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10 CFR 50.90

April 18, 2022

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

R. E. Ginna Nuclear Power Plant
Renewed Facility Operating License No. DPR-18
NRC Docket No. 50-244

Subject: License Amendment Request to Revise Technical Specifications (TS) for the Spent Fuel Pool Charcoal System and Two (2) TS Administrative Changes

In accordance with 10 CFR (Code of Federal Regulations) 50.90, "Application for amendment of license, construction permit, or early site permit," Constellation Energy Generation, LLC (CEG) requests amendments to the Technical Specifications (TS) of the R. E. Ginna Nuclear Power Plant (Ginna).

The first proposed amendment (AMENDMENT-1) revises TS for the Auxiliary Building Ventilation System (ABVS) and Ventilation Filter Testing Program (VFTP). This change will remove testing requirements for the ABVS per TS Surveillance Requirement (SR) 3.7.10.3 and remove TS Section 5.5.10(c), Spent Fuel Pool (SFP) Charcoal Adsorber System.

The second amendment (AMENDMENT-2) proposes three additions to TS 5.6.5 "CORE OPERATING LIMITS REPORT (COLR), to ensure TS 5.6.5a matches the current Ginna COLR.

The third amendment (AMENDMENT-3) proposes to update TS 5.5.15 based on approved TS Amendment 136 (reference ML19325D824). TS 5.5.15 currently references NEI (Nuclear Energy Institute) 94-01, Rev. 0. Rev. 0 will be removed from TS 5.5.15, consistent with previous approval of Amendment 136.

CEG has determined that there are no significant hazard considerations associated with the proposed change and that the change qualifies for a categorical exclusion from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9).

The proposed changes have been reviewed by the Ginna Plant Operations Review Committee in accordance with the requirements of the CEG/Exelon Quality Assurance Program.

CEG requests approval of the proposed license amendments by April 1, 2023, to support the 2023 Spring Outage. Once approved, the amendments shall be implemented within 60 days of receipt.

In accordance with 10 CFR 50.91, "Notice for public comment; State consultation," paragraph (b), CEG is notifying the State New York of this application for license amendment by transmitting a copy of this letter and its attachments to a designated State Official.

There are no regulatory commitments contained in this letter. Should you have any questions concerning this letter, please contact Jessie Hodge at (610) 765-5532.

I declare under penalty of perjury that the foregoing is true and correct. This statement was executed on the 18th day of April, 2022.

Respectfully,

David T. Gudger

David T. Gudger
Sr Manager - Licensing and Regulatory Affairs
Constellation Energy Generation, LLC

Attachments: 1. Evaluation of Proposed Change
2. Markup of Proposed Technical Specifications Pages
3. DA-NS-08-050, Rev 001, Ginna Fuel Handling Accident Offsite and Control Room Doses

cc: NRC Regional Administrator, Region I
NRC Senior Resident Inspector, Ginna
NRC Project Manager, Ginna
A. L. Peterson, NYSERDA

Attachment 1
Evaluation of Proposed Change

Attachment 1
Evaluation of Proposed Change

1.0 SUMMARY DESCRIPTION

In accordance with the provisions of Title 10 of the Code of Federal Regulations (10 CFR) 50.90, "Application for amendment of license, construction permit, or early site permit," Constellation Energy Generation, LLC (CEG) is requesting license amendments to the Technical Specifications (TS) for Renewed Facility Operating License No. DPR-18 for the R.E. Ginna Nuclear Power Plant (Ginna).

The proposed AMENDMENT-1 revises TS for the ABVS and VFTP. This change will remove testing requirements for the ABVS per TS SR 3.7.10.3 and remove TS Section 5.5.10(c), SFP Charcoal Adsorber System. The proposed change will align TS with the updated Fuel Handling Accident (FHA) Analysis in which the charcoal banks are not credited.

This change to the ABVS and VFTP TS are supported by DA-NS-08-050, Revision 001, Ginna Fuel Handling Accident Offsite and Control Room Doses. The proposed change will not make any physical or design changes to the ABVS nor will it change the way in which the ABVS is operated or controlled. The system will continue to exhaust through currently established flow paths and filters during normal operation and continue to maintain a negative pressure to control the flow of airborne radioactivity. During a FHA, the ABVS will no longer be credited for dose reduction. However, all automatic responses for the ABVS will continue to actuate upon a high radiation alarm, and the ABVS will continue (although not credited) to reduce dose following a design basis accident. All procedural direction involving the ABVS will remain in effect.

AMENDMENT-2 proposes three additions to TS 5.6.5 “CORE OPERATING LIMITS REPORT (COLR), to ensure TS 5.6.5a matches the current Ginna COLR. TS 3.1.4, “Rod Group Alignments”, 3.1.8, “PHYSICS TESTS Exceptions – Mode 2”, and 3.4.5, “RCS (REACTOR COOLANT SYSTEM) Loops – Modes 1 ≤ 8.5% RTP (Rated Thermal Power), 2, and 3” will be added to TS 5.6.5a.

AMENDMENT-3 proposes to update TS 5.5.15 based on approved TS Amendment 136 (reference ML19325D824). TS 5.5.15 currently references NEI 94-01, Rev. 0 (the incorrect revision) and Rev. 2-A (the correct revision). Rev.0 will be removed from TS 5.5.15, consistent with previous approval of Amendment 136.

2.0 DETAILED DESCRIPTION

The proposed AMENDMENT-1 revises TS for the ABVS and VFTP. This change will remove testing requirements for the ABVS per TS Surveillance Requirement (SR) 3.7.10.3 and remove TS Section 5.5.10(c), SFP Charcoal Adsorber System. The proposed change will align TS with the updated Fuel Handling Accident (FHA) Analysis in which the charcoal banks are not credited.

The ABVS provides clean, filtered, and tempered air to the operating floor of the Auxiliary Building (AB) and mitigates the effects of fission product activity. The ABVS sweeps air from the AB over the SFP and Decontamination Pit and into the suction of the exhaust system. The air flows through the SFP charcoal filter bank and through multiple fans and HEPA (High Efficiency Particulate Air) filters before discharging out the Intermediate Building roof vent. Per TS 3.7.10, the ABVS shall be OPERABLE and in operation during movement of irradiated fuel assemblies in the AB when one or more fuel assemblies in the AB has decayed < 60 days since being irradiated. SR 3.7.10.2 requires that the ABVS maintain a negative pressure with respect

to the outside environment at the AB operating floor level. SR 3.7.10.3 requires that the SFP charcoal filters comply with TS 5.5.10 (Ventilation Filter Testing Program) for the ABVS to be OPERABLE. TS 5.5.10 contains specific requirements for total air flow rate testing acceptance criteria, in-place penetration and bypass testing acceptance criteria, and laboratory penetration testing acceptance criteria.

The previous design basis case assumed a flow path of airborne radioactivity out of the AB south roll-up door and took no credit for the ABVS. An alternate case assumed a flow path out the plant vent but credited the SFP charcoal filters for mitigation of the dose consequences of the accident. The case in which air flowed out of the AB roll-up door previously resulted in higher dose consequences and was therefore considered the design basis accident scenario. DA-NS-08-050, Rev 001, removes dose-reduction credit for the SFP charcoal filters and re-calculates the dose consequences of a FHA. Revision 001 includes an evaluation of both the design basis case and the alternate case to ensure the dose consequences remain bounded and concludes that the SFP Charcoal Filters are not required.

The ABVS is considered by the Emergency Response Organization (ERO) when calculating potential radiological release to the public. Specifically, the ABVS is credited for dose reduction by the Dose Assessment team if the SFP charcoal filters are in service. The software used by dose assessment assumes the filters meet the testing criteria contained in ITS 5.5.10(c). A note will be added to filter test procedures to ensure that current acceptance criterion is procedurally maintained OR to ensure that the dose assessment software is updated to be consistent with any changes in the criterion, as the ABVS will no longer be controlled by TS.

The proposed change will not make any physical or design changes to the ABVS nor will it change the way in which the ABVS is operated or controlled. The system will continue to exhaust through currently established flow paths and filters during normal operation and continue to maintain a negative pressure to control the flow of airborne radioactivity. During a FHA, the ABVS will no longer be credited for dose reduction by filtering airborne reactivity before discharging out the plant vent due to removal of credit for the SFP charcoal filters. However, all automatic responses for the ABVS will continue to actuate upon a high radiation alarm, and the ABVS will continue (although not credited) to reduce dose following a design basis accident. All procedural direction involving the ABVS will remain in effect.

AMENDMENT-2 is an administrative change that proposes three additions to TS 5.6.5 “CORE OPERATING LIMITS REPORT (COLR), to ensure TS 5.6.5a matches the current Ginna COLR. TS 3.1.4, “Rod Group Alignments”, 3.1.8, “PHYSICS TESTS Exceptions – Mode 2”, and 3.4.5, “RCS Loops – Modes 1 ≤ 8.5% RTP, 2, and 3” will be added to TS 5.6.5a. The three proposed additions are captured in the current site COLR for Cycle 43, Revision 0. AMENDMENT-2 is considered administrative.

AMENDMENT-3 proposes an administrative change to update TS 5.5.15 based on approved TS Amendment 136 (reference ML19325D824). TS 5.5.15 currently references both Rev. 0 and Rev. 2-A for NEI 94-01. During submission of the License Amendment Request (ML19045A282) with the applicable change to TS that was incorporated in Amendment 136, the TS markup did not correctly identify the need to remove “Rev. 0” and it was therefore retained. However, the evaluation section correctly identified the need to remove “Rev. 0” and was approved. AMENDMENT-3 is considered administrative.

3.0 TECHNICAL EVALUATION

A FHA is one of two design basis accidents (the other being a Tornado Missile Accident) in which fuel stored in the SFP is damaged resulting in radioactive release to the public. Per UFSAR Section 15.7.3, it is assumed for a FHA that an assembly is dropped from Fuel Handling Equipment onto the top of the racks in the SFP and the assembly is damaged such that there is a release of all radioactive material from the single assembly. DA-NS-08-050 is the underlying accident analysis for a FHA and includes multiple cases which evaluate different potential release paths from the SFP to the environment. Currently, the most limiting release path is through the AB south roll-up door and includes no credit taken for dose reduction via the ABVS. An alternate case is analyzed in which the release path is through the plant vent and credit is taken for dose reduction via the ABVS. Because the most limiting release path does not utilize the ABVS, discussion of the case within UFSAR Section 15.7.3 does not include the ABVS. However, the ABVS is required during fuel moves via ITS 3.7.10, because it is credited for the release path out of the plant vent.

For the Tornado Missile Accident which must be assumed at any point in the cycle, Iodine removal is assumed to be 0%. The SFP Charcoal System is only required to be in service during fuel moves within 60 days of reactor shutdown and is not currently credited; therefore, it is not impacted by the proposed change.

The consequences of a FHA are required to be at, or below federal limits contained in 10 CFR 50.67. Currently, the dose consequences are well below federal limits and are listed in UFSAR Section 15.7.3. DA-NS-08-050, Rev 001, removed the dose reduction credit of the SFP charcoal filters in the case using the plant vent as the release path. The result was that the case which assumed a release path out the AB roll-up door was no longer the bounding case and that overall dose consequences of a FHA increased.

Specifically, the Control Room dose during a FHA in the SFP increased from 0.80831 rem to 1.1949 rem against an acceptance criteria of 5 rem. The EAB (Exclusion Area Boundary) and LPZ (Low Population Zone) dose during a FHA in the SFP were not affected, and all dose consequences of a FHA in Containment were not affected. The increase in dose consequences to the CR (Control Room) due to the removal of credit for the ABVS was 0.38659 rem. The criteria for considering this a minimal increase are an increase that is less than 10% of the existing margin between calculated dose consequence and federal limits per NEI 96-07, Rev. 1, “Guidelines for 10 CFR 50.59 Implementation” as endorsed by Regulatory Guide (RG) 1.187, Rev. 3, “Guidance for Implementation of 10 CFR 50.59, “Changes, Tests, and Experiments””. The margin between the previous dose of 0.80831 rem and the federal limit of 5 rem is 4.19169 rem, 10% of which is 0.41916 rem. The increase in calculated dose of 0.38659 rem is less than 0.41916 rem; therefore, the change in dose consequences is considered minimal, and dose consequences continue to remain well below federal limits.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

Generic Design Criteria 18 (GDC):

Ginna Updated Final Safety Analysis Report (UFSAR) Section 3.1.1.3.8 details GDC 18, including the following:

A controlled ventilation system removes gaseous radioactivity from the atmosphere and fuel storage and waste treating areas of the AB and discharges it to the atmosphere via the plant vent. Radiation monitors are in continuous service in these areas to actuate high activity alarms on the control board annunciator.

The proposed change will not make any physical or design changes to the ABVS nor will it change the way in which the ABVS is operated or controlled. The system will continue to exhaust through currently established flow paths and filters during normal operation and continue to maintain a negative pressure to control the flow of airborne radioactivity. During a FHA, the ABVS will no longer be credited for dose reduction by filtering airborne reactivity before discharging out the plant vent. However, all automatic responses for the ABVS will continue to actuate upon a high radiation alarm, and the ABVS will continue (although not credited) to reduce dose following a design basis accident. All procedural direction involving the ABVS will remain in effect. The requirements of GDC 18 will continue to be met. Changes under this proposed amendment are limited to the dose consequences of a FHA, equipment credited, and aligning TS to reflect the revised accident analysis.

GDC 19:

GDC 19 requires that adequate radiation protection be provided to permit access to and occupancy of the control room under accident conditions and for the duration of the accident without personnel radiation exposures more than 5 rem to the whole body.

Attachment 3 provides the technical justification for removing credit for the SFP Charcoal absorbers in the FHA while maintaining compliance with GDC 19. The Control Room dose during a FHA in the SFP increased from 0.80831 rem to 1.1949 rem against an acceptance criteria of 5 rem. The EAB and LPZ dose during a FHA in the SFP were not affected, and all dose consequences of a FHA in Containment were not affected. The increase in dose consequences to the CR due to the removal of credit for the ABVS was 0.38659 rem. The criteria for considering this a minimal increase are an increase that is less than 10% of the existing margin between calculated dose consequence and federal limits per NEI 96-07, Rev. 1. The margin between the previous dose of 0.80831 rem and the federal limit of 5 rem is 4.19169 rem, 10% of which is 0.41916 rem. The increase in calculated dose of 0.38659 rem is less than 0.41916 rem; therefore, the change in dose consequences is considered minimal, and dose consequences continue to remain well below federal limits.

GDC 61:

GDC 61 requires that fuel storage and handling systems, radioactive waste systems, and other systems that may contain radioactivity be designed to ensure adequate safety under normal and postulated accident conditions and that they be designed with appropriate containment, confinement, and filtering systems.

As shown in Attachment 3, the SFP Charcoal Adsorbers are not required to maintain postulated accident conditions below federal limits. Therefore, the fuel storage and handling systems remain in compliance with GDC 61 with the proposed change. The proposed change will not make any physical or design changes to the ABVS nor will it change the way in which the ABVS is operated or controlled. The system will continue to exhaust through currently established flow paths and filters during normal operation and continue to maintain a negative pressure to control

the flow of airborne radioactivity. During a FHA, the ABVS will no longer be credited for dose reduction by filtering airborne reactivity before discharging out the plant vent. However, all automatic responses for the ABVS will continue to actuate upon a high radiation alarm, and the ABVS will continue (although not credited) to reduce dose following a design basis accident. All procedural direction involving the ABVS will remain in effect.

4.2 Precedent

The proposed changes to the Ginna TS are fundamentally the same as those approved in the following Safety Evaluation.

Letter from D. Pickett, U.S. Nuclear Regulatory Commission (NRC), to J. Spina (Calvert Cliffs Nuclear Power Plant), "CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2 - AMENDMENT RE: IMPLEMENTATION OF ALTERNATIVE RADIOLOGICAL SOURCE TERM (TAC NOS. MC8845 AND MC8846)," dated August 29, 2007, (Agencywide Documents Access and Management System (ADAMS) Accession Number ML072130521).

4.3 No Significant Hazards Consideration

CEG has evaluated whether a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.
   The probability of a FHA under the proposed change is unchanged. The dose consequence of a FHA with credit for the SFP Charcoal Adsorbers was evaluated in Attachment 3. The increase in dose consequences to the Control Room (CR) due to the removal of credit for the ABVS was 0.38659 rem. The criteria for considering this a minimal increase are an increase that is less than 10% of the existing margin between calculated dose consequence and federal limits per NEI 96-07, Rev. 1. The margin between the previous dose of 0.80831 rem and the federal limit of 5 rem is 4.19169 rem, 10% of which is 0.41916 rem. The increase in calculated dose of 0.38659 rem is less than 0.41916 rem; therefore, the change in dose consequences is considered minimal, and dose consequences continue to remain well below federal limits.

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.
   The proposed change does not create a new or different kind of accident. Attachment 3 provides the technical justification for the proposed change given a FHA that has been previously evaluated. No new or different kind of accident was identified and the impact of removing credit for the SFP Charcoal Adsorbers during a design basis FHA. The changes to the FHA analysis were limited to dose consequence only.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

   Response: No.
   The increase in dose consequences to the CR due to the removal of credit for the ABVS was 0.38659 rem. The criteria for considering this a minimal increase are an increase that is less than 10% of the existing margin between calculated dose consequence and federal limits per NEI 96-07, Rev. 1. The margin between the previous dose of 0.80831 rem and the federal limit of 5 rem is 4.19169 rem, 10% of which is 0.41916 rem. The increase in calculated dose of 0.38659 rem is less than 0.41916 rem; therefore, the change in dose consequences is considered minimal, and dose consequences continue to remain well below federal limits.

4.4 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need to be prepared in connection with the proposed amendment.

Attachment 2
Markup of Proposed Technical Specifications Pages

REVISED TECHNICAL SPECIFICATIONS PAGES

3.7.10-1
5.5-8
5.5-11
5.6-2

3.7 PLANT SYSTEMS

3.7.10 Auxiliary Building Ventilation System (ABVS)

LCO 3.7.10 The ABVS shall be OPERABLE and in operation.

APPLICABILITY: During movement of irradiated fuel assemblies in the Auxiliary Building when one or more fuel assemblies in the Auxiliary Building has decayed < 60 days since being irradiated.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ABVS inoperable.	A.1 - NOTE - LCO 3.0.3 is not applicable. Suspend movement of irradiated fuel assemblies in the Auxiliary Building.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.10.1	Verify ABVS is in operation.	In accordance with the Surveillance Frequency Control Program
SR 3.7.10.2	Verify ABVS maintains a negative pressure with respect to the outside environment at the Auxiliary Building operating floor level.	In accordance with the Surveillance Frequency Control Program
~~SR 3.7.10.3~~	~~Perform required Spent Fuel Pool Charcoal Adsorber System filter testing in accordance with the Ventilation Filter Testing Program (VFTP).~~	~~In accordance with the VFTP~~

5.5.1 Secondary Water Chemistry Program

This program provides controls for monitoring secondary water chemistry to inhibit SG tube degradation. This program shall include:

a. Identification of a sampling schedule for the critical variables and control points for these variables;

b. Identification of the procedures used to measure the values of the critical variables;

c. Identification of process sampling points;

d. Procedures for the recording and management of data;

e. Procedures defining corrective actions for all off control point chemistry conditions; and

f. A procedure identifying the authority responsible for the interpretation of the data and the sequence and timing of administrative events, which is required to initiate corrective action.

5.5.10 Ventilation Filter Testing Program (VFTP)

A program shall be established to implement the following required testing of Engineered Safety Feature filter ventilation systems and the Spent Fuel Pool (SFP) Charcoal Adsorber System. The test frequencies will be in accordance with Regulatory Guide 1.52, Revision 2, except that in lieu of 18 month test intervals, a 24 month interval will be implemented. The test methods will be in accordance with Regulatory Guide 1.52, Revision 2, except as modified below.

a. Containment Recirculation Fan Cooler System

1. Demonstrate the pressure drop across the high efficiency particulate air (HEPA) filter bank is < 3 inches of water at a design flow rate (± 10%).

2. Demonstrate that an in-place dioctylphthalate (DOP) test of the HEPA filter bank shows a penetration and system bypass < 1.0%.

b. Control Room Emergency Air Treatment System (CREATS)

1. Demonstrate the pressure drop across the combined HEPA filters, the prefilters, the charcoal adsorbers and the post-filters is < 11 inches of water at a design flow rate (± 10%).

2. Demonstrate that an in-place DOP test of the HEPA filter bank shows a penetration and system bypass < 0.05%.

3. Demonstrate that an in-place Freon test of the charcoal adsorber bank shows a penetration and system bypass < 0.05%, when tested under ambient conditions.

4. Demonstrate that a laboratory test of a sample of the charcoal adsorber, when obtained as described in Regulatory Guide 1.52, Revision 2, shows a methyl iodide penetration of less than 1.5% when tested in accordance with ASTM D3803-1989 at a test temperature of 30°C (86°F), a relative humidity of 95%, and a face velocity of 61 ft/min.

~~c. SFP Charcoal Adsorber System~~

~~1. Demonstrate that the total air flow rate from the charcoal adsorbers shows at least 75% of that measured with a complete set of new adsorbers.~~

~~2. Demonstrate that an in-place Freon test of the charcoal adsorbers bank shows a penetration and system bypass < 1.0%, when tested under ambient conditions.~~

~~3. Demonstrate that a laboratory test of a sample of the charcoal adsorber, when obtained as described in Regulatory Guide 1.52, Revision 2, shows a methyl iodide penetration of less than 14.5% when tested in accordance with ASTM D3803-1989 at a test temperature of 30°C (86°F) and a relative humidity of 95%.~~

The provisions of SR 3.0.2 and SR 3.0.3 are applicable to the VFTP frequencies.

5.5.11 Explosive Gas and Storage Tank Radioactivity Monitoring Program

This program provides controls for potentially explosive gas mixtures contained in the waste gas decay tanks and the quantity of radioactivity contained in waste gas decay tanks. The gaseous radioactivity quantities shall be determined following the methodology in NUREG-0133.

The program shall include:

a. The limits for concentrations of hydrogen and oxygen in the waste gas decay tanks and a surveillance program to ensure the limits are maintained. Such limits shall be appropriate to the system's design criteria (i.e., whether or not the system is designed to withstand a hydrogen explosion); and

a. A required system redundant to the system(s) in turn supported by the inoperable supported system is also inoperable; or

b. A required system redundant to the inoperable support system(s) for the supported systems (a) and (b) above is also inoperable.

The SFDP identifies where a loss of safety function exists. If a loss of safety function is determined to exist by this program, the appropriate Conditions and Required Actions of the LCO in which the loss of safety function exists are required to be entered. When a loss of safety function is caused by the inoperability of a single Technical Specification support system, the appropriate Conditions and Required Actions to enter are those of the support system.

5.5.15 Containment Leakage Rate Testing Program

A program shall be established to implement the leakage rate testing of the containment as required by 10 CFR 50.54(o) and 10 CFR 50, Appendix J, Option B, as modified by approved exemptions. This program shall be in accordance with the guidelines contained in NEI 94-01, Revision 2-A, ~~Rev. 0,~~ "Industry Guideline for Implementing Performance- Based Option of 10 CFR 50, Appendix J," ~~Revision 2-A,~~ dated October
2008.

The peak calculated containment internal pressure for the design basis loss of coolant accident, P_a, is 60 psig.

The maximum allowable primary containment leakage rate, L_a, at P_a, shall be 0.2% of containment air weight per day.

Leakage Rate acceptance criteria are:

a. Containment leakage rate acceptance criterion is $\leq 1.0\ L_a$. During the first plant startup following testing in accordance with this program, the leakage rate acceptance criteria are $\leq 0.60\ L_a$ for the Type B and Type C tests and $\leq 0.75\ L_a$ for Type A tests;

b. Air lock testing acceptance criteria are:

1. For each air lock, overall leakage rate is $\leq 0.05\ L_a$ when tested at $\geq P_a$, and

2. For each door, leakage rate is $\leq 0.01\ L_a$ when tested at $\geq P_a$.

5.6.5 CORE OPERATING LIMITS REPORT (COLR)

The following administrative requirements apply to the COLR:

a. Core operating limits shall be established prior to each reload cycle, or prior to any remaining portion of a reload cycle, and shall be documented in the COLR for the following:

2.1,	"Safety Limits (SLs)";
LCO 3.1.1,	"SHUTDOWN MARGIN (SDM)";
LCO 3.1.3,	"MODERATOR TEMPERATURE COEFFICIENT (MTC)";
LCO 3.1.4,	"Rod Group Alignment Limits",
LCO 3.1.5,	"Shutdown Bank Insertion Limit";
LCO 3.1.6,	"Control Bank Insertion Limits";
LCO 3.1.8,	"PHYSICS TEST Exceptions – MODE 2",
LCO 3.2.1,	"Heat Flux Hot Channel Factor ($F_Q(Z)$)";
LCO 3.2.2,	"Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)";
LCO 3.2.3,	"AXIAL FLUX DIFFERENCE (AFD)";
LCO 3.3.1,	"Reactor Protection System (RPS) Instrumentation";
LCO 3.4.1,	"RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits"; ~~and~~
LCO 3.4.5,	"RCS Loops – MODES 1 ≤ 8.5% RTP, 2, and 3", and
LCO 3.9.1,	"Boron Concentration."

Attachment 3

Ginna Fuel Handling Accident Offsite and Control Room Doses
DA-NS-08-050, Rev 001 (September 14, 2021)

ATTACHMENT 1
Design Analysis Cover Sheet

Design Analysis		**Last Page No.** 113	
Analysis No.: [1]	DA-NS-08-050	**Revision:** [2] 001 Major ☒	Minor ☐
Title: [3]	Ginna Fuel Handling Accident Offsite and Control Room Doses		
EC No.: [4]	ECP-21-000367	**Revision:** [5] 000	

		Component(s): [14]	
Station(s): [7]	Ginna Power Station		
Unit No.: [8]	1	N/A	
Discipline: [9]	N/A		
Descrip. Code/Keyword: [10]	N/A		
Safety/QA Class: [11]	SR		
System Code: [12]	01A, 18		
Structure: [13]	N/A		

CONTROLLED DOCUMENT REFERENCES [15]

Controlled Documents listed below

Is this Design Analysis Safeguards Information? [16] **Yes** ☐ **No** ☒ If yes, see SY-AA-101-106

Does this Design Analysis contain Unverified Assumptions? [17] **Yes** ☐ **No** ☒ If yes, ATI/AR#: _____

This Design Analysis SUPERCEDES: [18] None **in its entirety.**

Description of Revision (list changed pages when all pages of original analysis were not changed): [19]
Revision 1 of this calculation removes credit for Spent Fuel Pool vent filters in support of relaxing filter testing.

Preparer: [20]	Isabella Iaccino/Shane Gardner		
	Print Name	Sign Name	Date

Method of Review: [21] **Detailed Review** ☒ **Alternate Calculations (attached)** ☐ **Testing** ☐

Reviewer: [22]	Annie Wong		
	Print Name	Sign Name	Date

Review Notes: [23] Independent review ☒ Peer review ☐

(For External Analyses Only)

External Approver: [24]	N/A		
	Print Name	Sign Name	Date
Exelon Reviewer: [25]	N/A		
	Print Name	Sign Name	Date

Independent 3rd Party Review Reqd? [26] **Yes** ☐ **No** ☒

Exelon Approver: [27]	Tamara Stathes		
	Print Name	Sign Name	Date

CONTROLLED DOCUMENT REFERENCES [15]			
Document No.:	**From/To**	**Document No.:**	**From/To**
DA-NS-2001-060 Rev.2	From	REG DWG 33013-2108 R6	From
REG DWG 33013-2101 R5	From	REG DWG 33013-2109 R3	From
REG DWG 33013-2104 R9	From	REG DWG 33013-2110 R5	From
REG DWG 33013-2105 R4	From	REG DWG 33013-2119 R6	From
REG DWG 33013-2120 R5	From	REG DWG 33013-2121 R3	From
REG DWG 33013-2131 R1	From	REG DWG 33013-2132 R2	From
REG DWG 33013-2133 R2	From	REG DWG 33013-2134 R1	From
REG DWG 33013-2135 R1	From	REG DWG 33013-2136 R3	From
REG DWG 33013-2126 R6	From	REG DWG 33013-4603 R3	From
REG DWG 33013-4613 R2	From	DA-NS-08-049 Rev.0	From

2. LIST OF EFFECTIVE PAGES

All pages are revision 1 and changes are indicated by change bars in the margins.

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(B) ARCON96 OUTPUT FILE SELECTION REGABCBR.OUT
(C) ARCON96 OUTPUT FILE SELECTION REGABCBW.OUT
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4. PURPOSE AND SCOPE

The purpose of this calculation is to determine the offsite and control room doses (TEDE) for a fuel handling accident (FHA) in containment and in the spent fuel pool (SFP). This calculation supersedes DA-NS-2002-004 Rev.3 (Ref.8.13) and incorporates the following revisions:

- This analysis supports an open personnel air lock (PAL) during fuel movement in containment, an open equipment hatch (EH) during fuel movement in containment, and an open roll-up door in the south wall of the Auxiliary Building during fuel movement in the SFP.
- This analysis supports operation of the containment purge via the containment vent during fuel movement in containment and after the fuel handling accident (FHA).
- This analysis supports operation of the plant vent with no credit to filtration during fuel movement and after a FHA.
- This analysis supports a minimum 72 hour decay time prior to fuel movement in containment after shutdown.
- This analysis incorporates gas gap fractions meeting the requirements of Regulatory Guide 1.183 (Ref.8.2).
- This analysis incorporates atmospheric dispersion coefficients meeting the requirements of Regulatory Guide 1.194 (Ref.8.3).

This work uses revised gas gap fractions from those utilized in the previous design-basis analysis DA-NS-2002-004 Rev.3 (Ref.8.13) and from those listed in Regulatory Guide (RG) 1.183 (Reference 8.2) Table 3, because the footnote 11 criteria associated with Table 3 are exceeded by some high burnup fuel pins. Footnote 11 states

- "The release fractions listed here have been determined to be acceptable for use with currently approved LWR fuel with a peak burnup up to 62000 MWd/MTU provided that the maximum linear heat generation rate does not exceed 6.3 kw/ft peak rod average power for burnups exceeding 54 GWd/MTU. As an alternative, fission gas release calculations performed using NRC approved methodologies may be considered on a case-by-case basis. To be acceptable, these calculations must use a projected power history that will bound the limiting projected plant specific power history for the specific fuel load."

The revised gas gap fraction releases were determined in calculation DA-NS-08-049 (Ref.8.21). The results indicate that gas gap fractions must be significantly increased for the limiting pins with burnups over 54 GWd/MTU and with linear heat generation rates in excess of 6.3 kw/ft. Doubling of the I-131, I-132, I-134, I-135, Xe-135, Xe-135m, Xe-138, Kr-85, Kr-85m, Kr-87, and Kr-88 gas gap release fractions detailed in RG 1.183 and tripling of the I-133, Xe-133, and Xe-133m gas gap release fractions detailed in RG 1.183 yield bounding and conservative results. All of the gas gap activity in the damaged rods is released and consists of 20% of the Kr-85, 15% of Xe-133 and Xe-133m, 10% of the other noble gases, 16% of the I-131 , 15% of I-133, and 10% of the other iodine isotopic inventories at the time of the accident.

This work assumes that the radionuclides released from a FHA in containment are released to the environment via the most limiting pathway associated with an isolated containment, an open equipment hatch (EH), an open personnel air lock (PAL), or an open and operating containment vent. The activity released via the PAL is assumed to reach the environment via either the plant vent, the intermediate building (IB) walls or roof, or the auxiliary building (AB) walls or roof. Note that structures not contiguous to the containment were not modeled as release pathways (e.g. Service Building, Turbine Building). If the IB fans are functioning, the PAL release will be from the plant vent, while if they are not functioning, the release should be uniformly distributed from the building roof and walls. Thus the following release pathways were modeled:

- Containment Walls
- Plant Vent
- Containment Vent
- Equipment Hatch Roll-Up Door

- Equipment Hatch Barrel Access Door
- Auxiliary Building Roof
- Auxiliary Building Walls
- Intermediate Building Roof
- Intermediate Building Walls

Note that the above are modeled as diffuse and point releases. The point release from a given structure will bound all other releases from that structure, since the point release assumes the minimum separation between source and receptor and minimum initial diffusion coefficients which maximize the atmospheric dispersion coefficients. Conservative CR atmospheric dispersion coefficient (X/Q) values were calculated using the ARCON96 code (Refs.8.4-8.5) per Regulatory Guide 1.194 methodology (Ref.8.3).

The radionuclides released from a FHA in the SFP area are assumed to be released via the plant vent, which is consistent with the previous design-basis pathway (Ref.8.13) and via the roll-up door on the Auxiliary Building south wall, which is an unfiltered pathway and which constitutes the new design-basis pathway. The plant vent is assumed to provide no filtration.

The receptor for the control room is assumed to be the control room air intake on the roof of the control building (CB), which is consistent with the previous design-basis assumption in DA-NS-2002-004 Rev.3 (Ref.8.13).

Doses are calculated using the alternative source term (AST) methodology of 10 CFR 50.67 (Ref.8.1) and Regulatory Guide 1.183 (Ref.8.2) with the accompanying TEDE dose measurement via the RADTRAD 3.03 computational code. The dose methodology requires construction of two RADTRAD models, modeling a FHA in containment and in the SFP incorporating the limiting atmospheric dispersion coefficient values. The RADTRAD computer code calculates TEDE and thyroid doses per 10 CFR 50.67 and thyroid and whole body doses per TID-14844 (Ref.8.18) to individuals at the exclusion area boundary (EAB), outer boundary of the low population zone (LPZ), and control room (CR) resulting from any postulated accident which releases radioactivity within the containment, spent fuel pool, or within any primary system. RADTRAD models the transport of radioactivity (elemental, particulate, and organic iodine isotopes and krypton and xenon isotopes for the FHA) from the sprayed and unsprayed regions of a primary containment or a SFP area, through the secondary containment if any, and then to the environment and to the control room. The code includes the capability to model time-dependent activity release; containment spray, filtration, and leakage; control room filtration and inleakage; primary and secondary containment purge filters; control room intake filters; atmospheric dispersion; and natural decay.

