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Docket No.: STN-52-003

September 30, 1994

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: R. W. BORCHARDT

SUBJECT: WESTINGHOUSE RESPONSES TO NRC REQUESTS FOR ADDITIONAL INFORMATION ON THE AP600

Dear Mr. Borchardt:

Enclosed are three copies of the Westinghouse responses to NRC requests for additional information and open items on the AP600 from your letters of May 16, 1994, August 15, 1994, August 18, 1994, August 29, 1994 and August 30, 1994. This completes the responses associated with the May 16, letter. In addition, revisions of responses previously submitted are provided. A listing of the NRC requests for additional information and open items responded to in this letter is contained in Attachment A. Attachment B is a listing of the questions associated with your letter of May 16, 1994 and the date of the Westinghouse letters that transmitted the responses.

These responses are also provided as electronic files in WordPerfect 5.1 format with Mr. Kenyon's copy.

If you have any questions on this material, please contact Mr. Brian A. McIntyre at 412-374-4334.

[signature] for

Nicholas J. Liparulo, Manager
Nuclear Safety Regulatory And Licensing Activities

/nja

Enclosure

cc: B. A. McIntyre - Westinghouse
T. Kenyon - NRR

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NTD-NRC-94-4311
ATTACHMENT A
AP600 RAI RESPONSES
SUBMITTED SEPTEMBER 30, 1994

RAI No.	Issue
260.033	Submittal of WCAP-12600
410.264	Drawing of turbine bypass system
440.256	Temperature distribution in relector
440.257	Main steam/feedwater flow mismatch trip setpoints
460.003R01	Liquid radwaste systems
460.008R01	Radwaste management system source terms
460.009R01	Liquid radwaste
460.010R01	Gaseous radwaste
470.016	Control room operator doses
952.095	4th stage ADS valve sensitivity study

Printed: 09/30/94

ATTACHMENT B

CROSS REFERENCE OF WESTINGHOUSE RAI RESPONSE TRANSMITTALS TO NRC LETTERS OF MAY 16, 1994,

Question No.	Issue	NRC Letter	Westinghouse Transmittal Date
440.122	DWS makeup isolation actuation logic	05/16/94	07/29/94
440.157	Controls on isolation of unborated water sources	05/16/94	06/27/94
440.158	CVCS design pressures	05/16/94	07/22/94
440.159	Design of pressurizer safety valves	05/16/94	06/27/94
440.160	Relief & safety valve power sources & QA	05/16/94	07/22/94
440.161	Remote venting of PRHR heat exchangers	05/16/94	06/27/94
440.162	RVLIS	05/16/94	08/12/94
440.163	Conformance to TMI action items	05/16/94	07/22/94
440.164	Loose parts monitoring system	05/16/94	06/16/94
440.165	Startup feedwater isolation valves	05/16/94	07/27/94
440.166	GSI-129 & GSI-137	05/16/94	07/22/94
470.016	Control room operator doses	05/16/94	09/30/94

Records printed: 12

Question 260.33

The staff understands that WCAP-12600, "Quality Assurance Plan," is an addendum to Westinghouse's generic quality assurance (QA) program that is applied specifically during the development of the AP600 design, and therefore, is an integral part of the AP600 QA program. The staff concludes that this document should be submitted to support the design certification review. Therefore, submit WCAP-12600, "AP600 Quality Assurance Plan."

Response:

Revision 2 of WCAP-12600 was submitted to the NRC via Westinghouse letter NTD-NRC-94-4293, dated September 9, 1994.

SSAR Revision: NONE
PRA Revision: NONE

Question 410.264

Section 10.4.4.2.1 of the SSAR states that the turbine bypass system is shown in Figure 10.3.2-2. The referenced figure is entitled, "Main Steam System Piping and Instrumentation Diagram," where the turbine bypass system is not clearly identified. Identify the system in the referenced figure or provide a separate drawing for the system.

Response:

The turbine bypass system is an integral portion of the main steam system and is shown on SSAR Figure 10.3.2-2. This figure will be revised to include the label "Turbine Bypass Banks A and B" in the applicable locations.

SSAR Revision:

Figure 10.3.2-2 will be revised to incorporate labels for the turbine bypass system. New figure will be included in Revision 2 of the SSAR.

Question 440.256

Provide a color version of the figure on page A-11 of Attachment A to the letter from N. J. Liparulo to T. Murley, NRC Request for Additional AP600 Information Pertaining to INEL Use of the RELAP5 Computer Code, ET-NRC-92-3763, dated October 30, 1992, which shows the temperature distribution in the reflector. The date on the figure is March 8, 1991.

Response:

A color copy of the requested figure was provided via Westinghouse letter NTD-NRC-94-4309, dated September 29, 1994.

SSAR Revision: NONE
PRA Revision: NONE

Question 440.257

Provide information on the main steam/feedwater flow mismatch trip (trip setpoints, logic, gains, lead, lag, etc.), which is part of the Diverse Actuation System, and is not shown on Sheet 29 of Figure 7.2-1 of the SSAR.

Response:

The AP600 Diverse Actuation System (DAS) is discussed in Subsection 7.7.1.11 of the AP600 SSAR and includes a discussion of the actuation functions. A main steam/feedwater flow mismatch trip is not one of the DAS actuation functions.

SSAR Revision: NONE
PRA Revision NONE

Question 460.3

Provide schematics for the processing of the various liquid radwaste streams and explain how you have arrived at the decontamination factors (DFs) given in Table 11.2-6 of the SSAR for the different radionuclide categories in the various streams (Section 11.2).

NRC Comment (from letter of May 12, 1994) on the original response

NUREG-0017, Rev. 1, Figure 2-1 shows the purification demineralizers upstream of the shim bleed while Figure 11.2-3 of the SSAR shows the bleed downstream of the subject demineralizers. For the AP600, the starting point for radwaste processing for shim bleed, equipment drains and clean waste is the effluent holdup tank (see comment on Q460.9). Revise the schematic.

Response:

The attached figure contains a schematic showing the processing of the various liquid radwaste streams modeled in the analysis of anticipated releases to the environment. The decontamination factors for each of the radionuclide categories are from Subsection 2.2.18 of NUREG-0017, Revision 1. These decontamination factors are included on the schematic.

