STP Nuclear Operating Company
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October 11, 2007
NOC-AE-07002215
10CFR50.90

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Response to Request for Additional Information on
Proposed Amendment for Alternate Radiological Source Term (AST) Methodology;
TAC Nos. MD 4996 & MD 4997

Reference: Letter from David W. Rencurrel to NRC Document Control Desk dated March 22, 2007, "Request for License Amendment Related to Application of the Alternate Source Term" (NOC-AE-07002127)

In the referenced letter, the STP Nuclear Operating Company (STPNOC) submitted a license amendment request to support application of an alternate source term (AST) methodology. This submittal responds to NRC questions regarding this request received by electronic mail on August 14, 2007.

There are no commitments in this submittal. If you have any questions, please call Ken Taplett at 361-972-8416 or me at 361-972-7867.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 10/11/2007.
Date

David W. Rencurrel
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Attachment: STPNOC Response to Request for Additional Information

A001
NRR

STI: 32211591

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STPNOC RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

STP NUCLEAR OPERATING COMPANY (STPNOC)
UNITS 1 AND 2 NUCLEAR POWER PLANT
REQUEST FOR ADDITIONAL INFORMATION
REGARDING PROPOSED LICENSE AMENDMENT REQUEST FOR IMPLEMENTATION OF ALTERNATIVE SOURCE TERM
SOUTH TEXAS PROJECT UNITS 1 & 2 (TAC NOS. MD4996/MD4997)

NRC RAI #1

Commitment 8 states that, until a plant modification is completed to support the limiting single failure assumptions in the steam generator tube rupture (SGTR) analysis, South Texas Project (STP) will maintain an administrative limit for reactor coolant system dose equivalent iodine so that the radiological dose limits for the SGTR analysis remain bounding.

Regarding commitment 8 of the subject license amendment request (LAR), please provide additional information describing the administrative limit for reactor coolant system dose equivalent iodine and the calculated SGTR doses at the Technical Specification (TS) Reactor Coolant System (RCS) limit with the most limiting single failure as identified in Westinghouse Electric Company Nuclear Safety Advisory Letter (NSAL)-06-15.

STPNOC Response

The response to this requested information will be provided to the NRC by a separate letter.

NRC RAI #2

The following statement is made in the LAR regarding the natural removal rate of elemental iodine in containment, "The current licensing basis (CLB) uses 3.59 per hour for the sprayed region and 0.91 per hour for the unsprayed region. However, if it is assumed that the volumes have the same surface area to volume ratio, then 4.5 may be used for both volumes."

The application of the same removal coefficient for both volumes is based on the assumption that both volumes have the same surface area to volume ratio however as stated in Standard Review Plan (SRP) 6.5.2 the area in question is the wetted surface area.

Please provide additional information describing the basis for the application of the elemental iodine natural deposition removal coefficient of 4.5 per hour to both the sprayed and unsprayed volumes of the containment.

STPNOC Response

The use of the 4.5 per hour for both volumes represents a correction to a conceptual error (albeit, conservative) in the current licensing basis (CLB). A stated assumption was made in the CLB that the area-to-volume ratio is the same for both the sprayed and unsprayed regions, and λ_W was calculated accordingly using the following expression from SRP 6.5.2:

$$\lambda_W = K_W \, A/V$$

However, the resulting 4.5 per hour value was then incorrectly "apportioned" between the sprayed and unsprayed regions according to the volume fraction. Since the removal lambda is simply the product of the given deposition velocity, K_W, and the area-to-volume ratio, the removal rate must be the same for both volumes if the area-to-volume ratio is the same; i.e., $\lambda_W = K_W(A/W)_{SPRAYED} = K_W(A/W)_{UNSPRAYED} = K_W(A/W)_{COMBINED}$. Use of the 4.5 per hour value represents a corrected application of the CLB.

NRC RAI #3

In the CLB analysis the containment spray is continued until the aerosol decontamination factor (DF) reaches 1000 at 6.335 hours post loss of coolant accident (LOCA). In the alternative source term (AST) analysis, after the aerosol DF reaches 50 the diminished aerosol removal rate of 0.7 appears to continue for the duration of the accident evaluation period.

In Section 6.5.2.3.2 of the Updated Final Safety Analysis Report (UFSAR) markups the following statement is made concerning the containment spray particulate removal coefficient: "Although it would be expected that spray removal of particulate iodine would continue indefinitely, it is assumed that there is no additional removal once a DF of 1000 is reached."

Please provide additional information describing the application of the aerosol removal rate of 0.7 after the DF reaches 50 and whether this rate is intended to continue for the duration of the accident evaluation period or until a DF of 1000 is reached.

STPNOC Response

Per Section 3.3 of Appendix A of NRC Regulatory Guide 1.183, "There is no specified maximum DF for aerosol removal by sprays." Therefore, no DF limit has been applied for aerosol removal. For this analysis, sprays are assumed to run indefinitely, as noted. As a practical matter, stopping the sprays at the time the aerosol DF reaches 1000 (t = 7.6 hours) would have little effect on doses (i.e., the Control Room dose would increase by approximately 2%).

NRC RAI #4

The following statements are made in the LAR regarding the determination that contaminated sump water will not reach the Reactor Water Storage Tank (RWST) and contribute to the calculated LOCA dose.

1. **The motive force for leakage in the containment sump suction line is the high pressure in the containment resulting from the large break LOCA. This pressure is reduced, within the first 3.36 hours of an accident, below a pressure capable of forcing water into the RWST. No contaminated sump water will reach the RWST via this leak path.**

2. **The containment spray pumps may be secured up to 13.4 days after initiation of a design basis accident (DBA) LOCA and containment water will not reach the RWST via this leak path.**

3. **The minimum time for leakage from valves assumed to have the degraded leak rate to reach the RWST following the initiation or the recirculation phase of the DBA LOCA is 44.1 days. At this point in time the leakage into the RWST would be 1200 cc/hr.**

LAR Section 4.3.3.2, Radiological Releases from engineered safety feature (ESF) Equipment, states that, "The Actual leakage from the RCS sump through ESF equipment would not start until after the recirculation phase of the accident begins. However, for conservatism, and to decouple the dose analyses from the actual calculated recirculation start time, ESF leakage is assumed to begin at t=0."

In addition, LAR Section 4.3.3.2 states, "Also, at the time the injection phase of the accident ended and the recirculation phase begins (minimum of 1000 seconds into the accident, UFSAR Table 6.2.1.1-10, Revision 13), the containment building pressure would have dropped from its peak pressure of about 42 pounds per square inch gauge (psig) to about 28 psig."

The revision note to Revision 9 of NC-6013 states that, "Calculation MC-6458 shows that the RCS back-leakage to the RWST will not contribute to the LOCA doses at 30 days. The minimum time for the back-leakage to reach the RWST is 42 days. Previous calculations (MC-6313 Rev. 0) showed this time to be 13.4 days."

NRC RAI 4.1

Please provide additional information describing the basis for the conclusion that no contaminated sump water will reach the RWST via the containment sump suction line assuming that the recirculation phase begins at 1000 seconds into the accident and that the containment pressure remains high enough to provide a motive force for the leakage until 3.36 hours after the accident.