5. CONCLUSIONS

Table 5: RADTRAD Dose Results		
	Acceptance	
	Criteria	Results
Containment	Rem	Rem
EAB	6.3	1.4820E+00
LPZ	6.3	1.7142E-01
CR	5	4.0416E+00
SFP		
EAB	6.3	1.4820E+00
LPZ	6.3	1.7142E-01
CR	5	1.1949E+00

Offsite and Control Room TEDE doses have been conservatively calculated for Fuel Handling Accidents in the Containment and in the SFP.

- This analysis assumes limiting gas gap fractions.
- This analysis assumes 72 hours of decay prior to fuel offload.
- This analysis assumes limiting atmospheric dispersion coefficients.
- This analysis supports an open personnel air lock during fuel movement in containment, an open equipment hatch during fuel movement in containment, and an open roll-up door in the south wall of the Auxiliary Building during fuel movement in the SFP.
- This analysis supports operation of the containment purge via the containment vent during fuel movement in containment and after the fuel handling accident.
- This analysis supports operation of the plant vent with no credit for filtration during fuel movement and after a FHA.

The resulting TEDE doses are shown in Table 5. All of the calculated TEDE doses are less than the regulatory acceptance values listed in Section 10 and in Table 5.

6. DESIGN INPUTS AND METHOD OF ANALYSIS

6.1 ARCON96 Methodology and Inputs

This work assumes that the radionuclides released from a FHA in containment are released to the environment via the most limiting pathway associated with an isolated containment, an open equipment hatch (EH), an open personnel air lock (PAL), or an open and operating containment vent. The activity released via the PAL is assumed to reach the environment via either the plant vent, the intermediate building (IB) walls or roof, or the auxiliary building (AB) walls or roof. Note that structures not contiguous to the containment were not modeled as release pathways (e.g. Service Building, Turbine Building). If the IB fans are functioning, the PAL release will be from the plant vent, while if they are not functioning, the release should be uniformly distributed from the building roof and walls. The radionuclides released from a FHA in the SFP area are assumed to be released via the plant vent, which is consistent with the previous design-basis pathway (Ref.8.13) and via the roll-up door on the Auxiliary Building south wall, which is an unfiltered pathway and which constitutes the new design-basis pathway. The plant vent is assumed to provide no filtration. Thus the following release pathways were modeled:

- Containment Walls
- Plant Vent
- Containment Vent
- Equipment Hatch Roll-Up Door
- Equipment Hatch Barrel Access Door
- Auxiliary Building Roof
- Auxiliary Building Walls
- Auxiliary Building Roll-Up Door
- Intermediate Building Roof
- Intermediate Building Walls

Note that the above are modeled as diffuse and point releases. The point release from a given structure should bound all other releases from that structure, since the point release assumes minimum separation between source and receptor and minimum initial diffusion coefficients, which maximize the atmospheric dispersion coefficients. Conservative CR atmospheric dispersion coefficient (X/Q) values were calculated using the ARCON96 code (Refs.8.4-8.5) per Regulatory Guide 1.194 methodology (Ref.8.3).

The general inputs and references for ARCON96 are the following:

Table 6.1a: ARCON96 General Inputs

ARCON96 Input Description	ARCON96 Input Value	Reference
Number of Meteorological Data Files	5	Ref. 8.15
Meteorological Data File Names	RGE99B.MET	Ref. 8.15
	RGE00B.MET	Ref. 8.15
	RGE01B.MET	Ref. 8.15
	RGE02B.MET	Ref. 8.15
	RGE03B.MET	Ref. 8.15
Height of Lower Wind Instrument (m)	10.06	UFSAR 2.3.4.2.3
Height of Upper Wind Instrument (m)	45.72	UFSAR 2.3.4.2.3
Wind Speed Units	(1) m/sec	Ref. 8.15
Release Type	(1) Ground-level	Ref. 8.2
Release Height	Case Dependent	
Building Area Wake (m2)	2000	Ref. 8.2, Section 11.2
Effluent Vertical Velocity (m/sec)	0	Ref. 8.2
Vent or Stack Flow (m3/sec)	0	Ref. 8.2
Vent or Stack Radius (m)	0	Ref. 8.2
Direction - Intake to Source (deg)	Case Dependent	

Wind Direction Sector Width (deg)	90	Ref. 8.2
Distance to Intake (m)	Case Dependent	
Intake Height (m)	Case Dependent	
Terrain Elevation Difference (m)	0	Ref. 8.2
Output File Name	Case Dependent	
JFD File Name	Case Dependent	
Surface Roughness Length (m)	0.2	Ref. 8.2
Minimum Wind Speed (m/sec)	0.5	Ref. 8.2
Sector Averaging Constant	4.3	Ref. 8.2
Hours in Averages	1,2,4,8,12,24,96,168,360,720	Ref. 8.2
Minimum Number of Hours	1,2,4,8,11,22,87,152,324,648	Ref. 8.2
Initial Value of Sigma-Y	Case Dependent	
Initial Value of Sigma-Z	Case Dependent	

The case dependent inputs are the distances, directions, and source areas associated with each pathway. To determine distances, directions, and diffuse source areas, the following Ginna plant dimensions and elevations were extracted from plant drawings:

Table 6.1b: Distances

Column Number	Column Number	Distance ft	Distance in	Distance ft	Reference
1	2	32	6	32.5000	33013-2110 R5
2	2b	20	6	20.5000	33013-2110 R5
2b	3	27	0	27.0000	33013-2110 R5
3	4a	26	10	26.8333	33013-2108R6/2121R3
4a	4d	18	10	18.8333	33013-2108R6/2121R3
4d	5a	8	0	8.0000	33013-2108R6/2121R3
5a	6a	26	10	26.8333	33013-2108R6/2121R3
6a	7a	24	10	24.8333	33013-2108R6/2121R3
7a	8a	32	4	32.3333	33013-2108R6/2121R3
8a	9a	25	8	25.6667	33013-2108 R6
9a	10a	25	8	25.6667	33013-2108 R6
10a	11a	25	5	25.4167	33013-2108 R6
3	4d			45.6667	33013-2121 R3
1	3			80.0000	33013-2110 R5
3	11a	214	5	214.4167	33013-2108 R6
8a	11a			76.7500	
3	5a	53	8	53.6667	33013-2108R6/2121R3
1	2	32	6	32.5000	33013-2110 R5
2	2b	20	6	20.5000	33013-2110 R5
2b	3	27	0	27.0000	33013-2110 R5
3	3a	6	4	6.3333	33013-2110 R5
3a	3b	15	10.5	15.8750	33013-2110 R5
1	3a			86.3333	33013-2110 R5
3	Ctmt cl	71	8	71.6667	33013-2108R6/2121R3
Ctmt cl	6a	8	10	8.8333	33013-2108R6/2121R3
3	6a	80	6	80.5000	33013-2121 R3

3	12			231.7500	
11	CR Inlet	15.45		15.4500	33013-2127 R2
CR Inlet	12	10.3	0	10.3000	33013-2127 R2
3	CR Inlet			221.4500	
Ctmt cl	CR inlet	E-W		149.7833	ctmt cl-cr in=149.78'
J	Ctmt cl	1	6	1.5000	33013-2101 R5
F	J			72.7500	33013-2121 R3
F	Ctmt cl			74.2500	
F	CR Inlet			10.3500	33013-2127 R2
CR Inlet	Ctmt cl	N-S		63.9000	
3	4	25	9	25.7500	33013-2105R4/2121R3
4	5	25	9	25.7500	33013-2105R4/2121R3
5	6	25	9	25.7500	33013-2105R4/2121R3
6	7	13	1.25	13.1042	33013-2105R4/2121R3
7	7b	13	10.75	13.8958	33013-2121 R3
7b	7c	7	5.625	7.4688	33013-2121 R3
7c	8	13	4.625	13.3854	33013-2121 R3
8	9	34	9	34.7500	33013-2105 R4
9	10	20	4.75	20.3958	33013-2105 R4
10	11	25	9	25.7500	33013-2105 R4
11	12	25	9	25.7500	33013-2104 R9
12	13	25	9	25.7500	33013-2104 R9
13	14	6	0	6.0000	33013-2119 R6
14	15	26	6	26.5000	33013-2119 R6
15	16	26	6	26.5000	33013-2119 R6
3	13			257.5000	33013-2120 R5
11	13			51.5000	33013-2136 R3
14	16			53.0000	33013-2119 R6
3	7c			111.7188	33013-2105 R4
5	11			154.5000	
6	11			128.7500	
7	11			115.6458	
7c	11			94.2813	
A	B	27	6	27.5000	33013-2120 R5
B	C	24	3	24.2500	33013-2120R5/2119R6
C	D	24	3	24.2500	33013-2120R5/2119R6
D	E	24	3	24.2500	33013-2120R5/2119R6
E	F	24	3	24.2500	33013-2120R5/2119R6
F	G	24	3	24.2500	33013-2121 R3
G	H	24	3	24.2500	33013-2121 R3
H	J	24	3	24.2500	33013-2121 R3
J	K	24	3	24.2500	33013-2121 R3
K	L	11	9	11.7500	33013-2121 R3
L	M	12	6	12.5000	33013-2121 R3
M	N	12	3	12.2500	33013-2121 R3
N	O	11	6	11.5000	33013-2110 R5

O	P	25	0	25.0000	33013-2110 R5
P	Q	8	6	8.5000	33013-2110 R5
Q	R	15	6	15.5000	33013-2110 R5
A	F			124.5000	33013-2120 R5
F	N			133.5000	33013-2105 R4
F	H			48.5000	33013-2105 R4
H	N			85.0000	33013-2105 R4
L	Q			70.7500	33013-2108 R6
N	Q			46.0000	33013-2108 R6
A	R			319.5000	33013-2109R3/2110R5
F	L			108.7500	
F	F'	23	6	23.5000	33013-2136 R3
F'	G'	17	4	17.3333	33013-2136 R3
F	G'			40.8333	33013-2136 R3
L	outer wall	1	3	1.2500	33013-2108 R6
Q	outer wall	1	3	1.2500	33013-2108 R6
11a	outer wall	1	3	1.2500	33013-2108 R6
7c	outer wall	1	2.25	1.1875	33013-2121 R3

Table 6.1c: Dimensions					
Location	**Description**			**References**	
Plant	Grade Elevation	270.0000	ft	33013-2131 R1	
Containment	Inner radius	52.5000	ft	33013-2131 R1	33013-2132 R2
	Liner	0.0313	ft	33013-2131 R1	33013-2132 R2
	Concrete thickness	3.5000	ft	33013-2132 R2	
	Outer radius	56.0313	ft	33013-2134 R1	
	Spring line EL	330.6667	ft	33013-2134 R1	33013-2131 R1
	Dome outer EL	385.6979	ft	33013-2131 R1	
	Dome inner radius	52.5000	ft	33013-2131 R1	
	Dome liner	0.0313	ft	33013-2131 R1	
	Dome concrete thickness	2.5000	ft	33013-2131 R1	
	Dome outer radius	55.0313	ft	33013-2134 R1	
	PAL-Pen 1000 CL EL	283.7500	ft	33013-2131 R1	33013-2135 R1
	PAL-Pen 1000 Sleeve Size	9.5625	ft	33013-2135 R1	
	PAL-Pen 1000 Azimuthal Loc	277.8750	deg	33013-2135 R1	
	EH-Pen 2000 CL EL	281.5938	ft	33013-2131 R1	33013-2135 R1
	EH-Pen 2000 Sleeve Size	14.0000	ft	33013-2135 R1	
	EH-Pen 2000 Azimuthal Loc	100.1250	deg	33013-2135 R1	
	MiniPurgeEx-Pen 132 CL EL	256.2500	ft	33013-2135 R1	
	MiniPurgeEx-Pen 132 Sleeve Size	0.8333	ft	33013-2135 R1	
	MiniPurgeEx-Pen 132 Azimuthal Loc	181.1250	deg	33013-2135 R1	
	SDPurgeSup-Pen 204 CL EL	263.0000	ft	33013-2135 R1	
	SDPurgeSup-Pen 204 Sleeve Size	4.5000	ft	33013-2135 R1	
	SDPurgeSup-Pen 204 Azimuthal Loc	235.1250	deg	33013-2135 R1	
	SDPurgeEx-Pen 300 CL EL	310.0000	ft	33013-2135 R1	
	SDPurgeEx-Pen 300 Sleeve Size	4.5000	ft	33013-2135 R1	
	SDPurgeEx-Pen 300 Azimuthal Loc	3.3750	deg	33013-2135 R1	
Reactor	Hot Leg CL EL	246.8333	ft	33013-2132 R2	
AB	Roof EL	328.0156	ft	33013-2132 R2	33013-2133 R2
CB	Air intake duct cl EL	315.4167	ft	33013-2136 R3	
	CB Roof Parapet EL	313.0000	ft	33013-2136 R3	
IB	Roof EL (H-7c)	336.3229	ft	33013-2134 R1	33013-2133 R2
	Roof EL (4d-H)	318.4688	ft	33013-2134 R1	33013-2133 R2
TB	TB Roof Parapet EL	361.0000	ft	33013-2136 R3	

See Figure 6.1.14 for a graphical representation of the plant layout.

6.1.1 Containment Surface to Control Room Intake

Table 6.1.1: ARCON96 Inputs for Containment Cylinder + Dome to CR Inlet					
X	Source to Receptor E-W	149.7833	ft	45.6540	m
Y	Source to Receptor N-S	63.9000	ft	19.4767	m
R	Ctmt Radius	56.0313	ft	17.0783	m
S	sqrt(X^2+Y^2)-R	106.8130	ft	32.5566	m
theta	270-arcsin(Y/(R+S))	246.8961	deg		
Zsu	Source elevation upper	373.1168	ft	113.7260	m
Zsl	Source elevation lower	270.0000	ft	82.2960	m
Hs	Source elevation=(Zsu-Zsl)/2	51.5584	ft	15.7150	m
sigma-z	(Zsu-Zsl)/6	17.1861	ft	5.2383	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Elevation above Grade	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
W	Source width	112.0625	ft	34.1567	m
sigma-y	W/6	18.6771	ft	5.6928	m

A graphical representation is shown in Figure 6.1.1.

- X is the East-West distance from the containment centerline to the CR inlet per Table 6.1b.
- Y is the North-South distance from the containment centerline to the CR inlet per Table 6.1b.
- R is the containment outer radius per Table 6.1c.
- Zsu=weighted upper source elevation = π*Rd^2/(2*R)+Esl = π*(55.0313)^2/(4*56.0313)+330.6667 = 373.1168'
    - Rd is the containment dome radius (Table 6.1c)
    - R is the containment cylinder radius (Table 6.1c)
    - Esl is the containment spring line elevation (Table 6.1c)
- Zsl and Zg are the plant grade elevations (Table 6.1c).
- Per RG 1.194 (Ref.8.3) 3.2.4.5: "The height and width of the area source are taken as the maximum vertical and horizontal dimensions of the above-grade building cross-sectional area perpendicular to the line of sight from the building center to the control room intake. These dimensions are projected onto a vertical plane perpendicular to the line of sight and located at the closest point to the building surface to the control room intake. The release height is set at the vertical center of the projected plane." Thus,
    - The source elevation is Hs=(Zsu-Zsl)/2.
    - The projected source width is W=2*R.
    - The distance from the projected plane to the inlet is S=sqrt(X^2+Y^2)-R.
    - The direction from inlet to source is theta=270-arcsin(Y/(R+S)).
- Per RG 1.194 3.2.4.4, the vertical initial diffusion coefficient (sigma-z) should be the source height divided by 6.
- Per RG 1.194 3.2.4.4, the horizontal initial diffusion coefficient (sigma-y) should be the source width divided by 6.
- Zi is the inlet elevation per Table 6.1c.
- Hi is the inlet elevation above grade Hi=Zi-Zg.

6.1.2 Plant Vent Point Source to Control Room Intake

Table 6.1.2: ARCON96 Inputs for Plant Vent Point Source to CR Inlet					
X	Source to Receptor E-W	172.6167	ft	52.6136	m
Y	Source to Receptor N-S	5.3500	ft	1.6307	m
D	sqrt(X^2+Y^2)	172.6996	ft	52.6388	m
S	D-W/2	170.4079	ft	51.9403	m
theta	360-arcsin(X/S)	271.7752	deg		
Zsu	Source elevation	387.0000	ft	117.9576	m
Hs	Source height	117.0000	ft	35.6616	m
sigma-z	Point Source	0.0000	ft	0.0000	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
W	Source diameter	4.5833	ft	1.3970	m
sigma-y	Point source	0.0000	ft	0.0000	m

A graphical representation is shown in Figure 6.1.2.

- X is the East-West distance from the plant vent center to the CR inlet. Figure 6.1.15 shows a distance of 2'8" from the plant vent to column 5. Column 5 to column 11 is 154.5' per Table 6.1b. Column 11 to the control room inlet is 15.45' per Table 6.1b. The sum is 172.6167'.
- Y is the North-South distance from the plant vent center to the CR inlet. Figure 6.1.15 shows a distance of 5'0" from the plant vent to column F. Column F to the control room inlet is 10.35' per Table 6.1b. The difference is 5.35'.
- Zsu is the plant vent discharge elevation per Ref. 8.13, while Hs is the discharge height relative to plant grade.
- Zi is the inlet elevation per Table 6.1c, while Hi is the inlet elevation relative to grade.
- Zg is the plant grade elevations (Table 6.1c).
- Per RG 1.194 (Ref.8.3) 3.2.4.7 for horizontal area sources: "The distance to the receptor is measured from the closest point on the perimeter of the assumed area source. For assumed areas that are not circular, the area width is measured perpendicular to the line of sight from the center of the assumed source to the control room intake. The initial diffusion coefficient σ_{yo} is found by equation 3 (area source width divided by 6); σ_{zo} is assumed to be zero." Thus,
    - The source width W is 55" per Ref. 8.13.
    - The distance from the source to the inlet is S=sqrt(X^2+Y^2)-W/2.
    - The direction from inlet to source is theta=360-arcsin(X/S).
    - A point source is assumed in this case, so sigma-y and sigma-z are set to zero.

6.1.3 Plant Vent Area Source to Control Room Intake

Table 6.1.3: ARCON96 Inputs for Plant Vent Area Source to CR Inlet					
X	Source to Receptor E-W	172.6167	ft	52.6136	m
Y	Source to Receptor N-S	5.3500	ft	1.6307	m
D	sqrt(X^2+Y^2)	172.6996	ft	52.6388	m
S	D-W/2	170.4079	ft	51.9403	m
theta	360-arcsin(X/S)	271.7752	deg		
Zsu	Source elevation	387.0000	ft	117.9576	m
Hs	Source height	117.0000	ft	35.6616	m
sigma-z	Area source	0.0000	ft	0.0000	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
W	Source diameter	4.5833	ft	1.3970	m
sigma-y	W/6	0.7639	ft	0.2328	m

A graphical representation is shown in Figure 6.1.2.

- X is the East-West distance from the plant vent center to the CR inlet. Figure 6.1.15 shows a distance of 2'8" from the plant vent to column 5. Column 5 to column 11 is 154.5' per Table 6.1b. Column 11 to the control room inlet is 15.45' per Table 6.1b. The sum is 172.6167'.
- Y is the North-South distance from the plant vent center to the CR inlet. Figure 6.1.15 shows a distance of 5'0" from the plant vent to column F. Column F to the control room inlet is 10.35' per Table 6.1b. The difference is 5.35'.
- Zsu is the plant vent discharge elevation per Ref. 8.13, while Hs is the discharge height relative to plant grade.
- Zi is the inlet elevation per Table 6.1c, while Hi is the inlet elevation relative to grade.
- Zg is the plant grade elevations (Table 6.1c).
- Per RG 1.194 (Ref.8.3) 3.2.4.7 for horizontal area sources: "The distance to the receptor is measured from the closest point on the perimeter of the assumed area source. For assumed areas that are not circular, the area width is measured perpendicular to the line of sight from the center of the assumed source to the control room intake. The initial diffusion coefficient σ_{yo} is found by equation 3 (area source width divided by 6); σ_{zo} is assumed to be zero." Thus,
    - The source width W is 55" per Ref. 8.13.
    - The distance from the source to the inlet is S=sqrt(X^2+Y^2)-W/2.
    - The direction from inlet to source is theta=360-arcsin(X/S).
    - An area source is assumed in this case, so
        - sigma-y is set to W/6
        - sigma-z is set to zero.

6.1.4 Containment Vent Point Source to Control Room Intake

Table 6.1.4: ARCON96 Inputs for Containment Vent Point Source to CR Inlet					
X	Source to Receptor E-W	167.2833	ft	50.9879	m
Y	Source to Receptor N-S	5.3500	ft	1.6307	m
D	sqrt(X^2+Y^2)	167.3688	ft	51.0140	m
S	S=D-W/2	165.9522	ft	50.5822	m
theta	360-arcsin(X/S)	271.8318	deg		
Zsu	Source elevation	387.0000	ft	117.9576	m
Hs	Source height	117.0000	ft	35.6616	m
sigma-z	Point source	0.0000	ft	0.0000	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
W	Source diameter	2.8333	ft	0.8636	m
sigma-y	Point source	0.0000	ft	0.0000	m

A graphical representation is shown in Figure 6.1.3.

- X is the East-West distance from the containment vent center to the CR inlet. Figure 6.1.15 shows a distance of -2'8" from the containment vent center to column 5. Column 5 to column 11 is 154.5' per Table 6.1b. Column 11 to the control room inlet is 15.45' per Table 6.1b. The sum is 167.2833'.
- Y is the North-South distance from the containment vent center to the CR inlet. Figure 6.1.15 shows a distance of 5'0" from the containment vent to column F. Column F to the control room inlet is 10.35' per Table 6.1b. The difference is 5.35'.
- Zsu is the plant vent discharge elevation per Ref. 8.13, while Hs is the discharge height relative to plant grade.
- Zi is the inlet elevation per Table 6.1c, while Hi is the inlet elevation relative to grade.
- Zg is the plant grade elevations (Table 6.1c).
- Per RG 1.194 (Ref.8.3) 3.2.4.7 for horizontal area sources: "The distance to the receptor is measured from the closest point on the perimeter of the assumed area source. For assumed areas that are not circular, the area width is measured perpendicular to the line of sight from the center of the assumed source to the control room intake. The initial diffusion coefficient σ_{yo} is found by equation 3 (area source width divided by 6); σ_{zo} is assumed to be zero." Thus,
    - The source width W is 34" per Ref. 8.13.
    - The distance from the source to the inlet is S=sqrt(X^2+Y^2)-W/2.
    - The direction from inlet to source is theta=360-arcsin(X/S).
    - A point source is assumed in this case, so sigma-y and sigma-z are set to zero.

6.1.5 Containment Vent Area Source to Control Room Intake

Table 6.1.5: ARCON96 Inputs for Containment Vent Area Source to CR Inlet					
X	Source to Receptor E-W	167.2833	ft	50.9879	m
Y	Source to Receptor N-S	5.3500	ft	1.6307	m
D	sqrt(X^2+Y^2)	167.3688	ft	51.0140	m
S	S=D-W/2	165.9522	ft	50.5822	m
theta	360-arcsin(X/S)	271.8318	deg		
Zsu	Source elevation	387.0000	ft	117.9576	m
Hs	Source height	117.0000	ft	35.6616	m
sigma-z	Area Source	0.0000	ft	0.0000	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
W	Source diameter	2.8333	ft	0.8636	m
sigma-y	W/6	0.4722	ft	0.1439	m

A graphical representation is shown in Figure 6.1.3.

- X is the East-West distance from the containment vent center to the CR inlet. Figure 6.1.15 shows a distance of -2'8" from the containment vent center to column 5. Column 5 to column 11 is 154.5' per Table 6.1b. Column 11 to the control room inlet is 15.45' per Table 6.1b. The sum is 167.2833'.
- Y is the North-South distance from the containment vent center to the CR inlet. Figure 6.1.15 shows a distance of 5'0" from the containment vent to column F. Column F to the control room inlet is 10.35' per Table 6.1b. The difference is 5.35'.
- Zsu is the plant vent discharge elevation per Ref. 8.13, while Hs is the discharge height relative to plant grade.
- Zi is the inlet elevation per Table 6.1c, while Hi is the inlet elevation relative to grade.
- Zg is the plant grade elevations (Table 6.1c).
- Per RG 1.194 (Ref.8.3) 3.2.4.7 for horizontal area sources: "The distance to the receptor is measured from the closest point on the perimeter of the assumed area source. For assumed areas that are not circular, the area width is measured perpendicular to the line of sight from the center of the assumed source to the control room intake. The initial diffusion coefficient σ_{yo} is found by equation 3 (area source width divided by 6); σ_{zo} is assumed to be zero." Thus,
    - The source width W is 34" per Ref. 8.13.
    - The distance from the source to the inlet is S=sqrt(X^2+Y^2)-W/2.
    - The direction from inlet to source is theta=360-arcsin(X/S).
    - An area source is assumed in this case, so
        - sigma-y is set to W/6
        - sigma-z is set to zero.

6.1.6 Equipment Hatch Roll-Up Door Point Source to Control Room Intake

Table 6.1.6: ARCON96 Inputs for Equipment Hatch Roll-Up Door Point Source to CR Inlet					
X	Source to Receptor E-W	68.2800	ft	20.8117	m
Y	Source to Receptor N-S	64.1900	ft	19.5651	m
S	sqrt(X^2+Y^2)	93.7151	ft	28.5644	m
theta	270-arcsin(Y/S)	226.7684	deg		
Zsu	Source elevation upper	292.0000	ft	89.0016	m
Zsl	Source elevation lower	270.0000	ft	82.2960	m
Hs	Source height	11.0000	ft	3.3528	m
sigma-z	Point source	0.0000	ft	0.0000	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
sigma-y	Point source	0.0000	ft	0.0000	m

A graphical representation is shown in Figure 6.1.4.

- X is the East-West distance from the EH northeast corner to the CR inlet per Ref.8.13.
- Y is the North-South distance from the EH northeast corner to the CR inlet per Ref.8.13.
- Zsu is the upper source elevation per Refs. 8.13 and 8.32.
- Zsl is the lower source elevation per Refs. 8.13 and 8.32.
- Zg is the plant grade elevations (Table 6.1c).
- Per RG 1.194 (Ref.8.3) 3.2.4.5: "The height and width of the area source are taken as the maximum vertical and horizontal dimensions of the above-grade building cross-sectional area perpendicular to the line of sight from the building center to the control room intake. These dimensions are projected onto a vertical plane perpendicular to the line of sight and located at the closest point to the building surface to the control room intake. The release height is set at the vertical center of the projected plane." Thus,
    - The source elevation is Hs=(Zsu-Zsl)/2.
    - The minimum distance from the northeast corner of the EH Roll-Up Door to the inlet is S=sqrt(X^2+Y^2).
    - The direction from inlet to source is theta=270-arcsin(Y/S).
    - A point source is assumed in this case, so sigma-y and sigma-z are set to zero.
- Zi is the inlet elevation per Table 6.1c.
- Hi is the inlet elevation above grade Hi=Zi-Zg.

6.1.7 Equipment Hatch Roll-Up Door Area Source to Control Room Intake

Table 6.1.7: ARCON96 Inputs for Equipment Hatch Roll-Up Door Area Source to CR Inlet					
X	Source to Receptor E-W	68.2800	ft	20.8117	m
Y	Source to Receptor N-S	64.1900	ft	19.5651	m
S	sqrt(X^2+Y^2)	93.7151	ft	28.5644	m
theta	270-arcsin(Y/S)-arctan(W'/2/S)	221.5489	deg		
Zsu	Source elevation upper	292.0000	ft	89.0016	m
Zsl	Source elevation lower	270.0000	ft	82.2960	m
Hs	Source height	11.0000	ft	3.3528	m
sigma-z	(Zsu-Zsl)/6	3.6667	ft	1.1176	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
W	Source width	23.5000	ft	7.1628	m
W'	Projected width = W*X/S	17.1219	ft	5.2188	m
sigma-y	W'/6	2.8536	ft	0.8698	m

A graphical representation is shown in Figure 6.1.5.

- X is the East-West distance from the EH northeast corner to the CR inlet per Ref.8.13.
- Y is the North-South distance from the EH northeast corner to the CR inlet per Ref.8.13.
- Zsu is the upper source elevation per Refs. 8.13 and 8.32.
- Zsl is the lower source elevation per Refs. 8.13 and 8.32.
- Zg is the plant grade elevations (Table 6.1c).
- Per RG 1.194 (Ref.8.3) 3.2.4.5: "The height and width of the area source are taken as the maximum vertical and horizontal dimensions of the above-grade building cross-sectional area perpendicular to the line of sight from the building center to the control room intake. These dimensions are projected onto a vertical plane perpendicular to the line of sight and located at the closest point to the building surface to the control room intake. The release height is set at the vertical center of the projected plane." Thus,
  - The source elevation is Hs=(Zsu-Zsl)/2.
  - The minimum distance from the EH Roll-Up Door to the inlet is S=sqrt(X^2+Y^2).
  - The width of the EH Roll-Up Door is 23.5' per Ref. 8.38.
  - The projected width of the EH Roll-Up Door is W*X/S.
  - The direction from inlet to mid-point of the projected planar source is theta=270-arcsin(Y/S)-arctan(W'/2/S).
- Per RG 1.194 3.2.4.4, the vertical initial diffusion coefficient (sigma-z) should be the source height divided by 6.
- Per RG 1.194 3.2.4.4, the horizontal initial diffusion coefficient (sigma-y) should be the projected source width divided by 6.
- Zi is the inlet elevation per Table 6.1c.
- Hi is the inlet elevation above grade Hi=Zi-Zg.

6.1.8 Equipment Hatch Barrel Access Door Point Source to Control Room Intake

Table 6.1.8: ARCON96 Inputs for Equipment Hatch Barrel Access Door Point Source to CR Inlet					
X	Source to Receptor E-W	73.1919	ft	22.3089	m
Y	Source to Receptor N-S	77.2967	ft	23.5600	m
S	sqrt(X^2+Y^2)	106.4511	ft	32.4463	m
theta	270-arcsin(Y/S)	223.4376	deg		
Zsu	Source elevation midpoint	281.6563	ft	85.8488	m
Hs	Source height	11.6563	ft	3.5528	m
sigma-z	Point source	0.0000	ft	0.0000	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
sigma-y	Point source	0.0000	ft	0.0000	m

A graphical representation is shown in Figures 6.1.6 and 6.1.13.

- X is the East-West distance and Y is the North-South distance from the Equipment Hatch Barrel Access Door (EHBAD) northeast corner to the CR inlet.
  - The width (W) of the EHBAD is 3.625’ per Ref. 8.14.
  - The width of the Equipment Hatch Barrel (EHB) is 14’ per Ref. 8.36.
  - Thus, the distance between the outsides of the EHBAD and the EHB is 5.1875’.
  - The EHB centerline is at 100.125^{o} from true north.
  - The East-West distance from the EH northeast corner to the CR inlet is 68.28’ per Ref.8.13.
  - The North-South distance from the EH northeast corner to the CR inlet is 64.19’ per Ref.8.13.
  - The East-West distance from the EH to the EHB is 4’ per Ref.8.14.
  - The North-South distance from the EH to the EHB is 8’ per Ref. 8.14.
  - Thus, X=68.28’ + 4’ + 5.1875’ * sin(10.125^{o}) = 73.1919’
  - Thus, Y=64.19’ + 8’ + 5.1875’ * cos(10.125^{o}) = 77.2967’
- Zsu is the source elevation midpoint per Ref. 8.14.
  - The bottom of the EHBAD is at elevation 278.2604’.
  - The height of the EHBAD is 6.7917’.
  - Thus the EHBAD midpoint is at 281.6563’.
- Zg is the plant grade elevations (Table 6.1c).
- Per RG 1.194 (Ref.8.3) 3.2.4.5: “The height and width of the area source are taken as the maximum vertical and horizontal dimensions of the above-grade building cross-sectional area perpendicular to the line of sight from the building center to the control room intake. These dimensions are projected onto a vertical plane perpendicular to the line of sight and located at the closest point to the building surface to the control room intake. The release height is set at the vertical center of the projected plane.” Thus,
  - The source elevation is Hs=(Zsu-Zg).
  - The minimum distance from the northeast corner of the EHBAD to the inlet is S=sqrt(X^2+Y^2).
  - The direction from inlet to source is theta=270-arcsin(Y/S).
  - A point source is assumed in this case, so sigma-y and sigma-z are set to zero.
- Zi is the inlet elevation per Table 6.1c.
- Hi is the inlet elevation above grade Hi=Zi-Zg.

6.1.9 Equipment Hatch Barrel Access Door Area Source to Control Room Intake

Table 6.1.9: ARCON96 Inputs for Equipment Hatch Barrel Access Door Area Source to CR Inlet					
X	Source to Receptor E-W	73.1919	ft	22.3089	m
Y	Source to Receptor N-S	77.2967	ft	23.5600	m
S	sqrt(X^2+Y^2)	106.4511	ft	32.4463	m
phi	arcsin(X/S)	43.4376	deg		
gamma	Barrel angle from 90 degrees	10.1250	deg		
beta	arctan(W'/2/S)	0.5358	deg		
theta	180+phi-beta	222.9018	deg		
Zsu	Source elevation upper	285.0521	ft	86.8839	m
Zsl	Source elevation lower	278.2604	ft	84.8138	m
Hs	Source height	11.6563	ft	3.5528	m
sigma-z	(Zsu-Zsl)/6	1.1320	ft	0.3450	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
W	Source width	3.6250	ft	1.1049	m
W'	Projected width=W*cos(90+gamma-phi)	1.9909	ft	0.6068	m
sigma-y	W'/6	0.3318	ft	0.1011	m

A graphical representation is shown in Figures 6.1.7 and 6.1.13.