There is no discrepancy between the schematic showing the shim bleed passing through a chemical and volume control system mixed bed demineralizer and Figure 2-1 of NUREG-0017, Revision 1. The flow in question is the letdown flow but when the flow is diverted to the effluent holdup tank it can be called "shim bleed." In both the attached schematic and in the figure from NUREG-0017 the shim bleed flow passes through the chemical and volume control system mixed bed demineralizer before being diverted to the liquid radwaste system (or, in the case of NUREG-0017, to the boron recovery system). Although the starting point for cleanup of the shim bleed flow is actually the mixed bed demineralizer in the chemical and volume control system (and credit for this demineralizer was assumed in the original GALE code analysis), credit for this demineralizer is being deleted and a new GALE code analysis is being performed with the results to be included in Revision 2 of the SSAR. Also, as discussed in Revision 1 of the response to RAI 460.9, credit for demineralizer cleanup of the various waste streams will be limited to no more than a DF of 1000. For each of the waste streams shown on the schematic, the assumed cleanup will be:

Nuclides	System DF
Iodine	1000
Cs & Rb	200
Others	1000

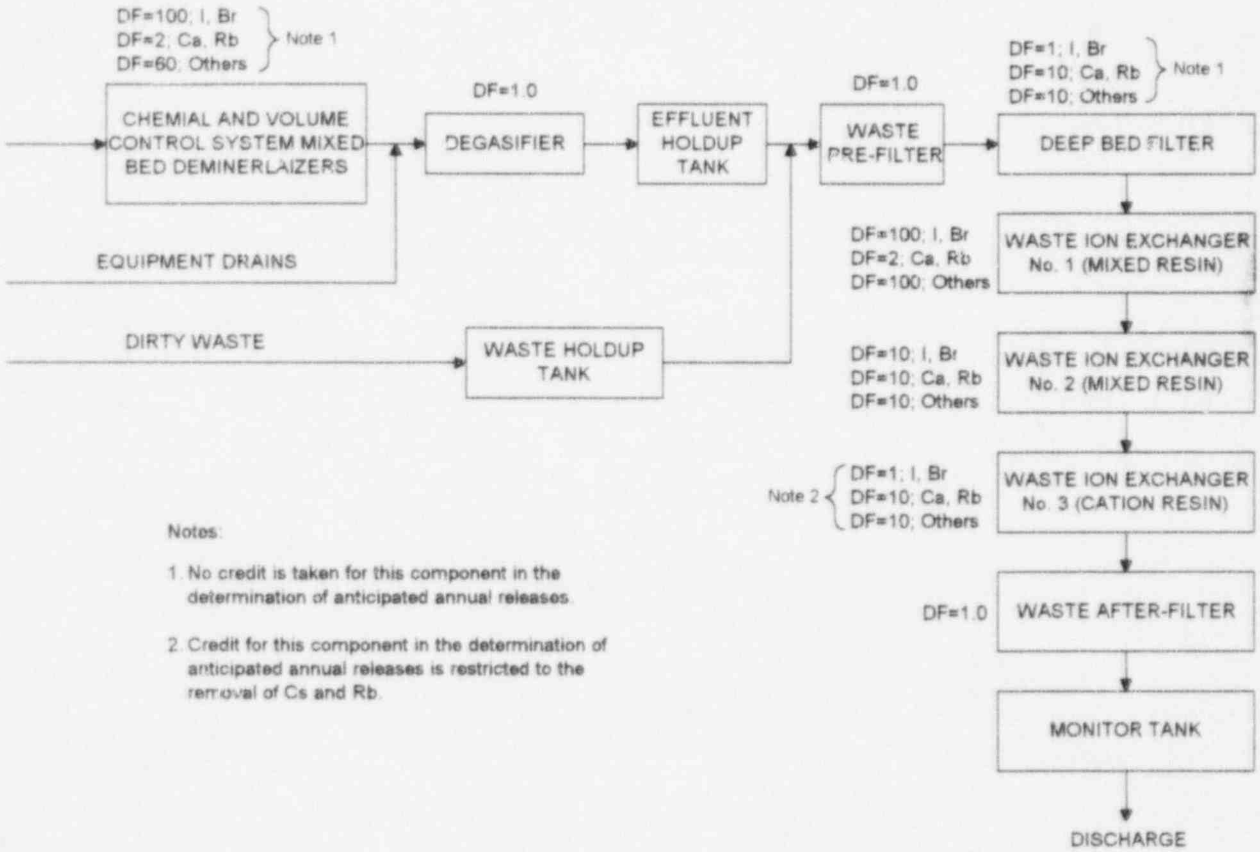
SSAR Revision:

The SSAR will be revised to include the schematic, which will be designated as Figure 11.2-3. The schematic has been revised since Revision 0 of this RAI response, to indicate that credit for the demineralizers will be limited as

discussed in Revision 1 to the response to RAI 460.9 and to reflect the elimination of onsite laundry. The first paragraph of Subsection 11.2.3.2 ~~will be~~ was revised in Revision 1 of the SSAR as follows:

~~SSAR Revision:~~

The annual average release of radionuclides from the plant is determined using the PWR-GALE code (Reference 3). The PWR-GALE code models releases utilizing realistic source terms derived from data obtained from the accumulated experience of operating PWRs. The code input parameters used in the analysis to model the AP600 plant are listed in Table 11.2-6. A schematic of the liquid waste process paths modeled by the PWR-GALE code is provided in Figure 11.2-3. The annual releases for a single-unit site are presented in Table 11.2-7.



Notes:

1. No credit is taken for this component in the determination of anticipated annual releases.

2. Credit for this component in the determination of anticipated annual releases is restricted to the removal of Cs and Rb.

Figure 11.2-3 Schematic Showing Basis for PWR-GALE Code Modeling of Liquid Radwaste Flow Paths

Question 460.8

Provide the following information regarding the source terms for evaluating the expected performance of radwaste management systems (Sections 11.1 and 11.2):

a. Table 11.2-6 states that the shim bleed rate is 737 gallons per day (gpd). The staff has determined that this rate is 288 gpd using the value of the reactor coolant letdown flow given in Table 11.1-7 of the SSAR and 657.5 gpd calculated from the yearly average of the CVCS letdown given in Table 11.2-1 of the SSAR. The staff has verified that a shim bleed rate of 288 gpd gives the same reactor coolant activity (RCA) values for noble gas radionuclides given in Table 11.1-8 of the SSAR. Resolve the inconsistencies among the tables.

b. The staff has determined that a primary-to-secondary leak rate of 75 lb/day (NUREG-0017, Rev. 1 value) rather than the 100 lb/day given in Table 11.1-7 of the SSAR results in the steam generator steam activity values given in Table 11.1-8 of the SSAR for noble gases. Correct the inconsistency.

c. Tables 11.1-7 and 11.2-6 of the SSAR give the total steam flow rate as 8.4×10^6 lb/hr and 8.4×10^5 lb/hr, respectively. The staff believes that the first value is correct. Correct the inconsistency.

d. The staff concludes that the steam generator liquid activities and, consequently, the steam generator steam activities of halogens, Cesium (Cs), Rubidium (Rb), and other nuclides listed in Table 11.1-8 of the SSAR are not consistent with those that would be calculated using the method given in Revision 1 of NUREG-0017. Describe how the activities were calculated, and correct them, if appropriate.

<u>NRC comment (from letter of May 12, 1994) on the original respone</u>:

The response needs further discussion. The staff's calculations show that I-131 secondary concentration (SC) will be 6.7×10^{-7} μCi/gm or 1.14×10^{-6} μCi/gm accordingly as SG blowdown is 8.4×10^4 lb/hr or 4.2×10^4 lb/hr. SG blowdown is processed by the blowdown demineralizer as per Section 10.4.8.2.2 of the SSAR. Tables 11.1-7 and 11.2-6 of the SSAR contradict this. Remove discrepancies regarding the SG blowdown, and correct the secondary concentrations all radionuclides.