STPNOC Response

The value of 3.36 hours in the Item 1 of LAR Section 4.3.3.2 is from an earlier analysis and is in error. Item 1 in LAR Section 4.3.3.2 should be revised as follows:

1.. The motive force for leakage in the containment sump suction line is the high pressure in the containment resulting from the large break LOCA. This pressure is reduced, within the first 11.4 hours after recirculation begins, below a pressure capable of forcing water into the RWST. No contaminated sump water will reach the RWST via this leak path.

The analysis makes the following assumptions:

1. The design basis maximum seat leakage rate for each Emergency Core Cooling System (ECCS) isolation valve is used to determine the rate of sump water back leakage into the RWST.
2. A leak rate 10 times that amount is used to determine the transport time for the leakage from the valve to the RWST, displacing all of the water in the piping.
3. One valve of a series of valves fails to close.
4. The driving force (head) for the leakage through the RWST suction line isolation valves (SI-0001 and -0002) is the post-accident pressure in the reactor containment building (RCB).
5. All three trains of Containment Spray (CS), High-Head Safety Injection (HHSI), and Low-Head Safety Injection (LHSI) operate at t=0.

The analysis is performed as follows:

1. Determine the head required to force water from the RCB sump to the RWST (elevation difference of 16.75 ft., 22 psia required).
2. Determine the pressure head on the RCB sump at recirculation switchover (43 psia at switchover, to a maximum of 45 psia).
3. Determine time when RCB pressure is less than the differential pressure to the RWST (~11.4 hours)
4. Determine the distance sump water will travel past the isolation valve farthest downstream (8 cc/min would traverse 0.15 ft in 11.4 hours through a 16" line).

Therefore, leakage from the RCB sump would not reach the RWST via the containment sump suction line due to RCB pressure.

Note: The assumption that radiological releases from ESF leakage begin at time zero (i.e., beginning at recirculation switchover time) is only an analytical simplification used to bound scenarios which produce various values for the switchover time.

NRC RAI 4.2

Please provide additional information describing the basis for the conclusion that no contaminated sump water will reach the RWST via the containment spray pumps assuming that the recirculation phase begins at 1000 seconds into the accident.

STPNOC Response

This analysis is similar to the analysis described in the response to RAI 4.1, above. The CS pumps may be secured after about 6.3 hours (after full credit for iodine scrubbing has been reached in the CLB analysis). Using a leakage rate of 3 cc/min in a 6" pipe, the contaminated sump water would only progress 0.21 feet. If the CS cutoff time is increased to 7.6 hours (when the aerosol DF of 1000 is reached, see RAI 3), as reflected in the AST analysis, the progression of the sump water toward the RWST would only be slightly increased.

The time for sump water to reach the RWST via the CS pumps was determined to be 13.48 days, with continuous pump operation. The emergency operating procedures allow for operation of the CS pumps for longer than 6.3 hours but the CS spray would be terminated much sooner than 13.5 days. Therefore, the assumption that sump fluid does not reach the RWST is justifiable.

NRC RAI 4.3

Please provide additional information describing the significance and distinction in the reference to 13.4 days as stated in item 2 of the LAR cited above and the 13.4 days mentioned in the notes describing Revision 9 to NC-6013.

STPNOC Response

Older analyses of the progression of sump water toward the RWST (MC-6313, Rev 0) assumed none of the SI pumps would be turned off during the 30 day accident period. The bounding time was the 13.4 days for leakage pushed by the CS pumps. Hence the statement that "[p]revious calculations (MC-6313 Rev. 0) showed this time to be 13.4 days ." MC-6458, Rev 1, noted that the CS pumps would be turned off rather quickly and determined that leakage to the RWST from the HHSI/LHSI pumps would require 44 days to reach the RWST.

Thus, the NC-6013, Rev 9, note reflects the change in assumption that the SI pumps would not be continuously operated and the shortest time for radioactive fluid to reach the RWST was changed from 13.4 days to 42 days (later changed to 44 days). Item 2 cites the same 13.4 days as the time limit for CS pump operation in the current analysis (since no release from the RWST is postulated).

The release via the RWST has a very small impact on the total dose. The dose results of NC-6013, Rev 8, include the contribution of a release from the RWST after 13.4 days. Converted to rem TEDE (using the formulation provided in footnote 7 of Regulatory Guide 1.183), the addition of the RWST release increases the Control Room dose by only 0.6%. The dose to the LPZ and Technical Support Center (TSC) is increased 0.4%.

Taken together, the timing of spray termination and RWST back leakage have a minor impact on the analyses. If sprays are terminated after the allowable iodine decontamination factors are reached, the Control Room dose would increase by approximately 2% (see RAI 3) over the reported AST results. Alternately, if the sprays continue to operate after 13.48 days and a release from the RWST occurs, the Control Room dose would increase by about 0.6% over the reported AST results.

NRC RAI #5

Section 4.3.4.2 of the LAR states that, "For shine from the radioactive cloud, the 30-day shine dose increment for the low population zone (LPZ) (no shielding protection considered and no occupancy factor credited) was adjusted by the ratio of the maximum onsite χ/Q value to that for the LPZ for each χ/Q averaging period. The result was then reduced by shielding attenuation factors for the Control Room (CR) and Technical Support Center (TSC) (Table 4.3-5). The final shine dose was obtained by adding the increments for each averaging period."

Please provide additional information describing the basis for the shielding factors applied in the calculation of the shine dose from the radioactive cloud outside the CR and the TSC.

STPNOC Response

The CR shielding attenuation factor (1.03E-3) and the TSC shielding attenuation factor (1.56E-2) are taken from the pre-AST (i.e., CLB) calculations as the attenuation provided by 2.5 feet of concrete shielding and 1.5 feet of concrete shielding, respectively, for sources outside the CR and TSC. Originally, the 1.03E-3 factor was applied to both the CR and the TSC. In fact, the 1.56E-2 factor is the appropriate one for the TSC, and that change has been incorporated as part of the AST application.

While these factors were taken from the CLB, the reasonableness of these factors is evident from the fact that the tenth-thickness of concrete is usually given as 8" to 12" depending on photon energy. Using a tenth-thickness value of 10", the 30"of control room shielding would afford a factor of 1E-3 protection while the 18" of TSC shielding would afford a factor of 1.585E-2 protection. Since cloud shine dose is dominated by noble gas releases, and since noble gas releases are similar for both the CLB and the AST (except that the short-lived Kr-87 and Kr-88 sources which represent the most significant challenge to shielding attenuation are reduced because of the delayed release for AST), these CLB shielding attenuation factors are judged to be applicable for AST.

NRC RAI #6

In Section 4.3.4.2 CR/TSC Doses from Gamma Shine, it is stated that, "For the CLB, it is assumed that the activity trapped on the Control Room recirculation clean-up filters is one-tenth of that on the Control Room make-up filters (i.e., one-tenth of Table 4.3-6) due to the iodine removal by the makeup filters."

