Attachment 3

Additional Information Related to Application of Alternative Radiological Source Term – Dose Calculations

BRAIDWOOD STATION
UNITS 1 AND 2

Docket Nos. STN 50-456 and STN 50-457
License Nos. NPF-72 and NPF-77

and

BYRON STATION
UNITS 1 AND 2

Docket Nos. STN 50-454 and STN 50-455
License Nos. NPF-37 and NPF-66

BYR04-047 & BRW-04-0041-M, "Re-analysis of Fuel Handling Accident (FHA) Using Alternative Source Terms," Revision 1, dated November 29, 2004

Exelon Nuclear

ATTACHMENT 1
Design Analysis Cover Sheet

CC-AA-309-1001
Revision 1

			Last Page No.
Analysis No.	BYR04-047 & BRW-04-0041-M	**Revision** 1	
EC/ECR No.	Byron: 348720 Braidwood: 348697	**Revision** 0	
Title:	Re-analysis of Fuel Handling Accident (FHA) Using Alternative Source Terms		

		Component(s)	
Station(s)	Byron/Braidwood	N/A	
Unit No.:	00 (Common)		
Discipline	M		
Description Code/ Keyword	R02		
Safety Class	S		
System Code	Varies		
Structure	N/A		

CONTROLLED DOCUMENT REFERENCES

Document No.	From/To	Document No.	From/To
UFSAR	From/To	TODI No. BYR-04-020, BRW-2004-0029	From
BYR04-050 & BRW-04-0044-M, "Calculation of Alternative Source Term Onsite and Offsite Atmospheric Dispersion Coefficients"	From	TODI No. DIT-BRW-2004-0017	From
P&ID M-95-03 BYR & M-95-03 BRW, "Auxiliary Building HVAC System (VA) Diagram"	From	VC-400, "Control Room Volume"	From
P&ID M-96-03 BYR & M-96-03 BRW, "Diagram of Control Room HVAC System"	From		

Is this Design Analysis Safeguards? Yes ☐ No ☒

Does this Design Analysis Contain Unverified Assumptions? Yes ☐ No ☒ ATI/AR#

Is a Supplemental Review Required? Yes ☐ No ☒ If yes, complete Attachment 3

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Reviewer	Paul Reichert (Print Name)	Paul Reichert (Sign Name)	11/18/2004 (Date)

Method of Review ☒ Detailed Review ☐ Alternate Calculations ☐ Testing

Review Notes:

Approver	Harold Rothstein (Print Name)	Harold Rothstein (Sign Name)	11/18/2004 (Date)

(For External Analyses Only)

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Approver	Wayne R. Lenz (Print Name)	Wayne R. Lenz (Sign Name)	11/24/04 (Date)

Description of Revision (list affected pages for partials): All pages affected. Revision to incorporate Independent Third Party Review and Technical Verification Team comments.

THIS DESIGN ANALYSIS SUPERCEDES: CN-CRA-00-1

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OWNER'S ACCEPTANCE REVIEW CHECKLIST FOR EXTERNAL DESIGN ANALYSIS

	Yes	No	N/A
1. Do assumptions have sufficient rationale?	☑	☐	☐
2. Are assumptions compatible with the way the plant is operated and with the licensing basis?	☑	☐	☐
3. Do the design inputs have sufficient rationale?	☑	☐	☐
4. Are design inputs correct and reasonable?	☑	☐	☐
5. Are design inputs compatible with the way the plant is operated and with the licensing basis?	☑	☐	☐
6. Are Engineering Judgments clearly documented and justified?	☑	☐	☐
7. Are Engineering Judgments compatible with the way the plant is operated and with the licensing basis?	☑	☐	☐
8. Do the results and conclusions satisfy the purpose and objective of the design analysis?	☑	☐	☐
9. Are the results and conclusions compatible with the way the plant is operated and with the licensing basis?	☑	☐	☐
10. Does the design analysis include the applicable design basis documentation?	☑	☐	☐
11. Have any limitations on the use of the results been identified and transmitted to the appropriate organizations?	☑	☐	☐
12. Are there any unverified assumptions?	☐	☑	☐
13. Do all unverified assumptions have a tracking and closure mechanism in place?	☐	☐	☑
14. Have all affected design analyses been documented on the Affected Documents List (ADL) for the associated Configuration Change?	☑	☐	☐
15. Do the sources of input and analysis methodology used meet current technical requirement and regulatory commitments? (If the input sources or analysis methodology are based on an out-of-date methodology or code, additional reconciliation may be required if the site had committed to a more recent code)	☑	☐	☐
16. Have vendor supporting technical documents and references (including GE DRFs) been reviewed when necessary?	☑	☐	☐