- X is the East-West distance and Y is the North-South distance from the Equipment Hatch Barrel Access Door (EHBAD) northeast corner to the CR inlet.
  - The width (W) of the EHBAD is 3.625’ per Ref. 8.14.
  - The width of the Equipment Hatch Barrel (EHB) is 14’ per Ref. 8.36.
  - Thus, the distance between the outsides of the EHBAD and the EHB is 5.1875’.
  - The EHB centerline is at 100.125° from true north.
  - The East-West distance from the EH northeast corner to the CR inlet is 68.28’ per Ref.8.13.
  - The North-South distance from the EH northeast corner to the CR inlet is 64.19’ per Ref.8.13.
  - The East-West distance from the EH to the EHB is 4’ per Ref.8.14.
  - The North-South distance from the EH to the EHB is 8’ per Ref. 8.14.
  - Thus, X=68.28’ + 4’ + 5.1875’ * sin(10.125°) = 73.1919’
  - Thus, Y=64.19’ + 8’ + 5.1875’ * cos(10.125°) = 77.2967’
- Zsu and Zsl are the upper and lower source elevations per Refs. 8.14.
  - The bottom of the EHBAD is at elevation 278.2604’.
  - The height of the EHBAD is 6.7917’.
  - Thus the top of the EHBAD is at 285.0521’.
  - The source midpoint elevation is Hs=(Zsl-Zg)+(Zsu-Zsl)/2=11.6563.
- Zg is the plant grade elevations (Table 6.1c).
- Per RG 1.194 (Ref.8.3) 3.2.4.5: “The height and width of the area source are taken as the maximum vertical and horizontal dimensions of the above-grade building cross-sectional area perpendicular to the line of sight from the building center to the control room intake. These dimensions are projected onto a vertical plane perpendicular to the line of sight and located at the closest point to the building surface to the control room intake. The release height is set at the vertical center of the projected plane.” Thus,
  - The minimum distance from the northeast corner of the EHBAD to the inlet is S=sqrt(X^2+Y^2).
  - The direction from inlet to source is theta=180+phi-beta=180-arcsin(X/S)—arctan(W’/2/S)

- The projected width (W') of the EHBAD is 3.625'*cos(90+gamma-phi).
- The vertical initial diffusion coefficient (sigma-z) should be the source height (Zsu-Zsl) divided by 6.
- The horizontal initial diffusion coefficient (sigma-y) should be the projected source width (W') divided by 6.

- Zi is the inlet elevation per Table 6.1c.
- Hi is the inlet elevation above grade Hi=Zi-Zg.

6.1.10 Auxiliary Building Point Source to Control Room Intake

Table 6.1.10: ARCON96 Inputs for Auxiliary Building Point Source to CR Inlet					
X	Source to Receptor E-W	5.7833	ft	1.7627	m
Y	Source to Receptor N-S	97.1500	ft	29.6113	m
S	sqrt(X^2+Y^2)	97.3220	ft	29.6637	m
theta	270-arcsin(Y/S)	183.4068	deg		
Zsu	Source elevation upper	328.0156	ft	99.9792	m
Hs	Source height	29.0078	ft	8.8416	m
sigma-z	Point source	0.0000	ft	0.0000	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
sigma-y	Point source	0.0000	ft	0.0000	m

A graphical representation is shown in Figure 6.1.8.

- X is the East-West distance from the AB northeast corner to the CR inlet per Table 6.1b.
  - Column 3 to the CR Inlet is 221.45'
  - Column 3 to column 11a is 214.4167'.
  - Column 11a to the AB outer wall is 1.25'
  - Distance = 221.45 – 214.4167 – 1.25 = `5.7833'
- Y is the North-South distance from the EH northeast corner to the CR inlet per Table 6.1b.
  - Column F to L is108.75'
  - Column F to the CR Inlet is 10.35'.
  - Column L to the AB outer wall is 1.25'.
  - Distance = 108.75 – 10.35 – 1.25 = 97.15'
- Zsu is the upper source elevation per Table 6.1c.
- Zg is the plant grade elevation per Table 6.1c.
- Per RG 1.194 (Ref.8.3) 3.2.4.5: "The height and width of the area source are taken as the maximum vertical and horizontal dimensions of the above-grade building cross-sectional area perpendicular to the line of sight from the building center to the control room intake. These dimensions are projected onto a vertical plane perpendicular to the line of sight and located at the closest point to the building surface to the control room intake. The release height is set at the vertical center of the projected plane." Thus,
  - The source elevation is Hs=(Zsu-Zg)/2.
  - The minimum distance from the northeast corner of the AB to the CR inlet is S=sqrt(X^2+Y^2).
  - The direction from inlet to source is theta=270-arcsin(Y/S).
  - A point source is assumed in this case, so sigma-y and sigma-z are set to zero.
- Zi is the inlet elevation per Table 6.1c.
- Hi is the inlet elevation above grade Hi=Zi-Zg.

6.1.11 Auxiliary Building Roof Area Source to Control Room Intake

Table 6.1.11: ARCON96 Inputs for Auxiliary Building Roof Area Source to CR Inlet					
X	Source to Receptor E-W	5.7833	ft	1.7627	m
Y	Source to Receptor N-S	97.1500	ft	29.6113	m
S	sqrt(X^2+Y^2)	97.3220	ft	29.6637	m
W	Source width	215.6667	ft	65.7352	m
V	Source width	47.2500	ft	14.4018	m
U	Source width	73.2500	ft	22.3266	m
a	W/2+X	113.6167	ft	34.6304	m
b	U/2+Y	133.7750	ft	40.7746	m
theta	270-phi	220.3416	deg		
phi	arctan(b/a)	49.6584	deg		
Zsu	Source elevation upper	328.0156	ft	99.9792	m
Hs	Source height	58.0156	ft	17.6832	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
L	V cos(phi) + W sin(phi)	194.9677	ft	59.4262	m
sigma-z	area source	0.0000	ft	0.0000	m
sigma-y	L/6	32.4946	ft	9.9044	m

A graphical representation is shown in Figure 6.1.9.

- X is the East-West distance from the AB northeast corner to the CR inlet per Table 6.1b.
  - Column 3 to the CR Inlet is 221.45'
  - Column 3 to column 11a is 214.4167'.
  - Column 11a to the AB outer wall is 1.25'
  - Distance = 221.45 – 214.4167 – 1.25 = `5.7833'
- Y is the North-South distance from the EH northeast corner to the CR inlet per Table 6.1b.
  - Column F to L is108.75'
  - Column F to the CR Inlet is 10.35'.
  - Column L to the AB outer wall is 1.25'.
  - Distance = 108.75 – 10.35 – 1.25 = 97.15'
- U is the AB East Wall width between columns L and Q (70.75') plus twice the wall thickness (2*1.25') to yield a total width of 73.25' (Table 6.1b).
- V is the AB West Wall width between columns N and Q (46') plus the wall thickness (1.25') to yield a total width of 47.25' (Table 6.1b).
- W is the AB south wall width between columns 3 and 11a (214.4167') plus the wall thickness (1.25') to yield a total width of 215.6667' (Table 6.1b).
- Zsu is the upper source elevation per Table 6.1c.
- Zg is the plant grade elevation per Table 6.1c.
- Per RG 1.194 (Ref.8.3) 3.2.4.7 for horizontal area sources: "The distance to the receptor is measured from the closest point on the perimeter of the assumed area source. For assumed areas that are not circular, the area width is measured perpendicular to the line of sight from the center of the assumed source to the control room intake. The initial diffusion coefficient σ_{yo} is found by equation 3 (area source width divided by 6); σ_{zo} is assumed to be zero." Thus,
  - The minimum distance from the source to the inlet is S=sqrt(X^2+Y^2).
  - The center of the AB roof area source is
    - a = X + W/2
    - b = Y + U/2

- The direction from inlet to source is theta=360-phi
  - phi = arctan(b/a).
- The source height relative to grade is Hs=Zsu-Zg
- An area source is assumed in this case, so
  - sigma-y is set to one-sixth of the width of the projected area: L/6
    - L = V*cos(phi) + W*sin(phi)
  - sigma-z is set to zero.

- Zi is the inlet elevation per Table 6.1c.
- Hi is the inlet elevation above grade Hi=Zi-Zg.

6.1.12 Auxiliary Building Wall Area Source to Control Room Intake

Table 6.1.12: ARCON96 Inputs for Auxiliary Building Walls Area Source to CR Inlet					
X	Source to Receptor E-W	5.7833	ft	1.7627	m
Y	Source to Receptor N-S	97.1500	ft	29.6113	m
S	sqrt(X^2+Y^2)	97.3220	ft	29.6637	m
phi	arcsin(Y/S)	86.5932	deg		
beta	90-phi	3.4068	deg		
theta	270-arcsin(Y/S)+arctan((W-V')/2/S)	204.0963	deg		
Zsu	Source elevation upper	328.0156	ft	99.9792	m
Hs	Source height	29.0078	ft	8.8416	m
sigma-z	(Zsu-Zsl)/6	9.6693	ft	2.9472	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
W	Source width	78.0000	ft	23.7744	m
W'	Projected width = W*cos(beta)	77.8622	ft	23.7324	m
V	Source width	73.2500	ft	22.3266	m
V'	Projected width = V*sin(beta)	4.3528	ft	1.3267	m
sigma-y	(W'+V')/6	13.7025	ft	4.1765	m

A graphical representation is shown in Figure 6.1.10.

- X is the East-West distance from the AB northeast corner to the CR inlet per Table 6.1b.
  - Column 3 to the CR Inlet is 221.45’
  - Column 3 to column 11a is 214.4167’.
  - Column 11a to the AB outer wall is 1.25’
  - Distance = 221.45 – 214.4167 – 1.25 = `5.7833’
- Y is the North-South distance from the EH northeast corner to the CR inlet per Table 6.1b.
  - Column F to L is108.75’
  - Column F to the CR Inlet is 10.35’.
  - Column L to the AB outer wall is 1.25’.
  - Distance = 108.75 – 10.35 – 1.25 = 97.15’
- V is the AB East Wall width between columns L and Q (70.75’) plus twice the wall thickness (2*1.25’) to yield a total width of 73.25’ (Table 6.1b).
- W is the AB north wall width between columns 8a and 11a (76.75’) plus the wall thickness (1.25’) to yield a total width of 78’ (Table 6.1b).
- Zsu is the upper source elevation per Table 6.1c.
- Zg is the plant grade elevation per Table 6.1c.
- Per RG 1.194 (Ref.8.3) 3.2.4.5: “The height and width of the area source are taken as the maximum vertical and horizontal dimensions of the above-grade building cross-sectional area

perpendicular to the line of sight from the building center to the control room intake. These dimensions are projected onto a vertical plane perpendicular to the line of sight and located at the closest point to the building surface to the control room intake. The release height is set at the vertical center of the projected plane." Thus,

- The minimum distance from the northeast corner of the AB to the inlet is S=sqrt(X^2+Y^2).
- The direction from inlet to source is theta=270-arcsin(Y/S)+arctan((W'-V')/2/S)
- Phi is defined as the angle between "S" and 270°.
- Beta, which is 90° – phi, is then the angle between W and W'.
- Phi is then the angle between V and V'.
- The projected width (W') is W*cos(beta).
- The projected width (V') is V*sin(beta).
- The vertical initial diffusion coefficient (sigma-z) should be the source height (Zsu-Zg) divided by 6.
- The horizontal initial diffusion coefficient (sigma-y) should be the projected source width (W'+V') divided by 6.

- Zi is the inlet elevation per Table 6.1c.
- Hi is the inlet elevation above grade Hi=Zi-Zg.

6.1.13 Intermediate Building Point Source to Control Room Intake

Table 6.1.13: ARCON96 Inputs for Intermediate Building Point Source to CR Inlet					
X	Source to Receptor E-W	108.5438	ft	33.0842	m
Y	Source to Receptor N-S	0.0000	ft	0.0000	m
S	sqrt(X^2+Y^2)	108.5438	ft	33.0842	m
theta	270-arcsin(Y/S)	270.0000	deg		
Zsu	Source elevation upper	336.3229	ft	102.5112	m
Hs	Source height	33.1615	ft	10.1076	m
sigma-z	Point source	0.0000	ft	0.0000	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
sigma-y	Point source	0.0000	ft	0.0000	m

A graphical representation is shown in Figure 6.1.11.

- X is the East-West distance from the IB to the CR inlet per Table 6.1b.
  - Column 11 to the CR Inlet is 15.45'
  - Column 7c to column 11 is 94.2813'.
  - Column 7c to the IB outer wall is 1.1875'
  - Distance = 15.45 + 94.2813 – 1.1875 = 108.5438'
- Y is the North-South distance from the IB to the CR inlet per Table 6.1b.
  - To minimize the distance, set Y=0.
- Zsu is the upper source elevation per Table 6.1c.
- Zg is the plant grade elevation per Table 6.1c.
- Per RG 1.194 (Ref.8.3) 3.2.4.5: "The height and width of the area source are taken as the maximum vertical and horizontal dimensions of the above-grade building cross-sectional area perpendicular to the line of sight from the building center to the control room intake. These dimensions are projected onto a vertical plane perpendicular to the line of sight and located at the closest point to the building surface to the control room intake. The release height is set at the vertical center of the projected plane." Thus,
  - The source elevation is Hs=(Zsu-Zg)/2.

- The minimum distance from the IB to the CR inlet is S=sqrt(X^2+Y^2).
- The direction from inlet to source is theta=270-arcsin(Y/S).
- A point source is assumed in this case, so sigma-y and sigma-z are set to zero.

- Zi is the inlet elevation per Table 6.1c.
- Hi is the inlet elevation above grade Hi=Zi-Zg.

6.1.14 Intermediate Building Roof Area Source to Control Room Intake

Table 6.1.14: ARCON96 Inputs for Intermediate Building Roof Area Source to CB Inlet					
X	Source to Receptor E-W=Min Dist	108.5438	ft	33.0842	m
Y	Source to Receptor N-S	7.1834	ft	2.1895	m
S	sqrt(X^2+Y^2)	108.7812	ft	33.1565	m
theta	270-arcsin(Y/S)	266.2137	deg		
Zsu	Source elevation upper	336.3229	ft	102.5112	m
Hs	Source height	66.3229	ft	20.2152	m
sigma-z	Area source	0.0000	ft	0.0000	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
W	Source width	35.0667	ft	10.6883	m
W'	Projected source width	34.9902	ft	10.6650	m
sigma-y	W'/6	5.8317	ft	1.7775	m

A graphical representation is shown in Figure 6.1.12.

- X is the East-West distance from the IB to the CR inlet per Table 6.1b.
  - Column 11 to the CR Inlet is 15.45'
  - Column 7c to column 11 is 94.2813'.
  - Column 7c to the IB outer wall is 1.1875'
  - Distance = 15.45 + 94.2813 – 1.1875 = 108.5438' (Note that this value is input into ARCON96 as the minimum separation distance.)
- Y is the North-South distance from the midpoint of the IB roof to the CR inlet per Table 6.1b.
  - Containment centerline to column 7c is 40.0521'.
  - Column F to the containment centerline is 74.25'.
  - Column F to the CR inlet is 10.35'.
  - The containment outer radius is 56.0313' (Table 6.1c).
  - Thus, Y=(74.25 – sqrt(56.0313^2-40.0521^2))/2-10.35 = 7.1834'
  - The roof width W = 74.25 - sqrt(56.0313^2-40.0521^2) = 35.0667'
- Zsu is the upper source elevation per Table 6.1c.
- Zg is the plant grade elevation per Table 6.1c.
- Per RG 1.194 (Ref.8.3) 3.2.4.7 for horizontal area sources: "The distance to the receptor is measured from the closest point on the perimeter of the assumed area source. For assumed areas that are not circular, the area width is measured perpendicular to the line of sight from the center of the assumed source to the control room intake. The initial diffusion coefficient σ_{yo} is found by equation 3 (area source width divided by 6); σ_{zo} is assumed to be zero." Thus,
  - The minimum distance from the source to the CR inlet is X.
  - The distance from the IB roof midpoint to the CR inlet is S=sqrt(X^2+Y^2)
  - The direction from the CR inlet to the source midpoint is theta=270-arcsin(Y/S)
  - The source height relative to grade is Hs=Zsu-Zg
  - An area source is assumed in this case, so
    - sigma-y is set to one-sixth of the width of the projected area: W'/6
      - The roof width W = 74.25 - sqrt(56.0313^2-40.0521^2) = 35.0667'

- The projected roof width W' = W*X/S = 34.9902'
  - sigma-z is set to zero.
- Zi is the inlet elevation per Table 6.1c.
- Hi is the inlet elevation above grade Hi=Zi-Zg.

6.1.15 Intermediate Building Wall Area Source to Control Room Intake

Table 6.1.15: ARCON96 Inputs for Intermediate Building Wall Area Source to CR Inlet					
X	Source to Receptor E-W=Min Dist	108.5438	ft	33.0842	m
Y	Source to Receptor N-S	7.1834	ft	2.1895	m
S	sqrt(X^2+Y^2)	108.7812	ft	33.1565	m
theta	270-arcsin(Y/S)	266.2137	deg		
Zsu	Source elevation upper	336.3229	ft	102.5112	m
Hs	Source height	33.1615	ft	10.1076	m
sigma-z	(Zsu-Zg)/6	11.0538	ft	3.3692	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
W	Source width	35.0667	ft	10.6883	m
W'	Projected source width	34.9902	ft	10.6650	m
sigma-y	W'/6	5.8317	ft	1.7775	m

A graphical representation is shown in Figure 6.1.12.

- X is the East-West distance from the IB to the CR inlet per Table 6.1b.
  - Column 11 to the CR Inlet is 15.45'
  - Column 7c to column 11 is 94.2813'.
  - Column 7c to the IB outer wall is 1.1875'
  - Distance = 15.45 + 94.2813 – 1.1875 = 108.5438' (Note that this value is input into ARCON96 as the minimum separation distance.)
- Y is the North-South distance from the midpoint of the IB roof to the CR inlet per Table 6.1b.
  - Containment centerline to column 7c is 40.0521'.
  - Column F to the containment centerline is 74.25'.
  - Column F to the CR inlet is 10.35'.
  - The containment outer radius is 56.0313' (Table 6.1c).
  - Thus, Y=(74.25 – sqrt(56.0313^2-40.0521^2))/2-10.35 = 7.1834'
  - The wall width W = 74.25 - sqrt(56.0313^2-40.0521^2) = 35.0667'
- Zsu is the upper source elevation per Table 6.1c.
- Zg is the plant grade elevation per Table 6.1c.
- Per RG 1.194 (Ref.8.3) 3.2.4.5: "The height and width of the area source are taken as the maximum vertical and horizontal dimensions of the above-grade building cross-sectional area perpendicular to the line of sight from the building center to the control room intake. These dimensions are projected onto a vertical plane perpendicular to the line of sight and located at the closest point to the building surface to the control room intake. The release height is set at the vertical center of the projected plane." Thus,
  - The minimum distance from the source to the CR inlet is X.
  - The distance from the IB wall midpoint to the CR inlet is S=sqrt(X^2+Y^2)
  - The direction from the CR inlet to the source midpoint is theta=270-arcsin(Y/S)
  - The source height relative to grade is Hs=(Zsu-Zg)/2
  - An area source is assumed in this case, so
    - sigma-y is set to one-sixth of the width of the projected area: W'/6
      - The wall width W = 74.25 - sqrt(56.0313^2-40.0521^2) = 35.0667'

- The projected roof width W' = W*X/S = 34.9902'
  - sigma-z is set to (Zsu-Zg)/6
- Zi is the inlet elevation per Table 6.1c.
- Hi is the inlet elevation above grade Hi=Zi-Zg.

6.1.16 Auxiliary Building Roll-Up Door Point Source to Control Room Intake

ARCON96 Inputs for Auxiliary Building Roll-Up Door to CR Inlet					
X	Source to Receptor E-W	168.3250	ft	51.3055	m
Y	Source to Receptor N-S	170.4000	ft	51.9379	m
S	sqrt(X^2+Y^2)	239.5192	ft	73.0055	m
phi	arcsin(X/S)	44.6490	deg		
theta	180+phi	224.6490	deg		
Zsu	Source elevation upper	307.5	ft	93.726	m
Zsl	Source elevation lower	278.3333	ft	84.8360	m
Hs	Source height	58.0156	ft	17.6832	m
sigma-z	Point source	0.0000	ft	0.0000	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
sigma-y	Point source	0.0000	ft	0.0000	m

A graphical representation is shown in Figure 6.1.16.

- X is the East-West distance from the eastern edge of the AB roll-up door to the CR inlet.
  - Column 3 to the CR Inlet is 221.45' per Table 6.1b.
  - Column 3 to column 5a is 53.6667' per Table 6.1b.
  - AB roll-up door to Column 5a is 0.5417' per Ref. 8.43.
  - Distance = 221.45 – 53.6667 + 0.5417 = 168.3250'.
- Y is the North-South distance from the eastern edge of the AB roll-up door to the CR inlet.
  - Column Q to L is 70.75' per Table 6.1b.
  - Column L to F is 108.75' per Table 6.1b.
  - Column F to the CR Inlet is 10.35' per Table 6.1b.
  - Column Q to the AB outer wall is 1.25' per Table 6.1b.
  - Distance = 108.75 + 1.25 +70.75 – 10.35 = 170.40'
- Zsu is the upper source elevation per Refs. 8.43-8.44.
- Zsl is the lower source elevation per Refs. 8.43-8.44.
- Zg is the plant grade elevation per Table 6.1c.
- Per RG 1.194 (Ref.8.3) 3.2.4.5: "The height and width of the area source are taken as the maximum vertical and horizontal dimensions of the above-grade building cross-sectional area perpendicular to the line of sight from the building center to the control room intake. These dimensions are projected onto a vertical plane perpendicular to the line of sight and located at the closest point to the building surface to the control room intake. The release height is set at the vertical center of the projected plane." Thus,
  - The source elevation Hs is assumed to be the top of the AB, since there is no direct line of sight between the AB roll-up door and the CR.
  - The minimum distance from the source to the CR inlet is S=sqrt(X^2+Y^2).
  - The direction from inlet to source is theta=180 + phi.
  - The angle between S and Y is phi=arcsin(X/S).
  - A point source is assumed in this case, so sigma-y and sigma-z are set to zero.
- Zi is the inlet elevation per Table 6.1c.

- Hi is the inlet elevation above grade Hi=Zi-Zg.

6.1.17 Auxiliary Building Roll-Up Door Area Source to Control Room Intake

ARCON96 Inputs for Auxiliary Building Roll-Up Door to CR Inlet					
X	Source to Receptor E-W	168.3250	ft	51.3055	m
Y	Source to Receptor N-S	170.4000	ft	51.9379	m
S	sqrt(X^2+Y^2)	239.5192	ft	73.0055	m
W	Source width	25.7500	ft	7.8486	m
phi	arcsin(X/S)	44.6490	deg		
W'	W*cos(phi)	18.3192	ft	5.5837	m
ksi	arctan(W'/2/S)	2.1900	deg		
theta	180+phi+ksi	226.8390	deg		
Zsu	Source elevation upper	307.5	ft	93.726	m
Zsl	Source elevation lower	278.3333	ft	84.8360	m
Hs	Source height	58.0156	ft	17.6832	m
Zi	Inlet elevation	315.4167	ft	96.1390	m
Hi	Inlet Height	45.4167	ft	13.8430	m
Zg	Grade elevation	270.0000	ft	82.2960	m
sigma-z	line source	0.0000	ft	0.0000	m
sigma-y	W'/6	3.0532	ft	0.9306	m

A graphical representation is shown in Figure 6.1.17.

- X is the East-West distance from the eastern edge of the AB roll-up door to the CR inlet.
  - Column 3 to the CR Inlet is 221.45’ per Table 6.1b.
  - Column 3 to column 5a is 53.6667’ per Table 6.1b.
  - AB roll-up door to Column 5a is 0.5417’ per Ref. 8.43.
  - Distance = 221.45 – 53.6667 + 0.5417 = 168.3250’.
- Y is the North-South distance from the eastern edge of the AB roll-up door to the CR inlet.
  - Column Q to L is 70.75’ per Table 6.1b.
  - Column L to F is 108.75’ per Table 6.1b.
  - Column F to the CR Inlet is 10.35’ per Table 6.1b.
  - Column Q to the AB outer wall is 1.25’ per Table 6.1b.
  - Distance = 108.75 + 1.25 +70.75 – 10.35 = 170.40’
- Zsu is the upper source elevation per Refs. 8.43-8.44.
- Zsl is the lower source elevation per Refs. 8.43-8.44.
- Zg is the plant grade elevation per Table 6.1c.
- Per RG 1.194 (Ref.8.3) 3.2.4.5: “The height and width of the area source are taken as the maximum vertical and horizontal dimensions of the above-grade building cross-sectional area perpendicular to the line of sight from the building center to the control room intake. These dimensions are projected onto a vertical plane perpendicular to the line of sight and located at the closest point to the building surface to the control room intake. The release height is set at the vertical center of the projected plane.” Thus,
  - The source elevation Hs is assumed to be the top of the AB, since there is no direct line of sight between the AB roll-up door and the CR.
  - The minimum distance from the source to the CR inlet is S=sqrt(X^2+Y^2).
  - The source width W is 25’9” per Refs. 8.43-8.44.
  - The angle between S and Y is phi=arcsin(X/S).
  - The projected source width W’ is W*cos(phi).

  - The angle ksi defined in Figure 6.1.17 is arctan(W'/2/S).
  - The direction from inlet to source is theta=180 + phi + ksi.
  - Since there is no direct line of sight between the AB roll-up door and the CR, the source is projected onto the AB roof and sigma-z is zero.
  - Sigma-y is W'/6.
- Zi is the inlet elevation per Table 6.1c.
- Hi is the inlet elevation above grade Hi=Zi-Zg.