NRC RAI 6.1

Please provide additional information describing the basis for the assumption that the activity trapped on the CR recirculation clean-up filters is one-tenth of that on the CR make-up filters due to the iodine removal by the makeup filters.

STPNOC Response

The 10:1 factor was assumed in the CLB, and the shine doses to the CR and TSC were based on the assumption that the activity trapped on the CR recirculation clean-up filters is one-tenth of that on the CR make-up filters due to the iodine removal by the makeup filters. However, when applying AST, the source strengths were rigorously calculated using actual deposition on the CR makeup and recirculation clean-up filters.

For the CR recirculation clean-up filters, the CLB CR shine dose contribution was based on the following, time-dependent source strengths:

Hours	MeV/sec
0.05	9.03E+09
0.7882	3.41E+10
8	3.8E+10
24	3.1E+10
44	2.1E+10
64	1.7E+10
84	1.5E+10
96	1.5E+10
150	1.2E+10
400	7.3E+09
720	3.3E+09

For the AST, the corresponding time-dependent source strengths are as follows (based on a rigorous calculation which ignores the CR makeup filters):

Hours	MeV/sec
0.05	2.19E+08
0.7882	7.54E+09
8	3.66E+10
24	2.12E+10
44	1.65E+10
64	1.48E+10
84	1.39E+10
96	1.36E+10
150	1.21E+10
400	8.66E+09
720	5.79E+09

The maximum ratio of time-dependent source strengths (AST:CLB) is 1.74; therefore, the recirculation clean-up filter CR shine dose of 2.18 mR shine for the CLB was increased to 4 mR for the AST application.

In like manner, the source strengths for the CR makeup filters (as used to calculate the CLB shine contribution to the TSC dose) are as follows:

Hours	MeV/sec
0.05	9.03E+10
0.7882	3.41E+11
8	3.8E+11
24	3.1E+11
44	2.1E+11
64	1.7E+11
84	1.5E+11
96	1.5E+11
150	1.2E+11
400	7.3E+10
720	3.3E+10

As expected, these values are exactly ten times the CLB values for the CR recirculation clean-up filter dose to the CR. The rigorously calculated AST values for the CR makeup filter are as follows:

Hours	MeV/sec
0.05	2.78E+09
0.7882	2.16E+10
8	4.84E+10
24	2.82E+10
44	2.21E+10
64	1.97E+10
84	1.84E+10
96	1.79E+10
150	1.58E+10
400	1.11E+10
720	7.39E+09

These values are roughly an order of magnitude less than the CLB values that were used to calculate the CR makeup filter shine contribution to the TSC dose (i.e., 844 mR). However, no credit has been taken in the AST application for any dose reduction below the CLB value.

One may note that the rigorously calculated AST CR recirculation clean-up filter source strength values are only slightly lower than the rigorously calculated AST CR makeup filter source strengths. This is because the former takes no credit for the latter. In fact, the only reason the values are different is because ~22% of the activity leaks from the CR without being trapped on the recirculation clean-up filters when the CR immersion and inhalation doses are calculated.

LAR Tables 4.3-5 and 4.3-8 should be revised as follows:

Table 4.3-5
CR and TSC Gamma Shine Dose Analysis Inputs for DBA LOCA

Input/Assumption	CLB Analysis	AST Analysis
Attenuation factor for Control Room shine from atmospheric activity	1.03E-3	1.03E-3
Attenuation factor for TSC shine from atmospheric activity	1.03E-3	1.56E-2
Activity on one Control Room make-up filter	Table 4.3-6	N/A
Gamma power due to activity on two Control Room make-up filters	Table 4.3-7	Table 4.3-7
Gamma power ~~by photon energy~~ due to activity on Control Room recirculation clean-up filters	One-tenth of Table 4.3-7 or Table 4.3-8	~~One-tenth of Table 4.3-7~~ Table 4.3-8
~~AST gamma power by photon energy due to activity on Control Room recirculation clean-up filters~~	~~N/A~~	~~Table 4.3-8~~
Maximum ratio of one-tenth of Table 4.3-7 to Table 4.3-8 (AST column)	N/A	1.74 at 720 hours

Table 4.3-8
Gamma Power from Activity on Two Control Room Cleanup Filters
(Mev/sec)

Time (hours)	CLB		AST	% Difference	
0.05	~~4.14E+10~~	9.03E+09	2.19E+08	~~-99.5%~~	97.57%
0.7882	~~1.57E+11~~	3.41E+10	7.54E+09	~~-95.2%~~	77.89%
8	~~1.76E+11~~	3.8E+10	3.66E+10	~~-79.2%~~	3.68%
24	~~1.45E+11~~	3.1E+10	2.12E+10	~~-85.4%~~	31.61%
44	~~9.68E+10~~	2.1E+10	1.65E+10	~~-82.9%~~	21.43%
64	~~8.02E+10~~	1.7E+10	1.48E+10	~~-81.5%~~	12.94%
84	~~7.23E+10~~	1.5E+10	1.39E+10	~~-80.8%~~	7.33%
96	~~6.96E+10~~	1.5E+10	1.36E+10	~~-80.5%~~	9.33%
150	~~5.67E+10~~	1.2E+10	1.21E+10	~~-78.7%~~	-0.83%

Table 4.3-8
Gamma Power from Activity on Two Control Room Cleanup Filters
(Mev/sec)

Time (hours)	CLB		AST	% Difference	
400	~~3.45E+10~~	7.3E+09	8.66E+09	~~74.9%~~	-18.63%
720	~~1.58E+10~~	3.3E+09	5.79E+09	~~63.4%~~	-75.45%

NRC RAI 6.2

Please provide additional information describing the relative positions of the filter systems which are assumed to contribute to the CR and TSC direct shine evaluations. This information may be provided in the form of a diagram similar to Figure 4.2-1 Control Room Envelope.