Response:

a. The calculation of the coolant source terms in Table 11.1-8 used a shim bleed of 288 gallons per day based on the assumption of continued operation with no forced cold shutdowns. The Table 11.2-1 shim bleed value of 240,000 gallons per year (658 gallons per day) is based on one forced shutdown per year. The use of the 288 gallon per day value tends to maximize the source terms but the assumption also reduces the annual release of activity from this pathway. Tables 11.1-7 and 11.1-8 have been corrected to utilize a shim bleed flow of 658 gallons per day (230 lb/hr) so that the defined source term is consistent with the determination of annual releases.

The use of 737 gallons per day in Table 11.2-6 for the shim bleed rate has been revised to 658 gallons per day and the calculated releases in Table 11.2-7 have been revised to reflect this change. There is no significant impact on the total calculated releases.

b. Table 11.1-7 has been corrected to list the primary-to-secondary leak rate as 75 lb/day instead of the 100 lb/day previously listed. The determination of source terms correctly used the 75 lb/day value.

c. Table 11.2-6 has been corrected to list the total steam flow rate as $8.4x10^6$ lb/hr (instead of the previously listed value of $8.4x10^5$ lb/hr). The determination of anticipated releases of activity to the environment correctly used the $8.4x10^6$ lb/hr value.

d. The activities in the steam generator liquid and steam that were presented in Table 11.1-8 were based on the equations provided in ANSI/ANS 18.1-1984. These equations are the same as those used in NUREG-0017, Revision 1. To assure that there is no discrepancy with NUREG-0017, The values for primary and secondary coolant activities in Table 11.1-8 **in Revision 1 of the SSAR were** have been replaced by the values calculated using the GALE code. The steam generator steam activities are not provided in the GALE code output so these have been calculated using the equations from NUREG-0017, Revision 1. **The current GALE code analysis does not include consideration of the steam generator blowdown demineralizer; the GALE code analysis will be rerun including the effects of steam generator blowdown cleanup. The results of this reanalysis will be provided in Revision 2 of the SSAR with a revised Table 11.1-8.**

SSAR Tables 11.1-7 and 11.2-6, Sheet 1, will be revised to reflect the changes made in the analytical assumptions. Tables 11.1-8, 11.2-7, and 11.2-8 will be revised to reflect the results of the analyses performed. Sections 11.1 and 11.1.3 will be revised to reflect the fact that the realistic primary and secondary source terms are calculated using the PWR-GALE code. Subsection 11.1.6 will be revised to include a reference for the PWR-GALE code and to respecify the reference to ANSI-18.1 as Reference 3. Subsections 11.2.3.3 and 11.2.3.4 will be revised to reflect the impact of the larger total waste flow (increase from 1742 gpd to 2150 gpd).

SSAR Revision:

In Revision 2 of the SSAR, sheets 1, 2 and 3 of Table 11.2-6 will be revised to reflect the modeling of the steam generator blowdown demineralizer and Tables 11.1-8, 11.2-7, and 11.2-8 will be revised to reflect the results of the revised GALE code analysis. The revisions to Table 11.2-6 are attached. The changes to Tables 11.1-8, 11.2-7 and 11.2-8 will be provided with Revision 2 of the SSAR.

Table 11.2-6 (Sheet 1 of 4)

Input Parameters for the GALE Computer Code

Thermal power level (MWt)	1933
Mass of primary coolant (lb)	3.46×10^5
Primary system letdown rate (gpm)	100
Letdown cation demineralizer flow rate, annual average (gpm)	10
Number of steam generators	2
Total steam flow (lb/hr)	8.4×10^6
Mass of liquid in each steam generator (lb)	1.075×10^5
Total mass of secondary coolant (lb)	2.15×10^5
Total blowdown rate (lb/hr)	8.4×10^4
Blowdown treatment method	*
Condensate demineralizer regeneration time	N/A
Condensate demineralizer flow fraction	0.33
Primary coolant bleed for boron control	
Bleed flow rate (gpd)	658
Decontamination factor for I	10^5
Decontamination factor for Cs and Rb	4×10^3
Decontamination factor for others	5×10^6
Collection time (day)	21
Process and discharge time (day)	0
Fraction discharged	1.0

* A ~~"1"~~ "0" is input to indicate that the blowdown is recycled ~~directly~~ to the condensate system demineralizers ~~without prior~~ after treatment in the blowdown system.

Table 11.2-6 (Sheet 2 of 4)

Input Parameters for the GALE Computer Code

Equipment Drains and Clean Waste	
Equipment drains flow rate (gpd)	90
Fraction of reactor coolant activity	1.07
Decontamination factor for I	10^3
Decontamination factor for Cs and Rb	2×10^3
Decontamination factor for others	10^5
Collection time (day)	21
Process and discharge time (day)	0
Fraction discharged	1.0
Dirty Waste	
Dirty waste input flow rate (gpd)	1400
Fraction of reactor coolant activity	0.012
Decontamination factor for I	10^3
Decontamination factor for Cs and Rb	2×10^3
Decontamination factor for others	10^5
Collection time (day)	8
Process and discharge time (day)	0
Fraction discharged	1.0
Blowdown Waste	
Blowdown fraction processed	~~0~~ 1
Decontamination factor for I	~~N/A~~ 100
Decontamination factor for Cs and Rb	~~N/A~~ 10

Table 11.2-6 (Sheet 3 of 4)

Input Parameters for the GALE Computer Code

Decontamination factor for others	~~N/A~~ 100
Collection time	N/A
Process and discharge time	N/A
Fraction discharged	0
Regenerant waste	N/A
Gaseous Waste System	
Continuous gas stripping of full letdown purification flow	None
Holdup time for xenon, normal operation (days)	435
RCS degassing (days)	8.7
Holdup time for krypton, normal operation (days)	24
RCS degassing (days)	0.5
Fill time of decay tanks for gas stripper	N/A
Gas waste system: HEPA filter	None
Auxiliary building: Charcoal filter	None
Auxiliary building: HEPA filter	None
Containment volume (ft^3)	1.73×10^6
Containment atmosphere internal cleanup rate (ft^3/min)	N/A
Containment high volume purge:	
Number of purges per year (in addition to two shutdown purges)	0
Charcoal filter efficiency (%)	90
HEPA filter efficiency (%)	99

Question 460.9

Provide the following information regarding the liquid radwaste management system (Section 11.2):

a. Section 11.2.2.1.1 of the SSAR states that any of the four ion exchangers provided in series for processing all liquid radwaste streams can be manually bypassed. In addition, the SSAR does not provide sufficient test data that supports additional radioactivity removal from waste streams by a third and a fourth ion exchanger in series with the first two ion exchangers. Further, the staff notes that the additional credit due to the ion exchangers of the chemical volume control system for the shim bleed stream is already built into the code since such credit is used for calculating the primary coolant concentrations of radionuclides. For the above reasons, the staff estimates that the following DFs appear more appropriate than the ones used in Table 11.2-6 of the SSAR:

Halogens	10^3
Cs, Rb	20
Others	10

These values a

In light of the ... rect the values, as a ... two of these four be ... ium removal capabil

NRC comment

DFs - Using ... o the staff. For this, the ... ed (10 for Cs and Rb) and ... for any isotope will be more ... For special ion removal also,

