4.57E-10	Fe-59	1.25E-09
Cs-134	1.18E-06	Rh-105	1.09E-10	Co-58	1.95E-08
Cs-136	3.10E-07	Rh-106	1.84E-10	Co-60	2.35E-09
Cs-137	7.47E-07	Ce-141	5.75E-10	Zn-65	2.19E-09
Te-127m	2.98E-09	Ce-143	1.34E-10	W-187	2.13E-09
Te-127	3.34E-09	Ce-144	4.76E-10	H-3	6.92E+01
Te-129m	9.39E-09	Np-239	2.57E-09	Kr-83m	9.46E-08
Te-129	6.12E-09	Y-90	1.34E-10	Xe-131m	9.30E-07
Te-131m	5.92E-09	Y-91m	4.76E-10	Xe-133m	4.11E-06
Te-131	1.33E-09	Y-91	5.86E-10	Xe-133	6.07E-05
Te-132	1.50E-07	Zr-95	6.22E-10	Xe-135m	1.22E-05
Sr-89	4.27E-09	Nb-95	6.46E-10	Xe-135	4.37E-05

Source Volume = 70 cubic meters.

Table 12.2-28—Radioactivity Content of Purge Gas Circuit

Nuclide	Activity (Ci)
Kr-83m	1.26E+01
Kr-85m	8.15E+01
Kr-85	1.10E+03
Kr-87	2.61E+01
Kr-88	1.25E+02
Kr-89	1.28E-01
Xe-131m	2.22E+02
Xe-133m	2.69E+02
Xe-133	1.93E+04
Xe-135m	4.52E+00
Xe-135	5.77E+02
Xe-137	2.90E-01
Xe-138	3.57E+00
Rb-88	1.09E+02
Rb-89	1.14E-01
Cs-137	2.22E-06
Cs-138	2.81E+00
Sr-89	1.88E-04
Ba-137m	2.06E-06

Source Volume = 290 cubic meters.

Note: Activity is based on a surge gas flow rate to the decay beds of 0.0765 lbs/sec.

Table 12.2-29—Radioactivity Content of Charcoal Holdup Beds

Nuclide	Activity (Ci)
Kr-83m	2.12E+01
Kr-85m	1.21E+02
Kr-85	1.62E+03
Kr-87	3.96E+01
Kr-88	1.85E+02
Kr-89	2.00E-01
Kr-90	5.86E-03
Rb-88	2.02E+02
Rb-89	1.04E+00
Rb-90m	6.21E-03
Rb-90	2.94E-02
Sr-89	1.85E-01
Xe-131m	3.99E+02
Xe-133m	4.12E+02
Xe-133	3.16E+04
Xe-135m	3.88E+01
Xe-135	8.89E+02
Xe-137	4.53E-01
Xe-138	5.53E+00
Xe-139	1.05E-02
Cs-135	1.64E-05
Cs-137	2.39E-02
Cs-138	1.52E+01
Cs-139	1.50E-01
Ba-137m	2.27E-02
Ba-139	8.49E-01

Source Volume = 14.25 cubic meters.

Note: Activity is based on zero decay time after degasification flow (30 kg/sec) termination.

Table 12.2-30—Radioactivity Content of KPC Concentrate Buffer Tank

Nuclide	Activity (Ci)	Nuclide	Activity (Ci)	Nuclide	Activity (Ci)
Br-83	4.79E-01	Te-133m	2.14E-02	Y-92	6.10E-03
Br-84	5.62E-02	Te-133	5.09E-03	Y-93	4.15E-03
Br-85	6.09E-04	Te-134	2.92E-02	Y-95	3.06E-06
I-129	1.33E-02	Sr-89	4.96E+00	Zr-95	9.14E-01
I-130	3.95E+00	Sr-90	8.55E+00	Zr-97	7.20E-03
I-131	9.33E+02	Sr-91	6.14E-02	Nb-95	1.42E+00
I-132	2.60E+01	Sr-92	2.95E-03	Ag-110m	7.56E-03
I-133	1.68E+02	Ba-137m	1.38E+04	Ag-110	1.01E-04
I-134	1.36E+00	Ba-139	1.87E-01	La-140	1.26E+00
I-135	3.33E+01	Ba-140	1.22E+00	La-141	1.30E-03
Rb-86m	1.63E-08	Mo-99	4.55E+01	La-142	3.05E-04
Rb-86	2.89E+00	Tc-99m	4.17E+01	Pr-143	2.00E-01
Rb-88	9.70E-01	Ru-103	4.68E-01	Pr-144	3.01E+00
Rb-89	3.83E-02	Ru-105	2.65E-03	Nd-147	5.84E-02
Cs-134	9.24E+03	Ru-106	1.50E+00	Am-241	1.28E-02
Cs-136	5.58E+01	Rh-103m	4.22E-01	Cm-242	4.68E-02
Cs-137	1.46E+04	Rh-105	1.27E-02	Cm-244	2.55E-02
Cs-138	3.78E-01	Rh-106	1.50E+00	Na-24	3.54E+00
Sb-125	1.03E-01	Ce-141	4.45E-01	Cr-51	8.52E+00
Sb-127	2.99E-03	Ce-143	1.61E-02	Mn-54	4.76E+01
Sb-129	1.86E-04	Ce-144	3.01E+00	Fe-55	9.46E+01
Sb-131	6.24E-06	Pu-238	5.79E-02	Fe-59	1.31E+00
Te-127m	7.36E+00	Pu-239	5.87E-03	Co-58	3.15E+01
Te-127	7.31E+00	Pu-240	8.05E-03	Co-60	6.21E+01
Te-129m	7.49E+00	Pu-241	1.66E+00	Zn-65	1.19E+01
Te-129	4.88E+00	Np-239	3.18E-01	W-187	2.75E-01
Te-131m	7.20E-01	Y-90	8.54E+00	H-3	9.88E+00
Te-131	1.67E-01	Y-91m	3.84E-02		
Te-132	2.06E+01	Y-91	7.92E-01		

Source Volume = 10 cubic meters.