STPNOC Response

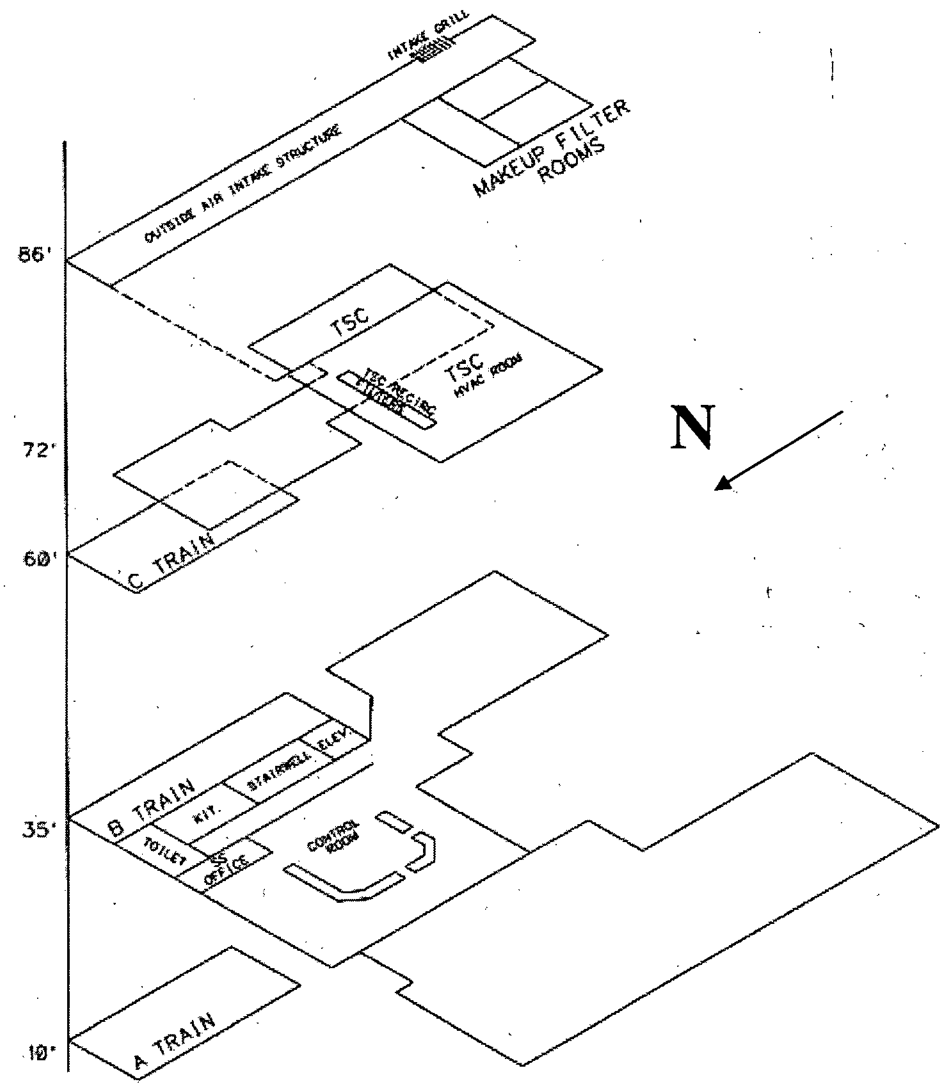
Figure 1 below provides a 3D representation of the Control Room Envelope and its relationship to the TSC.

The Control Room proper is located on the 35' elevation of the Electrical Auxiliary Building (EAB). This is the area depicted by Figure 4.2-1 of the LAR. The cleanup filter systems are located in the three HVAC equipment rooms stacked vertically on the 10', 35', and 60' elevations (labeled as "A Train", "B Train", etc., on Figure 1). The CR HVAC makeup filters are located in concrete-walled rooms on the roof elevation (86') of the EAB, directly above the TSC. These walls are 1' thick.

The north and east walls of the CRE on the 35' elevation and the CRE HVAC rooms on the 35', and 60' elevations are EAB exterior walls (the room at 10' is below grade). These are 2 to 2.5' thick concrete walls. Interior walls are 1' concrete, as are the floors and ceilings.

The TSC is located on the top floor of the EAB at the 72' elevation. The TSC HVAC equipment and filters are located in a metal building on the EAB roof (86' elevation) above and to the west of the TSC (the filters are not directly above the TSC). The north and east walls of the TSC are exterior EAB walls and are 2' to 2.5' thick. The floor is 1' thick concrete and the roof is the EAB roof and is 1.5' thick.

Figure 1: Control Room Envelope
(Not to Scale)



NRC RAI #7

Section 15.1.5 of the UFSAR markup states the following: "During plant start-up, the above Main Steam Isolation Valve (MSIV) seat drain line valves are opened for removal of accumulated condensate to protect the turbine from water induction damage and to prevent water hammer in the steam lines. During normal operations, manual valves isolate the above MSIV seat drain lines. Specific analyses for simultaneous steam releases from all four steam generators via opened above MSIV seat drain lines concurrent with a SGTR event or a main steam line break with a design primary to secondary system leak demonstrates that radiological doses will not exceed 10 CFR 50.67 limits and the additional steam demand will not result in exceeding applicable reactor safety acceptance criteria. Due to the use of restricting orifices, flow from the lines will be limited and no operator action is required to close the above MSIV seat drain isolation valves."

Please provide additional information describing the basis for the assumption that leakage through the MSIV above seat orifices will continue for 36 hours after the start of the accident for all the applicable DBA dose consequence analyses. Please include the relationship, if any, to the assumed continuation of releases through the MSIV above seat orifices after the RHR system is assumed to be in operation.

STPNOC Response

The time used for the release through the MSIV above seat orifices is taken from the Technical Specifications requirement for plant cooldown to Mode 5 following a SGTR or MSLB event. Per TS Section 3.6.3, the plant is required to be in at least HOT STANDBY within 6 hours and in COLD SHUTDOWN within the following 30 hours.

Since the release through the 3/8" orifices is very small compared to the total release, STP takes a simple and rather conservative approach to capture the dose consequence due to this additional release path.

1. The release of 1.93 lbm/sec (or 1.86 cfm) per loop is calculated assuming critical flow through the orifices at 1200 psia.
2. The leakage is assumed constant for the entire 36-hour period, regardless of the impact to the secondary side of cooling the plant to the point that the RHR system is placed in operation.
3. It is assumed that the steam release through the orifices goes directly to the environment. However, the actual flow path is to the condenser.

NRC RAI #8

LAR Section 4.7.3.2.3, RCS Cesium and Rubidium Concentrations, reads as follows: "The RCS cesium and rubidium concentrations corresponding to a 1% failed fuel (Table 4.2-14). The Cs and Rb is assumed not to spike along with the iodines. Since the Cs and Rb are bound into particulate iodines, and since the iodines do not leave the water in the Steam Generators (SGs) or are appreciably from the reactor containment building (RCB), the impact of this assumption is negligible."

Assumption 15 from NC-6014, Rod Ejection Accident (UFSAR Chapter 15.4.8), states in part that, "A partition coefficient of 100 is assumed for isotopes of iodine, cesium and rubidium released from the steam generators with the exception for the organic species of iodine."

Assumption 17 from LAR Section 4.7.5 Assumptions and Inputs which states, "This analysis assumes that iodine released from the SGs to the environment is 4.2% elemental, 13.1% organic, and 82.7% particulate (see Section 4.2.5)."

Assumption 18 from LAR Section 4.7.5 Assumptions and Inputs which states, "A partition coefficient of 100 is assumed for iodine, cesium, and rubidium released from the steam generators. (Regulatory Guide 1.183, Appendix G, Section 5.6) Organic iodine is not partitioned. Organic iodine is assumed to migrate directly to the steam space and become immediately available for release."

Please provide additional information to clarify the selected statements in relation to the assumptions for the release of particulate activity in the CRE accident analysis.

STPNOC Response

LAR Section 4.7.3.2.3 is incorrect in stating that the Cs and Rb are bound to the iodine and do not leave the water in the SG. The release of Cs and Rb from the containment building and steam generators is modeled in the CRE analysis.

The CRE analysis uses a partition factor of 100 for all isotopes of iodine, Cs, and Rb with the exception of organic iodine as stated in Assumption 15 from NC-6014. The CRE analysis applies the partition coefficient by reducing the flow from the SG by 100.