Don -
RAIs 460.9(r1)
460.10(r1)
470.16
are ready for transmittal +
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b. Section 11.2.3 of ... states that, except for the steam generator blowdown wastes, all other processed liquid radwastes will be discharged to the environment rather than recycled within the plant. However, Table 11.1-8 of the SSAR shows a tritium RCA of $1\mu Ci/gm$, which indicates that a moderate amount of tritium will be recycled (see Table 2-6 of Revision 1 to NUREG-0017). Further, the staff is concerned that, with minimum processing of Cs and Rb nuclides in the waste streams (DF of 20) and maximum discharge of the processed liquid radwastes, Cs and Rb radionuclide releases via liquid effluents can pose a problem in terms of compliance with the concentration limits of 10 CFR Part 20 and the offsite dose limits of Appendix I of 10 CFR Part 50, unless there is substantial dilution of the waste streams prior to their discharge. In light of the above discussion, describe why the AP600 is designed for minimum recycling, which is at variance with industry practice and standards (see Subsection 4.1.5 of ANSI/ANS 55.6)

c. Collection times for various wastes given in Table 11.2-6 of the SSAR appear to be inconsistent with the values that will result from using the methodology of Revision 1 to NUREG-0017. The NUREG recommends using only 80 percent of one collector tank's full capacity as the fill volume provided there are two tanks of equal capacity. It is not clear whether the volumes of all tanks given in Table 11.2-2 of the SSAR represent 80 percent of their full capacity. Justify or resolve the inconsistency.

<u>NRC comment (from letter of May 12, 1994) on the original response</u>:

The collection times should not be undervalued; this is non conservative. Shim bleed, equipment drains, and clean wastes collection time should be 21.4 days. Dirty wastes collection time should be 8.6 days.

d. The process and discharge times for the various liquid waste streams given in Table 11.2-6 of the SSAR (1 day for all of them) appear to be inconsistent with the methodology of Revision 1 to NUREG-0017. The calculated process time cannot be further increased by half of the calculated discharge time when the monitor tanks have smaller volumes than their corresponding holdup or collection tanks. Further, the methodology recommends using only 80 percent of the full capacity of one monitor tank, provided that there are two monitor tanks of equal capacity. Justify or resolve the inconsistency.

<u>NRC comment (from letter of May 12, 1994) on the original response</u>:

Shim bleed, equipment drains, and clean wastes process time should be 0.148 days. Dirty wastes process time should be 0.111 days.

e. The input from leakage of the spent fuel pit liner, the reactor containment cooling system, and the reactor coolant pump seal, and the sampling drains of the secondary coolant system are either not included in Table 11.2-1 of the SSAR or are much lower in the subject table than the inputs from these sources given in Section 3.2.1 of Revision 1 to NUREG-0017 and ANSI/ANS-55.6. The staff recognizes that the product of the expected activity level and the daily input given in the subject table for the applicable sources discussed above is greater than the corresponding NUREG products. However, the inputs have a bearing on the sizing of the liquid radwaste system equipment and collection and processing times. Additionally, the equipment drain tank may also be a source (NUREG-0017 gives a much higher combined total waste generation rate for equipment drains and clean wastes than the AP600 design). Provide the missing information. Provide the reasons for the inconsistencies or correct the values.

f. Appendix 1A of the SSAR demonstrates that the liquid radwaste management system for the AP600 design meets Position C.1.2 of RG 1.143 with respect to the design features for applicable tanks (i.e., tanks located outside the containment and carrying radioactive materials). However, Table 11.2-3 of the SSAR, which lists the applicable tanks with level and alarm features, does not include the condensate storage tank (CST). Clarify whether the CST has level indication and alarm features in accordance with Position C.1.2.1 of RG 1.143. Also, clarify whether the AP600 design includes the specific design features discussed in Positions C.1.2.2 through C.1.2.5 of RG 1.143 for all the applicable tanks.

g. Clarify whether the AP600 design has a single liquid waste discharge path as shown in Figure 11.2-1 of the SSAR. Also, clarify whether the AP600 design permits different categories of wastes to be discharge simultaneously at any time, provided such cumulative discharge is within the applicable regulatory limits. If not, identify the design features that preclude such a simultaneous discharge.

Response:

a. The GALE code analysis will be rerun using revised decontamination factors. The results of this reanalysis of anticipated operating releases will be provided in Revision 2 of the SSAR. The system decontamination factors (DFs) specified in Table 11.2-6 ~~are appropriate for use in determining anticipated annual releases of activity for the liquid pathway~~ will be revised at that time to be 1000 for iodine, 200 for Cs & Rb, and 1000 for others; these values will apply to the primary coolant bleed for boron control, to the equipment drains and clean waste, and to the dirty waste flow paths. These values reflect credit for two mixed bed demineralizers in series plus a single cation bed demineralizer (system DF values being the product of the component DF values, with an assumed upper limit of 1000 assumed for the system DF).

The processing of liquid wastes is schematically shown in Figure 11.2-3 (provided as part of the response to QRAI 460.3). This figure identifies the DF values assumed for each component in the process path. The system decontamination factors ~~suggested in the question do not properly reflect the design of~~ to be used in the reanalysis of the anticipated releases do not take credit for all of the equipment provided in the liquid radwaste system which contains a series of two mixed resin ion exchangers and two cation bed ion exchangers (one specified as the deep bed filter). Nor do they reflect the fact that the shim bleed flow will be processed by the mixed bed ion exchanger in the chemical and volume control system.

The "special demineralizer" referred to in the staff's comment as having a component DF of 100 for Cs & Rb is assumed to refer to the deep bed filter in the liquid radwaste system which contains both charcoal and resin layered in the vessel. As indicated on sheet 5 of Table 11.2-2, the resin is a zeolyte resin, although the actual resin used is a function of plant operation, not of system design. Credit for this component was originally taken as a DF of 10 for Cs & Rb but for the reanalysis no credit for this component will be assumed.

The reduction in DF values follows the staff suggestion that the credit for demineralizer cleanup be limited to no more than a DF of 1000. The DF of 200 for Cs & Rb is based on taking credit for three demineralizers in series. The performance of the third demineralizer is not dependent on what equipment is located upstream but on what ion concentrations are present in the water and, since ion removal does not exceed a DF of 1000, crediting the third demineralizer is appropriate.

The specific issues raised in the question are addressed below:

<u>Bypassing of ion exchangers</u>: While ~~it is true that~~ any of the four ion exchangers in the liquid radwaste system can be bypassed, the bypassing of any ion exchanger(s) would be an operating plant decision based on the activity levels in the water being processed for discharge. It is possible that, if activity levels are low enough, there would be no need for processing and the water could be discharged directly to environment. ~~In modeling~~

~~the anticipated annual releases to the environment it is assumed that all equipment is in operation.~~ It is noted that the analysis to determine normal annual releases does not model what would happen in every expected circumstance. If the activity levels are low, the amount of processing can be reduced. If the activity levels are exceptionally high, it may be necessary to perform additional processing by recirculating the monitor tank contents through the series of ion exchangers. The calculation of normal releases to the environment is ~~representative~~ **for illustrative purposes** only. **The reduction of demineralization credit for the GALE code analysis to a system DF of 1000 for iodines, 200 for Cs & Rb, and 1000 for other ions adds operational margin so that the analysis is not dependent on all components being in use.**