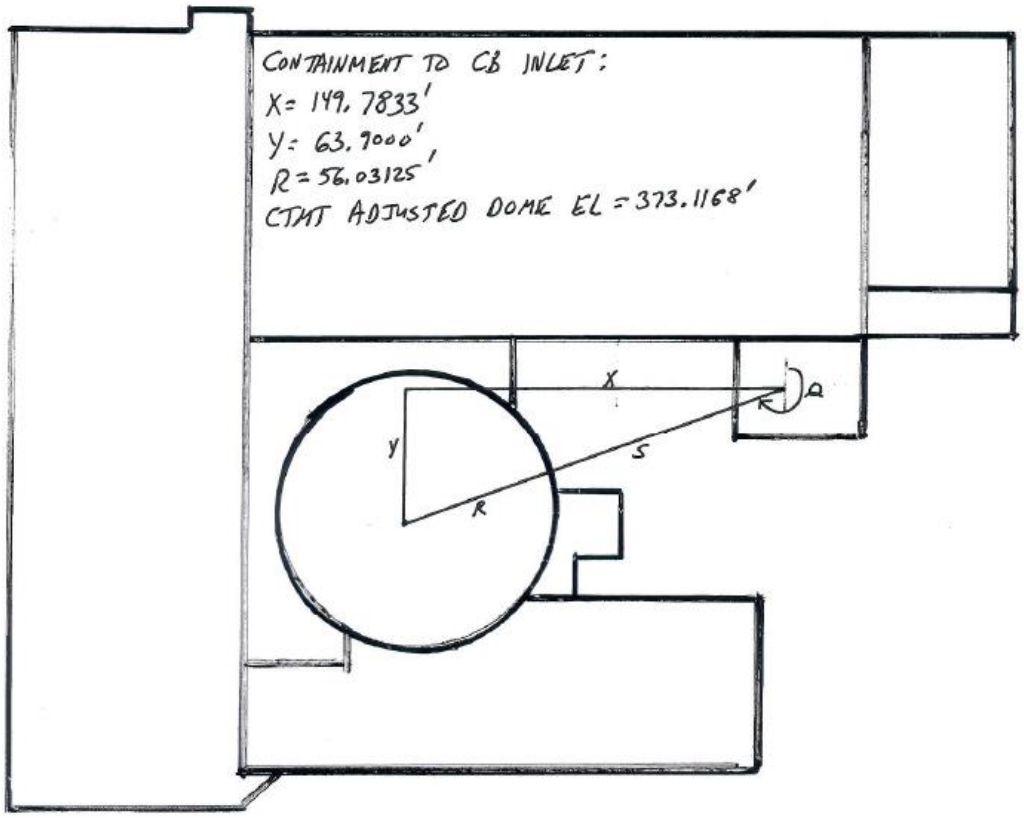

Figure 6.1.1 Containment to Control Room Inlet

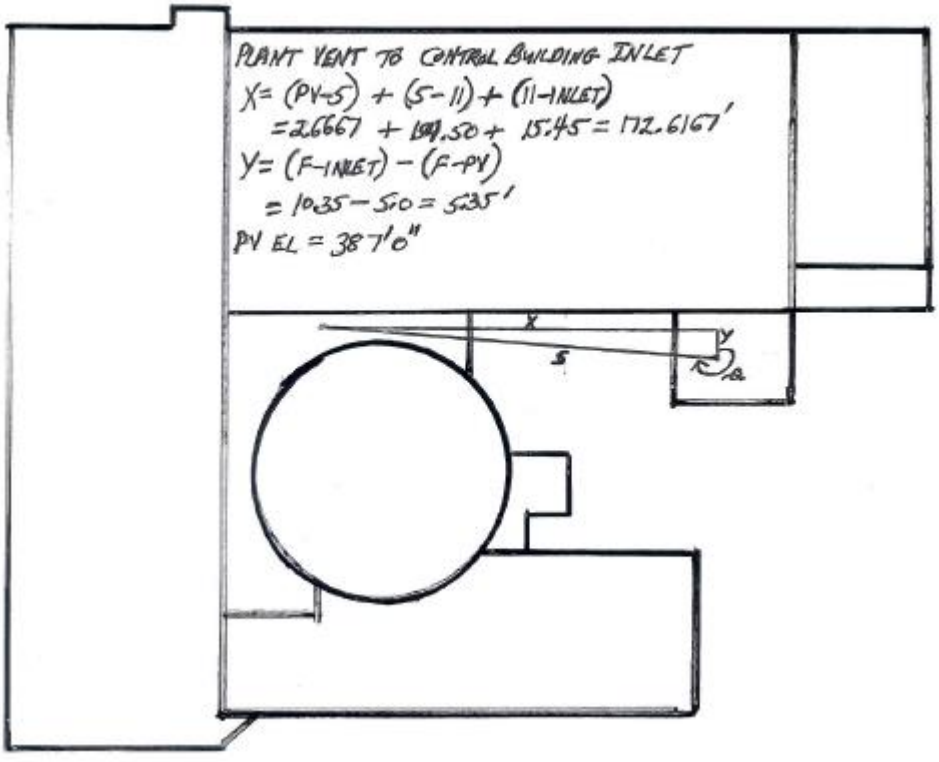

Figure 6.1.2 Plant Vent to Control Room Inlet

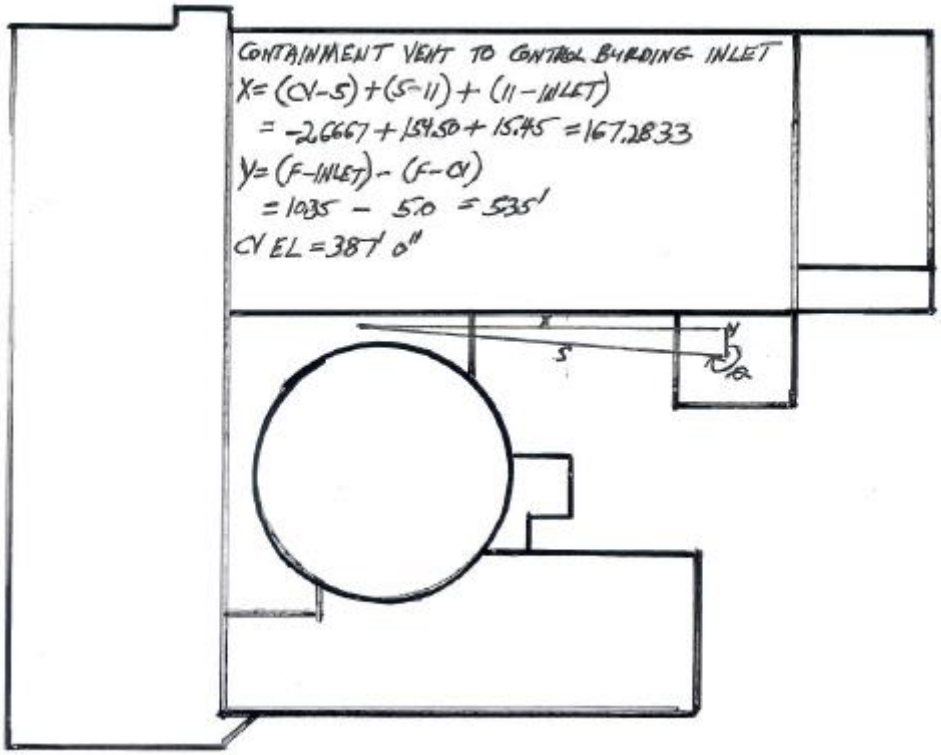

Figure 6.1.3 Containment Vent to Control Room Inlet

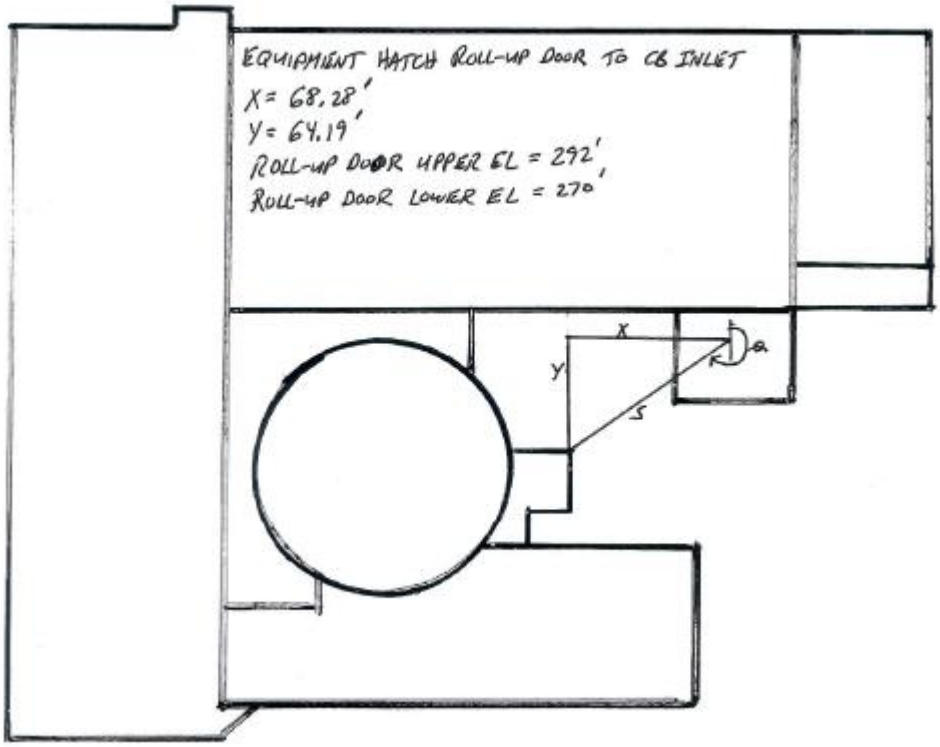

Figure 6.1.4 Equipment Hatch Roll-Up Door (Point Source) to Control Room Inlet

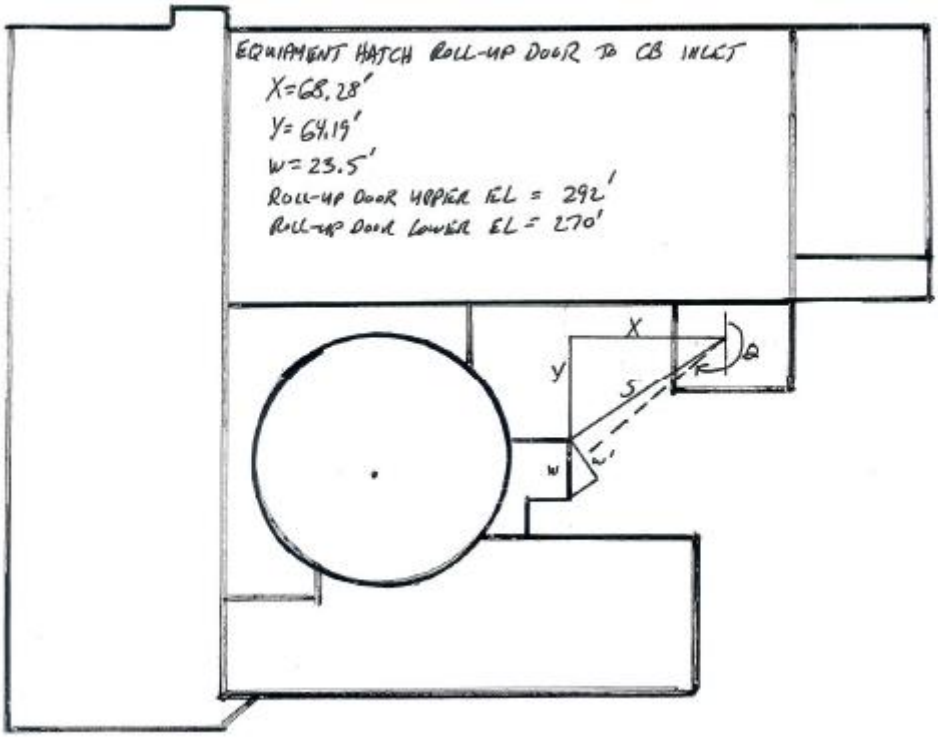

Figure 6.1.5 Equipment Hatch Roll-Up Door (Area Source) to Control Room Inlet

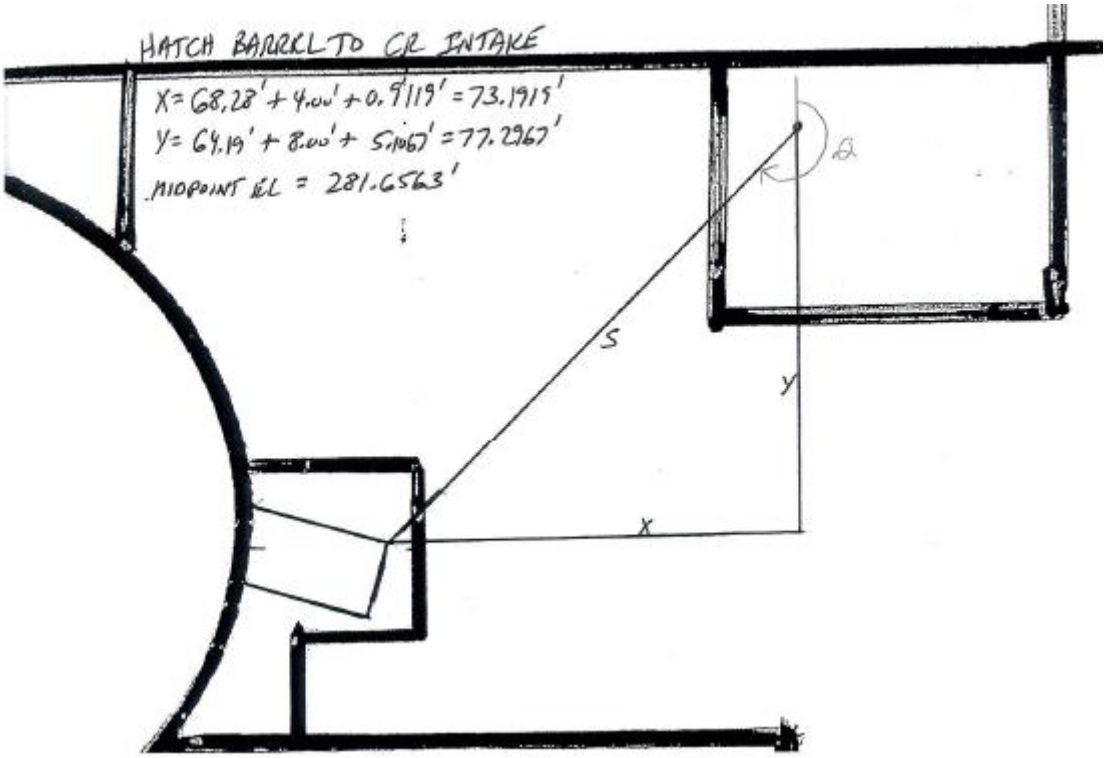

Figure 6.1.6 Equipment Hatch Barrel Access Door (Point Source) to Control Room Inlet

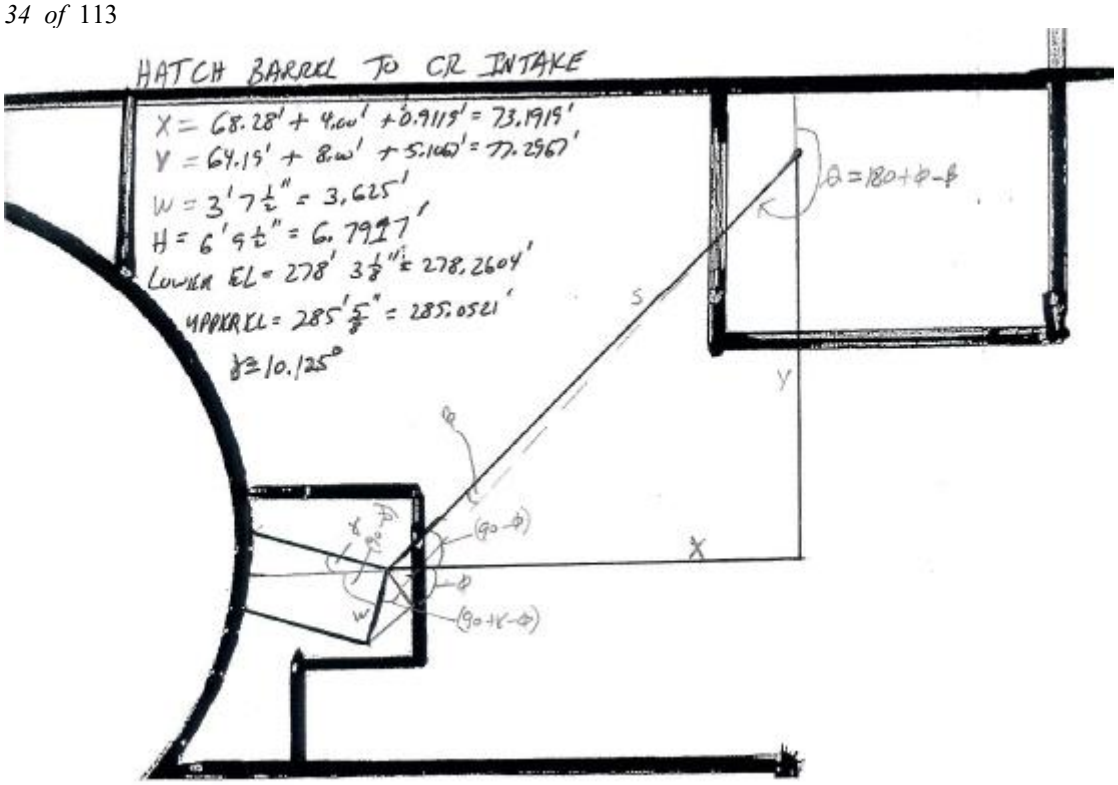

Figure 6.1.7 Equipment Hatch Barrel Access Door (Area Source) to Control Room Inlet

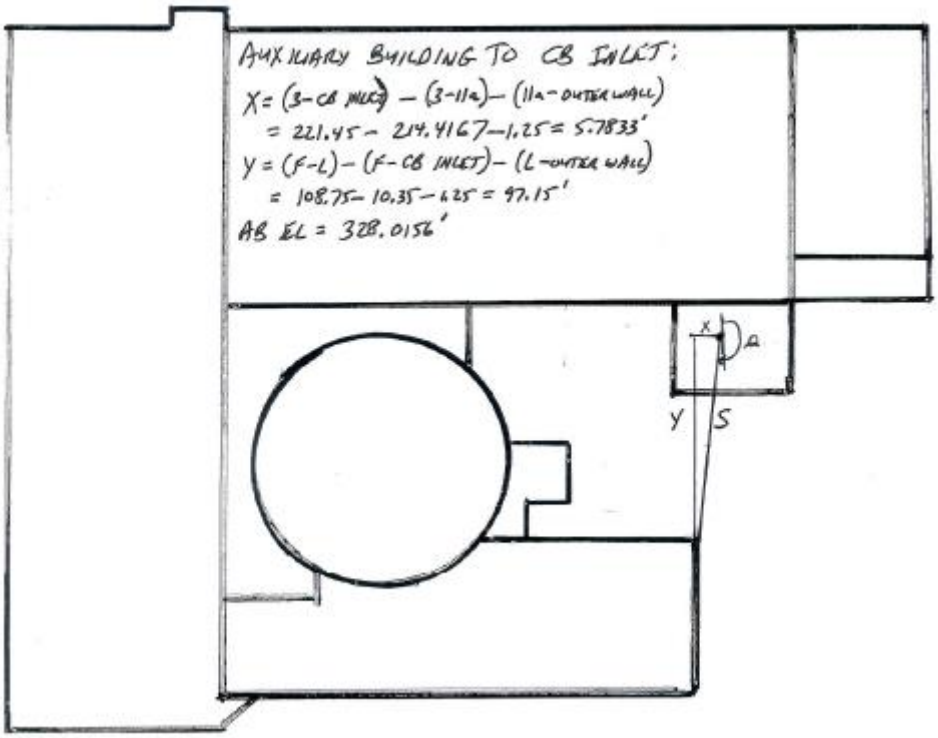

Figure 6.1.8 Auxiliary Building (Point Source) to Control Room Inlet

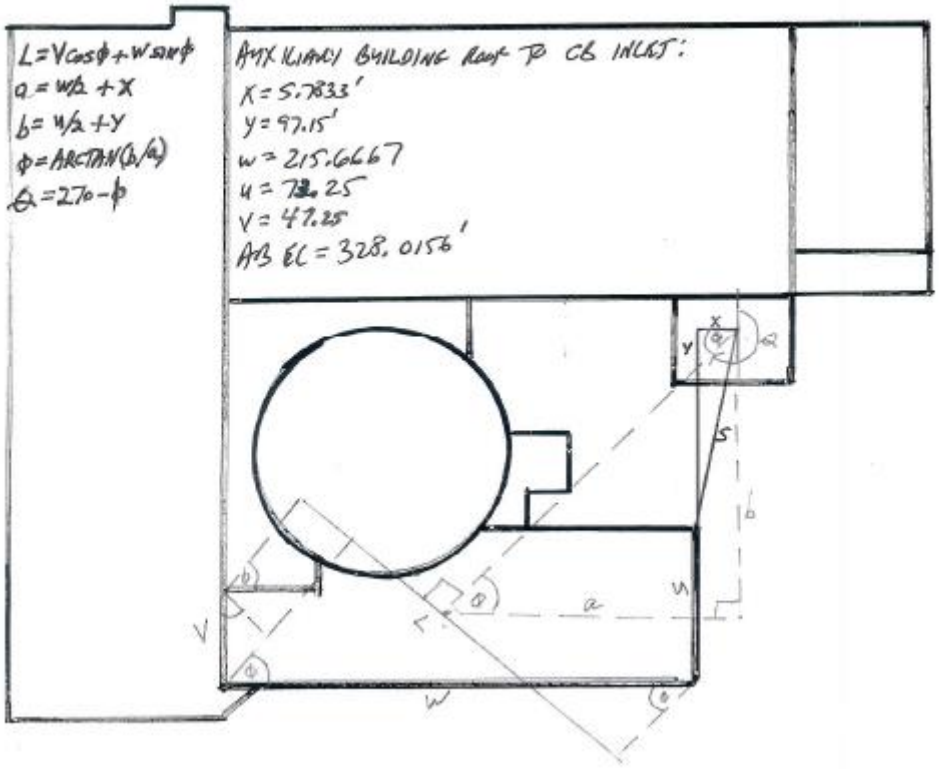

Figure 6.1.9 Auxiliary Building Roof (Area Source) to Control Room Inlet

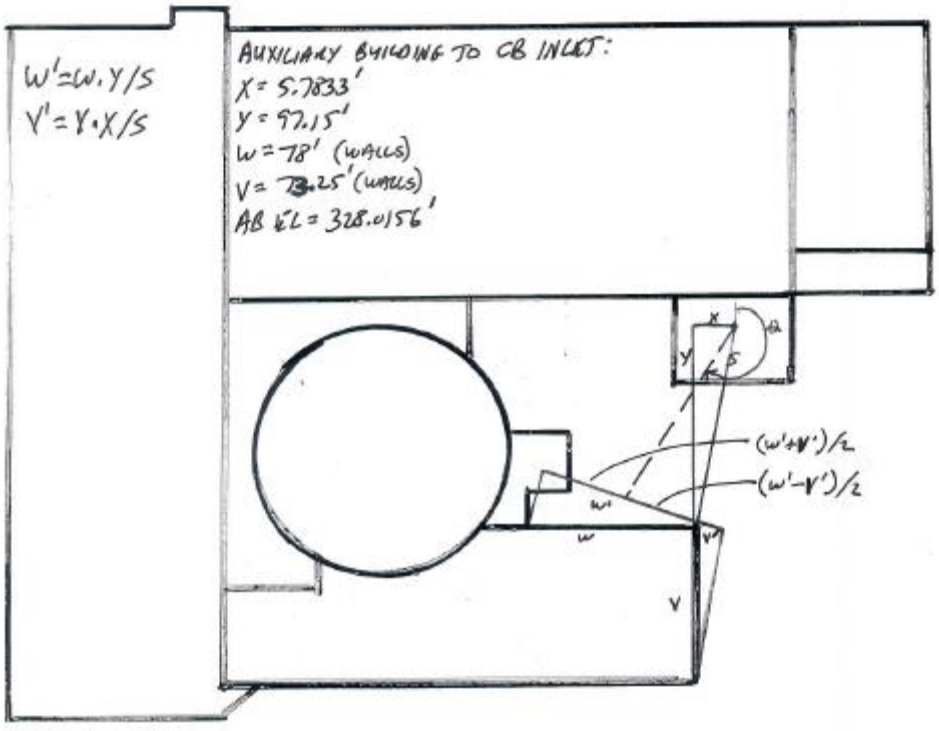

Figure 6.1.10 Auxiliary Building Walls (Area Source) to Control Room Inlet

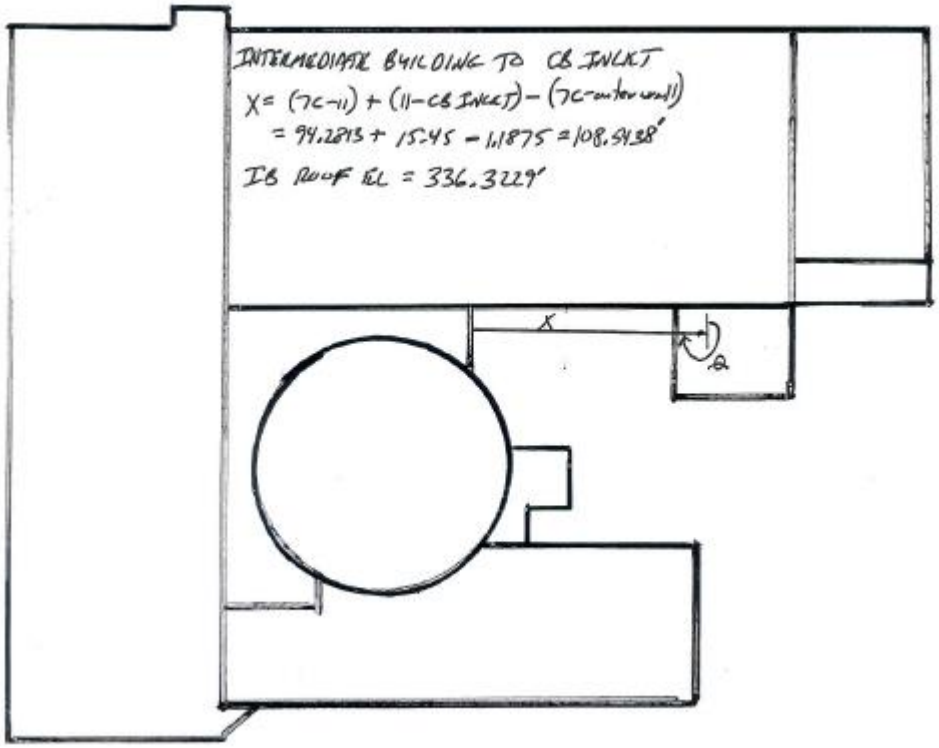

Figure 6.1.11 Intermediate Building (Point Source) to Control Room Inlet

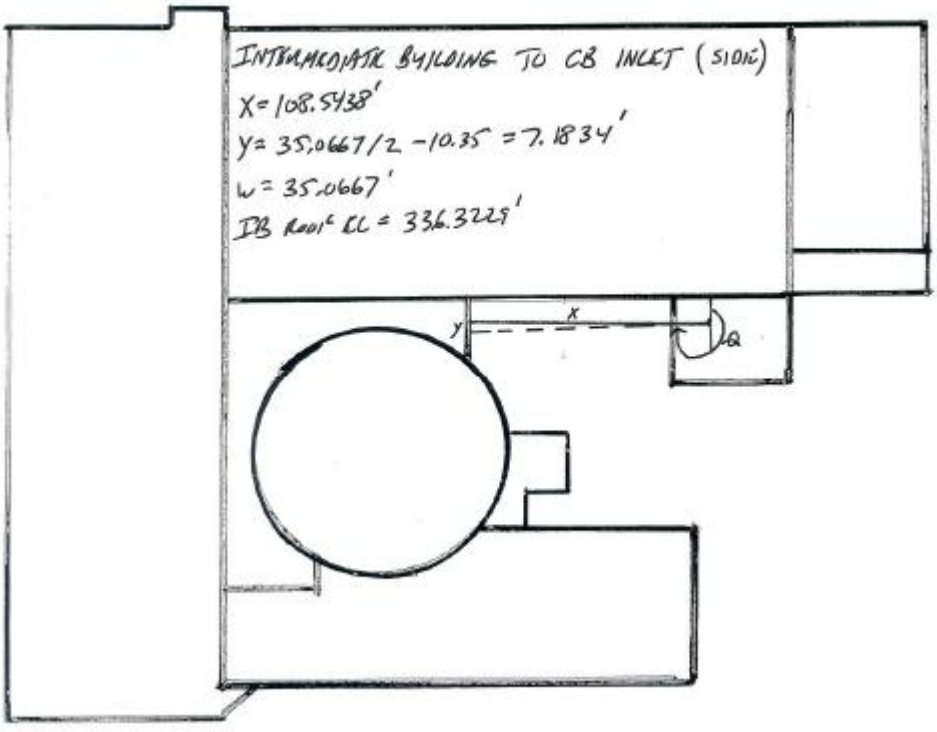

Figure 6.1.12 Intermediate Building Roof and Walls (Area Source) to Control Room Inlet

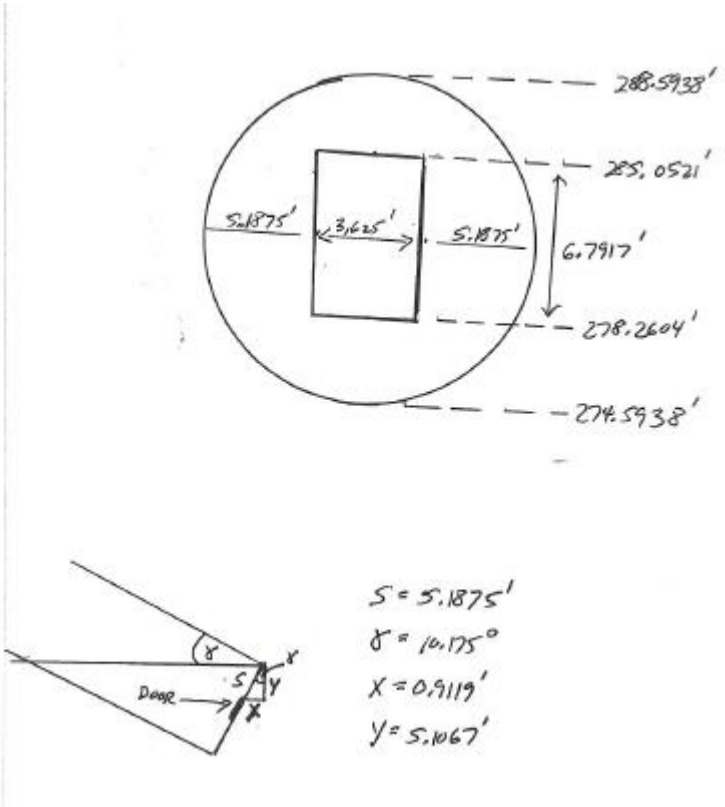

Figure 6.1.13 Equipment Hatch Barrel Access Door (Area Source)

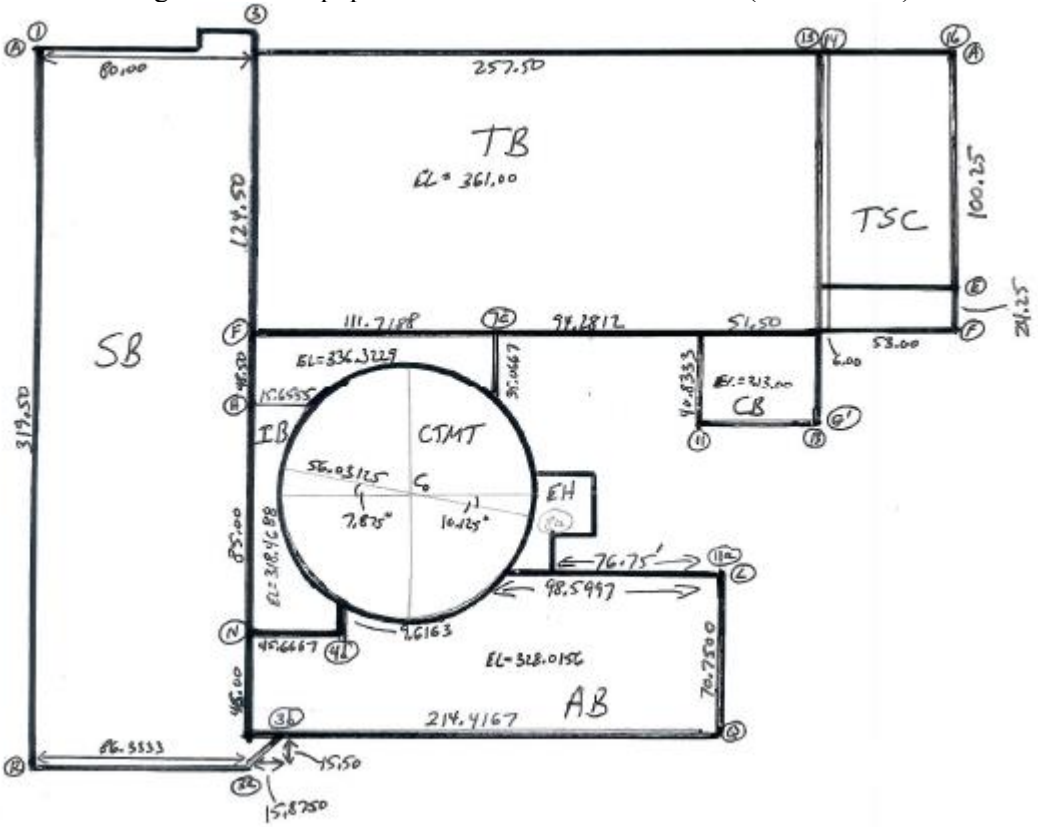

Figure 6.1.14 Plant Layout

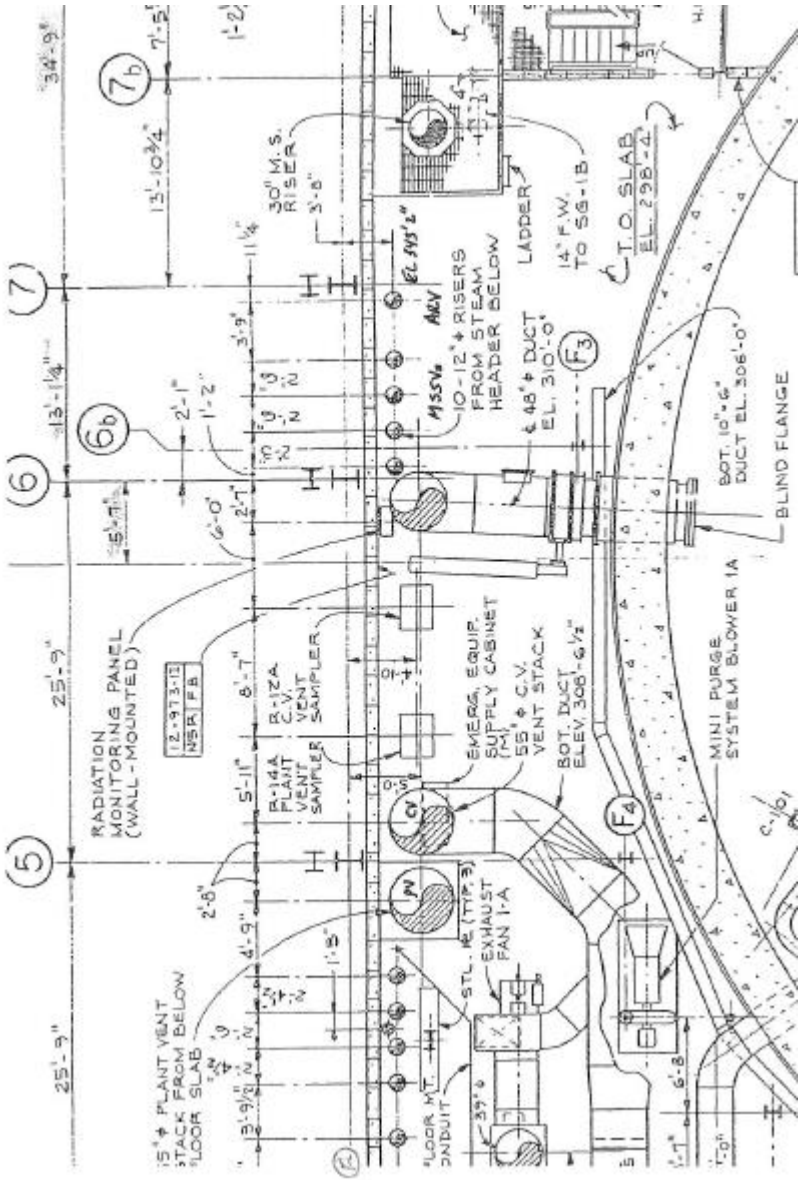

Figure 6.1.15 Plant Vent and Containment Vent Layout (Dwg 33013-2121 R3)

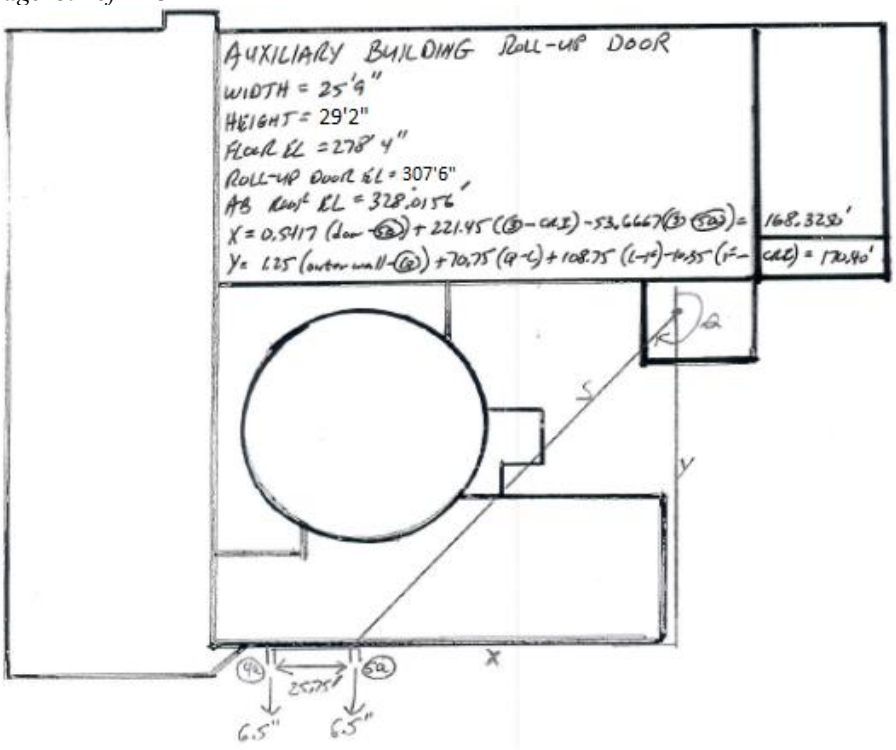

Figure 6.1.16 Auxiliary Building Roll-Up Door (Point Source) to Control Room Inlet

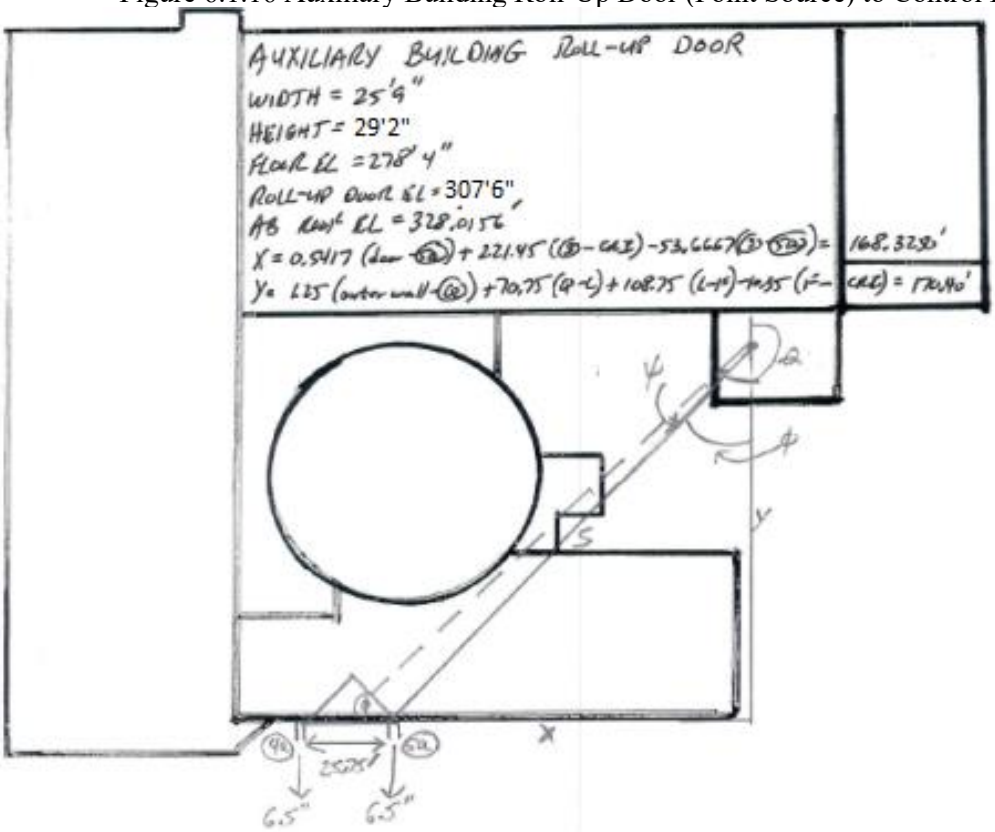

Figure 6.1.17 Auxiliary Building Roll-Up Door (Area Source) to Control Room Inlet

6.2 RADTRAD Methodology and Inputs

6.2.1 Nuclear Inventory File Source Terms

The core isotopic activities at shutdown, 100 hours post-shutdown, and 1440 hours post-shutdown were extracted from Design Input 3.7 of Ref. 8.13. The core isotopic activities at 72 hours post-shutdown (Technical Assumption 7.9) were estimated by calculating the shutdown precursor activities that would yield the correct activities at 100 and 1440 hours post-shutdown and then using those values together with the original shutdown activities to calculate the 72 hour post-shutdown values.