LAR assumptions 17 and 18 from Section 4.7.5 are a result of the treatment of organic iodines, as discussed in LAR Section 4.2.5. However, the conclusion reached in the last paragraph of LAR Section 4.2.5 was in error. The RADTRAD input does use the Regulatory Guide 1.183 split of 4.85% elemental/ 0.15% organic/ 95% particulate. However, after the application of the partition factors, the effective release to the environment is then 4.2% elemental/ 13.1% organic/ 82.7% particulate.

The following changes to the LAR should be made:

1. Revise Section 4.7.3.2.3, RCS Cesium and Rubidium Concentrations as follows:

   "The RCS cesium and rubidium concentrations correspond to 1% failed fuel (Table 4.2-14). The Cs and Rb are assumed not to spike along with the iodines."

2. Revise Assumption 17 from Section 4.7.5 to read as follows:

   "This analysis assumes that iodine released from the SGs to the environment is 4.85% elemental, 0.15% organic, and 95% particulate (see Section 4.2.5)."

3. In Assumption 18 from Section 4.7.5, revise the reference to Section 7.4 of Regulatory Guide 1.183, Appendix H.

4. The last paragraph of Section 4.2.5 should be revised as follows:

   "The analysis input uses the Regulatory Guide 1.183 split of 4.85% elemental/ 0.15% organic/ 95% particulate. However, after the application of the partition factors, the effective release to the environment is then 4.2% elemental/ 13.1% organic/ 82.7% particulate. Note that the number of curies of iodines released is greater than that had Regulatory Guide 1.183 been strictly followed (particulates are released and no partition factor is used to reduce the amount of organics released)."

5. Add the following row to Table 4.7-7:

Parameter	CLB	AST
Iodine Species released from the SG to the Environment, % (elemental/organic/particulate)	91/4/5	4.85/0.15/95

6. Revise the following row in Table 4.7-7:

Parameter	CLB	AST
Effective ~~Resulting~~ Iodine Species Released from the Secondary Side to the Environment, after application of the Partition Factors, % (elemental/organic/particulate)	91/4/5	4.2/13.1/82.7[53]

These changes are changes to the manner in which the analyses are described in the LAR – not changes to the actual analyses. Therefore, the changes described in the response to this RAI do not impact the radiological results presented for the Control Rod Ejection Accident in LAR Table 4.7-10.

NRC RAI #9

Section 4.8.3.2.3 of the LAR, Secondary System Cesium and Rubidium Concentrations, states the following, "The secondary system Cs and Rb concentrations corresponding to 1% failed fuel are used (Table 4.2-20). Cesium and rubidium are assumed to be bound with iodines as particulates. Therefore, there is no release of Cs or Rb from water in the steam generators."

Assumption 5 from NC-6028, RC Pump Shaft Seizure Doses For FSAR Chapter 15.3.3, states in part that, "A partition coefficient of 100 is assumed for particulates and elemental iodine released from the steam generators."

Please provide additional information to clarify the assumptions for the release of particulate activity from the SGs and the distinction if any in the treatment of particulate activity releases from the SGs in all of the pertinent DBA dose consequence analyses.

STPNOC Response

The release of Cs and Rb from the steam generators is modeled in the Locked Rotor analysis. LAR Section 4.8.3.2.3 is incorrect in stating that the Cs and Rb are bound to the iodine and do not leave the water in the SG. The Locked Rotor analysis uses a partition factor of 100 for all isotopes of iodine, Cs, and Rb with the exception of organic iodine as stated in Assumption 5 from NC-6028.

The following changes to the LAR should be made:

1. Revise Section 4.8.3.2.3, RCS Cesium and Rubidium Concentrations as follows:

   "The secondary system Cs and Rb concentrations corresponding to 1% failed fuel are used (Table 4.2-20). Cesium and rubidium are assumed to be bound with iodines as particulates."

2. Add the following rows to Table 4.8-4:

Parameter	CLB	AST
Iodine Species released into the RCS (elemental/organic/particulate)	91/4/5	4.85/0.15/95
Iodine Species released from the SG to the Environment (elemental/organic/particulate)	91/4/5	4.85/0.15/95

3. Revise the following row in Table 4.8-4:

Parameter	CLB	AST
Effective ~~Resulting~~ Iodine Species released from the Secondary Side to the Environment, <u>after application of the Partition Factors</u> (elemental/organic/particulate)	91/4/5	4.2/13.1/82.7[54]

These changes are changes to the manner in which the analyses are described in the LAR – not changes to the actual analyses. Therefore, the changes described in the response to this RAI do not impact the radiological results presented for the Locked Rotor Accident in LAR Table 4.8-5.

NRC RAI #10

Page 28 of Attachment 1 to the March 22, 2007 letter states that the delta-temperature (Δ-T) methodology is the primary method of determining atmospheric stability and data from the 60-m tower the primary source of wind data. However, in order to maintain a 90 percent data recovery, when Δ-T data are not available wind direction sigma theta (σ_θ) data are used and when wind data are not available from the 60-m tower wind data from the 10-m backup tower are used.

NRC RAI 10.1

About how much of the 2000-2004 meteorological data used to support this license amendment request (LAR) were based upon σ_θ data?

STPNOC Response

Sigma-theta (σ_θ) data were used approximately 6% of the time.

NRC RAI 10.2

Given that the PAVAN and ARCON96 computer codes were written to use atmospheric stability categories derived from Δ-T measurements, what adjustments, if any, were made to the σ_θ data to better simulate atmospheric stability categorization using the Δ-T methodology?

STPNOC Response

STPNOC occasionally used σ_θ data from 10-meter wind direction measurements to estimate atmospheric stability when Δ-T data were not available. Δ-T data were entered into the database that corresponded to the estimated stability categories using Tables 2.4 and 2.5 of NUREG/CR-3332. If the stability class of an unstable atmosphere at night was estimated using σ_θ data, "D" stability was assumed. Likewise, if the stability class of a stable atmosphere during the day was estimated using σ_θ data, "D" stability was assumed.

NRC RAI 10.3

About how much wind data were used from the 10-meter back-up tower?

STPNOC Response

Back-up wind speed or direction data were used approximately 8% of the time.

NRC RAI #11

Page 3 of Attachment 7 states that all releases are assumed to be at the ground and, as a result, only lower elevation wind data are relevant. However, the upper level hourly wind data fields provided in the ARCON96 format were not flagged as missing. Thus, in some situations when the lower level wind data were flagged as invalid, the ARCON96 computer code may have interpreted blanks in the upper wind data fields as zeros and calculated atmospheric dispersion factors (χ/Q values).

What impact would this have on determination of the resultant 95 percentile χ/Q values?

STPNOC Response

All missing data were coded with a stability of 9, interpreted as missing data. This is used for both upper and lower level meteorological data. Thus, the upper level meteorological data would have been interpreted as missing, as well. Therefore, there would be no impact on the resultant 95% χ/Q values.