EXELON REVIEWER: T. J. Meis DATE: 11/24/04

Table of Contents

1. PURPOSE/OBJECTIVE

The objective of this calculation is to determine the radiological consequences of a Fuel Handling Accident (FHA) at the Byron and Braidwood Generating Stations, based on the use of Alternative Source Terms (AST) as defined in Regulatory Guide (RG) 1.183 (Ref. 1).

As per B/B-UFSAR Section 15.7.4 on Fuel Handling Accidents, the accident is defined as a spent fuel assembly (SFA) drop onto the spent fuel pool floor or the core, resulting in the postulated rupture of the cladding of all the fuel rods in the dropped assembly. Also as per the UFSAR, the dropped fuel assembly is assumed to be a discharged assembly from the reactor operating at 102% of licensed core power up to the end of its refueling cycle with 1.7 times the average assembly power (peaking factor). It is also assumed as per UFSAR Section 15.7.4.2 that 48 hours has passed from shutdown to the beginning of fuel handling operations for this assembly.

This re-analysis of the design basis fuel handling accident, using the RG 1.183 methodology, seeks to achieve an increase in existing operating margin that can be distributed to various plant systems. Specific design basis changes that are being sought include:

- An increased allowance in the amount of time required for the Control Room (CR) to be isolated (i.e., Mode 2), to 30 minutes,
- Control Room Intake charcoal adsorber filter credit reduction from 99% to 95%, and
- An increase in the maximum allowable unfiltered inleakage into the Control Room, from 100 cfm to 1000 cfm.

Each of these new design basis assumptions will have the benefit of allowing for relaxation in the current plants licensing basis; in terms of testing, surveillance, and other requirements.

For the design basis case, no filtration of the radioactive gas released from the pool or automatic isolation of the accident location is assumed. Therefore, the results can be used to justify a future design change to allow for the Fuel Handling Building or Containment not being isolated with a hatch left open during core alterations or movement of the appropriate fuel, provided that the capability for closure is maintained. The results also allow for addition to the Technical Specifications (TS) a new definition of the term "recently irradiated fuel" as fuel that has occupied part of the critical reactor core within the previous 48 hours, with associated related relaxations in system requirements in accordance with the Technical Specification Task Force (TSTF) 51 provisions for all resulting fuel movements and core alterations that would involve fuel not recently irradiated.

A limiting case is also evaluated that assumes that the Fuel Handling Building/Containment post-accident filtration of releases as well as the Control Room filtration system are available to show that under this condition a six (6) hour decay period from shutdown to the beginning of fuel handling operations is sufficient to prevent post-accident doses from exceeding the acceptance criteria. Additionally, sensitivity analyses were performed to determine the limiting decay time necessary to enable movement of irradiated fuel without requiring any isolation of the accident location or Control Room filtration systems. The final outputs for these two limiting cases are shown in Attachment B.

This analysis is performed using the most conservative values for assumptions and inputs applicable to either of the units for both the Byron and Braidwood Stations, and therefore the results are conservative for all four units.

As noted above, RG 1.183 (Ref. 1) is the basis for this evaluation. Concerning the FHA, this new guidance has the advantage of smaller gap fractions, a larger pool decontamination factor [DF], and dose criteria that replace both the whole body and thyroid dose limits with a limit on Total Effective Dose Equivalent [TEDE].

The other changes from the current UFSAR calculation are listed below.

- An offsite dose limit of 6.3 rem TEDE (Reg. Guide 1.183 & 10 CFR 50.67(b)(2)(iii)) is applied instead of the Standard Review Plan (SRP) 15.7.4 values of 25% of the 10CFR100 limits).
- A control room dose limit of 5-rem TEDE (10 CFR 50 Appendix B (II) GDC 19) is applied instead of the SRP 15.7.4 values of 5 rem whole body, or its equivalent.
- Design Basis analysis is based on NRC Regulatory Guide 1.183.
- The Control Room and offsite χ/Q's were recalculated for the worst case release locations and the new limiting χ/Q's were applied to this analysis.
- Dose Conversion Factors (DCFs) for Immersion and Inhalation are taken from Federal Guidance Reports (FGRs) 12 (Ref.14) and 11 (Ref. 13), respectively. Regulatory Guide 1.183 cites these DCFs as acceptable current estimates for evaluating the radiological impact of nuclear plant accidents.