Note: Activity is based on a mix of concentrates and resins.

Table 12.2-31—Radioactivity Content of Waste Resin Tank

Nuclide	Activity (Ci)	Nuclide	Activity (Ci)	Nuclide	Activity (Ci)
Br-83	3.88E+00	Te-133m	1.73E-01	Y-92	4.92E-02
Br-84	4.55E-01	Te-133	4.12E-02	Y-93	3.33E-02
Br-85	4.94E-03	Te-134	2.36E-01	Y-95	2.48E-05
I-129	1.07E-01	Sr-89	3.95E+01	Zr-95	7.27E+00
I-130	3.16E+01	Sr-90	6.89E+01	Zr-97	5.74E-02
I-131	7.37E+03	Sr-91	4.93E-01	Nb-95	1.13E+01
I-132	2.06E+02	Sr-92	2.39E-02	Ag-110m	6.04E-02
I-133	1.34E+03	Ba-137m	1.11E+05	Ag-110	8.03E-04
I-134	1.10E+01	Ba-139	1.51E+00	La-140	9.99E+00
I-135	2.68E+02	Ba-140	9.67E+00	La-141	1.05E-02
Rb-86m	1.32E-07	Mo-99	3.59E+02	La-142	2.47E-03
Rb-86	2.24E+01	Tc-99m	3.29E+02	Pr-143	1.58E+00
Rb-88	7.85E+00	Ru-103	3.72E+00	Pr-144	2.40E+01
Rb-89	3.10E-01	Ru-105	2.14E-02	Nd-147	4.62E-01
Cs-134	7.37E+04	Ru-106	1.20E+01	Am-241	1.03E-01
Cs-136	4.33E+02	Rh-103m	3.35E+00	Cm-242	3.73E-01
Cs-137	1.17E+05	Rh-105	1.00E-01	Cm-244	2.05E-01
Cs-138	3.06E+00	Rh-106	1.20E+01	Na-24	2.82E+01
Sb-125	8.31E-01	Ce-141	3.53E+00	Cr-51	6.77E+01
Sb-127	2.36E-02	Ce-143	1.27E-01	Mn-54	3.81E+02
Sb-129	1.50E-03	Ce-144	2.40E+01	Fe-55	7.61E+02
Sb-131	5.05E-05	Pu-238	4.67E-01	Fe-59	1.04E+01
Te-127m	5.86E+01	Pu-239	4.73E-02	Co-58	2.51E+02
Te-127	5.82E+01	Pu-240	6.49E-02	Co-60	5.00E+02
Te-129m	5.95E+01	Pu-241	1.34E+01	Zn-65	9.52E+01
Te-129	3.88E+01	Np-239	2.51E+00	W-187	2.19E+00
Te-131m	5.71E+00	Y-90	6.89E+01	H-3	1.50E+01
Te-131	1.32E+00	Y-91m	3.08E-01		
Te-132	1.62E+02	Y-91	6.30E+00		

Source Volume = 15 cubic meters.

Note: Activity is based on zero decay time following 7.5 annual sluicing transfers.

Table 12.2-32—Radioactivity Content of Steam Generator Blowdown Demineralizer

Nuclide	Activity (Ci)	Nuclide	Activity (Ci)	Nuclide	Activity (Ci)
Br-83	5.27E-03	Y-90	2.64E-02	Te-134	1.48E-04
Br-84	2.28E-04	Y-91m	6.76E-04	Ba-137m	8.37E+01
Br-85	2.69E-07	Y-91	1.67E-02	Ba-140	2.58E-02
I-129	3.80E-05	Y-92	9.39E-05	La-140	2.68E-02
I-130	7.08E-02	Y-93	7.30E-05	Ce-141	9.44E-03
I-131	1.94E+01	Zr-95	1.91E-02	Ce-143	3.19E-04
I-132	4.88E-01	Nb-95	2.94E-02	Ce-144	3.80E-02
I-133	3.20E+00	Mo-99	9.32E-01	Pr-143	4.22E-03
I-134	8.25E-03	Tc-99m	8.64E-01	Pr-144	3.80E-02
I-135	5.30E-01	Ru-103	9.93E-03	Np-239	6.48E-03
Rb-88	4.36E-03	Ru-106	1.61E-02	Na-24	6.57E-02
Rb-89	1.49E-04	Rh-103m	8.96E-03	Cr-51	1.81E-01
Cs-134	1.20E+02	Rh-106	1.61E-02	Mn-54	5.68E-01
Cs-136	2.26E+00	Ag-110m	1.03E-04	Fe-55	5.53E-01
Cs-137	8.84E+01	Te-127m	1.42E-01	Fe-59	2.79E-02
Cs-138	2.84E-03	Te-129m	1.59E-01	Co-58	6.53E-01
Sr-89	1.06E-01	Te-129	1.04E-01	Co-60	2.64E-01
Sr-90	2.66E-02	Te-131m	1.42E-02	Zn-65	1.65E-01
Sr-91	1.07E-03	Te-131	3.22E-03	W-187	5.36E-03
Sr-92	3.47E-05	Te-132	4.23E-01	H-3	negligible

Resin Volume: 3.06 cubic meters.

Note: Activity is based on one year of operation.