NRC RAI #12

Page 46 of Attachment 1 discusses selection of wind speed categories for use with the PAVAN computer code. This section states that seven wind speed categories as defined in Regulatory Guide (RG) 1.23 were used as input in the assessment to support this LAR. The section also discusses NRC Regulatory Issues Summary (RIS) 2006-4, "Experience with Implementation of Alternative Source Terms," which states that input to PAVAN should have a large number of wind speed categories at the lower wind speeds in order to produce the best results. Page 4 of Attachment 7 which discusses how you addressed RIS 2006-4 states that the RG 1.23 categories were judged to be adequate for determining the offsite χ/Q values using PAVAN, but provides no details.

How was this conclusion reached?

STPNOC Response

The data were reassessed with the alternate wind speed binning as suggested in RIS 2006-4. The results are as follows (the limiting χ/Q values in each set are identified by being boxed) for the LPZ:

Alternate Binning (as suggested in RIS 2006-4)

SECTOR	(METERS)	0-2 HOURS	0-8 HOURS	8-24 HOURS	1-4 DAYS	4-30 DAYS
S	4800	3.64E-05	1.49E-05	9.55E-06	3.62E-06	9.02E-07
SSW	4800	4.53E-05	1.88E-05	1.21E-05	4.69E-06	1.20E-06
SW	4800	5.04E-05	2.12E-05	1.38E-05	5.40E-06	1.41E-06
WSW	4800	4.75E-05	1.94E-05	1.24E-05	4.71E-06	1.17E-06
W	4800	4.16E-05	1.73E-05	1.12E-05	4.32E-06	1.10E-06
WNW	4800	3.73E-05	1.58E-05	1.02E-05	4.02E-06	1.05E-06
NW	4800	3.43E-05	1.53E-05	1.02E-05	4.26E-06	1.21E-06
NNW	4800	2.40E-05	1.11E-05	7.51E-06	3.24E-06	9.71E-07
N	4800	1.24E-05	5.81E-06	3.98E-06	1.74E-06	5.34E-07
NNE	4800	8.17E-06	3.57E-06	2.35E-06	9.57E-07	2.63E-07
NE	4800	6.13E-06	2.51E-06	1.61E-06	6.11E-07	1.52E-07
ENE	4800	2.15E-06	9.59E-07	6.41E-07	2.67E-07	7.61E-08
E	4800	8.98E-06	3.62E-06	2.30E-06	8.61E-07	2.10E-07
ESE	4800	3.00E-05	1.12E-05	6.80E-06	2.33E-06	4.98E-07
SE	4800	3.21E-05	1.22E-05	7.55E-06	2.65E-06	5.91E-07
SSE	4800	3.38E-05	1.35E-05	8.49E-06	3.12E-06	7.44E-07

Original Binning (seven RG 1.23 categories as used in LOCA dose calculation)

SECTOR	(METERS)	0-2 HOURS	0-8 HOURS	8-24 HOURS	1-4 DAYS	4-30 DAYS
S	4800	3.54E-05	1.48E-05	9.57E-06	3.71E-06	9.52E-07
SSW	4800	4.59E-05	1.93E-05	1.25E-05	4.88E-06	1.27E-06
SW	4800	5.27E-05	2.24E-05	1.46E-05	5.75E-06	1.51E-06
WSW	4800	4.79E-05	1.98E-05	1.28E-05	4.90E-06	1.24E-06
W	4800	4.12E-05	1.74E-05	1.13E-05	4.43E-06	1.16E-06
WNW	4800	3.62E-05	1.55E-05	1.02E-05	4.07E-06	1.09E-06
NW	4800	3.31E-05	1.49E-05	9.98E-06	4.19E-06	1.21E-06
NNW	4800	2.64E-05	1.21E-05	8.14E-06	3.47E-06	1.02E-06
N	4800	1.32E-05	6.13E-06	4.18E-06	1.82E-06	5.50E-07
NNE	4800	9.23E-06	3.97E-06	2.60E-06	1.04E-06	2.79E-07
NE	4800	6.09E-06	2.50E-06	1.60E-06	6.08E-07	1.52E-07
ENE	4800	2.10E-06	9.47E-07	6.37E-07	2.69E-07	7.80E-08
E	4800	8.55E-06	3.46E-06	2.20E-06	8.27E-07	2.02E-07
ESE	4800	2.72E-05	1.04E-05	6.41E-06	2.25E-06	5.02E-07
SE	4800	2.94E-05	1.15E-05	7.21E-06	2.61E-06	6.05E-07
SSE	4800	3.28E-05	1.33E-05	8.44E-06	3.16E-06	7.72E-07

A comparison of these two tables shows that the results of the two binning schemes are essentially identical; in fact, the RG 1.23 scheme (as used in the LAR) is actually slightly conservative. It is on this basis that the adequacy of the RG 1.23 binning scheme as applied to STP may be demonstrated.

The following changes to the LAR should be made:

Insert the following paragraph immediately after Table 4.1-12:

"The data were reassessed with the alternate wind speed binning as suggested in RIS 2006-4. A comparison of the resulting χ/Q indicates that the two binning schemes are essentially identical; in fact, the RG 1.23 scheme (as used in the LAR) is actually slightly conservative. It is on this basis that the adequacy of the RG 1.23 binning scheme as applied to STP may be demonstrated."

NRC RAI #13

Page 61 of Attachment 1 states that loss of offsite power would not change the location of release/receptor pairings.

NRC RAI 13.1

Is this also true for any other single failures such as loss of system or building integrity which might, for example, result in loss of effluent release through the plant vent?

STPNOC Response

As identified in LAR Table 4.1-25, releases from the ESF leakage component of a LOCA, the Supplemental Purge component of a LOCA, the Fuel Handling Accident (FHA) in the Fuel Handling Building (FHB), and the FHA in the Reactor Containment Building (RCB) are vented to the atmosphere via the plant vent. The impact of an assumed loss of building integrity and loss of HVAC system integrity on each of these accidents is discussed below.

LOCA ESF Leakage: Loss of Building Integrity

The LOCA ESF Leakage occurs in the bottom of the FHB in the ESF pump rooms. The release is assumed to be picked up by the FHB HVAC system, filtered, and released into the plant vent. The FHB is designed to be kept at a negative pressure with respect to the outside. There is no single active failure that would cause a loss of building integrity in such a manner as to prevent the building from being vented via the Plant Vent.

LOCA ESF Leakage: Loss of System Integrity

There is no single active failure that would cause a loss of the FHB HVAC system integrity in such a manner as to prevent the building from being vented via the Plant Vent.

RCB Supplemental Purge: Loss of Building Integrity

The RCB Supplemental Purge system exhausts air from the RCB through the Plant Vent. A loss of integrity of the RCB, in addition to the allowed Technical Specification leakage, is not postulated.

RCB Supplemental Purge: Loss of System Integrity

The RCB Supplemental Purge HVAC ducts exit the RCB near the FHB/Mechanical Auxiliary Building (MAB) door on the 60' of the MAB. The plant vent ductwork is also in this elevation of the MAB. A rupture of the Supplemental Purge Ducts or the plant vent ducts due to the increase in RCS pressure before the isolation valve closes (within 23 seconds) would release radionuclides on the MAB 60' elevation. In contrast to the ESF leakage release, this release would also contain noble gases. However, the source term is limited to the RCS inventory, and not the core inventory.