2. METHODOLOGY AND ACCEPTANCE CRITERIA

2.1. General Description

As per B/B-UFSAR Section 15.7.4 on Fuel Handling Accidents, the accident is defined as a spent fuel assembly (SFA) drop onto the spent fuel pool floor or the core, resulting in the postulated rupture of the cladding of all the fuel rods in the dropped assembly. Consistent with this UFSAR Section and RG 1.183 (Ref. 1), two potential accident locations were considered; i.e., the Fuel Handling Building (FHB) and the Containment Building (CB). Release modeling uses the RADTRAD computer program (Reference 12).

The doses from either accident location should not exceed the acceptance criteria shown in Section 2.7.

2.2. Fuel Damage and Core Source Term

The fuel source term is based on the reactor core source terms described in Attachment A. The fraction of the core fuel damaged is based on the current UFSAR design basis of a postulated rupture of the cladding of all the fuel rods in the dropped assembly. With 193 fuel assemblies in a core at full power of 3658.3 MWth (102% of the rated thermal power of 3586.6 MW) and the fuel assumed to have been operating with a 1.7 radial peaking factor, the associated dropped assembly power = 3658.3 MWth * 1.7/193 = 32.22 MWth.

Based on References 4 and 7, movement of irradiated fuel will not occur less than 48 hours after the associated reactor shutdown, and therefore, a 48 hour delay period is used. However, for the case that credits both Fuel Handling Building/Containment and Control Room filtration, this analysis calculates doses assuming six (6) hour decay of the dropped irradiated fuel assembly. Additionally, for the case that assumes no filtration, sensitivity has determined a decay time of 15 days as necessary before an FHA in the worst-case location could be adequately mitigated.

2.3. Pool Decontamination Factor and Fuel Fission Product Gap Inventory

The analyzed water depth above damaged fuel is 23 feet. This value corresponds to the minimum depth of water coverage over the top of irradiated fuel assemblies seated in the spent fuel pool racks within the spent fuel pool, as per TS 3.7.14. This depth is more limiting in comparison to the *actual* water depth over the top of irradiated fuel assemblies seated in the core, as TS 3.9.7 requires maintaining at least 23 feet of water above the top of the reactor vessel flange during movement of irradiated fuel assemblies within containment. No further credit is taken for additional water depth in order to maintain conservatism and consistency with regulatory guidance. As prescribed in RG 1.183, Appendix C, an overall DF of 200 is used as the overall effective iodine decontamination factor for iodine for this 23-foot water depth, with a decontamination factor of 1 for noble gases and particulate radionuclides assumed to be retained in the pool water.

RG 1.183, Table 3 allows application of the following gap activity fractions for non-LOCA events for fuel whose burnup and power limits are bounded by those specified in RG 1.183, footnote 11:

- 5% of the noble gases (excluding Kr-85)
- 10% of the Kr-85
- 5% of the iodine inventory (excluding I-131)
- 8% of the I-131
- 12% of the Alkali metal inventory

B/B may utilize some high burnup fuel assemblies driven to linear heat generation rates slightly in excess footnote 11 limits. To account for such fuel conditions, a conservative estimate of gap fractions double the values noted above is utilized, as previously justified and accepted by the NRC for the Fort Calhoun Station AST analyses and License Amendment Request of reference 6.

Because RADTRAD does not allow for application of isotope specific release fractions, the bounding isotopic core inventory data from Table 2 of Attachment A is used to create the "B/B AST Source Terms for FHA.nif" file of Attachment C, based on the Curies per Megawatt thermal (for the 3586.6 MW rated thermal power used for Attachment A) for each of the RADTRAD isotopes (or standard RADTRAD PWR library values for isotopes not included in Attachment A) except to multiply the Kr-85 and I-131 gap activity fractions by a factor of 2.0 and 1.6, respectively, as dictated by the RG 1.183 fractions above.