Credit for mixed bed ion exchangers in the chemical and volume control system: As stated in the question, credit for the ion exchangers in the chemical and volume control system are built into the PWR-GALE code as part of the calculation of primary coolant activity levels. However, the mixed bed ion exchanger **in the chemical and volume control system** is also part of the shim bleed flow path and ~~should be included as~~ **thus is** part of the **waste** processing train. **In the reanalysis of anticipated annual releases no credit will be taken for this ion exchanger. Demineralization credit will be limited to that provided by two mixed bed ion exchangers and one cation bed ion exchanger, all in the liquid radwaste system.**

Credit for more than two ion exchangers in series: NUREG-0017 does not disallow credit for more than two ion exchangers in series but it also does not address DFs that would exist if there were more than two of one type in series; thus the use of two mixed bed ion exchangers plus two cation bed ion exchangers is consistent with the modeling described in NUREG-0017. Credit for a third ion exchanger of one type in series is not recognized by NUREG-0017; however, the situation that exists on the AP600 relative to the inclusion of the chemical and volume control system ion exchanger is not that of three ion exchangers operating in series. The shim bleed flow passes through the mixed bed ion exchanger in the chemical and volume control system and then is collected in the effluent drain tank. Also collected in this tank are the flows from equipment drains (90 gpd at 1.07 times primary coolant activity). After this combined solution accumulates to a volume justifying processing for discharge, it is assumed to be directed through the series of four ion exchangers; two of which are mixed bed and two of which are cation bed. The first of the mixed bed ion exchangers in the liquid waste processing train does not function as a "second ion exchanger in series." First of all, it is separated from the chemical and volume control system ion exchanger by both time and by the collection tank. Secondly, it is processing not only shim bleed but equipment drain water as well. The situation of a third ion exchanger of the same type operating in series does not exist.

Despite the above, credit will be limited to that provided by two mixed bed demineralizers and one cation bed demineralizer. While this does take credit for three demineralizers in series for the removal of Cs & Rb, the DF credit claimed is not in excess of the limit of 1000 suggested by the NRC.

b. No recycling of the liquid wastes is assumed. The value of 1.0 microcurie per gram for the tritium concentration in the primary coolant comes from the NUREG-0017 model which does not actually calculate a tritium concentration. The specified tritium concentration is used without modification by the GALE code. ~~Even with no recycling of wastes there will be a buildup of tritium in the reactor coolant.~~ The use of 1.0 microcurie per gram has been evaluated with respect to annual tritium production and average shim bleed flow and is found to be appropriate for the AP600.

Relative to the stated staff concerns regarding the low level of processing of Cs and Rb, see the above discussion in response to part a. As indicated in Figure 11.2-3, the available system DF for Cs and Rb when taking credit for all components is not the suggested value of 20 but is 4000 for the shim bleed and 2000 for the remaining processed wastes. The GALE code analysis is being rerun using a system DF of 200 for both of these process paths. The results of the reanalysis will be provided in Revision 2 of the SSAR.

Current industry practice with regard to recycle of reactor coolant system effluents is to discharge a sufficient amount of coolant to prevent tritium levels in the coolant from building to a level which would cause maintenance problems. The practice of many plant operators is to discharge between three and five system volumes of effluent per year for this purpose. The AP600 is designed to operate without recycle of effluents from the reactor coolant system, but also to minimize the amount of effluent generated. The 240,000 gallons per year of effluent generated and discharged corresponds to approximately four system volumes per year, which is comparable to current industry practice for tritium control.

c. The collection times have been recalculated to be consistent with the methodology of Revision 1 to NUREG-0017. Using the equations from Revision 1 to NUREG-0017, the collection times are:

Combined shim bleed, equipment drains, and clean waste	21 days
Dirty waste	8 days

Table 11.2-6, Sheets 1 & 2, ~~will be~~ were revised in Revision 1 to the SSAR to reflect these collection times. ~~The annual releases have been reanalyzed and Tables 11.2-7 & 11.2-8 will be revised per the new analysis. The reanalysis shows no significant impact on the total calculated releases.~~

The above collection times are values that were rounded down from the calculated values of 21.4 days and 8.6 days. The use of rounded down values for collection times results in a conservative determination of releases (this has been confirmed by running the GALE code).

d. Based on the equations listed in Revision 1 to NUREG-0017, the processing and discharge time would be ~~0.1~~ 0.148 days for the shim bleed and equipment drains and 0.111 days for the dirty wastes. The annual releases have been reanalyzed assuming that there is no delay associated with processing and discharge. Neglecting the processing time yields a conservative determination of releases.

Table 11.2-6 has been revised in Revision 1 to the SSAR to reflect this change in the processing and discharge times. ~~The annual releases have been reanalyzed and Tables 11.2-7 & 11.2-8 will be revised per the new analysis. The reanalysis shows no significant impact on the total calculated releases.~~

e. The format of the information originally provided in Table 11.2-1 of the SSAR followed the November 1990 draft update of ANSI/ANS-55.6. The last approved version of this standard is ANSI/ANS-55.6-1979, and Table 11.2-1 has been revised in Revision 1 to the SSAR to reflect this version; in particular, the value for spent fuel pit liner leakage has been changed from 25 gpd to 700 gpd, and the floor drains value of 675 gpd has been eliminated since the floor drains entry pertains to the November 1990 draft update of ANSI/ANS-55.6 and is not included in ANSI/ANS-55.6-1979. Note that there is no net change in waste volume.

Also, some of the previous interpretations of ANSI/ANS-55.6 used for the AP600 have been revised as follows:

- Reactor containment cooling, changed from 15 gpd to 500 gpd
- Hot shower, changed from 800 gpy to 10 gpd.
- Hand wash, changed from 30,000 gpy to 240 gpd.
- Equipment and area decontamination, changed from 60,000 gpy to 130 gpd.
- ~~Laundry, changed from 300 gpd to 350 gpd.~~

For each of these, the original value used reflects an off-normal event that was translated to annual average release rates. The replacement values reflect the expected annual waste generation.

A specific exception was taken to the values in ANSI/ANS-55.6 for reactor coolant pump seal leakage. Since the AP600 incorporates canned motor reactor coolant pumps, there is no seal leakage.

The contribution to liquid effluent due to laundry has been deleted as the result of modification to the liquid radwaste system to eliminate onsite laundry.

Secondary coolant system sampling drains are not routed to the radwaste system. These drains are routed to the plant's waste water system which is monitored for radioactivity before disposal. **If a significant level of radioactivity is detected, the sampling drain water is diverted to the liquid radwaste system for disposal. This contribution to the liquid radwaste system processing burden is not modeled since it is not the anticipated operating mode.**

f. The CST is level controlled and communicates with both the Demineralized Water Transfer and Storage System and the Condensate System. The storage tank level is maintained by a high and low level switch which opens and closes the demineralized water supply valve. On low level, the supply valve is opened and it is closed on high level. High and low level alarms are provided. The CST supplies water as makeup to the condenser. As level falls in the condenser, a system control valve modulates flow to the condenser hotwell. As level rises in the condenser hotwell, another system control valve modulates condensate pump discharge return to the CST. The CST is provided with high-high level alarm and overflow capability. Overflow from the CST and the CST drains are routed to the plant's waste water system where further monitoring, dilution, and routing to the liquid radwaste system can occur. Design features of the CST conform to Positions C.1.2.1 through C.1.2.5 of RG 1.143.