The one set of doors between the MAB 60' elevation and the EAB 60' elevation are normally closed and controlled as part of the Radiological Restricted Area Boundary. The CRE boundary doors to the 60' "C" HVAC Equipment Room in the EAB are locked closed and tested as part of the CRE HVAC boundary. The multiple doors between the MAB and the CRE form effective airlocks. These airlock arrangements would be effective in limiting the in-leakage of radionuclides into the CRE.

There is an equipment removal door which opens to the outside on the MAB 60' elevation. This door is about 31' above ground level and requires a crane to access it. It is located approximately 178 feet east of the Supplemental Purge ductwork. However, it is directly beneath the CRE/TSC HVAC intake on the east face of the MAB. The door is controlled as part of the Radiological Restricted Area Boundary and as a security boundary. It is attended by Health Physics when opened. It is not considered a release point because it is normally closed and infrequently used.

Therefore, the most conservative assumption for a release point is via the FHB HVAC and Plant Vent. The Plant Vent-to-CR χ/Q would be limiting in this scenario.

Fuel Handling Accident in the Fuel Handling Building: Loss of Building Integrity

The release from a Fuel Handling Accident in the Fuel Handling Building is handled in a similar fashion to the LOCA ESF leakage described above. However, the release would be from the 68' operating deck in the FHB. There is no single active failure that would cause a loss of building integrity in such a manner as to prevent the building from being vented via the Plant Vent.

Fuel Handling Accident in the Fuel Handling Building: Loss of System Integrity

There is no single active failure that would cause a loss of FHB HVAC system integrity in such a manner as to prevent the building from being vented via the Plant Vent.

Fuel Handling Accident in the Reactor Containment Building: Loss of Building Integrity

The release from a Fuel Handling Accident in the Reactor Containment Building would be exhausted to the environment by one or more of several pathways:

- the RCB Normal Purge System (until the system is isolated on high radiation); or,
- directly to the environment through an open RCB Equipment Hatch; or,
- into the MAB 60' elevation via an open Personnel Air Lock door.

If the equipment hatch is assumed to be open, a release from this area is on the opposite side of the RCB, with respect to the plant vent and the CRE intake. As described above, it is unlikely that a release into the MAB 60' would enter the CRE due the several doors in the path. Therefore, the Plant Vent-to-CRE intake χ/Q would be limiting in these scenarios.

Fuel Handling Accident in the Reactor Containment Building: Loss of System Integrity

There is no single active failure that would cause a loss of the RCB Normal Purge Subsystem integrity in such a manner as to prevent the RCB from being vented via the Plant Vent.

NRC RAI 13.2

The March 22, 2007 letter states that you have been informed by Westinghouse that the single failure scenario for the steam generator tube rupture analysis may not be limiting.

Could this impact the limiting control room χ/Q values, for example, due to a change in release/receptor pairing?

STPNOC Response

The scenario in question would move the release point from the SG PORV (locations G and C on LAR Figure 4.1-13) to inside the Turbine Generator Building (TGB) which is immediately north of the PORV location. The release would be from the condenser in the TGB to the interior of the TGB. Subsequently, the radionuclides would escape from the TGB via building openings. These release points are farther away from the Control Room HVAC intake than the PORV location.

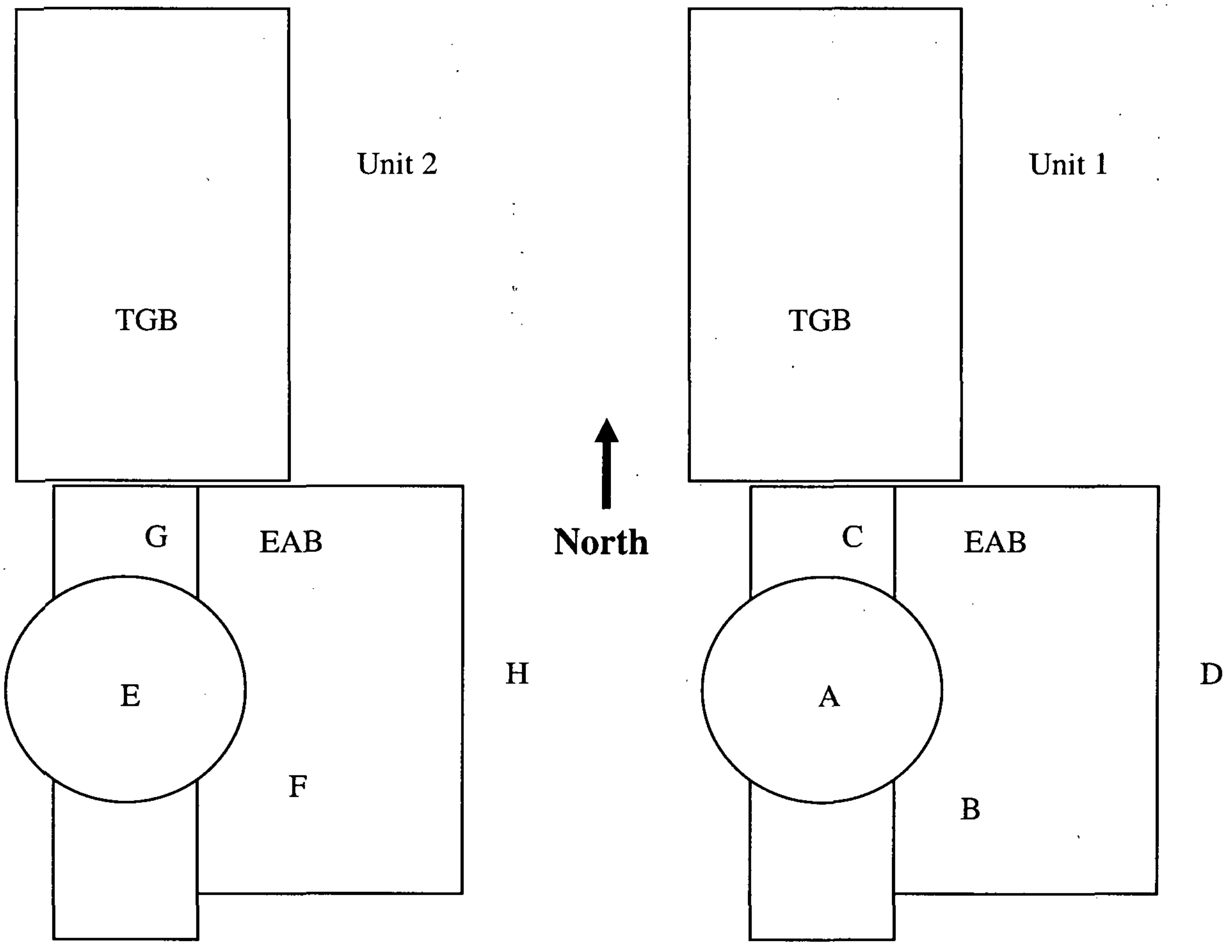
The TGB's HVAC system brings air into the building and distributes the air flow to various areas. There is no forced exhaust from the general building areas. Cooling and exhaust is provided to battery rooms. However, these rooms are isolated from the general building volume by doors. There is forced exhaust from the areas around the condensate pumps. This exhaust is vented from the east side of the TGB, near the southeast corner.