Table 6.2.1.a: Core Isotopic Activity

Shutdown(hrs)	0	72	100	1440
Nuclide	Ci	Ci	Ci	Ci
I-131	5.080E+07	4.026E+07	3.640E+07	2.920E+05
I-132	7.510E+07	3.953E+07	3.070E+07	1.717E+02
I-133	1.030E+08	9.610E+06	3.780E+06	1.528E-13
I-134	1.140E+08	8.525E-17	2.070E-26	0.000E+00
I-135	9.720E+07	5.218E+04	2.720E+03	1.090E-58
Kr-85m	1.360E+07	1.975E+02	2.595E+00	2.364E-90
Kr-85	5.850E+05	5.847E+05	5.846E+05	5.788E+05
Kr-87	2.620E+07	2.247E-10	5.184E-17	0.000E+00
Kr-88	3.680E+07	8.592E-01	9.252E-04	8.533E-146
Xe-133m	3.170E+06	1.817E+06	1.310E+06	2.921E-02
Xe-133	1.010E+08	8.200E+07	7.130E+07	4.495E+04
Xe-135m	2.040E+07	8.364E+03	4.360E+02	1.747E-59
Xe-135	2.560E+07	1.042E+06	1.320E+05	6.536E-40
Xe-138	8.610E+07	5.068E-85	6.880E-121	0.000E+00

The activity released into the atmosphere post-FHA can then be calculated via Table 6.2.1.b.

Table 6.2.1.b: FHA Inventory at 1811 MWt

	Ao	d	CDF	PF	DF	GF	A
	Core						Released
	Activity	Decay	Core		Overall		Activity
	72	Constant	damage	Peaking	pool	Gap	72
Nuclide	Ci	1/sec	fraction	factor	DF	fraction	Ci
I-131	4.03E+07	1.000E-06	0.0082645	1.75	200	0.16	4.66E+02
I-132	3.95E+07	8.445E-05	0.0082645	1.75	200	0.10	2.86E+02
I-133	9.61E+06	9.257E-06	0.0082645	1.75	200	0.15	1.04E+02
I-134	8.52E-17	2.196E-04	0.0082645	1.75	200	0.10	6.16E-22
I-135	5.22E+04	2.931E-05	0.0082645	1.75	200	0.10	3.77E-01
Kr-85m	1.97E+02	4.298E-05	0.0082645	1.75	1	0.10	2.86E-01
Kr-85	5.85E+05	2.043E-09	0.0082645	1.75	1	0.20	1.69E+03
Kr-87	2.25E-10	1.516E-04	0.0082645	1.75	1	0.10	3.25E-13
Kr-88	8.59E-01	6.780E-05	0.0082645	1.75	1	0.10	1.24E-03
Xe-133m	1.82E+06	3.663E-06	0.0082645	1.75	1	0.15	3.94E+03
Xe-133	8.20E+07	1.530E-06	0.0082645	1.75	1	0.15	1.78E+05
Xe-135m	8.36E+03	7.551E-04	0.0082645	1.75	1	0.10	1.21E+01
Xe-135	1.04E+06	2.116E-05	0.0082645	1.75	1	0.10	1.51E+03
Xe-138	5.07E-85	8.19E-04	0.0082645	1.75	1	0.10	7.33E-88

Where

- The core activity at 72 hours post-shutdown was extracted from Table 6.2.1.a. Note that this inventory incorporates the 1.02 power measurement uncertainty factor required by Regulatory Guide 1.49 (Ref.8.40).
- The decay constants were calculated from the decay half-lives listed in Ref. 8.39.
- Per Technical Assumption 7.2, all 179 fuel rods from the highest power fuel assembly are assumed to fail in the FHA. Per UFSAR 4.1.1 and UFSAR Table 4.2-3, there are 121 assemblies in a fully loaded core. Thus, the release fraction is 1/121 = 0.00826446.
- Per Technical Assumption 7.2, all 179 fuel rods from the highest power fuel assembly are assumed to fail in the FHA. Per Ref. 8.13 and UFSAR 4.4.2.2.5, a power peaking factor of 1.75 is conservatively applied to the average assembly inventory.
- An overall pool decontamination factor (DF) of 200 for iodine and 1 for noble gases was utilized in this work per RG 1.183 (Ref. 8.2).
- The isotopic gas gap fractions were extracted from DA-NS-08-049 (Ref.8.21). The DA-NS-08-049 results indicate that gas gap fractions must be significantly increased over those recommended in RG 1.183 (Ref.8.2) for the limiting pins with burnups over 54 GWd/MTU and with linear heat generation rates in excess of 6.3 kw/ft.
- The isotopic release activity is thus A=Ao*CDF*PF*GF/DF.

The isotopic release activity was manually inserted into the nuclear inventory file FHAC0.NIF listed in Attachment T. The activities are the total gas gap activities that are released from the pool water at the appropriate decay time and are not per unit power. Thus a power of one should be designated when employing these files.

6.2.2 Dose Conversion Factor File

The dose conversion factors (DCFs) were extracted from Federal Guidance Reports 11 and 12 (Refs.8.16 and 8.17). This data is included in the Conversion Factor File FGR14.INP listed in Attachment R for use by RADTRAD. Note that the cloudshine data in FGR14.INP corresponds to the FGR-12 data, while the inhaled chronic data in FGR14.INP corresponds to the worst-case effective data in FGR-11. The remaining data in FGR14.INP is extraneous and not used by RADTRAD.

6.2.3 Release Fraction and Timing File

The Release Fraction and Timing (RFT) File is displayed in Attachment S. This file directs RADTRAD to release the entire iodine and noble gas activity that resides in the failed fuel pin gas gaps as defined by the unclear inventory file instantaneously (0.0001 hour) to the containment or spent fuel environment.

6.2.4 RADTRAD Plant and Scenario File Inputs

The RADTRAD Plant and Scenario File (PSF) inputs are as follows:

Table 6.2.4: Radtrad Plant and Scenario File Inputs

						Reference
Containment Volume		1.00E+06	cf			UFSAR 1.2.3.2
Fuel Building Volume		1.00E+06	cf			Note 1.
Control Room Volume		36211	cf			Ref. 8.41 Table 10.3
Reactor Power		1.00				Section 6.2.1
Containment to Environment Exhaust		76800	cfm			Note 2
Fuel Building to Environment Exhaust		76800	cfm			Note 2
Vent Stack Filter Eff	elemental	0				Assumption 7.4
	organic	0				"
Control Room Inleakage		0	hrs	2200	cfm	Ref. 8.42 Section 3.10
		0.0167	hrs	300	cfm	"
		720	hrs			"

Control Room Recirculation Flow		0	hrs	0	cfm	Ref. 8.42 Section 3.2.2
		0.0194	hrs	5400	cfm	"
		720	hrs			"
CR Filter Eff	elemental	90				Ref. 8.42 Section 3.2.2
	organic	70				"
	particulate	98				"
I Species Fraction	elemental	0.57				Ref. 8.2 App.B
	organic	0.43				"
	particulate	0.00				"
X/Q	EAB	0	hr	2.17E-04	sec/m3	Ref. 8.42 Table 3
		2	hr			"
	LPZ	0	hr	2.51E-05	sec/m3	Ref. 8.42 Table 3
		8	hr	1.78E-05	sec/m3	"
		24	hr	8.50E-06	sec/m3	"
		96	hr	2.93E-06	sec/m3	"
		720	hr			"
	Ctmt to CR	0	hr	6.90E-03	sec/m3	Section 11.2
	via Equipment Hatch	2	hr	5.99E-03	sec/m3	"
		8	hr	2.22E-03	sec/m3	"
		24	hr	2.05E-03	sec/m3	"
		96	hr	1.67E-03	sec/m3	"
		720	hr			"
	SFP to CR	0	hr	2.04E-03	sec/m3	Section 11.2
	via Plant Vent	2	hr	1.53E-03	sec/m3	"
		8	hr	6.57E-04	sec/m3	"
		24	hr	5.19E-04	sec/m3	"
		96	hr	4.58E-04	sec/m3	"
		720	hr			"
	SFP to CR	0	hr	1.38E-03	sec/m3	Section 11.2
	via Roll-Up Door	2	hr	1.13E-03	sec/m3	"
		8	hr	3.96E-04	sec/m3	"
		24	hr	3.79E-04	sec/m3	"
		96	hr	3.15E-04	sec/m3	"
		720	hr			"
CR Occupancy Factor		0	hr	1.0		Ref. 8.2 Section 4.1.3
		24	hr	0.6		"
		96	hr	0.4		"
		720	hr			"
Breathing Rate		0	hr	3.47E-04	m3/sec	Ref. 8.2 Section 4.2.6
		8	hr	1.75E-04	m3/sec	"
		24	hr	2.32E-04	m3/sec	"
		720	hr			"

Notes:

1. The fuel building volume is an arbitrary value selected in DA-NS-2002-004 (Ref.8.13). It was selected to be the same volume as the inside containment volume. It is used in combination with the fuel building exhaust flow rate to transfer the released activity from the fuel building to the environment in two hours.

2. Per RG 1.183 (Ref.8.2), the radioactive material that escapes from the fuel pool to the fuel building or to containment is assumed to be released to the environment over a two hour time period. The value of 76800 cfm was selected in Ref.8.13 to release 99.99% of the released activity in the two hour time period: exp(-76800*120/1E6) = 0.0001.

7. TECHNICAL ASSUMPTIONS

The following technical inputs were assumed in this work.

7.1 This work conservatively calculates atmospheric dispersion coefficients from the source to the receptor assuming no thermal plume or momentum plume rise.

7.2 All 179 fuel rods from the highest power fuel assembly are assumed to fail in the FHA.

7.3 No credit is taken for atmospheric cleanup systems in containment (spray, filter, plateout).

7.4 The radioactive release from a FHA in the SFP area is assumed to be discharged into the environment through either the plant vent, or the AB roll-up door. In both of these cases there is assumed to be no filtration. The filtration credit was eliminated in support of a technical specification change to relax filter testing requirements.

7.5 No credit is taken for deposition of the plume on the ground or decay of isotopes in transit to the site boundary.

7.6 Buildup of daughter nuclides is taken into account as source term nuclides decay.

7.7 The results indicate that gas gap fractions must be significantly increased for the limiting pins with burnups over 54 GWd/MTU and with linear heat generation rates in excess of 6.3 kw/ft. These gas gap fractions are conservatively applied to all failed fuel pins.

7.8 The limiting point-source atmospheric dispersion coefficients from the equipment hatch roll-up door to the control room inlet were assumed for the FHA in containment.

7.9 The FHA is assumed to occur 72 hours following reactor shutdown.

8. REFERENCES

8.1 10 CFR 50.67, “Accident Source Term”

8.2 Regulatory Guide 1.183, "Alternate Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors", July 2000.

8.3 Regulatory Guide 1.194, “Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants", June, 2003.

8.4 NUREG/CR-6331 Rev.1, “Atmospheric Relative Concentrations in Building Wakes”, May 1997.

8.5 NUREG/CR-6331, “Atmospheric Relative Concentrations in Building Wakes”, May, 1995.

8.6 CA03940: “ARCON96: Atmospheric Relative Concentrations in Building Wakes”

8.7 CA06734: “ARCON96 Installation and Verification on PCG2487"

8.8 NUREG/CR-6604, SAND98-0272, "RADTRAD: A Simplified Model for Radionuclide Transport and Removal and Dose Estimation"

8.9 NUREG/CR-6604, SAND98-0272/1, Supplement 1, "RADTRAD: A Simplified Model for Radionuclide Transport and Removal and Dose Estimation"

8.10 NUREG/CR-6604, Supplement 2, "RADTRAD: A Simplified Model for Radionuclide Transport and Removal and Dose Estimation"

8.11 EX0009077, RADTRAD Version 3.03

8.12 no longer used

8.13 DA-NS-2002-004, Rev.3, "Fuel Handling Accident Offsite and Control Room Doses"

8.14 KRE Applied Technology, "Additional X/Q Cases for Containment Equipment Hatch", 4/27/2006.

8.15 DA-NS-2001-060, Rev.2, “Atmospheric Dispersion Factors for the Control Room Air Intake”

8.16 Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion," Keith F. Eckerman, et al., Oak Ridge National Laboratory, 1989.

8.17 Federal Guidance Report No. 12, " External Exposure to Radionuclides in Air, Water, and Soil," Keith F. Eckerman, et al., Oak Ridge National Laboratory, 1993.

8.18 TID-14844, “Calculation of Distance Factors for Power and Test Reactor Sites”, 3/23/62

8.19 Calvert Cliffs Units 1 and 2 License Amendments 281/258, "Implementation of AST", 8/29/2007

8.20 "CCNPP Units 1 and 2 LAR: Revision to Accident Source Term and Associated Technical Specifications", 12/3/2005.

8.21 DA-NS-08-049 Rev.0, “Ginna Gas Gap Isotopic Fraction Calculations”

8.22 RG&E Letter, "Input for Ginna Dose Reassessment," September 6, 2001.

8.23 REG DWG 33013-2101 R5, Plant Arrangement Cont Structure & Intermediate Building Plan-Basement Fl.El.235'8"

8.24 REG DWG 33013-2104 R9, Plant Arrangement Turbine Building Plan-Basement Floor El.253'6"

8.25 REG DWG 33013-2105 R4, Plant Arrangement Cont Structure & Intermediate Building Plan-Intermediate Fl.El.253'3"

8.26 REG DWG 33013-2108 R6, Plant Arrangement Auxiliary Building Plan-Intermediate Fl.El.253'0"

8.27 REG DWG 33013-2109 R3, Plant Arrangement Service Building Plan-Basement Fl.El.253'6"

8.28 REG DWG 33013-2110 R5, Plant Arrangement Service Building Plan-Basement Fl.El.253'6"

8.29 REG DWG 33013-2119 R6, Plant Arrangement Technical Support Center Plan Above El.271'0" and 272'0"

8.30 REG DWG 33013-2120 R5, Plant Arrangement Turbine Building Plan-Operating Floor El.289'6"

8.31 REG DWG 33013-2121 R3, Plant Arrangement Intermediate Building Plans-El.293'0",El.298'4", & El.315'4"

8.32 REG DWG 33013-2131 R1, Plant Arrangement Reactor Containment Structure Section 1-1

8.33 REG DWG 33013-2132 R2, Plant Arrangement Reactor Containment Structure Section 2-2

8.34 REG DWG 33013-2133 R2, Plant Arrangement Reactor Containment Structure Stretch-Out Az360 to Az180

8.35 REG DWG 33013-2134 R1, Plant Arrangement Reactor Containment Structure Stretch-Out Az180 to Az0

8.36 REG DWG 33013-2135 R1, Plant Arrangement Reactor Containment Structure, Penetration Schedule

8.37 REG DWG 33013-2136 R3, Plant Arrangement Control Building Sections

8.38 REG DWG 33013-2126 R6, Plant Arrangement Transformer Yard Plan El. 270’

8.39 GE Nuclear Energy Chart of the Nuclides, Nuclides and Isotopes, Fifteenth Edition.

8.40 Regulatory Guide 1.49 Rev.1, "Power Levels of Nuclear Power Plants"

8.41 RGE LAR Regarding Revision to Ginna TS Sections 1.1, 3.3.6, 3.4.16, 3.6.6, 3.7.9, 5.5.10, 5.5.16, and 5.6.7 Resulting from Modification of the CREATS and Change in Dose Calculation Methodology to AST, 5/21/2003.

8.42 License Amendment No. 87, R.E.Ginna Nuclear Power Plant – Amendment Re: Modification of the CREATS and Change in Dose Calculation Methodology to AST, 2/25/2005.

8.43 REG DWG 33013-4603 R3, Architectural – Floor Plan – Canister Preparation Building Addition

8.44 REG DWG 33013-4613 R2, Architectural – Door Schedule, Door Details and Door Elevations – Canister Preparation Building Addition

9. DOCUMENTATION OF COMPUTER CODES

9.1 ARCON96

ARCON96 implements a computational model for calculating atmospheric dispersion coefficients (X/Q's) in the vicinity of buildings. An atmospheric dispersion coefficient is simply the ratio of the relative concentration at the receptor (gm/m^3) to the release rate at the release point (gm/sec). Thus atmospheric dispersion coefficients are in units of sec/m^3. The model estimates impacts from ground-level, vent, and elevated releases using a single year or multi-years of hourly meteorological data. This model also treats diffusion more realistically under low wind speed conditions than previous NRC-issued models. ARCON96 is a revision of ARCON95. The differences between ARCON96 and ARCON95 are relatively modest. ARCON96 allows users to enter initial diffusion coefficients that may be used to approximate dimensions of diffuse area sources. The method of calculating average relative concentrations for periods longer than two hours was also changed. Centerline concentrations are now used for the first eight hours in each time period, while sector-average concentrations are used for the remaining hours.

The ARCON96 computer code was documented and described in NUREG/CR-6331 (Refs.8.4-8.5). The code was benchmarked and validated in Ref.8.6. The installation on the safety-related computer PCG2487 is documented in Ref.8.7.

The methodology for calculating atmospheric dispersion coefficients via ARCON96 was submitted to the NRC in the CCNPP AST LAR (Ref.8.20) and accepted by the NRC in the CCNPP License Amendments 281/258 (Ref.8.19).

9.2 RADTRAD 3.03

The RADTRAD computer code can calculates TEDE and thyroid doses to personnel at the site boundary, low population zone, and control room per the alternate source term methodology 10 CFR 50.67 (Ref.8.1) and Regulatory Guide 1.183 (Ref.8.2) or can calculates whole body and thyroid doses to personnel at the site boundary, low population zone, and control room per the standard source term methodology of TID-14844 (Ref.8.18) resulting from any postulated accident which releases radioactivity within the containment, spent fuel pool, or within any primary system. RADTRAD models the transport of radioactivity from up to 63 radioisotopes from the sprayed and unsprayed regions of a primary containment or a SFP area, through the secondary containment if any, and then to the environment and to the control room. The code includes the capability to model time-dependent activity release; containment spray, filtration, and leakage; control room filtration and inleakage; primary and secondary containment purge filters; control room intake filters; atmospheric dispersion; and natural decay. Doses are calculated for individuals residing at the site boundary or low population zone and in the control room.

The RADTRAD computer code was benchmarked and documented in Refs.8.8-8.10 and models the transport of halogen and noble gas isotopes from a primary containment to a secondary containment and thence to the environment and control room. The installation and validation of RADTRAD on the personal windows computers is detailed in Ref.8.11.

The methodology for calculating offsite and control room doses via RADTRAD 3.03 was submitted to the NRC in the CCNPP AST LAR (Ref.8.20) and accepted by the NRC in the CCNPP License Amendments 281/258 (Ref.8.19).

9.3 EXCEL SPREADSHEETS

Some inputs for the RADTRAD and ARCON96 computer programs were generated via an EXCEL spreadsheet.

10. ACCEPTANCE CRITERIA

Per 10 CFR 50.67(b)(2)(iii) (Ref.8.1), "adequate radiation protection is provided to permit access to and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 0.05 Sv (5 rem) total effective dose equivalent (TEDE) for the duration of the accident."

Regulatory Guide 1.183 Section 4.4 and Table 6 (Ref.8.2) detail the radiological criteria for the EAB and the outer boundary of the LPZ. These criteria are stated for evaluating reactor accidents of exceedingly low probability of occurrence and low risk of public exposure to radiation. For the fuel handling accident (FHA), the limiting EAB and LPZ dose criteria are 6.3 Rem TEDE for a two hour release duration.

Maximum Site Boundary (any 2-hour period)	LPZ (0-30 days)	Control Room (0-30 days)
6.3	6.3	5.0
Reference 8.2 Table 6		Reference 8.1

11 CALCULATIONS AND RESULTS

11.1 ARCON96 Calculations

Table 11.1 lists the ARCON96 input, joint frequency data (JFD), and output files for the cases of interest.

Table 11.1: ARCON96 Cases and File Names						
Receptor in all cases is the CR Intake.						
Source	Input Section	Area	Wake m2	Input File	JFD File	Output File
AB	6.1.10	Point	2000	REGABCB.dat	REGABCB.jfd	REGABCB.out
AB Roof	6.1.11	Area	2000	REGABCBr.dat	REGABCBr.jfd	REGABCBr.out
AB Wall	6.1.12	Area	2000	REGABCBw.dat	REGABCBw.jfd	REGABCBw.out
Containment	6.1.1	Area	2000	REGCTCB.dat	REGCTCB.jfd	REGCTCB.out
Containment Vent	6.1.4	Point	2000	REGCVCB.dat	REGCVCB.jfd	REGCVCB.out
Containment Vent	6.1.4	Point	1500	REGCVCB1.dat	REGCVCB1.jfd	REGCVCB1.out
Containment Vent	6.1.4	Point	2500	REGCVCB2.dat	REGCVCB2.jfd	REGCVCB2.out
Containment Vent	6.1.5	Area	2000	REGCVCBa.dat	REGCVCBa.jfd	REGCVCBa.out
EH Barrel Access Door	6.1.8	Point	2000	REGHBCB.dat	REGHBCB.jfd	REGHBCB.out
EH Barrel Access Door	6.1.9	Area	2000	REGHBCBa.dat	REGHBCBa.jfd	REGHBCBa.out
IB	6.1.13	Point	2000	REGIBCB.dat	REGIBCB.jfd	REGIBCB.out
IB Roof	6.1.14	Area	2000	REGIBCBr.dat	REGIBCBr.jfd	REGIBCBr.out
IB Wall	6.1.15	Area	2000	REGIBCBw.dat	REGIBCBw.jfd	REGIBCBw.out
Plant Vent	6.1.2	Point	2000	REGPVCB.dat	REGPVCB.jfd	REGPVCB.out
Plant Vent	6.1.3	Area	2000	REGPVCBa.dat	REGPVCBa.jfd	REGPVCBa.out
EH Roll-Up Door	6.1.6	Point	2000	REGRDCB.dat	REGRDCB.jfd	REGRDCB.out
EH Roll-Up Door	6.1.7	Area	2000	REGRDCBa.dat	REGRDCBa.jfd	REGRDCBa.out
AB Roll-Up Door	6.1.16	Point	2000	RGARDCB.dat	RGARDCB.jfd	RGARDCB.out
AB Roll-Up Door	6.1.17	Area	2000	RGARDCBr.dat	RGARDCBr.jfd	RGARDCBr.out

11.2 ARCON96 Results

Table 11.2a lists the ARCON96 results for the cases catalogued in Section 11.1.

Table 11.2a Revised Atmospheric Dispersion Coefficients (sec/m3)							
	Source	Wake	0-2 hrs	2-8 hrs	8-24 hrs	1-4 days	4-30 days
Ctmt - CR Intake	Area	2000	1.74E-03	1.22E-03	4.70E-04	4.20E-04	3.62E-04
Plant Vent - CR Intake	Point	2000	2.04E-03	1.53E-03	6.57E-04	5.19E-04	4.58E-04
Plant Vent - CR Intake	Area	2000	2.03E-03	1.52E-03	6.56E-04	5.15E-04	4.56E-04
Ctmt Vent - CR Intake	Point	2000	2.14E-03	1.59E-03	6.89E-04	5.45E-04	4.86E-04
Ctmt Vent - CR Intake	Point	1500	2.15E-03	1.60E-03	6.92E-04	5.46E-04	4.87E-04
Ctmt Vent - CR Intake	Point	2500	2.14E-03	1.59E-03	6.87E-04	5.44E-04	4.85E-04
Ctmt Vent - CR Intake	Area	2000	2.13E-03	1.59E-03	6.86E-04	5.44E-04	4.84E-04
EH Roll-Up Door - CR Intake	**Point**	**2000**	**6.90E-03**	**5.99E-03**	**2.22E-03**	**2.05E-03**	**1.67E-03**
EH Roll-Up Door - CR Intake	Area	2000	5.46E-03	4.60E-03	1.64E-03	1.56E-03	1.31E-03
EH Barrel Access Door-CR Intake	Point	2000	5.66E-03	4.85E-03	1.79E-03	1.65E-03	1.35E-03
EH Barrel Access Door-CR Intake	Area	2000	5.35E-03	4.59E-03	1.68E-03	1.57E-03	1.29E-03
Auxiliary Building-CR Intake	Point	2000	6.87E-03	5.94E-03	2.17E-03	1.74E-03	1.50E-03
Auxiliary Building Roof-CR Intake	Area	2000	3.89E-03	3.07E-03	1.00E-03	1.01E-03	8.59E-04
Auxiliary Building Side-CR Intake	Area	2000	3.23E-03	2.54E-03	8.74E-04	8.26E-04	7.14E-04

AB Roll-Up Door – CR Intake	Point	2000	1.38E-03	1.13E-03	3.96E-04	3.79E-04	3.15E-04
AB Roll-Up Door – CR Intake	Area	2000	1.37E-03	1.10E-03	3.86E-04	3.70E-04	3.10E-04
Intermediate Building-CR Intake	Point	2000	5.49E-03	4.24E-03	1.84E-03	1.36E-03	1.09E-03
Intermediate Building Roof-CR Intake	Area	2000	5.06E-03	3.59E-03	1.53E-03	1.19E-03	9.80E-04
Intermediate Building Side-CR Intake	Area	2000	2.67E-03	1.97E-03	8.73E-04	6.65E-04	5.45E-04

Table 11.2b lists the ARCON96 results for the cases analyzed in Refs.8.14 and 8.15.

Table 11.2b Current Atmospheric Dispersion Coefficients (sec/m3)

	Case	Ref.	0-2 hrs	2-8 hrs	8-24 hrs	1-4 days	4-30 days
EH Roll-Up Door – CR Intake (superseded)	3	8.15	5.58E-03	4.66E-03	1.65E-03	1.58E-03	1.32E-03
Plant Vent – CR Intake (superseded)	5	8.15	1.99E-03	1.46E-03	6.35E-04	5.01E-04	4.47E-04
AB North Wall - CR Intake	7	8.15	3.76E-03	3.01E-03	1.02E-03	9.85E-04	8.48E-04
AB North Wall Damper - CR Intake	7a	8.15	4.69E-03	3.97E-03	1.40E-03	1.32E-03	1.11E-03
AB Roof Vent - CR Intake	7b	8.15	4.24E-03	3.51E-03	1.19E-03	1.17E-03	9.87E-04
AB East Wall Steel Door - CR Intake	7c	8.15	3.62E-03	3.11E-03	1.14E-03	9.13E-04	7.89E-04
AB North Wall Steel Door-CR Intake	7d	8.15	4.14E-03	3.65E-03	1.32E-03	1.21E-03	1.01E-03
AB Roll-Up Door - CR Intake (superseded)	10	8.15	1.17E-03	9.81E-04	3.58E-04	3.36E-04	2.79E-04
Ref. 8.15: DA-NS-2001-060 Rev.2, "Atmospheric Dispersion Factors for the Control Room Air Intake"							
Ref. 8.14: Memo from KRE Applied Technology to Mike Ruby, "Additional X/Q Cases for Containment Equipment Hatch"							

Note the following conclusions:

- The limiting atmospheric dispersion coefficients are those of a point source from the Equipment Hatch Roll-Up Door to the Control Room Intake. The point release from a given structure will bound all other releases from that structure, since the point release assumes the minimum separation between source and receptor and minimum initial diffusion coefficients which maximize the atmospheric dispersion coefficients. Note that the Auxiliary Building to Control Room Inlet point-source X/Q values from Table 11.2a bound all of the Auxiliary Building to Control Room Inlet values displayed in Table 11.2b.
- Comparison of the three point source Containment Vent to Control Room Intake cases shows that the building area wake input has negligible effect on the X/Q results over a typical range of values. In addition, the methodology for calculation of the building area wake is fairly arbitrary. Thus the default value of 2000 m^2 will be used in all calculations per RG 1.183 (Ref.8.2).

11.3 RADTRAD Calculations

Table 11.3 lists the RADTRAD input files (INP), the release fraction and timing file (RFT), the nuclear inventory file (NIF), the plant scenario files (PSF), and the output files (OUT) for the containment and SFP cases.

Table 11.3: RADTRAD Cases and Filenames

	Containment	SFP (Plant Vent)	SFP (AB Roll-Up Door)
Plant Scenario File	fhactmthc0.psf	fhasfpc0.psf	fhasfpc1.psf
Output File	fhactmthc0.o0 (Att.U)	fhasfpc0.o0 (Att.V)	fhasfpc1.o0 (Att.Y)
DCF Input File	fgr14.inp (Att.R)	fgr14.inp (Att.R)	fgr14.inp (Att.R)
RFT File	fha.rft (Att.S)	fha.rft (Att.S)	fha.rft (Att.S)
Nuclear Inventory File	fhac0.nif (Att.T)	fhac0.nif (Att.T)	fhac0.nif (Att.T)

11.4 RADTRAD Results

Table 11.4 lists the RADTRAD results for the cases catalogued in Section 11.3.

Table 11.4: Radtrad Dose Results		
	Acceptance	
	Criteria	Results
Containment	Rem	Rem
EAB	6.3	1.4820E+00
LPZ	6.3	1.7142E-01
CR	5	4.0416E+00
SFP-Plant Vent		
EAB	6.3	1.4820E+00
LPZ	6.3	1.7142E-01
CR	5	1.1949E+00
SFP-AB Roll-Up Door		
EAB	6.3	1.4820E+00
LPZ	6.3	1.7142E-01
CR	5	8.0831E-01

Offsite and Control Room TEDE doses have been conservatively calculated for Fuel Handling Accidents in the Containment and in the SFP assuming

- limiting gas gap fractions
- 72 hours of decay prior to fuel offload
- limiting atmospheric dispersion coefficients

The resulting TEDE doses are shown in Table 11.4. All of the calculated TEDE doses are less than the regulatory acceptance values listed in Section 10 and in Table 11.4.