Please refer to RAI 460.20 which addresses the compliance of the radwaste systems to Reg. Guide 1.143.

g. The AP600 design has a single liquid discharge path from the radwaste system as shown in Figure 11.2-1. The design does permit different categories of wastes (e.g. detergent waste and floor drain waste) to be discharged simultaneously provided the cumulative discharge is within applicable regulatory limits.

All liquid discharge from the AP600 radwaste system is from monitor tanks; these wastes are mixed and sampled such that total activity inventories may be accurately determined prior to discharge.

~~Sheets 1 & 2 of Table 11.2-6 will be revised to reflect changes in the PWR-GALE code input for the times for waste collection and for waste processing & discharge. Tables 11.2-7 and 11.2-8, which present the results of the PWR-GALE code analysis will be corrected to reflect the revised analysis of anticipated annual releases.~~
~~Table 11.2-1 will be revised to reflect the 1979 version of ANSI/ANS-55.6. The changes in the waste flow rates resulted in changes to the PWR-GALE code input listed in sheet 2 of Table 11.2-6. Tables 11.2-7 and 11.2-8, which present the results of the PWR-GALE code analysis, will also be corrected to reflect the revised analysis of anticipated annual releases. (See the response to Q460.8.)~~

SSAR Revision: In Revision 1 of the SSAR Sheets 1 & 2 of Table 11.2-1 were revised to reflect the 1979 version of ANSI/ANS-55.6 and Sheets 1 & 2 of Table 11.2-6 were revised to reflect changes in the PWR-GALE code input for waste flow rates and for the times for waste collection and waste processing & discharge.

As a result of the revised response to this RAI, additional changes are required to sheet 2 of Table 11.2-1 to reflect elimination of onsite laundry and to Table 11.2-6 to reflect the changes in assumed process stream DF values (see attached for changes to sheets 1 and 2).

Tables 11.2-7 and 11.2-8, which present the results of the PWR-GALE code analysis, will also be corrected in Revision 2 to the SSAR to reflect the revised analysis of anticipated annual releases.

Table 11.2-1 (Sheet 2 of 2)

Liquid Inputs and Disposition

	Collection Tank and Sources	Expected Input Rate	Activity	Basis	Disposition
3.	Detergent waste				Filtered, monitored, and discharged. If necessary, processed with mobile equipment.
	Hot shower	10 gpd	10^{-7} μCi/g	ANSI/ANS-55.6-1979, applied to AP600 specific design (minimum 18 month fuel cycle, 17 day refueling outage).	
	Hand wash	240 gpd	10^{-7} μCi/g	ANSI/ANS-55.6-1979, applied to AP600 specific design (minimum 18 month fuel cycle, 17 day refueling outage).	
	Equipment and area decontamination	130 gpd	0.1% of reactor coolant	ANSI/ANS-55.6-1979, applied to AP600 specific design (minimum 18 month fuel cycle, 17 day refueling outage).	
	Laundry	~~350 gpd~~	~~10^{-4} μCi/g~~	Offsite laundry ~~ANSI/ANS-55.6-1979, applied to AP600 specific design (minimum 18 month fuel cycle, 17 day refueling outage)~~.	
4.	Chemical Wastes	Varies			Processed with mobile equipment

Table 11.2-6 (Sheet 1 of 4)

Input Parameters for the GALE Computer Code

Thermal power level (MWt)	1933
Mass of primary coolant (lb)	3.46×10^5
Primary system letdown rate (gpm)	100
Letdown cation demineralizer flow rate, annual average (gpm)	10
Number of steam generators	2
Total steam flow (lb/hr)	8.4×10^6
Mass of liquid in each steam generator (lb)	1.075×10^5
Total mass of secondary coolant (lb)	2.15×10^5
Total blowdown rate (lb/hr)	8.4×10^4
Blowdown treatment method	*
Condensate demineralizer regeneration time	N/A
Condensate demineralizer flow fraction	0.33
Primary coolant bleed for boron control	
Bleed flow rate (gpd)	658
Decontamination factor for I	10^3 ~~5~~
Decontamination factor for Cs and Rb	2×10^2 ~~4×10^3~~
Decontamination factor for others	10^3 ~~5×10^6~~
Collection time (day)	21
Process and discharge time (day)	0
Fraction discharged	1.0

* A "1" is input to indicate that the blowdown is recycled directly to the condensate system demineralizers without prior treatment in the blowdown system.

Table 11.2-6 (Sheet 2 of 4)

Input Parameters for the GALE Computer Code

Equipment Drains and Clean Waste	
Equipment drains flow rate (gpd)	90
Fraction of reactor coolant activity	1.07
Decontamination factor for I	10^{3}
Decontamination factor for Cs and Rb	$2 \times 10^{2\ 3}$
Decontamination factor for others	$10^{3\ 5}$
Collection time (day)	21
Process and discharge time (day)	0
Fraction discharged	1.0
Dirty Waste	
Dirty waste input flow rate (gpd)	1400
Fraction of reactor coolant activity	0.012
Decontamination factor for I	10^{3}
Decontamination factor for Cs and Rb	$2 \times 10^{2\ 3}$
Decontamination factor for others	$10^{3\ 5}$
Collection time (day)	8
Process and discharge time (day)	0
Fraction discharged	1.0
Blowdown Waste	
Blowdown fraction processed	0
Decontamination factor for I	N/A
Decontamination factor for Cs and Rb	N/A

Question 460.10

Provide the following information regarding the gaseous radwaste management system (Section 11.3):

a. Tables 11.2-6 and 11.3-1 of the SSAR give different holdup times for Xenon and Krypton in the charcoal delay beds. Clarify the discrepancy between the tables.

b. Describe the basis for the RCS degassing days (17.4 and 1.0 for Xenon and Krypton, respectively) given in Table 11.2-6 of the SSAR. The waste gas system releases given in Table 11.3-3 of the SSAR do not appear to be correct. Confirm the acceptability of this information or correct it, as appropriate.

c. Discuss the provisions for monitoring the individual performance of the equipment within the charcoal delay bed system. Include a list of alarmed process parameters for the delay bed system.

Response:

a. The gaseous radwaste management system includes two 100 percent capacity charcoal delay beds, both of which would normally be in use. The holdup times presented in Table 11.3-1 reflect credit for only one of the two delay beds in operation. This is reflected in the footnote at the bottom of Table 11.3-1. The holdup times currently presented in Table 11.2-6 reflect credit for both of the delay beds in operation.

The anticipated annual releases have been reanalyzed using the assumption of only one of the two delay beds in operation and Table 11.2-6, Sheet 3, has been revised to reflect this change in assumptions.

b. The holdup times specified for RCS degassing (17.4 days for xenons and 1.0 days for kryptons) do not represent the time associated with the RCS degassing process. These holdup times are the delay times that would exist if the continuous gas flow rate through the charcoal delay beds were at the maximum gas flow rate associated with the RCS degassing process (0.5 cfm instead of the average flow of 0.01 cfm for normal reactor operation). This is a conservative modelling of RCS degassing.