The Condenser Air Removal System (CARS) removes the non-condensable gases from the condenser and exhausts via the Plant Vent (points B and F on LAR Figure 4.1-13). However, this scenario assumes a loss of offsite power which would trip off the CARS. The pressure buildup in the condenser would blow out the condenser relief panels and the release would take place along the TGB sides.

The TGB is not physically connected to the Electrical Auxiliary Building (EAB) in such a manner as to allow air flow to pass between the TGB and the EAB and into the Control Room.

The PORV to Control Room χ/Q was used in the analyses for two reasons: (1) it is geometrically close to where a release from the TGB would be expected; and (2), it has a documented ARCON96 analysis as a reference. The impact of the choice of various release locations for this scenario, and the impact on the χ/Qs used, is dwarfed by the effect of the assumptions made on the treatment of iodines as the release passes through the steam piping, into the condenser, and into the TGB.

From LAR Figure 4.1-13, with the TGB added:



Summary

As a result of the reviews conducted to develop the above responses, the following revisions to the LAR have been identified:

1. Insert the following paragraph immediately after Table 4.1-12:

   The data were reassessed with the alternate wind speed binning as suggested in RIS 2006-4. A comparison of the resulting χ/Q indicates that the two binning schemes are essentially identical; in fact, the RG 1.23 scheme (as used in the LAR) is actually slightly conservative. It is on this basis that the adequacy of the RG 1.23 binning scheme as applied to STP may be demonstrated.

2. The last paragraph of Section 4.2.5 should be revised as follows:

   "The analysis input uses the Regulatory Guide 1.183 split of 4.85% elemental/ 0.15% organic/ 95% particulate. However, after the application of the partition factors, the effective release to the environment is then 4.2% elemental/ 13.1% organic/ 82.7% particulate. Note that the number of curies of iodines released is greater than that had Regulatory Guide 1.183 been strictly followed (particulates are released and no partition factor is used to reduce the amount of organics released)."

3. Item 1 in LAR Section 4.3.3.2 should be revised as follows:

   The motive force for leakage in the containment sump suction line is the high pressure in the containment resulting from the large break LOCA. This pressure is reduced, within the first 11.4 hours after recirculation begins, below a pressure capable of forcing water into the RWST. No contaminated sump water will reach the RWST via this leak path.

4. LAR Tables 4.3-5 and 4.3-8 should be revised as follows:

Table 4.3-5
CR and TSC Gamma Shine Dose Analysis Inputs for DBA LOCA

Input/Assumption	CLB Analysis	AST Analysis
Attenuation factor for Control Room shine from atmospheric activity	1.03E-3	1.03E-3
Attenuation factor for TSC shine from atmospheric activity	1.03E-3	1.56E-2
Activity on one Control Room make-up filter	Table 4.3-6	N/A
Gamma power due to activity on two Control Room make-up filters	Table 4.3-7	Table 4.3-7

Table 4.3-5
CR and TSC Gamma Shine Dose Analysis Inputs for DBA LOCA

Input/Assumption	CLB Analysis	AST Analysis
Gamma power ~~by photon energy~~ due to activity on Control Room recirculation clean-up filters	One-tenth of Table 4.3-7 or Table 4.3-8	~~One-tenth of~~ ~~Table 4.3-7~~ Table 4.3-8
~~AST gamma power by photon energy due to activity on Control Room recirculation clean-up filters~~	~~N/A~~	~~Table 4.3-8~~
Maximum ratio of one-tenth of Table 4.3-7 to Table 4.3-8 (AST column)	N/A	1.74 at 720 hours

Table 4.3-8
Gamma Power from Activity on Two Control Room Cleanup Filters
(Mev/sec)

Time (hours)	CLB		AST	% Difference	
0.05	~~4.14E+10~~	9.03E+09	2.19E+08	~~-99.5%~~	97.57%
0.79	~~1.57E+11~~	3.41E+10	7.54E+09	~~-95.2%~~	77.89%
8	~~1.76E+11~~	3.8E+10	3.66E+10	~~-79.2%~~	3.68%
24	~~1.45E+11~~	3.1E+10	2.12E+10	~~-85.4%~~	31.61%
44	~~9.68E+10~~	2.1E+10	1.65E+10	~~-82.9%~~	21.43%
64	~~8.02E+10~~	1.7E+10	1.48E+10	~~-81.5%~~	12.94%
84	~~7.23E+10~~	1.5E+10	1.39E+10	~~-80.8%~~	7.33%
96	~~6.96E+10~~	1.5E+10	1.36E+10	~~-80.5%~~	9.33%
150	~~5.67E+10~~	1.2E+10	1.21E+10	~~-78.7%~~	-0.83%
400	~~3.45E+10~~	7.3E+09	8.66E+09	~~-74.9%~~	-18.63%
720	~~1.58E+10~~	3.3E+09	5.79E+09	~~-63.4%~~	-75.45%

5. Revise Section 4.7.3.2.3, RCS Cesium and Rubidium Concentrations, as follows:

   The RCS cesium and rubidium concentrations correspond to 1% failed fuel (Table 4.2-14). The Cs and Rb are assumed not to spike along with the iodines.

6. Revise Assumption 17 from Section 4.7.5 to read as follows:

   This analysis assumes that iodine released from the SGs to the environment is 4.85% elemental, 0.15% organic, and 95% particulate (see Section 4.2.5).

7. In Assumption 18 from Section 4.7.5, revise the reference to Section 7.4 of Regulatory Guide 1.183, Appendix H.

8. Add the following row to Table 4.7-7:

Parameter	CLB	AST
Iodine Species released from the SG to the Environment, % (elemental/organic/particulate)	91/4/5	4.85/0.15/95

9. Revise the following row in Table 4.7-7:

Parameter	CLB	AST
Effective ~~Resulting~~ Iodine Species Released from the Secondary Side to the Environment, after application of the Partition Factors, % (elemental/organic/particulate)	91/4/5	4.2/13.1/82.7[54]

10. Revise Section 4.8.3.2.3, RCS Cesium and Rubidium Concentrations, as follows:

    The secondary system Cs and Rb concentrations corresponding to 1% failed fuel are used (Table 4.2-20). Cesium and rubidium are assumed to be bound with iodines as particulates.

11. Add the following rows to Table 4.8-4:

Parameter	CLB	AST
Iodine Species released into the RCS (elemental/organic/particulate)	91/4/5	4.85/0.15/95
Iodine Species released from the SG to the Environment (elemental/organic/particulate)	91/4/5	4.85/0.15/95

12. Revise the following row in Table 4.8-4:

Parameter	CLB	AST
Effective ~~Resulting~~ Iodine Species released from the Secondary Side to the Environment, <u>after application of the Partition Factors</u> (elemental/organic/particulate)	91/4/5	4.2/13.1/82.7[54]

<u>Note that the above changes to the LAR and the responses to the RAIs did not result in any changes to the dose results presented in the LAR.</u>