12. ACRONYMS

AB	Auxiliary Building
ADV	Atmospheric Dump Valve
AEB	Accident Evaluation Branch
AFR	Active Fuel Region
AFW	Auxiliary Feedwater
ANS	American Nuclear Society
ANSI	American National Standards Institute
AOO	Anticipated Operational Occurrence
ARV	Atmospheric Relief Valve
AST	Alternative Source Term
BGE	Baltimore Gas and Electric Company
BOC	Beginning of Cycle
BOL	Beginning of Life
BWR	Boiling Water Reactor
CB	Control Building
CCNPP	Calvert Cliffs Nuclear Power Plant
CE	Combustion Engineering
CEAEE	Control Element Assembly Ejection Event
CEDE	Committed Effective Dose Equivalent
CFQ	Maximum Heat Flux Hot Channel Factor
CFR	Code of Federal Regulations
COD	Containment Outage Door
COLR	Core Operating Limits Report
CP	Charging Pump
CR	Control Room
CRETS	Control Room Emergency Temperature System
CREVS	Control Room Emergency Ventilation System
CST	Condensate Storage Tank
CV	Containment Vent
DBA	Design Basis Accident
DCF	Dose Conversion Factor
DDE	Deep Dose Equivalent
DF	Decontamination Factor
DFI	Inorganic Decontamination Factor
DFO	Organic Decontamination Factor
DWG	Drawing
EAB	Exclusion Area Boundary
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EH	Equipment Hatch
EOC	End of Cycle
EOL	End of Life
EPRI	Electric Power Research Institute
ETP	Engineering Test Procedure
FGR	Federal Guidance Report
FHA	Fuel Handling Accident
GDC	General Design Criteria
GL	Generic Letter
GWd	GigaWatt Day
HVAC	Heating, Ventilation, and Air Conditioning
HEPA	High-Efficiency Particulate Air Filters

IB	Intermediate Building
ICRP	International Commission on Radiological Protection
IFBA	Integral Fuel Burnable Absorbers
IFI	Inorganic Iodine Fraction
IFO	Organic Iodine Fraction
IRS	Iodine Removal System
JFD	Joint Frequency Data
KI	Potassium Iodide Tablets
LAR	License Amendment Request
LEF	Assembly Lower End Fitting
LOCA	Loss of Coolant Accident
LOOP	Loss of Offsite Power
LRE	Locked Rotor Event
LWR	Light Water Reactor
LPZ	Low Population Zone
MFIV	Main Feedwater Isolation Valve
MFW	Main Feedwater
MSIV	Main Steam Isolation Valve
MSLB	Main Steam Line Break
MSSV	Main Steam Safety Valve
MTU	Metric Ton Uranium
MWd	MegaWatt Day
MWt	MegaWatt Thermal
NEI	Nuclear Energy Institute
NFE	Nuclear Fuel Elevator
NIF	Nuclear Inventory File
NMP	Nine Mile Point
NPP	Nuclear Power Plant
NRC	Nuclear Regulatory Commission
NRR	Nuclear Reactor Regulation
OFA	Optimized Fuel Assembly
ORNL	Oak Ridge National Laboratory
PAL	Personnel Air Lock
PFT	Perfluorocarbon Tracer Gas Test
PMH	Probable Maximum Hurricane
PREFS	Pump Room Exhaust Filtration System
PSB	Pin Storage Basket
PSF	Plant Scenario File
PV	Plant Vent
PWR	Pressurized Water Reactor
PZR	Pressurizer
RAI	Request for Additional Information
RCS	Reactor Coolant System
REG	R.E.Ginna
RFP	Refueling Pool
RFT	Release Fraction and Timing File
RG	Regulatory Guide
RWT	Refueling Water Tank
SB	Service Building
SCBA	Self Contained Breathing Apparatus
SDC	Shutdown Cooling
SFHM	Spent Fuel Handling Machine
SER	Safety Evaluation Report
SFP	Spent Fuel Pool
SFPC	Spent Fuel Pool Cooling

SFPEVS	Spent Fuel Pool Exhaust Ventilation System
SG	Steam Generator
SGTR	Steam Generator Tube Rupture
SIT	Safety Injection Tank
SRE	Seized Rotor Event
SRP	Standard Review Plan
SSC	Structure, System, or Component
SST	Standard Source Term
STP	Surveillance Test Procedure
TB	Turbine Building
TEDE	Total Effective Dose Equivalent=DDE+CEDE
TID	Technical Information Document
TRM	Technical Requirements Manual
TS	Technical Specifications
TSB	Technical Specification Bases
TSC	Technical Support Center
TSP	Trisodium Phosphate
UEF	Assembly Upper End Fitting
UFSAR	Updated Final Safety Analysis Report
V+	Vantage Plus Fuel Assembly
VAP	Value Added Pellet
WES	Westinghouse Electric Company
X/Q	Atmospheric Dispersion Coefficient

13 ATTACHMENTS

ATTACHMENT A
ARCON96 OUTPUT FILE SELECTION REGABCB.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =      8.8
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      183
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   138 - 228
   Distance to intake (m)               =     29.7
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGABCB.out
     REGABCB.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =       .00
   Initial value of sigma z             =       .00

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  14463
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  28300


   95% X/Q for standard averaging intervals

   0 to 2 hours        6.87E-03
   2 to 8 hours        5.94E-03
   8 to 24 hours       2.17E-03
   1 to 4 days         1.74E-03
   4 to 30 days        1.50E-03
```

ATTACHMENT B
ARCON96 OUTPUT FILE SELECTION REGABCBR.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =     17.7
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      220
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   175 - 265
   Distance to intake (m)               =     29.7
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGABCBr.out
     REGABCBr.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =      9.90
   Initial value of sigma z             =       .00

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  18277
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  24486

   95% X/Q for standard averaging intervals

   0 to 2 hours        3.89E-03
   2 to 8 hours        3.07E-03
   8 to 24 hours       1.00E-03
   1 to 4 days         1.01E-03
   4 to 30 days        8.59E-04
```

ATTACHMENT C
ARCON96 OUTPUT FILE SELECTION REGABCBW.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =      8.8
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      204
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   159 - 249
   Distance to intake (m)               =     29.7
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGABCBw.out
     REGABCBw.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =      4.18
   Initial value of sigma z             =      2.95

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  17189
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  25574

   95% X/Q for standard averaging intervals

   0 to 2 hours        3.23E-03
   2 to 8 hours        2.54E-03
   8 to 24 hours       8.74E-04
   1 to 4 days         8.26E-04
   4 to 30 days        7.14E-04
```

ATTACHMENT D
ARCON96 OUTPUT FILE SELECTION REGCTCB.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =     15.7
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      247
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   202 - 292
   Distance to intake (m)               =     32.6
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGCTCB.out
     REGCTCB.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =      5.69
   Initial value of sigma z             =      5.24

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  17224
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  25539

   95% X/Q for standard averaging intervals

   0 to 2 hours        1.74E-03
   2 to 8 hours        1.22E-03
   8 to 24 hours       4.70E-04
   1 to 4 days         4.20E-04
   4 to 30 days        3.62E-04
```

ATTACHMENT E
ARCON96 OUTPUT FILE SELECTION REGCVCB.OUT

```
Program Run   9/ 8/2008  at  13:34:33

  ******* ARCON INPUT **********

     Number of Meteorological Data Files  =  5
     Meteorological Data File Names
       RGE99B.MET
       RGE00B.MET
       RGE01B.MET
       RGE02B.MET
       RGE03B.MET

     Height of lower wind instrument (m)  =     10.1
     Height of upper wind instrument (m)  =     45.7
     Wind speeds entered as meters/second

     Ground-level release
     Release height (m)                   =     35.7
     Building Area (m^2)                  =   2000.0
     Effluent vertical velocity (m/s)     =       .00
     Vent or stack flow  (m^3/s)          =       .00
     Vent or stack radius (m)             =       .00

     Direction .. intake to source (deg)  =      272
     Wind direction sector width (deg)    =       90
     Wind direction window (deg)          =   227 - 317
     Distance to intake (m)               =     50.6
     Intake height  (m)                   =     13.8
     Terrain elevation difference (m)     =       .0

     Output file names
       REGCVCB.out
       REGCVCB.jfd

     Minimum Wind Speed (m/s)             =       .5
     Surface roughness length (m)         =       .20
     Sector averaging constant            =      4.3

     Initial value of sigma y             =       .00
     Initial value of sigma z             =       .00

     Expanded output for code testing not selected

     Total number of hours of data processed =  43824
     Hours of missing data                   =    556
     Hours direction in window               =  17533
     Hours elevated plume w/ dir. in window  =      0
     Hours of calm winds                     =    810
     Hours direction not in window or calm   =  24925

     95% X/Q for standard averaging intervals

     0 to 2 hours        2.14E-03
     2 to 8 hours        1.59E-03
     8 to 24 hours       6.89E-04
     1 to 4 days         5.45E-04
     4 to 30 days        4.86E-04
```

ATTACHMENT F
ARCON96 OUTPUT FILE SELECTION REGCVCB1.OUT

```
Program Run   9/ 8/2008  at  13:34:37

  ******* ARCON INPUT **********

     Number of Meteorological Data Files  =  5
     Meteorological Data File Names
       RGE99B.MET
       RGE00B.MET
       RGE01B.MET
       RGE02B.MET
       RGE03B.MET

     Height of lower wind instrument (m)  =     10.1
     Height of upper wind instrument (m)  =     45.7
     Wind speeds entered as meters/second

     Ground-level release
     Release height (m)                   =     35.7
     Building Area (m^2)                  =   1500.0
     Effluent vertical velocity (m/s)     =       .00
     Vent or stack flow  (m^3/s)          =       .00
     Vent or stack radius (m)             =       .00

     Direction .. intake to source (deg)  =      272
     Wind direction sector width (deg)    =       90
     Wind direction window (deg)          =   227 - 317
     Distance to intake (m)               =     50.6
     Intake height  (m)                   =     13.8
     Terrain elevation difference (m)     =       .0

     Output file names
       REGCVCB1.out
       REGCVCB1.jfd

     Minimum Wind Speed (m/s)             =       .5
     Surface roughness length (m)         =       .20
     Sector averaging constant            =      4.3

     Initial value of sigma y             =       .00
     Initial value of sigma z             =       .00

     Expanded output for code testing not selected

     Total number of hours of data processed =  43824
     Hours of missing data                   =    556
     Hours direction in window               =  17533
     Hours elevated plume w/ dir. in window  =      0
     Hours of calm winds                     =    810
     Hours direction not in window or calm   =  24925

     95% X/Q for standard averaging intervals

     0 to 2 hours        2.15E-03
     2 to 8 hours        1.60E-03
     8 to 24 hours       6.92E-04
     1 to 4 days         5.46E-04
     4 to 30 days        4.87E-04
```

ATTACHMENT G
ARCON96 OUTPUT FILE SELECTION REGCVCB2.OUT

```
Program Run   9/ 8/2008  at  13:34:41

  ******* ARCON INPUT **********

     Number of Meteorological Data Files  =  5
     Meteorological Data File Names
       RGE99B.MET
       RGE00B.MET
       RGE01B.MET
       RGE02B.MET
       RGE03B.MET

     Height of lower wind instrument (m)  =     10.1
     Height of upper wind instrument (m)  =     45.7
     Wind speeds entered as meters/second

     Ground-level release
     Release height (m)                   =     35.7
     Building Area (m^2)                  =   2500.0
     Effluent vertical velocity (m/s)     =       .00
     Vent or stack flow  (m^3/s)          =       .00
     Vent or stack radius (m)             =       .00

     Direction .. intake to source (deg)  =      272
     Wind direction sector width (deg)    =       90
     Wind direction window (deg)          =   227 - 317
     Distance to intake (m)               =     50.6
     Intake height  (m)                   =     13.8
     Terrain elevation difference (m)     =       .0

     Output file names
       REGCVCB2.out
       REGCVCB2.jfd

     Minimum Wind Speed (m/s)             =       .5
     Surface roughness length (m)         =       .20
     Sector averaging constant            =      4.3

     Initial value of sigma y             =       .00
     Initial value of sigma z             =       .00

     Expanded output for code testing not selected

     Total number of hours of data processed =  43824
     Hours of missing data                   =    556
     Hours direction in window               =  17533
     Hours elevated plume w/ dir. in window  =      0
     Hours of calm winds                     =    810
     Hours direction not in window or calm   =  24925


     95% X/Q for standard averaging intervals

     0 to 2 hours        2.14E-03
     2 to 8 hours        1.59E-03
     8 to 24 hours       6.87E-04
     1 to 4 days         5.44E-04
     4 to 30 days        4.85E-04
```

ATTACHMENT H
ARCON96 OUTPUT FILE SELECTION REGCVCBA.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =     35.7
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      272
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   227 - 317
   Distance to intake (m)               =     50.6
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGCVCBa.out
     REGCVCBa.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =       .14
   Initial value of sigma z             =       .00

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  17533
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    810
   Hours direction not in window or calm   =  24925

   95% X/Q for standard averaging intervals

   0 to 2 hours        2.13E-03
   2 to 8 hours        1.59E-03
   8 to 24 hours       6.86E-04
   1 to 4 days         5.44E-04
   4 to 30 days        4.84E-04
```

ATTACHMENT I
ARCON96 OUTPUT FILE SELECTION REGHBCB.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =      3.5
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      223
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   178 - 268
   Distance to intake (m)               =     32.4
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGHBCB.out
     REGHBCB.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =       .00
   Initial value of sigma z             =       .00

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  18245
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  24518

   95% X/Q for standard averaging intervals

   0 to 2 hours        5.66E-03
   2 to 8 hours        4.85E-03
   8 to 24 hours       1.79E-03
   1 to 4 days         1.65E-03
   4 to 30 days        1.35E-03
```

ATTACHMENT J
ARCON96 OUTPUT FILE SELECTION REGHBCBA.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =      3.5
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      223
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   178 - 268
   Distance to intake (m)               =     32.4
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGHBCBa.out
     REGHBCBa.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =       .10
   Initial value of sigma z             =       .34

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  18245
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  24518

   95% X/Q for standard averaging intervals

   0 to 2 hours        5.35E-03
   2 to 8 hours        4.59E-03
   8 to 24 hours       1.68E-03
   1 to 4 days         1.57E-03
   4 to 30 days        1.29E-03
```

ATTACHMENT K
ARCON96 OUTPUT FILE SELECTION REGIBCB.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =     10.1
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      270
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   225 - 315
   Distance to intake (m)               =     33.1
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGIBCB.out
     REGIBCB.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =       .00
   Initial value of sigma z             =       .00

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  16549
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  26214

   95% X/Q for standard averaging intervals

   0 to 2 hours        5.49E-03
   2 to 8 hours        4.24E-03
   8 to 24 hours       1.84E-03
   1 to 4 days         1.36E-03
   4 to 30 days        1.09E-03
```

ATTACHMENT L
ARCON96 OUTPUT FILE SELECTION REGIBCBR.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =     20.2
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      266
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   221 - 311
   Distance to intake (m)               =     33.1
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGIBCBr.out
     REGIBCBr.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =      1.78
   Initial value of sigma z             =       .00

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  16678
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  26085

   95% X/Q for standard averaging intervals

   0 to 2 hours        5.06E-03
   2 to 8 hours        3.59E-03
   8 to 24 hours       1.53E-03
   1 to 4 days         1.19E-03
   4 to 30 days        9.80E-04
```

ATTACHMENT M
ARCON96 OUTPUT FILE SELECTION REGIBCBW.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =     10.1
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      266
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   221 - 311
   Distance to intake (m)               =     33.1
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGIBCBw.out
     REGIBCBw.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =      1.78
   Initial value of sigma z             =      3.36

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  16678
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  26085

   95% X/Q for standard averaging intervals

   0 to 2 hours        2.67E-03
   2 to 8 hours        1.97E-03
   8 to 24 hours       8.73E-04
   1 to 4 days         6.65E-04
   4 to 30 days        5.45E-04
```

ATTACHMENT N
ARCON96 OUTPUT FILE SELECTION REGPVCB.OUT

```
Program Run   9/ 8/2008  at  13:34:51

  ******* ARCON INPUT **********

     Number of Meteorological Data Files  =  5
     Meteorological Data File Names
       RGE99B.MET
       RGE00B.MET
       RGE01B.MET
       RGE02B.MET
       RGE03B.MET

     Height of lower wind instrument (m)  =     10.1
     Height of upper wind instrument (m)  =     45.7
     Wind speeds entered as meters/second

     Ground-level release
     Release height (m)                   =     35.7
     Building Area (m^2)                  =   2000.0
     Effluent vertical velocity (m/s)     =       .00
     Vent or stack flow  (m^3/s)          =       .00
     Vent or stack radius (m)             =       .00

     Direction .. intake to source (deg)  =      272
     Wind direction sector width (deg)    =       90
     Wind direction window (deg)          =   227 - 317
     Distance to intake (m)               =     51.9
     Intake height  (m)                   =     13.8
     Terrain elevation difference (m)     =       .0

     Output file names
       REGPVCB.out
       REGPVCB.jfd

     Minimum Wind Speed (m/s)             =       .5
     Surface roughness length (m)         =       .20
     Sector averaging constant            =      4.3

     Initial value of sigma y             =       .00
     Initial value of sigma z             =       .00

     Expanded output for code testing not selected

     Total number of hours of data processed =  43824
     Hours of missing data                   =    556
     Hours direction in window               =  17533
     Hours elevated plume w/ dir. in window  =      0
     Hours of calm winds                     =    810
     Hours direction not in window or calm   =  24925

     95% X/Q for standard averaging intervals

     0 to 2 hours        2.04E-03
     2 to 8 hours        1.53E-03
     8 to 24 hours       6.57E-04
     1 to 4 days         5.19E-04
     4 to 30 days        4.58E-04
```

ATTACHMENT O
ARCON96 OUTPUT FILE SELECTION REGPVCBA.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =     35.7
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      272
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   227 - 317
   Distance to intake (m)               =     51.9
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGPVCBa.out
     REGPVCBa.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =       .23
   Initial value of sigma z             =       .00

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  17533
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    810
   Hours direction not in window or calm   =  24925

   95% X/Q for standard averaging intervals

   0 to 2 hours        2.03E-03
   2 to 8 hours        1.52E-03
   8 to 24 hours       6.56E-04
   1 to 4 days         5.15E-04
   4 to 30 days        4.56E-04
```

ATTACHMENT P
ARCON96 OUTPUT FILE SELECTION REGRDCB.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =      3.3
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      227
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   182 - 272
   Distance to intake (m)               =     28.6
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGRDCB.out
     REGRDCB.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =       .00
   Initial value of sigma z             =       .00

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  18198
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  24565

   95% X/Q for standard averaging intervals

   0 to 2 hours        6.90E-03
   2 to 8 hours        5.99E-03
   8 to 24 hours       2.22E-03
   1 to 4 days         2.05E-03
   4 to 30 days        1.67E-03
```

ATTACHMENT Q
ARCON96 OUTPUT FILE SELECTION REGRDCBA.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =      3.3
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      222
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   177 - 267
   Distance to intake (m)               =     28.6
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     REGRDCBa.out
     REGRDCBa.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =       .87
   Initial value of sigma z             =      1.12

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  18262
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  24501

   95% X/Q for standard averaging intervals

   0 to 2 hours        5.46E-03
   2 to 8 hours        4.60E-03
   8 to 24 hours       1.64E-03
   1 to 4 days         1.56E-03
   4 to 30 days        1.31E-03
```

ATTACHMENT R
RADTRAD INPUT FILE FGR14.INP

```
         9 ORGANS DEFINED IN THIS FILE:
GONADS
BREAST
LUNGS
RED MARR
BONE SUR
THYROID
REMAINDER
EFFECTIVE
SKIN(FGR)
        14 NUCLIDES DEFINED IN THIS FILE:
Kr-85
Kr-85m
Kr-87
Kr-88
I-131     D
I-132     D
I-133     D
I-134     D
I-135     D     Including:Xe-135m
Xe-133
Xe-135
Xe-133m
Xe-135m
Xe-138
          CLOUDSHINE  GROUND    GROUND    GROUND    INHALED   INHALED  INGESTION
                      SHINE 8HR SHINE 7DAY SHINE RATE ACUTE    CHRONIC
Kr-85
GONADS     1.170E-16 8.121E-14 1.704E-12 2.820E-18-1.000E+00 0.000E+00 0.000E+00
BREAST     1.340E-16 7.891E-14 1.656E-12 2.740E-18-1.000E+00 0.000E+00 0.000E+00
LUNGS      1.140E-16 7.056E-14 1.481E-12 2.450E-18-1.000E+00 0.000E+00 0.000E+00
RED MARR   1.090E-16 6.998E-14 1.469E-12 2.430E-18-1.000E+00 0.000E+00 0.000E+00
BONE SUR   2.200E-16 1.287E-13 2.702E-12 4.470E-18-1.000E+00 0.000E+00 0.000E+00
THYROID    1.180E-16 7.459E-14 1.565E-12 2.590E-18-1.000E+00 0.000E+00 0.000E+00
REMAINDER  1.090E-16 6.941E-14 1.457E-12 2.410E-18-1.000E+00 0.000E+00 0.000E+00
EFFECTIVE  1.190E-16 7.603E-14 1.596E-12 2.640E-18-1.000E+00 0.000E+00 0.000E+00
SKIN(FGR)  1.320E-14 2.304E-11 4.835E-10 8.000E-16-1.000E+00 0.000E+00 0.000E+00
Kr-85m
GONADS     7.310E-15 2.594E-12 3.653E-12 1.570E-16-1.000E+00 0.000E+00 0.000E+00
BREAST     8.410E-15 2.527E-12 3.560E-12 1.530E-16-1.000E+00 0.000E+00 0.000E+00
LUNGS      7.040E-15 2.379E-12 3.351E-12 1.440E-16-1.000E+00 0.000E+00 0.000E+00
RED MARR   6.430E-15 2.346E-12 3.304E-12 1.420E-16-1.000E+00 0.000E+00 0.000E+00
BONE SUR   1.880E-14 5.286E-12 7.446E-12 3.200E-16-1.000E+00 0.000E+00 0.000E+00
THYROID    7.330E-15 2.395E-12 3.374E-12 1.450E-16-1.000E+00 0.000E+00 0.000E+00
REMAINDER  6.640E-15 2.313E-12 3.257E-12 1.400E-16-1.000E+00 0.000E+00 0.000E+00
EFFECTIVE  7.480E-15 2.511E-12 3.537E-12 1.520E-16-1.000E+00 0.000E+00 0.000E+00
SKIN(FGR)  2.240E-14 2.247E-11 3.164E-11 1.360E-15-1.000E+00 0.000E+00 0.000E+00
Kr-87
GONADS     4.000E-14 4.962E-12 5.026E-12 7.610E-16-1.000E+00 0.000E+00 0.000E+00
BREAST     4.500E-14 4.740E-12 4.802E-12 7.270E-16-1.000E+00 0.000E+00 0.000E+00
LUNGS      4.040E-14 4.603E-12 4.663E-12 7.060E-16-1.000E+00 0.000E+00 0.000E+00
RED MARR   4.000E-14 4.708E-12 4.769E-12 7.220E-16-1.000E+00 0.000E+00 0.000E+00
BONE SUR   6.020E-14 6.514E-12 6.598E-12 9.990E-16-1.000E+00 0.000E+00 0.000E+00
THYROID    4.130E-14 4.473E-12 4.531E-12 6.860E-16-1.000E+00 0.000E+00 0.000E+00
REMAINDER  3.910E-14 4.590E-12 4.650E-12 7.040E-16-1.000E+00 0.000E+00 0.000E+00
EFFECTIVE  4.120E-14 4.773E-12 4.835E-12 7.320E-16-1.000E+00 0.000E+00 0.000E+00
SKIN(FGR)  1.370E-13 8.802E-11 8.916E-11 1.350E-14-1.000E+00 0.000E+00 0.000E+00
Kr-88
GONADS     9.900E-14 2.278E-11 2.655E-11 1.800E-15-1.000E+00 0.000E+00 0.000E+00
BREAST     1.110E-13 2.177E-11 2.537E-11 1.720E-15-1.000E+00 0.000E+00 0.000E+00
LUNGS      1.010E-13 2.139E-11 2.493E-11 1.690E-15-1.000E+00 0.000E+00 0.000E+00
RED MARR   1.000E-13 2.190E-11 2.552E-11 1.730E-15-1.000E+00 0.000E+00 0.000E+00
BONE SUR   1.390E-13 2.886E-11 3.363E-11 2.280E-15-1.000E+00 0.000E+00 0.000E+00
THYROID    1.030E-13 2.012E-11 2.345E-11 1.590E-15-1.000E+00 0.000E+00 0.000E+00
REMAINDER  9.790E-14 2.139E-11 2.493E-11 1.690E-15-1.000E+00 0.000E+00 0.000E+00
EFFECTIVE  1.020E-13 2.202E-11 2.567E-11 1.740E-15-1.000E+00 0.000E+00 0.000E+00
SKIN(FGR)  1.350E-13 5.607E-11 6.534E-11 4.430E-15-1.000E+00 0.000E+00 0.000E+00
```

I-131							
GONADS	1.780E-14	1.119E-11	1.789E-10	3.940E-16	-1.000E+00	2.530E-11	4.070E-11
BREAST	2.040E-14	1.082E-11	1.730E-10	3.810E-16	-1.000E+00	7.880E-11	1.210E-10
LUNGS	1.760E-14	1.016E-11	1.626E-10	3.580E-16	-1.000E+00	6.570E-10	1.020E-10
RED MARR	1.680E-14	1.022E-11	1.635E-10	3.600E-16	-1.000E+00	6.260E-11	9.440E-11
BONE SUR	3.450E-14	1.675E-11	2.679E-10	5.900E-16	-1.000E+00	5.730E-11	8.720E-11
THYROID	1.810E-14	1.053E-11	1.685E-10	3.710E-16	-1.000E+00	2.920E-07	4.760E-07
REMAINDER	1.670E-14	9.908E-12	1.585E-10	3.490E-16	-1.000E+00	8.030E-11	1.570E-10
EFFECTIVE	1.820E-14	1.067E-11	1.707E-10	3.760E-16	-1.000E+00	8.890E-09	1.440E-08
SKIN(FGR)	2.980E-14	1.825E-11	2.920E-10	6.430E-16	-1.000E+00	0.000E+00	0.000E+00
I-132							
GONADS	1.090E-13	2.523E-11	2.771E-11	2.320E-15	-1.000E+00	9.950E-12	2.330E-11
BREAST	1.240E-13	2.414E-11	2.652E-11	2.220E-15	-1.000E+00	1.410E-11	2.520E-11
LUNGS	1.090E-13	2.305E-11	2.532E-11	2.120E-15	-1.000E+00	2.710E-10	2.640E-11
RED MARR	1.070E-13	2.360E-11	2.592E-11	2.170E-15	-1.000E+00	1.400E-11	2.460E-11
BONE SUR	1.730E-13	3.327E-11	3.655E-11	3.060E-15	-1.000E+00	1.240E-11	2.190E-11
THYROID	1.120E-13	2.381E-11	2.616E-11	2.190E-15	-1.000E+00	1.740E-09	3.870E-09
REMAINDER	1.050E-13	2.283E-11	2.509E-11	2.100E-15	-1.000E+00	3.780E-11	1.650E-10
EFFECTIVE	1.120E-13	2.403E-11	2.640E-11	2.210E-15	-1.000E+00	1.030E-10	1.820E-10
SKIN(FGR)	1.580E-13	8.199E-11	9.007E-11	7.540E-15	-1.000E+00	0.000E+00	0.000E+00
I-133							
GONADS	2.870E-14	1.585E-11	6.748E-11	6.270E-16	-1.000E+00	1.950E-11	3.630E-11
BREAST	3.280E-14	1.519E-11	6.468E-11	6.010E-16	-1.000E+00	2.940E-11	4.680E-11
LUNGS	2.860E-14	1.446E-11	6.156E-11	5.720E-16	-1.000E+00	8.200E-10	4.530E-11
RED MARR	2.770E-14	1.466E-11	6.242E-11	5.800E-16	-1.000E+00	2.720E-11	4.300E-11
BONE SUR	4.870E-14	2.161E-11	9.202E-11	8.550E-16	-1.000E+00	2.520E-11	4.070E-11
THYROID	2.930E-14	1.502E-11	6.393E-11	5.940E-16	-1.000E+00	4.860E-08	9.100E-08
REMAINDER	2.730E-14	1.418E-11	6.038E-11	5.610E-16	-1.000E+00	5.000E-11	1.550E-10
EFFECTIVE	2.940E-14	1.509E-11	6.425E-11	5.970E-16	-1.000E+00	1.580E-09	2.800E-09
SKIN(FGR)	5.830E-14	1.150E-10	4.897E-10	4.550E-15	-1.000E+00	0.000E+00	0.000E+00
I-134							
GONADS	1.270E-13	1.200E-11	1.202E-11	2.640E-15	-1.000E+00	4.250E-12	1.100E-11
BREAST	1.440E-13	1.145E-11	1.147E-11	2.520E-15	-1.000E+00	6.170E-12	1.170E-11
LUNGS	1.270E-13	1.100E-11	1.102E-11	2.420E-15	-1.000E+00	1.430E-10	1.260E-11
RED MARR	1.250E-13	1.127E-11	1.129E-11	2.480E-15	-1.000E+00	6.080E-12	1.090E-11
BONE SUR	1.960E-13	1.568E-11	1.571E-11	3.450E-15	-1.000E+00	5.310E-12	9.320E-12
THYROID	1.300E-13	1.127E-11	1.129E-11	2.480E-15	-1.000E+00	2.880E-10	6.210E-10
REMAINDER	1.220E-13	1.091E-11	1.093E-11	2.400E-15	-1.000E+00	2.270E-11	1.340E-10
EFFECTIVE	1.300E-13	1.150E-11	1.152E-11	2.530E-15	-1.000E+00	3.550E-11	6.660E-11
SKIN(FGR)	1.870E-13	4.477E-11	4.485E-11	9.850E-15	-1.000E+00	0.000E+00	0.000E+00
I-135							
GONADS	8.078E-14	3.113E-11	5.489E-11	1.599E-15	-1.000E+00	1.700E-11	3.610E-11
BREAST	9.143E-14	2.971E-11	5.240E-11	1.526E-15	-1.000E+00	2.340E-11	3.850E-11
LUNGS	8.145E-14	2.886E-11	5.089E-11	1.482E-15	-1.000E+00	4.410E-10	3.750E-11
RED MARR	8.054E-14	2.965E-11	5.228E-11	1.523E-15	-1.000E+00	2.240E-11	3.650E-11
BONE SUR	1.184E-13	3.983E-11	7.024E-11	2.046E-15	-1.000E+00	2.010E-11	3.360E-11
THYROID	8.324E-14	2.852E-11	5.030E-11	1.465E-15	-1.000E+00	8.460E-09	1.790E-08
REMAINDER	7.861E-14	2.883E-11	5.084E-11	1.481E-15	-1.000E+00	4.700E-11	1.540E-10
EFFECTIVE	8.294E-14	2.989E-11	5.271E-11	1.535E-15	-1.000E+00	3.320E-10	6.080E-10
SKIN(FGR)	1.156E-13	9.826E-11	1.733E-10	5.047E-15	-1.000E+00	0.000E+00	0.000E+00
Xe-133							
GONADS	1.610E-15	1.465E-12	2.052E-11	5.200E-17	-1.000E+00	0.000E+00	0.000E+00
BREAST	1.960E-15	1.505E-12	2.107E-11	5.340E-17	-1.000E+00	0.000E+00	0.000E+00
LUNGS	1.320E-15	1.045E-12	1.464E-11	3.710E-17	-1.000E+00	0.000E+00	0.000E+00
RED MARR	1.070E-15	8.791E-13	1.231E-11	3.120E-17	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	5.130E-15	4.254E-12	5.958E-11	1.510E-16	-1.000E+00	0.000E+00	0.000E+00
THYROID	1.510E-15	1.181E-12	1.653E-11	4.190E-17	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	1.240E-15	1.042E-12	1.460E-11	3.700E-17	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	1.560E-15	1.299E-12	1.819E-11	4.610E-17	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	4.970E-15	1.953E-12	2.734E-11	6.930E-17	-1.000E+00	0.000E+00	0.000E+00
Xe-135							
GONADS	1.170E-14	5.455E-12	1.194E-11	2.530E-16	-1.000E+00	0.000E+00	0.000E+00
BREAST	1.330E-14	5.325E-12	1.166E-11	2.470E-16	-1.000E+00	0.000E+00	0.000E+00
LUNGS	1.130E-14	4.959E-12	1.086E-11	2.300E-16	-1.000E+00	0.000E+00	0.000E+00
RED MARR	1.070E-14	4.959E-12	1.086E-11	2.300E-16	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	2.570E-14	9.120E-12	1.997E-11	4.230E-16	-1.000E+00	0.000E+00	0.000E+00
THYROID	1.180E-14	5.023E-12	1.100E-11	2.330E-16	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	1.080E-14	4.829E-12	1.058E-11	2.240E-16	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	1.190E-14	5.217E-12	1.142E-11	2.420E-16	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	3.120E-14	4.506E-11	9.867E-11	2.090E-15	-1.000E+00	0.000E+00	0.000E+00
Xe-133m							
GONADS	1.420E-15	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00

BREAST	1.700E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
LUNGS	1.190E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
RED MARR	1.100E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
BONE SUR	3.230E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
THYROID	1.360E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
REMAINDER	1.150E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	1.370E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	1.040E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
Xe-135m						
GONADS	2.000E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
BREAST	2.290E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
LUNGS	1.980E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
RED MARR	1.910E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
BONE SUR	3.500E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
THYROID	2.040E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
REMAINDER	1.890E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	2.040E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	2.970E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
Xe-138						
GONADS	5.590E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
BREAST	6.320E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
LUNGS	5.660E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
RED MARR	5.600E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
BONE SUR	8.460E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
THYROID	5.770E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
REMAINDER	5.490E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	5.770E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	1.070E-13	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00

ATTACHMENT S
RADTRAD RELEASE FRACTION AND TIMING FILE FHA.RFT

```
Release Fraction and Timing Name:
 PWR, RG 1.183, Table 2 Section 3.2
 Duration (h):  Design Basis Accident
  0.0001E+00  0.0000E+00  0.0000E+00  0.0000E+00
 Noble Gases:
  1.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 Iodine:
  1.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 Cesium:
  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 Tellurium:
  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 Strontium:
  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 Barium:
  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 Ruthenium:
  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 Cerium:
  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 Lanthanum:
  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 Non-Radioactive Aerosols (kg):
  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 End of Release File
```

ATTACHMENT T
RADTRAD NUCLEAR INVENTORY FILE FHAC0.NIF

```
Nuclide Inventory Name:
 Normalized MACCS Sample 3412 MWth PWR Core Inventory
 Power Level:
  0.1000E+01
 Nuclides:
  14
 Nuclide 001:
 Kr-85
   1
  0.3382974720E+09
  0.8500E+02
  1.6900E+03
 none     0.0000E+00
 none     0.0000E+00
 none     0.0000E+00
 Nuclide 002:
 Kr-85m
   1
  0.1612800000E+05
  0.8500E+02
  2.8600E-01
 Kr-85    0.2100E+00
 none     0.0000E+00
 none     0.0000E+00
 Nuclide 003:
 Kr-87
   1
  0.4578000000E+04
  0.8700E+02
  3.2500E-13
 Rb-87    0.1000E+01
 none     0.0000E+00
 none     0.0000E+00
 Nuclide 004:
 Kr-88
   1
  0.1022400000E+05
  0.8800E+02
  1.2400E-03
 Rb-88    0.1000E+01
 none     0.0000E+00
 none     0.0000E+00
 Nuclide 005:
 I-131
   2
  0.6946560000E+06
  0.1310E+03
  4.6600E+02
 Xe-131m  0.1100E-01
 none     0.0000E+00
 none     0.0000E+00
 Nuclide 006:
 I-132
   2
  0.8280000000E+04
  0.1320E+03
  2.8600E+02
 none     0.0000E+00
 none     0.0000E+00
 none     0.0000E+00
 Nuclide 007:
 I-133
   2
  0.7488000000E+05
  0.1330E+03
  1.0400E+02
 Xe-133m  0.2900E-01
```

```
Xe-133   0.9700E+00
none     0.0000E+00
Nuclide 008:
I-134
  2
 0.3156000000E+04
 0.1340E+03
 6.1600E-22
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 009:
I-135
  2
 0.2379600000E+05
 0.1350E+03
 3.7700E-01
Xe-135m  0.1500E+00
Xe-135   0.8500E+00
none     0.0000E+00
Nuclide 010:
Xe-133
  1
 0.4531680000E+06
 0.1330E+03
 1.7800E+05
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 011:
Xe-135
  1
 0.3272400000E+05
 0.1350E+03
 1.5100E+03
Cs-135   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 012:
Xe-133m
  1
 0.1892200000E+06
 0.1330E+03
 3.9400E+03
Xe-133   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 013:
Xe-135m
  1
 0.9180000000E+03
 0.1350E+03
 1.2100E+01
Xe-135   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 014:
Xe-138
  1
 0.8460000000E+03
 0.1380E+03
 1.0000E-12
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
End of Nuclear Inventory File
```

ATTACHMENT U
RADTRAD OUTPUT FILE FHACTMTC0.o0

```
########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  9/04/2008  at  7:54:33
########################################################################

########################################################################
                     File information
########################################################################

Plant file           = C:\Program Files\radtrad303\Files\GinnaFHA\fhactmtc0.psf
Inventory file       = c:\program files\radtrad303\files\ginnafha\fhac0.nif
Release file         = c:\program files\radtrad303\files\ginnafha\fha.rft
Dose Conversion file = c:\program files\radtrad303\files\ginnafha\fgr14.inp