As discussed above in the response to part a, the anticipated annual releases have been reanalyzed assuming that only one of the two delay beds is in service. With this assumed mode of operation, the holdup times for the RCS degassing operation are reduced to 8.7 days for xenons and 0.5 days for kryptons.

In determining the annual releases via the atmospheric pathway, two separate GALE runs were made. The first run utilized a xenon holdup time of 435 days and a krypton holdup time of 24 days. These holdup times are based on a gas flow rate of 0.01 scfm which is an average flow rate

resulting from intermittent operation of the gas stripper; gas stripping being performed only on the letdown flow being discharged to accommodate dilution of the primary coolant as fuel burnup continues during the cycle (shim bleed flow). The normal letdown flow being recirculated back to the reactor coolant system is not subjected to gas stripping. The results of this GALE run, with the exception of the gaseous radwaste system releases for shutdowns, are included in Table 11.3-3.

The second GALE run utilized a xenon holdup time of 8.7 days and a krypton holdup time of 0.5 days. These holdup times are based on a gas flow rate of 0.5 scfm which is the maximum flow rate to the gaseous radwaste system. It is conservatively assumed that the flow rate is maintained for the duration of the degassing operation associated with the plant shutdown (in actuality, the flow rate would decline as the concentration of gases in the primary coolant is reduced). The portion of this GALE run's results that are reported in Table 11.3-3 is the determination of gaseous radwaste system releases for shutdowns.

By combining the output from the two GALE runs to form Table 11.3-3, a more accurate and more conservative representation of the atmospheric releases is obtained than if using only the case with the annual average waste gas flow rate.

c. As shown on Figure 11.3-2, the AP600 gaseous radwaste system contains provisions for continuously monitoring the moisture level at the inlet of the guard bed in order to provide confidence that moisture will not intrude beyond the moisture separator, which may adversely affect system performance.

Monitoring performance of individual components in the gaseous radwaste system is done by collecting and analyzing grab samples. As shown on Figure 11.3-2 sample pumps and connections are provided which allow the collection of grab samples at the inlet and outlet of the guard bed, between the two delay beds, and at the outlet of the second delay bed. A list of gaseous radwaste system instrumentation and control items is provided below:

INSTRUMENTATION	Record	Indicate	Alarm	
Gas Cooler				
Gas inlet temperature		X		
Cooling water outlet temp.		X		
Gas inlet pressure	X		Hi	
Charcoal Guard Bed				
Gas inlet temperature	X	X	Hi	
Gas inlet moisture	X		Hi	
Gas flow	X		Hi	
Vault temperature		X	Hi	Note 1
Vault hydrogen		X	Hi	Note 2

Charcoal Delay Beds				
Gas inlet temperature		X	Hi	
Gas outlet temperature		X	Hi	
Vault temperature		X	Hi	Note 1
Vault hydrogen		X	Hi	Note 2
Gas outlet flow	X	X		
Gas outlet radiation	X	X	Hi	Note 3
Gas outlet pressure		X		
Moisture Separator				
Water level		X	Hi	Level control
Drain Pot				
Water level		X	Hi	Level control
Sampling Subsystem				
Hydrogen concentration	X	X		
Oxygen concentration	X	X	Hi	
Gas pressure		X		
Gas flow			Lo	

Notes: 1) Vault temperature monitor common for guard bed and delay bed
2) Vault hydrogen monitor common for guard bed and delay bed
3) High outlet radiation alarm closes gas outlet isolation valve

~~SSAR Table 11.2-6, Sheet 3 will be revised to reflect the changes in analysis assumptions discussed in the responses to parts a and b. The reanalysis of anticipated annual releases is reflected in revisions made to Table 11.3-3, Sheet 1 and to Table 11.3-4.~~

~~The first paragraph of SSAR Subsection 11.3.3.4 will be revised to reflect the changes in the calculated site boundary whole body and skin doses associated with the annual gaseous releases~~

SSAR Revision:

SSAR Table 11.2-6, Sheet 3 will be revised to reflect the changes in analysis assumptions discussed in the responses to parts a and b. The reanalysis of anticipated annual releases is reflected in revisions made in Revision 1 of the SSAR to Table 11.3-3, Sheet 1 and to Table 11.3-4.

The first paragraph of SSAR Subsection 11.3.3.4 was changed in Revision 1 of the SSAR to reflect the changes in the calculated site boundary whole body and skin doses associated with the annual gaseous releases. The changes are as shown below:

~~(Subsection 11.3.3.4)~~

With the annual releases of noble gases listed in Table 11.3-3, the immersion doses to an individual located at the site boundary are ~~1.1~~ 1.2 mrem to the whole body and ~~3.2~~ 3.5 mrem to the skin. These doses are based on the annual average atmospheric dispersion factor from Section 2.3 (2.0×10^{-5} seconds per cubic meter). These doses are below the 10 CFR 50, Appendix I, limits of five mrem per year to the whole body and 15 mrem per year skin dose.

Table 11.2-6 (Sheet 3 of 4)

Input Parameters for the GALE Computer Code

Decontamination factor for others	N/A
Collection time	N/A
Process and discharge time	N/A
Fraction discharged	0
Regenerant waste	N/A
Gaseous Waste System	
Continuous gas stripping of full letdown purification flow	None
Holdup time for xenon, normal operation (days)	435 ~~870~~
RCS degassing (days)	8.7 ~~17.4~~
Holdup time for krypton, normal operation (days)	24 ~~49~~
RCS degassing (days)	0.5 ~~1.0~~
Fill time of decay tanks for gas stripper	N/A
Gas waste system: HEPA filter	None
Auxiliary building: Charcoal filter	None
Auxiliary building: HEPA filter	None
Containment volume (ft^3)	1.73×10^6
Containment atmosphere internal cleanup rate (ft^3/min)	N/A
Containment high volume purge:	
Number of purges per year (in addition to two shutdown purges)	0
Charcoal filter efficiency (%)	90
HEPA filter efficiency (%)	99

Table 11.3-3 (Sheet 1 of 3)

Expected Annual Average Release of Airborne Radionuclides As Determined by the PWR-GALE Code, Revision 1

(Release Rates in Ci/yr)

Noble Gases[(a)(b)]

	Waste Gas System	Building Ventilation			Condenser Air Removal System	Total
		Cont.	Aux. Bldg.	Turbine		
Kr-85m	7.0 ~~1.0~~E+00	2.0 ~~1.9~~E+01	3.0E+00	0.	1.0E+00	3.1 ~~2.4~~E+01
Kr-85	8.1 ~~8.6~~E+01	9.8 ~~9.7~~E+01	1.5E+00	0.	0.	1.84E+02
Kr-87	0.	6.0E+00	3.0E+00	0.	1.0E+00	1.0E+01
Kr-88	4.0E+00 ~~0.~~	2.3 ~~2.2~~E+01	5.0E+00	0.	3.0E+00	3.5 ~~3.0~~E+01
Xe-131m	7.8E+01	8.6 ~~8.3~~E+02	1.5E+01	0.	7.0E+00	1.0E+03 ~~9.3E+02~~
Xe-133m	1.0E+00 ~~0.~~	5.1 ~~5.0~~E+01	1.0E+00	0.	0.	5.3 ~~5.1~~E+01
Xe-133	2.4E+02 ~~7.7E+01~~	2.6 ~~2.5~~E+03	5.2 ~~5.1~~E+01	0.	2.4E+01	2.9 ~~2.65~~E+03
Xe-135m	0.	1.0E+00	2.0E+00	0.	1.0E+00	4.0E+00
Xe-135	0.	2.0 ~~1.9~~E+02	1.6E+01	0.	8.0E+00	2.2 ~~2.14~~E+02
Xe-138	0.	0.	2.0E+00	0.	1.0E+00	3.0E+00
~~Total~~	~~2.42E+02~~	~~3.72E+03~~	~~9.95E+01~~	~~0.~~	~~4.6E+01~~	~~4.1E+03~~
					Total	4.4E+03