    #####    ####   #####    #  #     #  #####   #    #  #####
    #    #  #       #        #  ##    #  #    #  #    #    #
    #    #  #       #        #  # #   #  #    #  #    #    #
    #####    ####   ####     #  #  #  #  #####   #    #    #
    #            #  #        #  #   # #  #       #    #    #
    #            #  #        #  #    ##  #       #    #    #
    #        ####   #        #  #     #  #        ####     #


Radtrad 3.03 4/15/2001

Nuclide Inventory File:
c:\program files\radtrad303\files\ginnafha\fhac0.nif
Plant Power Level:
 1.0000E+00
Compartments:
  3
Compartment 1:
ctmt
  3
 1.0000E+06
  0
  0
  0
  0
  0
Compartment 2:
env
  2
 0.0000E+00
  0
  0
  0
  0
  0
Compartment 3:
cr
  1
 3.6211E+04
  0
  0
  1
  0
  0
Pathways:
  3
Pathway 1:
ctmt to env
  1
  2
```

```
  2
Pathway 2:
env to cr
  2
  3
  2
Pathway 3:
cr to env
  3
  2
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:

Source Term:
  1
  1   1.0000E+00
c:\program files\radtrad303\files\ginnafha\fgr14.inp
c:\program files\radtrad303\files\ginnafha\fha.rft
  0.0000E+00
  1
  0.0000E+00   5.7000E-01   4.3000E-01   1.0000E+00
Overlying Pool:
  0
  0.0000E+00
  0
  0
  0
  0
Compartments:
  3
Compartment 1:
  0
  1
  0
  0
  0
  0
  0
  0
Compartment 2:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 3:
  0
  1
  0
  0
  0
  0
  1
  5.4000E+03
  5
  0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  1.6700E-02   0.0000E+00   0.0000E+00   0.0000E+00
  1.9400E-02   9.8000E+01   9.0000E+01   7.0000E+01
  8.0000E+00   9.8000E+01   9.0000E+01   7.0000E+01
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
Pathways:
  3
```

```
 Pathway 1:
   0
   0
   0
   0
   0
   1
   3
   0.0000E+00   7.6800E+04   0.0000E+00   0.0000E+00   0.0000E+00
   2.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
   7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
   0
   0
   0
   0
   0
   0
 Pathway 2:
   0
   0
   0
   0
   0
   1
   3
   0.0000E+00   2.2000E+03   0.0000E+00   0.0000E+00   0.0000E+00
   1.6700E-02   3.0000E+02   0.0000E+00   0.0000E+00   0.0000E+00
   7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
   0
   0
   0
   0
   0
   0
 Pathway 3:
   0
   0
   0
   0
   0
   1
   3
   0.0000E+00   2.2000E+03   0.0000E+00   0.0000E+00   0.0000E+00
   1.6700E-02   3.0000E+02   0.0000E+00   0.0000E+00   0.0000E+00
   7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
   0
   0
   0
   0
   0
   0
 Dose Locations:
   3
 Location 1:
 eab
   2
   1
   2
   0.0000E+00   2.1700E-04
   7.2000E+02   0.0000E+00
   1
   4
   0.0000E+00   3.4700E-04
   8.0000E+00   1.7500E-04
   2.4000E+01   2.3200E-04
   7.2000E+02   0.0000E+00
   0
 Location 2:
 lpz
   2
   1
   5
```

```
   0.0000E+00   2.5100E-05
   8.0000E+00   1.7800E-05
   2.4000E+01   8.5000E-06
   9.6000E+01   2.9300E-06
   7.2000E+02   0.0000E+00
   1
   4
   0.0000E+00   3.4700E-04
   8.0000E+00   1.7500E-04
   2.4000E+01   2.3200E-04
   7.2000E+02   0.0000E+00
   0
 Location 3:
 cr
   3
   0
   1
   2
   0.0000E+00   3.4700E-04
   7.2000E+02   0.0000E+00
   1
   4
   0.0000E+00   1.0000E+00
   2.4000E+01   6.0000E-01
   9.6000E+01   4.0000E-01
   7.2000E+02   0.0000E+00
 Effective Volume Location:
   1
   6
   0.0000E+00   6.9000E-03
   2.0000E+00   5.9900E-03
   8.0000E+00   2.2200E-03
   2.4000E+01   2.0500E-03
   9.6000E+01   1.6700E-03
   7.2000E+02   0.0000E+00
 Simulation Parameters:
   1
   0.0000E+00   0.0000E+00
 Output Filename:
 C:\Program Files\radtrad303\Files\GinnaFHA\fhactmtc0.o0
   1
   1
   1
   0
   0
 End of Scenario File

 ##########################################################################
    RADTRAD Version 3.03 (Spring 2001) run on  9/04/2008  at  7:54:33
 ##########################################################################

 ##########################################################################
                      Plant Description
 ##########################################################################

 Number of Nuclides =  14

 Inventory Power =   1.0000E+00 MWth
 Plant Power Level =   1.0000E+00 MWth

 Number of compartments    =   3

 Compartment information

 Compartment number  1  (Source term fraction =   1.0000E+00
 )
 Name: ctmt
 Compartment volume =   1.0000E+06 (Cubic feet)
 Compartment type is Normal
 Pathways into and out of compartment  1
    Exit Pathway Number    1: ctmt to env
```

```
 Compartment number  2
 Name: env
 Compartment type is Environment
 Pathways into and out of compartment  2
    Inlet Pathway Number   1: ctmt to env
    Inlet Pathway Number   3: cr to env
    Exit Pathway Number    2: env to cr

 Compartment number  3
 Name: cr
 Compartment volume =   3.6211E+04 (Cubic feet)
 Compartment type is Control Room
 Removal devices within compartment:
      Filter(s)
 Pathways into and out of compartment  3
    Inlet Pathway Number   2: env to cr
    Exit Pathway Number    3: cr to env

 Total number of pathways =   3

 ************************************************************************
    RADTRAD Version 3.03 (Spring 2001) run on  9/04/2008  at  7:54:33
 ************************************************************************

 ************************************************************************
                      Scenario Description
 ************************************************************************

 Radioactive Decay is enabled
 Calculation of Daughters is enabled

 Release Fractions and Timings
                 GAP       EARLY IN-VESSEL  LATE RELEASE    RELEASE MASS
              0.000100 hr    0.0000 hrs      0.0000 hrs          (gm)
 NOBLES       1.0000E+00     0.0000E+00      0.0000E+00        5.268E+00
 IODINE       1.0000E+00     0.0000E+00      0.0000E+00        3.878E-03
 CESIUM       0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
 TELLURIUM    0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
 STRONTIUM    0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
 BARIUM       0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
 RUTHENIUM    0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
 CERIUM       0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
 LANTHANUM    0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00

 Inventory Power =         1. MWt

 Nuclide  Group  Specific     half     Whole Body   Inhaled     Inhaled
  Name          Inventory     life        DCF       Thyroid    Effective
                 (Ci/MWt)     (s)     (Sv-m3/Bq-s)  (Sv/Bq)     (Sv/Bq)
  Kr-85     1   1.690E+03  3.383E+08   1.190E-16   0.000E+00   0.000E+00
  Kr-85m    1   2.860E-01  1.613E+04   7.480E-15   0.000E+00   0.000E+00
  Kr-87     1   3.250E-13  4.578E+03   4.120E-14   0.000E+00   0.000E+00
  Kr-88     1   1.240E-03  1.022E+04   1.020E-13   0.000E+00   0.000E+00
  I-131     2   4.660E+02  6.947E+05   1.820E-14   2.920E-07   8.890E-09
  I-132     2   2.860E+02  8.280E+03   1.120E-13   1.740E-09   1.030E-10
  I-133     2   1.040E+02  7.488E+04   2.940E-14   4.860E-08   1.580E-09
  I-134     2   6.160E-22  3.156E+03   1.300E-13   2.880E-10   3.550E-11
  I-135     2   3.770E-01  2.380E+04   8.294E-14   8.460E-09   3.320E-10
  Xe-133    1   1.780E+05  4.532E+05   1.560E-15   0.000E+00   0.000E+00
  Xe-135    1   1.510E+03  3.272E+04   1.190E-14   0.000E+00   0.000E+00
  Xe-133m   1   3.940E+03  1.892E+05   1.370E-15   0.000E+00   0.000E+00
  Xe-135m   1   1.210E+01  9.180E+02   2.040E-14   0.000E+00   0.000E+00
  Xe-138    1   1.000E-12  8.460E+02   5.770E-14   0.000E+00   0.000E+00

 Nuclide    Daughter  Fraction   Daughter  Fraction   Daughter  Fraction
  Kr-85m    Kr-85      0.21       none       0.00       none       0.00
  Kr-87     Rb-87      1.00       none       0.00       none       0.00
  Kr-88     Rb-88      1.00       none       0.00       none       0.00
  I-131     Xe-131m    0.01       none       0.00       none       0.00
  I-133     Xe-133m    0.03       Xe-133     0.97       none       0.00
  I-135     Xe-135m    0.15       Xe-135     0.85       none       0.00
  Xe-135    Cs-135     1.00       none       0.00       none       0.00
```

Xe-133m	Xe-133	1.00	none	0.00	none	0.00
Xe-135m	Xe-135	1.00	none	0.00	none	0.00

Iodine fractions
Aerosol = 0.0000E+00
Elemental = 5.7000E-01
Organic = 4.3000E-01

COMPARTMENT DATA

Compartment number 1: ctmt

Compartment number 2: env

Compartment number 3: cr

Compartment Filter Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	5.4000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.6700E-02	5.4000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.9400E-02	5.4000E+03	9.8000E+01	9.0000E+01	7.0000E+01
8.0000E+00	5.4000E+03	9.8000E+01	9.0000E+01	7.0000E+01
7.2000E+02	5.4000E+03	0.0000E+00	0.0000E+00	0.0000E+00

PATHWAY DATA

Pathway number 1: ctmt to env

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	7.6800E+04	0.0000E+00	0.0000E+00	0.0000E+00
2.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 2: env to cr

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.2000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.6700E-02	3.0000E+02	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 3: cr to env

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.2000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.6700E-02	3.0000E+02	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

LOCATION DATA
Location eab is in compartment 2

Location X/Q Data

Time (hr)	X/Q (s * m^-3)
0.0000E+00	2.1700E-04
7.2000E+02	0.0000E+00

Location Breathing Rate Data

Time (hr)	Breathing Rate (m^3 * sec^-1)
0.0000E+00	3.4700E-04
8.0000E+00	1.7500E-04
2.4000E+01	2.3200E-04
7.2000E+02	0.0000E+00

```
      Location lpz     is in compartment   2

      Location X/Q Data
       Time (hr)         X/Q (s * m^-3)
        0.0000E+00          2.5100E-05
        8.0000E+00          1.7800E-05
        2.4000E+01          8.5000E-06
        9.6000E+01          2.9300E-06
        7.2000E+02          0.0000E+00

      Location Breathing Rate Data
       Time (hr)         Breathing Rate (m^3 * sec^-1)
        0.0000E+00                3.4700E-04
        8.0000E+00                1.7500E-04
        2.4000E+01                2.3200E-04
        7.2000E+02                0.0000E+00
      Location cr     is in compartment   3

      Location X/Q Data
       Time (hr)         X/Q (s * m^-3)
        0.0000E+00          6.9000E-03
        2.0000E+00          5.9900E-03
        8.0000E+00          2.2200E-03
        2.4000E+01          2.0500E-03
        9.6000E+01          1.6700E-03
        7.2000E+02          0.0000E+00

      Location Breathing Rate Data
       Time (hr)         Breathing Rate (m^3 * sec^-1)
        0.0000E+00                3.4700E-04
        7.2000E+02                0.0000E+00

      Location Occupancy Factor Data
       Time (hr)         Occupancy Factor
        0.0000E+00           1.0000E+00
        2.4000E+01           6.0000E-01
        9.6000E+01           4.0000E-01
        7.2000E+02           0.0000E+00

 USER SPECIFIED TIME STEP DATA - SUPPLEMENTAL TIME STEPS
      Time            Time step
       0.0000E+00       0.0000E+00

 ########################################################################
    RADTRAD Version 3.03 (Spring 2001) run on  9/04/2008  at  7:54:33
 ########################################################################




      ####   #    #  #####  #####   #    #  #####
     #    #  #    #    #    #    #  #    #    #
     #    #  #    #    #    #    #  #    #    #
     #    #  #    #    #    #####   #    #    #
     #    #  #    #    #    #       #    #    #
     #    #  #    #    #    #       #    #    #
      ####    ####     #    #        ####     #


 ########################################################################
                               Dose Output
 ########################################################################

 eab Doses:

 Time (h) =   0.0001    Whole Body   Thyroid       TEDE
 Delta dose (rem)        6.3829E-05  9.0898E-03  3.4216E-04
 Accumulated dose (rem)  6.3829E-05  9.0898E-03  3.4216E-04

 lpz Doses:
```

```
Time (h) =   0.0001    Whole Body   Thyroid       TEDE
Delta dose (rem)        7.3830E-06  1.0514E-03  3.9577E-05
Accumulated dose (rem)  7.3830E-06  1.0514E-03  3.9577E-05

cr Doses:

Time (h) =   0.0001    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.0955E-08  5.2674E-05  1.6238E-06
Accumulated dose (rem)  1.0955E-08  5.2674E-05  1.6238E-06

eab Doses:

Time (h) =   0.0167    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.0399E-02  2.9050E+00  1.0935E-01
Accumulated dose (rem)  2.0463E-02  2.9141E+00  1.0969E-01

lpz Doses:

Time (h) =   0.0167    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.3595E-03  3.3602E-01  1.2649E-02
Accumulated dose (rem)  2.3669E-03  3.3707E-01  1.2688E-02

cr Doses:

Time (h) =   0.0167    Whole Body   Thyroid       TEDE
Delta dose (rem)        5.6864E-04  2.7341E+00  8.4286E-02
Accumulated dose (rem)  5.6865E-04  2.7341E+00  8.4288E-02

eab Doses:

Time (h) =   0.0194    Whole Body   Thyroid       TEDE
Delta dose (rem)        3.1709E-03  4.5181E-01  1.7005E-02
Accumulated dose (rem)  2.3634E-02  3.3659E+00  1.2670E-01

lpz Doses:

Time (h) =   0.0194    Whole Body   Thyroid       TEDE
Delta dose (rem)        3.6677E-04  5.2260E-02  1.9669E-03
Accumulated dose (rem)  2.7337E-03  3.8933E-01  1.4655E-02

cr Doses:

Time (h) =   0.0194    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.8573E-04  8.9349E-01  2.7544E-02
Accumulated dose (rem)  7.5439E-04  3.6276E+00  1.1183E-01

eab Doses:

Time (h) =   2.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.5167E-01  3.6050E+01  1.3553E+00
Accumulated dose (rem)  2.7530E-01  3.9416E+01  1.4820E+00

lpz Doses:

Time (h) =   2.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.9110E-02  4.1698E+00  1.5677E-01
Accumulated dose (rem)  3.1844E-02  4.5591E+00  1.7142E-01

cr Doses:

Time (h) =   2.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.9851E-01  1.1768E+02  3.8011E+00
Accumulated dose (rem)  1.9927E-01  1.2131E+02  3.9130E+00

eab Doses:

Time (h) =   8.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  2.7530E-01  3.9416E+01  1.4820E+00

lpz Doses:
```

```
Time (h) =   8.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  3.1844E-02  4.5591E+00  1.7142E-01

cr Doses:

Time (h) =   8.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.2200E-01  1.3645E-02  1.2242E-01
Accumulated dose (rem)  3.2127E-01  1.2132E+02  4.0354E+00

eab Doses:

Time (h) =  24.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  2.7530E-01  3.9416E+01  1.4820E+00

lpz Doses:

Time (h) =  24.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  3.1844E-02  4.5591E+00  1.7142E-01

cr Doses:

Time (h) =  24.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        6.1920E-03  2.0184E-20  6.1920E-03
Accumulated dose (rem)  3.2746E-01  1.2132E+02  4.0416E+00

eab Doses:

Time (h) =  96.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  2.7530E-01  3.9416E+01  1.4820E+00

lpz Doses:

Time (h) =  96.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  3.1844E-02  4.5591E+00  1.7142E-01

cr Doses:

Time (h) =  96.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.1953E-06  3.8989E-67  1.1953E-06
Accumulated dose (rem)  3.2746E-01  1.2132E+02  4.0416E+00

eab Doses:

Time (h) = 720.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  2.7530E-01  3.9416E+01  1.4820E+00

lpz Doses:

Time (h) = 720.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  3.1844E-02  4.5591E+00  1.7142E-01

cr Doses:

Time (h) = 720.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.5165E-22  7.9542-279  1.5165E-22
Accumulated dose (rem)  3.2746E-01  1.2132E+02  4.0416E+00

    839

######################################################################
                           I-131 Summary
######################################################################

                  ctmt                  env                   cr
Time (hr)    I-131 (Curies)         I-131 (Curies)       I-131 (Curies)
```

0.000	4.6589E+02	1.0735E-01	7.6898E-04
0.017	4.3156E+02	3.4414E+01	2.3912E-01
0.019	4.2622E+02	3.9750E+01	2.4401E-01
0.419	6.7378E+01	3.9824E+02	8.1330E-02
0.719	1.6892E+01	4.4868E+02	2.3395E-02
1.019	4.2349E+00	4.6132E+02	6.2172E-03
1.319	1.0617E+00	4.6449E+02	1.6017E-03
1.619	2.6618E-01	4.6529E+02	4.0694E-04
1.919	6.6732E-02	4.6549E+02	1.0271E-04
2.000	4.6016E-02	4.6551E+02	7.0909E-05
2.300	4.5966E-02	4.6551E+02	7.6852E-06
2.600	4.5917E-02	4.6551E+02	8.8450E-07
2.900	4.5867E-02	4.6551E+02	1.0661E-07
3.200	4.5818E-02	4.6551E+02	1.3271E-08
3.500	4.5769E-02	4.6551E+02	1.6873E-09
3.800	4.5719E-02	4.6551E+02	2.1740E-10
4.100	4.5670E-02	4.6551E+02	2.8239E-11
4.400	4.5621E-02	4.6551E+02	3.6859E-12
4.700	4.5572E-02	4.6551E+02	4.8250E-13
5.000	4.5523E-02	4.6551E+02	6.3268E-14
5.300	4.5474E-02	4.6551E+02	8.3043E-15
5.600	4.5425E-02	4.6551E+02	1.0906E-15
5.900	4.5376E-02	4.6551E+02	1.4329E-16
6.200	4.5327E-02	4.6551E+02	1.8828E-17
6.500	4.5278E-02	4.6551E+02	2.4744E-18
6.800	4.5229E-02	4.6551E+02	3.2521E-19
7.100	4.5181E-02	4.6551E+02	4.2744E-20
7.400	4.5132E-02	4.6551E+02	5.6182E-21
7.700	4.5083E-02	4.6551E+02	7.3845E-22
8.000	4.5035E-02	4.6551E+02	9.7062E-23
8.300	4.4986E-02	4.6551E+02	1.2758E-23
8.600	4.4938E-02	4.6551E+02	1.6769E-24
8.900	4.4889E-02	4.6551E+02	2.2042E-25
9.200	4.4841E-02	4.6551E+02	2.8972E-26
9.500	4.4793E-02	4.6551E+02	3.8081E-27
9.800	4.4744E-02	4.6551E+02	5.0055E-28
10.100	4.4696E-02	4.6551E+02	6.5793E-29
10.400	4.4648E-02	4.6551E+02	8.6480E-30
24.000	4.2519E-02	4.6551E+02	9.6749E-70
96.000	3.2829E-02	4.6551E+02	3.0082-281
720.000	3.4896E-03	4.6551E+02	0.0000E+00

##
Cumulative Dose Summary
##

	eab		lpz		cr	
Time (hr)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.017	2.9141E+00	1.0969E-01	3.3707E-01	1.2688E-02	2.7341E+00	8.4288E-02
0.019	3.3659E+00	1.2670E-01	3.8933E-01	1.4655E-02	3.6276E+00	1.1183E-01
0.419	3.3725E+01	1.2686E+00	3.9009E+00	1.4673E-01	9.4461E+01	2.9376E+00
0.719	3.7993E+01	1.4287E+00	4.3945E+00	1.6526E-01	1.1400E+02	3.5733E+00
1.019	3.9062E+01	1.4688E+00	4.5182E+00	1.6989E-01	1.1942E+02	3.7731E+00
1.319	3.9330E+01	1.4788E+00	4.5492E+00	1.7105E-01	1.2085E+02	3.8461E+00
1.619	3.9397E+01	1.4813E+00	4.5570E+00	1.7134E-01	1.2121E+02	3.8826E+00
1.919	3.9414E+01	1.4819E+00	4.5589E+00	1.7141E-01	1.2130E+02	3.9073E+00
2.000	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2131E+02	3.9130E+00
2.300	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	3.9314E+00
2.600	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	3.9469E+00
2.900	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	3.9603E+00
3.200	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	3.9717E+00
3.500	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	3.9815E+00
3.800	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	3.9900E+00
4.100	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	3.9972E+00
4.400	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	4.0035E+00
4.700	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	4.0088E+00
5.000	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	4.0134E+00
5.300	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	4.0174E+00
5.600	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	4.0208E+00
5.900	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	1.2132E+02	4.0237E+00

```
    6.200 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0262E+00
    6.500 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0284E+00
    6.800 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0302E+00
    7.100 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0318E+00
    7.400 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0332E+00
    7.700 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0344E+00
    8.000 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0354E+00
    8.300 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0362E+00
    8.600 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0370E+00
    8.900 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0376E+00
    9.200 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0382E+00
    9.500 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0387E+00
    9.800 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0391E+00
   10.100 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0394E+00
   10.400 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0397E+00
   24.000 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0416E+00
   96.000 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0416E+00
  720.000 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 1.2132E+02 4.0416E+00

 ######################################################################
                           Worst Two-Hour Doses
 ######################################################################

 eab
    Time    Whole Body     Thyroid         TEDE
    (hr)       (rem)         (rem)          (rem)
     0.0    2.7530E-01    3.9416E+01    1.4820E+00
```

ATTACHMENT V
RADTRAD OUTPUT FILE FHASFPC0.o0

```
 ######################################################################
    RADTRAD Version 3.03 (Spring 2001) run on  9/08/2021  at 13:05:41
 ######################################################################

 ######################################################################
                     File information
 ######################################################################

 Plant file             = C:\Users\E096652\OneDrive - Exelon\Documents\Ongoing Projects\Ginna FHA
rev\RADTRAD\fhasfpc0.psf
 Inventory file         = c:\users\e096652\onedrive - exelon\documents\ongoing projects\ginna fha
rev\radtrad\fhac0.nif
 Release file           = c:\users\e096652\onedrive - exelon\documents\ongoing projects\ginna fha
rev\radtrad\fha.rft
 Dose Conversion file = c:\users\e096652\onedrive - exelon\documents\ongoing projects\ginna fha
rev\radtrad\fgr14.inp




     #####    ####   #####    #  #     #  #####   #    #  #####
     #    #  #       #        #  ##    #  #    #  #    #    #
     #    #  #       #        #  # #   #  #    #  #    #    #
     #####    ####   ####     #  #  #  #  #####   #    #    #
     #            #  #        #  #   # #  #       #    #    #
     #            #  #        #  #    ##  #       #    #    #
     #        ####   #        #  #     #  #        ####     #


 Radtrad 3.03 4/15/2001
 benchmark
 Nuclide Inventory File:
 c:\users\e096652\onedrive - exelon\documents\ongoing projects\ginna fha rev\radtrad\fhac0.nif
 Plant Power Level:
  1.0000E+00
 Compartments:
   3
 Compartment 1:
 sfp
   3
  1.0000E+06
   0
   0
   0
   0
   0
 Compartment 2:
 env
   2
  0.0000E+00
   0
   0
   0
   0
   0
 Compartment 3:
 cr
   1
  3.6211E+04
   0
   0
   1
   0
   0
 Pathways:
   3
```

```
Pathway 1:
sfp to env
  1
  2
  2
Pathway 2:
env to cr
  2
  3
  2
Pathway 3:
cr to env
  3
  2
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:

Source Term:
  1
  1   1.0000E+00
c:\users\e096652\onedrive - exelon\documents\ongoing projects\ginna fha rev\radtrad\fgr14.inp
c:\users\e096652\onedrive - exelon\documents\ongoing projects\ginna fha rev\radtrad\fha.rft
  0.0000E+00
  1
  0.0000E+00   5.7000E-01   4.3000E-01   1.0000E+00
Overlying Pool:
  0
  0.0000E+00
  0
  0
  0
  0
Compartments:
  3
Compartment 1:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 2:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 3:
  0
  1
  0
  0
  0
  0
  1
  5.4000E+03
  5
  0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  1.6700E-02   0.0000E+00   0.0000E+00   0.0000E+00
  1.9400E-02   9.8000E+01   9.0000E+01   7.0000E+01
  8.0000E+00   9.8000E+01   9.0000E+01   7.0000E+01
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00
```

```
  0
  0
Pathways:
  3
Pathway 1:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   7.6800E+04   0.0000E+00   0.0000E+00   0.0000E+00
  2.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 2:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   2.2000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  1.6700E-02   3.0000E+02   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 3:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   2.2000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  1.6700E-02   3.0000E+02   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Dose Locations:
  3
Location 1:
eab
  2
  1
  2
  0.0000E+00   2.1700E-04
  7.2000E+02   0.0000E+00
  1
  4
  0.0000E+00   3.4700E-04
  8.0000E+00   1.7500E-04
  2.4000E+01   2.3200E-04
  7.2000E+02   0.0000E+00
  0
Location 2:
```

```
lpz
  2
  1
  5
  0.0000E+00   2.5100E-05
  8.0000E+00   1.7800E-05
  2.4000E+01   8.5000E-06
  9.6000E+01   2.9300E-06
  7.2000E+02   0.0000E+00
  1
  4
  0.0000E+00   3.4700E-04
  8.0000E+00   1.7500E-04
  2.4000E+01   2.3200E-04
  7.2000E+02   0.0000E+00
  0
Location 3:
cr
  3
  0
  1
  2
  0.0000E+00   3.4700E-04
  7.2000E+02   0.0000E+00
  1
  4
  0.0000E+00   1.0000E+00
  2.4000E+01   6.0000E-01
  9.6000E+01   4.0000E-01
  7.2000E+02   0.0000E+00
Effective Volume Location:
  1
  6
  0.0000E+00   2.0400E-03
  2.0000E+00   1.5300E-03
  8.0000E+00   6.5700E-04
  2.4000E+01   5.1900E-04
  9.6000E+01   4.5800E-04
  7.2000E+02   0.0000E+00
Simulation Parameters:
  1
  0.0000E+00   0.0000E+00
Output Filename:
C:\Users\E096652\OneDrive - Exelon\Documents\Ongoing Projects\Ginna FHA rev\RADTRAD\fhasfpc0.o0
  1
  1
  1
  0
  0
End of Scenario File

########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  9/08/2021  at 13:05:41
########################################################################

########################################################################
                     Plant Description
########################################################################

Number of Nuclides =  14

Inventory Power =   1.0000E+00 MWth
Plant Power Level =   1.0000E+00 MWth

Number of compartments    =   3

Compartment information

Compartment number  1  (Source term fraction =   1.0000E+00
)
Name: sfp
Compartment volume =   1.0000E+06 (Cubic feet)
```

```
 Compartment type is Normal
 Pathways into and out of compartment  1
    Exit Pathway Number    1: sfp to env

 Compartment number  2
 Name: env
 Compartment type is Environment
 Pathways into and out of compartment  2
    Inlet Pathway Number   1: sfp to env
    Inlet Pathway Number   3: cr to env
    Exit Pathway Number    2: env to cr

 Compartment number  3
 Name: cr
 Compartment volume =   3.6211E+04 (Cubic feet)
 Compartment type is Control Room
 Removal devices within compartment:
      Filter(s)
 Pathways into and out of compartment  3
    Inlet Pathway Number   2: env to cr
    Exit Pathway Number    3: cr to env

 Total number of pathways =   3

 ##########################################################################
    RADTRAD Version 3.03 (Spring 2001) run on  9/08/2021  at 13:05:41
 ##########################################################################

 ##########################################################################
                      Scenario Description
 ##########################################################################

 Radioactive Decay is enabled
 Calculation of Daughters is enabled

 Release Fractions and Timings
                 GAP       EARLY IN-VESSEL  LATE RELEASE    RELEASE MASS
              0.000100 hr    0.0000 hrs      0.0000 hrs          (gm)
 NOBLES       1.0000E+00     0.0000E+00      0.0000E+00        5.268E+00
 IODINE       1.0000E+00     0.0000E+00      0.0000E+00        3.878E-03
 CESIUM       0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
 TELLURIUM    0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
 STRONTIUM    0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
 BARIUM       0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
 RUTHENIUM    0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
 CERIUM       0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
 LANTHANUM    0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00

 Inventory Power =         1. MWt

 Nuclide  Group  Specific     half     Whole Body   Inhaled     Inhaled
  Name          Inventory     life        DCF       Thyroid    Effective
                 (Ci/MWt)     (s)     (Sv-m3/Bq-s)  (Sv/Bq)     (Sv/Bq)
  Kr-85     1   1.690E+03  3.383E+08   1.190E-16   0.000E+00   0.000E+00
  Kr-85m    1   2.860E-01  1.613E+04   7.480E-15   0.000E+00   0.000E+00
  Kr-87     1   3.250E-13  4.578E+03   4.120E-14   0.000E+00   0.000E+00
  Kr-88     1   1.240E-03  1.022E+04   1.020E-13   0.000E+00   0.000E+00
  I-131     2   4.660E+02  6.947E+05   1.820E-14   2.920E-07   8.890E-09
  I-132     2   2.860E+02  8.280E+03   1.120E-13   1.740E-09   1.030E-10
  I-133     2   1.040E+02  7.488E+04   2.940E-14   4.860E-08   1.580E-09
  I-134     2   6.160E-22  3.156E+03   1.300E-13   2.880E-10   3.550E-11
  I-135     2   3.770E-01  2.380E+04   8.294E-14   8.460E-09   3.320E-10
  Xe-133    1   1.780E+05  4.532E+05   1.560E-15   0.000E+00   0.000E+00
  Xe-135    1   1.510E+03  3.272E+04   1.190E-14   0.000E+00   0.000E+00
  Xe-133m   1   3.940E+03  1.892E+05   1.370E-15   0.000E+00   0.000E+00
  Xe-135m   1   1.210E+01  9.180E+02   2.040E-14   0.000E+00   0.000E+00
  Xe-138    1   1.000E-12  8.460E+02   5.770E-14   0.000E+00   0.000E+00

 Nuclide    Daughter  Fraction   Daughter  Fraction   Daughter  Fraction
  Kr-85m    Kr-85      0.21       none       0.00       none       0.00
  Kr-87     Rb-87      1.00       none       0.00       none       0.00
  Kr-88     Rb-88      1.00       none       0.00       none       0.00
```

I-131	Xe-131m	0.01	none	0.00	none	0.00
I-133	Xe-133m	0.03	Xe-133	0.97	none	0.00
I-135	Xe-135m	0.15	Xe-135	0.85	none	0.00
Xe-135	Cs-135	1.00	none	0.00	none	0.00
Xe-133m	Xe-133	1.00	none	0.00	none	0.00
Xe-135m	Xe-135	1.00	none	0.00	none	0.00

Iodine fractions
Aerosol = 0.0000E+00
Elemental = 5.7000E-01
Organic = 4.3000E-01

COMPARTMENT DATA

Compartment number 1: sfp

Compartment number 2: env

Compartment number 3: cr

Compartment Filter Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	5.4000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.6700E-02	5.4000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.9400E-02	5.4000E+03	9.8000E+01	9.0000E+01	7.0000E+01
8.0000E+00	5.4000E+03	9.8000E+01	9.0000E+01	7.0000E+01
7.2000E+02	5.4000E+03	0.0000E+00	0.0000E+00	0.0000E+00

PATHWAY DATA

Pathway number 1: sfp to env

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	7.6800E+04	0.0000E+00	0.0000E+00	0.0000E+00
2.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 2: env to cr

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.2000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.6700E-02	3.0000E+02	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 3: cr to env

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.2000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.6700E-02	3.0000E+02	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

LOCATION DATA
Location eab is in compartment 2

Location X/Q Data

Time (hr)	X/Q (s * m^-3)
0.0000E+00	2.1700E-04
7.2000E+02	0.0000E+00

Location Breathing Rate Data
Time (hr) Breathing Rate (m^3 * sec^-1)

```
        0.0000E+00                3.4700E-04
        8.0000E+00                1.7500E-04
        2.4000E+01                2.3200E-04
        7.2000E+02                0.0000E+00
      Location lpz     is in compartment   2

      Location X/Q Data
       Time (hr)         X/Q (s * m^-3)
        0.0000E+00          2.5100E-05
        8.0000E+00          1.7800E-05
        2.4000E+01          8.5000E-06
        9.6000E+01          2.9300E-06
        7.2000E+02          0.0000E+00

      Location Breathing Rate Data
       Time (hr)         Breathing Rate (m^3 * sec^-1)
        0.0000E+00                3.4700E-04
        8.0000E+00                1.7500E-04
        2.4000E+01                2.3200E-04
        7.2000E+02                0.0000E+00
      Location cr     is in compartment   3

      Location X/Q Data
       Time (hr)         X/Q (s * m^-3)
        0.0000E+00          2.0400E-03
        2.0000E+00          1.5300E-03
        8.0000E+00          6.5700E-04
        2.4000E+01          5.1900E-04
        9.6000E+01          4.5800E-04
        7.2000E+02          0.0000E+00

      Location Breathing Rate Data
       Time (hr)         Breathing Rate (m^3 * sec^-1)
        0.0000E+00                3.4700E-04
        7.2000E+02                0.0000E+00

      Location Occupancy Factor Data
       Time (hr)         Occupancy Factor
        0.0000E+00             1.0000E+00
        2.4000E+01             6.0000E-01
        9.6000E+01             4.0000E-01
        7.2000E+02             0.0000E+00

 USER SPECIFIED TIME STEP DATA - SUPPLEMENTAL TIME STEPS
      Time            Time step
       0.0000E+00       0.0000E+00

 ########################################################################
    RADTRAD Version 3.03 (Spring 2001) run on  9/08/2021  at 13:05:41
 ########################################################################




      ####   #    #  #####  #####   #    #  #####
     #    #  #    #    #    #    #  #    #    #
     #    #  #    #    #    #    #  #    #    #
     #    #  #    #    #    #####   #    #    #
     #    #  #    #    #    #       #    #    #
     #    #  #    #    #    #       #    #    #
      ####    ####     #    #        ####     #


 ########################################################################
                                Dose Output
 ########################################################################

 eab Doses:

 Time (h) =   0.0001    Whole Body   Thyroid       TEDE
 Delta dose (rem)        6.3829E-05  9.0898E-03  3.4216E-04
```

```
Accumulated dose (rem)  6.3829E-05  9.0898E-03  3.4216E-04

lpz Doses:

Time (h) =   0.0001    Whole Body   Thyroid       TEDE
Delta dose (rem)        7.3830E-06  1.0514E-03  3.9577E-05
Accumulated dose (rem)  7.3830E-06  1.0514E-03  3.9577E-05

cr Doses:

Time (h) =   0.0001    Whole Body   Thyroid       TEDE
Delta dose (rem)        3.2390E-09  1.5573E-05  4.8009E-07
Accumulated dose (rem)  3.2390E-09  1.5573E-05  4.8009E-07

eab Doses:

Time (h) =   0.0167    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.0399E-02  2.9050E+00  1.0935E-01
Accumulated dose (rem)  2.0463E-02  2.9141E+00  1.0969E-01

lpz Doses:

Time (h) =   0.0167    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.3595E-03  3.3602E-01  1.2649E-02
Accumulated dose (rem)  2.3669E-03  3.3707E-01  1.2688E-02

cr Doses:

Time (h) =   0.0167    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.6812E-04  8.0833E-01  2.4919E-02
Accumulated dose (rem)  1.6812E-04  8.0835E-01  2.4920E-02

eab Doses:

Time (h) =   0.0194    Whole Body   Thyroid       TEDE
Delta dose (rem)        3.1709E-03  4.5181E-01  1.7005E-02
Accumulated dose (rem)  2.3634E-02  3.3659E+00  1.2670E-01

lpz Doses:

Time (h) =   0.0194    Whole Body   Thyroid       TEDE
Delta dose (rem)        3.6677E-04  5.2260E-02  1.9669E-03
Accumulated dose (rem)  2.7337E-03  3.8933E-01  1.4655E-02

cr Doses:

Time (h) =   0.0194    Whole Body   Thyroid       TEDE
Delta dose (rem)        5.4913E-05  2.6416E-01  8.1435E-03
Accumulated dose (rem)  2.2304E-04  1.0725E+00  3.3063E-02

eab Doses:

Time (h) =   2.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.5167E-01  3.6050E+01  1.3553E+00
Accumulated dose (rem)  2.7530E-01  3.9416E+01  1.4820E+00

lpz Doses:

Time (h) =   2.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.9110E-02  4.1698E+00  1.5677E-01
Accumulated dose (rem)  3.1844E-02  4.5591E+00  1.7142E-01

cr Doses:

Time (h) =   2.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        5.8691E-02  3.4793E+01  1.1238E+00
Accumulated dose (rem)  5.8914E-02  3.5866E+01  1.1569E+00

eab Doses:

Time (h) =   8.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
```

```
Accumulated dose (rem)  2.7530E-01  3.9416E+01  1.4820E+00

lpz Doses:

Time (h) =   8.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  3.1844E-02  4.5591E+00  1.7142E-01

cr Doses:

Time (h) =   8.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        3.6069E-02  4.0343E-03  3.6193E-02
Accumulated dose (rem)  9.4984E-02  3.5870E+01  1.1931E+00

eab Doses:

Time (h) =  24.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  2.7530E-01  3.9416E+01  1.4820E+00

lpz Doses:

Time (h) =  24.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  3.1844E-02  4.5591E+00  1.7142E-01

cr Doses:

Time (h) =  24.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.8307E-03  5.9674E-21  1.8307E-03
Accumulated dose (rem)  9.6814E-02  3.5870E+01  1.1949E+00

eab Doses:

Time (h) =  96.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  2.7530E-01  3.9416E+01  1.4820E+00

lpz Doses:

Time (h) =  96.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  3.1844E-02  4.5591E+00  1.7142E-01

cr Doses:

Time (h) =  96.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        3.5339E-07  1.1527E-67  3.5339E-07
Accumulated dose (rem)  9.6815E-02  3.5870E+01  1.1949E+00

eab Doses:

Time (h) = 720.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  2.7530E-01  3.9416E+01  1.4820E+00

lpz Doses:

Time (h) = 720.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  3.1844E-02  4.5591E+00  1.7142E-01

cr Doses:

Time (h) = 720.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        4.4835E-23  2.3517-279  4.4835E-23
Accumulated dose (rem)  9.6815E-02  3.5870E+01  1.1949E+00

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######################################################################
                           I-131 Summary
```

##

Time (hr)	sfp I-131 (Curies)	env I-131 (Curies)	cr I-131 (Curies)
0.000	4.6589E+02	1.0735E-01	2.2735E-04
0.017	4.3156E+02	3.4414E+01	7.0696E-02
0.019	4.2622E+02	3.9750E+01	7.2141E-02
0.419	6.7378E+01	3.9824E+02	2.4045E-02
0.719	1.6892E+01	4.4868E+02	6.9167E-03
1.019	4.2349E+00	4.6132E+02	1.8381E-03
1.319	1.0617E+00	4.6449E+02	4.7353E-04
1.619	2.6618E-01	4.6529E+02	1.2031E-04
1.919	6.6732E-02	4.6549E+02	3.0367E-05
2.000	4.6016E-02	4.6551E+02	2.0964E-05
2.300	4.5966E-02	4.6551E+02	2.2721E-06
2.600	4.5917E-02	4.6551E+02	2.6150E-07
2.900	4.5867E-02	4.6551E+02	3.1518E-08
3.200	4.5818E-02	4.6551E+02	3.9235E-09
3.500	4.5769E-02	4.6551E+02	4.9885E-10
3.800	4.5719E-02	4.6551E+02	6.4275E-11
4.100	4.5670E-02	4.6551E+02	8.3490E-12
4.400	4.5621E-02	4.6551E+02	1.0898E-12
4.700	4.5572E-02	4.6551E+02	1.4265E-13
5.000	4.5523E-02	4.6551E+02	1.8705E-14
5.300	4.5474E-02	4.6551E+02	2.4552E-15
5.600	4.5425E-02	4.6551E+02	3.2245E-16
5.900	4.5376E-02	4.6551E+02	4.2363E-17
6.200	4.5327E-02	4.6551E+02	5.5667E-18
6.500	4.5278E-02	4.6551E+02	7.3157E-19
6.800	4.5229E-02	4.6551E+02	9.6150E-20
7.100	4.5181E-02	4.6551E+02	1.2637E-20
7.400	4.5132E-02	4.6551E+02	1.6610E-21
7.700	4.5083E-02	4.6551E+02	2.1832E-22
8.000	4.5035E-02	4.6551E+02	2.8697E-23
8.300	4.4986E-02	4.6551E+02	3.7719E-24
8.600	4.4938E-02	4.6551E+02	4.9579E-25
8.900	4.4889E-02	4.6551E+02	6.5167E-26
9.200	4.4841E-02	4.6551E+02	8.5657E-27
9.500	4.4793E-02	4.6551E+02	1.1259E-27
9.800	4.4744E-02	4.6551E+02	1.4799E-28
10.100	4.4696E-02	4.6551E+02	1.9452E-29
10.400	4.4648E-02	4.6551E+02	2.5568E-30
24.000	4.2519E-02	4.6551E+02	2.8604E-70
96.000	3.2829E-02	4.6551E+02	8.8937-282
720.000	3.4896E-03	4.6551E+02	0.0000E+00

##
Cumulative Dose Summary
##

Time (hr)	eab Thyroid (rem)	eab TEDE (rem)	lpz Thyroid (rem)	lpz TEDE (rem)	cr Thyroid (rem)	cr TEDE (rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.017	2.9141E+00	1.0969E-01	3.3707E-01	1.2688E-02	8.0835E-01	2.4920E-02
0.019	3.3659E+00	1.2670E-01	3.8933E-01	1.4655E-02	1.0725E+00	3.3063E-02
0.419	3.3725E+01	1.2686E+00	3.9009E+00	1.4673E-01	2.7928E+01	8.6851E-01
0.719	3.7993E+01	1.4287E+00	4.3945E+00	1.6526E-01	3.3704E+01	1.0564E+00
1.019	3.9062E+01	1.4688E+00	4.5182E+00	1.6989E-01	3.5308E+01	1.1155E+00
1.319	3.9330E+01	1.4788E+00	4.5492E+00	1.7105E-01	3.5728E+01	1.1371E+00
1.619	3.9397E+01	1.4813E+00	4.5570E+00	1.7134E-01	3.5836E+01	1.1479E+00
1.919	3.9414E+01	1.4819E+00	4.5589E+00	1.7141E-01	3.5863E+01	1.1552E+00
2.000	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5866E+01	1.1569E+00
2.300	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5869E+01	1.1623E+00
2.600	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1669E+00
2.900	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1709E+00
3.200	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1742E+00
3.500	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1771E+00
3.800	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1796E+00
4.100	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1818E+00
4.400	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1836E+00
4.700	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1852E+00

5.000	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1866E+00
5.300	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1878E+00
5.600	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1888E+00
5.900	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1896E+00
6.200	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1904E+00
6.500	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1910E+00
6.800	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1915E+00
7.100	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1920E+00
7.400	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1924E+00
7.700	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1928E+00
8.000	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1931E+00
8.300	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1933E+00
8.600	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1935E+00
8.900	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1937E+00
9.200	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1939E+00
9.500	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1940E+00
9.800	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1942E+00
10.100	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1943E+00
10.400	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1944E+00
24.000	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1949E+00
96.000	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1949E+00
720.000	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	3.5870E+01	1.1949E+00

```
######################################################################
                        Worst Two-Hour Doses
######################################################################

eab
   Time    Whole Body     Thyroid         TEDE
   (hr)      (rem)         (rem)          (rem)
    0.0   2.7530E-01   3.9416E+01   1.4820E+00
```

ATTACHMENT W
ARCON96 OUTPUT FILE SELECTION RGARDCB.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =     17.7
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      225
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   180 - 270
   Distance to intake (m)               =     73.0
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     RGARDCB.out
     RGARDCB.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =       .00
   Initial value of sigma z             =       .00

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  18256
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  24507


   95% X/Q for standard averaging intervals

   0 to 2 hours        1.38E-03
   2 to 8 hours        1.13E-03
   8 to 24 hours       3.96E-04
   1 to 4 days         3.79E-04
   4 to 30 days        3.15E-04
```

ATTACHMENT X
ARCON96 OUTPUT FILE SELECTION RGARDCBR.OUT

```
******* ARCON INPUT **********

   Number of Meteorological Data Files  =  5
   Meteorological Data File Names
     RGE99B.MET
     RGE00B.MET
     RGE01B.MET
     RGE02B.MET
     RGE03B.MET

   Height of lower wind instrument (m)  =     10.1
   Height of upper wind instrument (m)  =     45.7
   Wind speeds entered as meters/second

   Ground-level release
   Release height (m)                   =     17.7
   Building Area (m^2)                  =   2000.0
   Effluent vertical velocity (m/s)     =       .00
   Vent or stack flow  (m^3/s)          =       .00
   Vent or stack radius (m)             =       .00

   Direction .. intake to source (deg)  =      227
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   182 - 272
   Distance to intake (m)               =     73.0
   Intake height  (m)                   =     13.8
   Terrain elevation difference (m)     =       .0

   Output file names
     RGARDCBR.out
     RGARDCBR.jfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =       .93
   Initial value of sigma z             =       .00

   Expanded output for code testing not selected

   Total number of hours of data processed =  43824
   Hours of missing data                   =    556
   Hours direction in window               =  18198
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    505
   Hours direction not in window or calm   =  24565

   95% X/Q for standard averaging intervals

   0 to 2 hours        1.37E-03
   2 to 8 hours        1.10E-03
   8 to 24 hours       3.86E-04
   1 to 4 days         3.70E-04
   4 to 30 days        3.10E-04
```

ATTACHMENT Y
RADTRAD OUTPUT FILE FHASFPC1.o0

```
########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 10/28/2008  at  8:15:31
########################################################################

########################################################################
                     File information
########################################################################

Plant file           = C:\Program Files\radtrad303\Files\GinnaFHA\New\fhasfpc1.psf
Inventory file       = c:\program files\radtrad303\files\ginnafha\fhac0.nif
Release file         = c:\program files\radtrad303\files\ginnafha\fha.rft
Dose Conversion file = c:\program files\radtrad303\files\ginnafha\fgr14.inp

    #####    ####   #####    #  #     #  #####   #    #  #####
    #    #  #       #        #  ##    #  #    #  #    #    #
    #    #  #       #        #  # #   #  #    #  #    #    #
    #####    ####   ####     #  #  #  #  #####   #    #    #
    #            #  #        #  #   # #  #       #    #    #
    #            #  #        #  #    ##  #       #    #    #
    #        ####   #        #  #     #  #        ####     #

Radtrad 3.03 4/15/2001

Nuclide Inventory File:
c:\program files\radtrad303\files\ginnafha\fhac0.nif
Plant Power Level:
 1.0000E+00
Compartments:
  3
Compartment 1:
sfp
  3
 1.0000E+06
  0
  0
  0
  0
  0
Compartment 2:
env
  2
 0.0000E+00
  0
  0
  0
  0
  0
Compartment 3:
cr
  1
 3.6211E+04
  0
  0
  1
  0
  0
Pathways:
  3
Pathway 1:
sfp to env
  1
  2
  2
Pathway 2:
env to cr
  2
  3
```

```
  2
Pathway 3:
cr to env
  3
  2
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:

Source Term:
  1
  1   1.0000E+00
c:\program files\radtrad303\files\ginnafha\fgr14.inp
c:\program files\radtrad303\files\ginnafha\fha.rft
  0.0000E+00
  1
  0.0000E+00   5.7000E-01   4.3000E-01   1.0000E+00
Overlying Pool:
  0
  0.0000E+00
  0
  0
  0
  0
Compartments:
  3
Compartment 1:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 2:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 3:
  0
  1
  0
  0
  0
  0
  1
  5.4000E+03
  5
  0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  1.6700E-02   0.0000E+00   0.0000E+00   0.0000E+00
  1.9400E-02   9.8000E+01   9.0000E+01   7.0000E+01
  8.0000E+00   9.8000E+01   9.0000E+01   7.0000E+01
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
Pathways:
  3
Pathway 1:
  0
  0
  0
  0
```

```
  0
  1
  3
  0.0000E+00   7.6800E+04   0.0000E+00   0.0000E+00   0.0000E+00
  2.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 2:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   2.2000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  1.6700E-02   3.0000E+02   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 3:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   2.2000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  1.6700E-02   3.0000E+02   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Dose Locations:
  3
Location 1:
eab
  2
  1
  2
  0.0000E+00   2.1700E-04
  7.2000E+02   0.0000E+00
  1
  4
  0.0000E+00   3.4700E-04
  8.0000E+00   1.7500E-04
  2.4000E+01   2.3200E-04
  7.2000E+02   0.0000E+00
  0
Location 2:
lpz
  2
  1
  5
  0.0000E+00   2.5100E-05
  8.0000E+00   1.7800E-05
  2.4000E+01   8.5000E-06
  9.6000E+01   2.9300E-06
  7.2000E+02   0.0000E+00
```

```
  1
  4
  0.0000E+00   3.4700E-04
  8.0000E+00   1.7500E-04
  2.4000E+01   2.3200E-04
  7.2000E+02   0.0000E+00
  0
Location 3:
cr
  3
  0
  1
  2
  0.0000E+00   3.4700E-04
  7.2000E+02   0.0000E+00
  1
  4
  0.0000E+00   1.0000E+00
  2.4000E+01   6.0000E-01
  9.6000E+01   4.0000E-01
  7.2000E+02   0.0000E+00
Effective Volume Location:
  1
  6
  0.0000E+00   1.3800E-03
  2.0000E+00   1.1300E-03
  8.0000E+00   3.9600E-04
  2.4000E+01   3.7900E-04
  9.6000E+01   3.1500E-04
  7.2000E+02   0.0000E+00
Simulation Parameters:
  1
  0.0000E+00   0.0000E+00
Output Filename:
C:\Program Files\radtrad303\Files\GinnaFHA\New\fhasfpc1.o0
  1
  1
  1
  0
  0
End of Scenario File

########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 10/28/2008  at  8:15:31
########################################################################

########################################################################
                    Plant Description
########################################################################

Number of Nuclides =  14

Inventory Power =   1.0000E+00 MWth
Plant Power Level =   1.0000E+00 MWth

Number of compartments    =   3

Compartment information

Compartment number  1  (Source term fraction =   1.0000E+00
)
Name: sfp
Compartment volume =   1.0000E+06 (Cubic feet)
Compartment type is Normal
Pathways into and out of compartment  1
   Exit Pathway Number    1: sfp to env

Compartment number  2
Name: env
Compartment type is Environment
Pathways into and out of compartment  2
   Inlet Pathway Number   1: sfp to env
```

```
   Inlet Pathway Number   3: cr to env
   Exit Pathway Number    2: env to cr

Compartment number  3
Name: cr
Compartment volume =   3.6211E+04 (Cubic feet)
Compartment type is Control Room
Removal devices within compartment:
     Filter(s)
Pathways into and out of compartment  3
   Inlet Pathway Number   2: env to cr
   Exit Pathway Number    3: cr to env

Total number of pathways =   3

########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 10/28/2008  at  8:15:31
########################################################################

########################################################################
                     Scenario Description
########################################################################

Radioactive Decay is enabled
Calculation of Daughters is enabled

Release Fractions and Timings
               GAP       EARLY IN-VESSEL  LATE RELEASE    RELEASE MASS
            0.000100 hr    0.0000 hrs      0.0000 hrs          (gm)
NOBLES      1.0000E+00     0.0000E+00      0.0000E+00        5.268E+00
IODINE      1.0000E+00     0.0000E+00      0.0000E+00        3.878E-03
CESIUM      0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
TELLURIUM   0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
STRONTIUM   0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
BARIUM      0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
RUTHENIUM   0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
CERIUM      0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00
LANTHANUM   0.0000E+00     0.0000E+00      0.0000E+00        0.000E+00

Inventory Power =         1. MWt

Nuclide  Group  Specific     half     Whole Body   Inhaled     Inhaled
 Name          Inventory     life        DCF       Thyroid    Effective
               (Ci/MWt)      (s)     (Sv-m3/Bq-s)  (Sv/Bq)     (Sv/Bq)
 Kr-85     1   1.690E+03  3.383E+08   1.190E-16   0.000E+00   0.000E+00
 Kr-85m    1   2.860E-01  1.613E+04   7.480E-15   0.000E+00   0.000E+00
 Kr-87     1   3.250E-13  4.578E+03   4.120E-14   0.000E+00   0.000E+00
 Kr-88     1   1.240E-03  1.022E+04   1.020E-13   0.000E+00   0.000E+00
 I-131     2   4.660E+02  6.947E+05   1.820E-14   2.920E-07   8.890E-09
 I-132     2   2.860E+02  8.280E+03   1.120E-13   1.740E-09   1.030E-10
 I-133     2   1.040E+02  7.488E+04   2.940E-14   4.860E-08   1.580E-09
 I-134     2   6.160E-22  3.156E+03   1.300E-13   2.880E-10   3.550E-11
 I-135     2   3.770E-01  2.380E+04   8.294E-14   8.460E-09   3.320E-10
 Xe-133    1   1.780E+05  4.532E+05   1.560E-15   0.000E+00   0.000E+00
 Xe-135    1   1.510E+03  3.272E+04   1.190E-14   0.000E+00   0.000E+00
 Xe-133m   1   3.940E+03  1.892E+05   1.370E-15   0.000E+00   0.000E+00
 Xe-135m   1   1.210E+01  9.180E+02   2.040E-14   0.000E+00   0.000E+00
 Xe-138    1   1.000E-12  8.460E+02   5.770E-14   0.000E+00   0.000E+00

Nuclide    Daughter  Fraction   Daughter  Fraction   Daughter  Fraction
 Kr-85m    Kr-85      0.21       none       0.00       none       0.00
 Kr-87     Rb-87      1.00       none       0.00       none       0.00
 Kr-88     Rb-88      1.00       none       0.00       none       0.00
 I-131     Xe-131m    0.01       none       0.00       none       0.00
 I-133     Xe-133m    0.03       Xe-133     0.97       none       0.00
 I-135     Xe-135m    0.15       Xe-135     0.85       none       0.00
 Xe-135    Cs-135     1.00       none       0.00       none       0.00
 Xe-133m   Xe-133     1.00       none       0.00       none       0.00
 Xe-135m   Xe-135     1.00       none       0.00       none       0.00

Iodine fractions
     Aerosol     =   0.0000E+00
```

Elemental = 5.7000E-01
Organic = 4.3000E-01

COMPARTMENT DATA

Compartment number 1: sfp

Compartment number 2: env

Compartment number 3: cr

Compartment Filter Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	5.4000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.6700E-02	5.4000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.9400E-02	5.4000E+03	9.8000E+01	9.0000E+01	7.0000E+01
8.0000E+00	5.4000E+03	9.8000E+01	9.0000E+01	7.0000E+01
7.2000E+02	5.4000E+03	0.0000E+00	0.0000E+00	0.0000E+00

PATHWAY DATA

Pathway number 1: sfp to env

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	7.6800E+04	0.0000E+00	0.0000E+00	0.0000E+00
2.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 2: env to cr

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.2000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.6700E-02	3.0000E+02	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 3: cr to env

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.2000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.6700E-02	3.0000E+02	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

LOCATION DATA
Location eab is in compartment 2

Location X/Q Data

Time (hr)	X/Q (s * m^-3)
0.0000E+00	2.1700E-04
7.2000E+02	0.0000E+00

Location Breathing Rate Data

Time (hr)	Breathing Rate (m^3 * sec^-1)
0.0000E+00	3.4700E-04
8.0000E+00	1.7500E-04
2.4000E+01	2.3200E-04
7.2000E+02	0.0000E+00

Location lpz is in compartment 2

Location X/Q Data

Time (hr)	X/Q (s * m^-3)
0.0000E+00	2.5100E-05

```
        8.0000E+00          1.7800E-05
        2.4000E+01          8.5000E-06
        9.6000E+01          2.9300E-06
        7.2000E+02          0.0000E+00

      Location Breathing Rate Data
       Time (hr)         Breathing Rate (m^3 * sec^-1)
        0.0000E+00                3.4700E-04
        8.0000E+00                1.7500E-04
        2.4000E+01                2.3200E-04
        7.2000E+02                0.0000E+00
      Location cr     is in compartment   3

      Location X/Q Data
       Time (hr)         X/Q (s * m^-3)
        0.0000E+00          1.3800E-03
        2.0000E+00          1.1300E-03
        8.0000E+00          3.9600E-04
        2.4000E+01          3.7900E-04
        9.6000E+01          3.1500E-04
        7.2000E+02          0.0000E+00

      Location Breathing Rate Data
       Time (hr)         Breathing Rate (m^3 * sec^-1)
        0.0000E+00                3.4700E-04
        7.2000E+02                0.0000E+00

      Location Occupancy Factor Data
       Time (hr)         Occupancy Factor
        0.0000E+00           1.0000E+00
        2.4000E+01           6.0000E-01
        9.6000E+01           4.0000E-01
        7.2000E+02           0.0000E+00

 USER SPECIFIED TIME STEP DATA - SUPPLEMENTAL TIME STEPS
      Time            Time step
       0.0000E+00       0.0000E+00

 ########################################################################
    RADTRAD Version 3.03 (Spring 2001) run on 10/28/2008  at  8:15:31
 ########################################################################

      ####   #    #  #####  #####   #    #  #####
     #    #  #    #    #    #    #  #    #    #
     #    #  #    #    #    #    #  #    #    #
     #    #  #    #    #    #####   #    #    #
     #    #  #    #    #    #       #    #    #
     #    #  #    #    #    #       #    #    #
      ####    ####     #    #        ####     #

 ########################################################################
                              Dose Output
 ########################################################################

 eab Doses:

 Time (h) =   0.0001    Whole Body   Thyroid       TEDE
 Delta dose (rem)        6.3829E-05  9.0898E-03  3.4216E-04
 Accumulated dose (rem)  6.3829E-05  9.0898E-03  3.4216E-04

 lpz Doses:

 Time (h) =   0.0001    Whole Body   Thyroid       TEDE
 Delta dose (rem)        7.3830E-06  1.0514E-03  3.9577E-05
 Accumulated dose (rem)  7.3830E-06  1.0514E-03  3.9577E-05

 cr Doses:

 Time (h) =   0.0001    Whole Body   Thyroid       TEDE
 Delta dose (rem)        2.1911E-09  1.0535E-05  3.2477E-07
 Accumulated dose (rem)  2.1911E-09  1.0535E-05  3.2477E-07
```

eab Doses:

Time (h) = 0.0167	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.0399E-02	2.9050E+00	1.0935E-01
Accumulated dose (rem)	2.0463E-02	2.9141E+00	1.0969E-01

lpz Doses:

Time (h) = 0.0167	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.3595E-03	3.3602E-01	1.2649E-02
Accumulated dose (rem)	2.3669E-03	3.3707E-01	1.2688E-02

cr Doses:

Time (h) = 0.0167	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.1373E-04	5.4681E-01	1.6857E-02
Accumulated dose (rem)	1.1373E-04	5.4683E-01	1.6858E-02

eab Doses:

Time (h) = 0.0194	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.1709E-03	4.5181E-01	1.7005E-02
Accumulated dose (rem)	2.3634E-02	3.3659E+00	1.2670E-01

lpz Doses:

Time (h) = 0.0194	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.6677E-04	5.2260E-02	1.9669E-03
Accumulated dose (rem)	2.7337E-03	3.8933E-01	1.4655E-02

cr Doses:

Time (h) = 0.0194	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.7147E-05	1.7870E-01	5.5088E-03
Accumulated dose (rem)	1.5088E-04	7.2552E-01	2.2366E-02

eab Doses:

Time (h) = 2.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.5167E-01	3.6050E+01	1.3553E+00
Accumulated dose (rem)	2.7530E-01	3.9416E+01	1.4820E+00

lpz Doses:

Time (h) = 2.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.9110E-02	4.1698E+00	1.5677E-01
Accumulated dose (rem)	3.1844E-02	4.5591E+00	1.7142E-01

cr Doses:

Time (h) = 2.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.9703E-02	2.3537E+01	7.6023E-01
Accumulated dose (rem)	3.9854E-02	2.4262E+01	7.8259E-01

eab Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	2.7530E-01	3.9416E+01	1.4820E+00

lpz Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	3.1844E-02	4.5591E+00	1.7142E-01

cr Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.4400E-02	2.7291E-03	2.4483E-02
Accumulated dose (rem)	6.4254E-02	2.4265E+01	8.0708E-01

eab Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	2.7530E-01	3.9416E+01	1.4820E+00

lpz Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	3.1844E-02	4.5591E+00	1.7142E-01

cr Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.2384E-03	4.0367E-21	1.2384E-03
Accumulated dose (rem)	6.5492E-02	2.4265E+01	8.0831E-01

eab Doses:

Time (h) = 96.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	2.7530E-01	3.9416E+01	1.4820E+00

lpz Doses:

Time (h) = 96.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	3.1844E-02	4.5591E+00	1.7142E-01

cr Doses:

Time (h) = 96.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.3906E-07	7.7977E-68	2.3906E-07
Accumulated dose (rem)	6.5492E-02	2.4265E+01	8.0831E-01

eab Doses:

Time (h) = 720.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	2.7530E-01	3.9416E+01	1.4820E+00

lpz Doses:

Time (h) = 720.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	3.1844E-02	4.5591E+00	1.7142E-01

cr Doses:

Time (h) = 720.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.0329E-23	1.5908-279	3.0329E-23
Accumulated dose (rem)	6.5492E-02	2.4265E+01	8.0831E-01

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##
I-131 Summary
##

Time (hr)	sfp I-131 (Curies)	env I-131 (Curies)	cr I-131 (Curies)
0.000	4.6589E+02	1.0735E-01	1.5380E-04
0.017	4.3156E+02	3.4414E+01	4.7824E-02
0.019	4.2622E+02	3.9750E+01	4.8801E-02
0.419	6.7378E+01	3.9824E+02	1.6266E-02
0.719	1.6892E+01	4.4868E+02	4.6789E-03
1.019	4.2349E+00	4.6132E+02	1.2434E-03
1.319	1.0617E+00	4.6449E+02	3.2033E-04
1.619	2.6618E-01	4.6529E+02	8.1388E-05
1.919	6.6732E-02	4.6549E+02	2.0542E-05
2.000	4.6016E-02	4.6551E+02	1.4182E-05

2.300	4.5966E-02	4.6551E+02	1.5370E-06
2.600	4.5917E-02	4.6551E+02	1.7690E-07
2.900	4.5867E-02	4.6551E+02	2.1321E-08
3.200	4.5818E-02	4.6551E+02	2.6541E-09
3.500	4.5769E-02	4.6551E+02	3.3746E-10
3.800	4.5719E-02	4.6551E+02	4.3480E-11
4.100	4.5670E-02	4.6551E+02	5.6478E-12
4.400	4.5621E-02	4.6551E+02	7.3719E-13
4.700	4.5572E-02	4.6551E+02	9.6500E-14
5.000	4.5523E-02	4.6551E+02	1.2654E-14
5.300	4.5474E-02	4.6551E+02	1.6609E-15
5.600	4.5425E-02	4.6551E+02	2.1813E-16
5.900	4.5376E-02	4.6551E+02	2.8657E-17
6.200	4.5327E-02	4.6551E+02	3.7657E-18
6.500	4.5278E-02	4.6551E+02	4.9489E-19
6.800	4.5229E-02	4.6551E+02	6.5043E-20
7.100	4.5181E-02	4.6551E+02	8.5488E-21
7.400	4.5132E-02	4.6551E+02	1.1236E-21
7.700	4.5083E-02	4.6551E+02	1.4769E-22
8.000	4.5035E-02	4.6551E+02	1.9412E-23
8.300	4.4986E-02	4.6551E+02	2.5516E-24
8.600	4.4938E-02	4.6551E+02	3.3539E-25
8.900	4.4889E-02	4.6551E+02	4.4084E-26
9.200	4.4841E-02	4.6551E+02	5.7944E-27
9.500	4.4793E-02	4.6551E+02	7.6163E-28
9.800	4.4744E-02	4.6551E+02	1.0011E-28
10.100	4.4696E-02	4.6551E+02	1.3159E-29
10.400	4.4648E-02	4.6551E+02	1.7296E-30
24.000	4.2519E-02	4.6551E+02	1.9350E-70
96.000	3.2829E-02	4.6551E+02	6.0163-282
720.000	3.4896E-03	4.6551E+02	0.0000E+00

##
Cumulative Dose Summary
##

	eab		lpz		cr	
Time (hr)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.017	2.9141E+00	1.0969E-01	3.3707E-01	1.2688E-02	5.4683E-01	1.6858E-02
0.019	3.3659E+00	1.2670E-01	3.8933E-01	1.4655E-02	7.2552E-01	2.2366E-02
0.419	3.3725E+01	1.2686E+00	3.9009E+00	1.4673E-01	1.8892E+01	5.8752E-01
0.719	3.7993E+01	1.4287E+00	4.3945E+00	1.6526E-01	2.2800E+01	7.1465E-01
1.019	3.9062E+01	1.4688E+00	4.5182E+00	1.6989E-01	2.3885E+01	7.5462E-01
1.319	3.9330E+01	1.4788E+00	4.5492E+00	1.7105E-01	2.4169E+01	7.6921E-01
1.619	3.9397E+01	1.4813E+00	4.5570E+00	1.7134E-01	2.4242E+01	7.7653E-01
1.919	3.9414E+01	1.4819E+00	4.5589E+00	1.7141E-01	2.4260E+01	7.8147E-01
2.000	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4262E+01	7.8259E-01
2.300	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	7.8628E-01
2.600	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	7.8939E-01
2.900	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	7.9205E-01
3.200	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	7.9434E-01
3.500	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	7.9631E-01
3.800	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	7.9800E-01
4.100	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	7.9945E-01
4.400	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0069E-01
4.700	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0177E-01
5.000	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0269E-01
5.300	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0348E-01
5.600	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0416E-01
5.900	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0474E-01
6.200	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0524E-01
6.500	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0568E-01
6.800	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0605E-01
7.100	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0637E-01
7.400	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0664E-01
7.700	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0687E-01
8.000	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0708E-01
8.300	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0725E-01
8.600	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0740E-01
8.900	3.9416E+01	1.4820E+00	4.5591E+00	1.7142E-01	2.4265E+01	8.0753E-01

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    9.200 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 2.4265E+01 8.0764E-01
    9.500 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 2.4265E+01 8.0773E-01
    9.800 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 2.4265E+01 8.0781E-01
   10.100 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 2.4265E+01 8.0788E-01
   10.400 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 2.4265E+01 8.0794E-01
   24.000 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 2.4265E+01 8.0831E-01
   96.000 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 2.4265E+01 8.0831E-01
  720.000 3.9416E+01 1.4820E+00 4.5591E+00 1.7142E-01 2.4265E+01 8.0831E-01

 ######################################################################
                          Worst Two-Hour Doses
 ######################################################################

 eab
    Time    Whole Body     Thyroid         TEDE
    (hr)      (rem)         (rem)          (rem)
     0.0   2.7530E-01   3.9416E+01   1.4820E+00
```