Additionally

H-3 released via gaseous pathway	77
C-14 released via gaseous pathway	7.3
Ar-41 released via containment vent	34

Table 11.3-4

Comparison of Calculated Offsite Airborne Concentrations With 10 CFR 20 Limits

	Maximum Permissible Conc. μCi/ml	Expected Site Boundary Conc. μCi/ml	Fraction of MPC (expected)	Maximum Site Boundary Conc. μCi/ml	Fraction of MPC (maximum)
Kr-85m	1.0E-7	2.5 ~~1.9~~E-11	2.5 ~~1.9~~E-4	9.8 ~~7.6~~E-11	9.8 ~~7.6~~E-4
Kr-85	7.0E-7	1.4 ~~1.5~~E-10	2.0 ~~2.1~~E-4	5.4 ~~6.2~~E-10	7.7 ~~8.9~~E-4
Kr-87	2.0E-8	7.9E-12	4.0E-4	1.9E-11	9.5E-4
Kr-88	9.0E-9	2.8 ~~2.4~~E-11	3.1 ~~2.7~~E-3	1.1 ~~9.4~~E-10 ~~11~~	1.2 ~~1.0~~E-2
Xe-131m	2.0E-6	8.0 ~~7.4~~E-10	4.0 ~~3.7~~E-4	6.2 ~~5.8~~E-10	3.1 ~~2.9~~E-4
Xe-133m	6.0E-7	4.2 ~~4.0~~E-11	7.0 ~~6.7~~E-5	3.3 ~~3.2~~E-10	5.5 ~~5.3~~E-4
Xe-133	5.0E-7	2.3 ~~2.1~~E-9	4.6 ~~4.2~~E-3	7.6 ~~7.0~~E-8	1.5 ~~1.4~~E-1
Xe-135m	4.0E-8	3.2E-12	8.0E-5	2.4E-12	6.0E-5
Xe-135	7.0E-8	1.8 ~~1.7~~E-10	2.6 ~~2.4~~E-3	5.3 ~~5.1~~E-10	7.6 ~~7.3~~E-3
Xe-138	2.0E-8	2.4E-12	1.2E-4	3.2E-12	1.6E-4
I-131	2.0E-10	5.2E-14	2.6E-4	7.9 ~~8.0~~E-13	4.0E-3
I-133	1.0E-9	1.9E-13	1.9E-4	1.3 ~~1.4~~E-12	1.3 ~~1.4~~E-3

a. Maximum permissible concentration is from Reference 1.

b. Expected site boundary concentration based on annual releases predicted by the PWR-GALE code (Table 11.3-3) and an annual average X/Q of 2.0 x 10^{-5} seconds per cubic meter.

c. Maximum site boundary concentration based on adjusting the releases predicted by the PWR-GALE code (Table 11.3-3) to reflect operation with design basis fuel defect level of 0.25% and an annual average X/Q of 2.0 x 10^{-5} seconds per cubic meter.

Question 470.16

Provide an assessment of the control room operator doses from the accidents postulated for the AP600 using the guidance of Murphy-Campe and Section 6.4 of the SRP. Provide the basis for the analysis presented in the February 3, 1994, response for Q470.9, that deviates from this guidance.

Response:

The control room operator doses for the large LOCA are provided in Subsection 15.6.5 (based on the source term defined in Tables 15.6.5-1 and 15.6.5-2) and in the response to RAI 470.9 (based on the NRC's draft source term). The guidance of Section 6.4 of the SRP and of the Murphy-Campe paper (from 13th AEC Air Cleaning Conference) was used to the extent judged applicable; however, much of the guidance of these two documents is not applicable to the AP600. This is particularly the case when calculating control room doses assuming operation of the passive, safety related compressed air system to pressurize the main control room. The guidance documents are directed toward a control room habitability system in which there is an active ventilation system providing pressurization of the control room with filtered air and recirculation cleanup of the air in the control room. The AP600 main control room does not rely on an active system for safety related control room habitability but, instead, relies on bottled air to provide pressurization. Pressurization of the main control room with bottled air requires a low leakage structure. Verification of low leakage through the main control room structure is addressed in ITAAC 3.2.6.

Assumptions used in the response to RAI 470.9 that differ from the guidance documents are:

1. Source term: The Murphy-Campe paper specifies a LOCA source term be used that is based on Regulatory Guide 1.4. This source term is no longer considered to be appropriate. The source term from draft NUREG-1465 was used with modifications as noted in the response to RAI 470.9.

2. Occupancy factor: The Murphy-Campe paper suggests occupancy factors of 1.0 for the first 24 hours, 0.6 for 24 to 96 hours, and 0.4 for the remainder of the accident (4 to 30 days). For the case in which the safety-related control room habitability system is assumed to be in operation, the analysis took credit for a strictly controlled ingress/egress with a 12 hour shift duration and with the operators working one shift out of three with the first shift change occurring 4 hours into the accident. This results in a reduced occupancy factor during the early part of the accident. This approach is considered to be a more accurate model of control room occupancy.

   The occupancy factors from the Murphy-Campe paper were used for the case in which the normal HVAC system was assumed to operate to pressurize the control room and to provide recirculation cleanup of the control room atmosphere (for a discussion of this mode of operation, see subsection 9.4.1.2.4).

3. Dose conversion factors: The Murphy-Campe paper states that the thyroid dose is to be determined by use of ICRP Publication No. 2 parameters. The analysis reported in the response to RAI 470.9 used iodine dose conversion factors from ICRP Publication No. 30. The information in ICRP Publication No. 30 supersedes that issued in ICRP Publication No. 2.

Control room operator doses resulting from other design basis accidents will be addressed in the response to RAI 470.4. As with the LOCA dose analyses, the guidance of Section 6.4 of the SRP and of the Murphy-Campe paper will be used where determined to be appropriate.

SSAR Revision: NONE

Question 952.95

Provide a commitment to submit a 4th stage automatic depressurization system (ADS) valve sensitivity study in which the capacity of the 4th stage ADS valves is reduced. The purpose of this study is to better quantify the margin in the 4th stage ADS valve design.

Response:

The requested 4th stage ADS valve sensitivity study was provided to the NRC via Westinghouse letter NTD-NRC-94-4298, dated September 15, 1994. The study investigated 15% and 30% reductions in ADS 4th stage valve areas. The results indicate that the AP600 design provides sufficient fourth stage venting capacity to enable the plant to reach stable IRWST injection without core uncovery even when accounting for uncertainty in critical flow modeling.

SSAR Revision: NONE
PRA Revision: NONE