The factor of 2.0 applied to all gap activity fractions is combined with the applicable decontamination factors discussed above to provide a 0.1 release multiplier for noble gases (2 x 0.05 x 1.0), a 0.0005 multiplier for iodine (2 x 0.05 / 200) and a 0 multiplier for alkali metals (particulates, retained in the pool water) in the B/B AST FHA.rft file of Attachment D.

2.4. Release Model

Release modeling uses the Refueling Floor Air Space (in the Fuel Handling Building), with the initial air change rate based on the 525,460 cubic feet (86' x 130' x 47' high) volume "exposed to the monitor" as developed for the post-accident radiation monitor response time calculation of reference 7, divided into the spent fuel storage pool total ventilation exhaust rate of 12,400 cfm as indicated in reference 11. The initial air change rate is therefore 0.0236 per minute, assumed to last for the entire period until initiation of Control Room Mode 2 operation. As per RG 1.183, the release from the fuel building to the environment is assumed over a 2-hour time period. To assure this, the refueling floor exhaust rate is set artificially high at 5 times this value or 0.118 air changes per minute during Control Room Mode 2 operation. The postulated exhaust point is the Plant Vent, with specific dispersion characteristics to the Control Room or offsite receiving locations which are defined by unique dispersion factors, or χ/Q's, as discussed in section 4.1.

As shown in the sensitivity analyses in Reference 10, the alternative release point through a major opening such as a Fuel Handling Building inner or outer rail bay roll-up door would have lower χ/Q's and therefore lower calculated dose results. Accordingly, a future design change to allow for the Fuel Handling Building not being isolated with this hatch left open during core alterations or movement of the appropriate fuel may be justified, provided that the capability for closure is maintained.

For the potential accident location in the Containment Building, the corresponding air change rate based on a containment volume of 2,850,000 cubic feet and containment purge ventilation exhaust rate of 40,000 cfm is 0.0140 per minute, considerably lower than the Fuel Handling Building exhaust rates developed above. The purge exhaust point would again be the Plant Vent, with the same χ/Q's for the Control Room or offsite receiving locations as for the potential accident location in the Fuel Handling Building (the alternative of releases by diffusion through the containment as a diffuse area source would have lower χ/Q's for the Control Room, as indicated in reference 10, and therefore lower Control Room dose consequences). The Fuel Handling Building potential accident location would therefore be controlling. For alternative release point through the major opening of the personnel/equipment hatch from the Containment to the outside, the sensitivity analyses in Reference 10 show that lower χ/Q's would apply with lower calculated dose results. For an alternative release points through the major opening of the personnel/equipment hatch from the

Containment to the Auxiliary Building, the release would be exhausted through the Auxiliary Building HVAC System to the Plant Vent, with the same Control Room χ/Q's as for the Fuel Handling Building potential accident location which would again be controlling. Accordingly, a future design change to allow for the Containment Building not being isolated with either of the personnel/equipment hatch left open during core alterations or movement of the appropriate fuel may be justified, provided that the capability for closure is maintained.

2.5. Dose Conversion Factors

The revised Dose Conversion Factors (DCFs) from the U.S. Federal Guidance Report 11 & 12 (Ref.13, 14) are used for this analysis. The RADTRAD code inputs these values directly from its internal database, and if used in spreadsheet analyses they are input directly.

2.6. Control Room Dose Model

For this analysis, as performed using the RADTRAD code, the air volumes characterizing the Control Rooms (CR) at the Byron and Braidwood plants are found to be 230,830 ft^3 and 232,872 ft^3 (Ref. 8), respectively. For conservatism and simplicity, these volumes are conservatively modeled as one characteristic 200,000-ft^3 volume applied universally. Using this smaller value, associated with the high flow rates discussed below, is conservative because it leads to the CR reaching its maximum activity concentration faster than if the actual, substantially larger, volume were used. This dose maximizing effect easily bounds the small minimizing effect that using a smaller volume has on the shine dose contribution from the Control Room's internal cloud, because CR inhalation dose decisively controls total dose in this iodine-dominated accident analysis. As seen in reference 4, Byron and Braidwood plants have a recirculation flow of 43,500 cfm and make-up airflow of 6000 cfm (± 10%), totaling 49,500 cfm of total combined flow to the Control Room volume. However, as per reference 5, there could be a failure scenario where open inlet and outlet dampers on the unused CR make-up train result in an additional 1500 cfm of filtered intake into the CR during Mode 2 operation. Therefore, for conservatism, as stated in reference 5, this 1500 cfm was rounded up to 2000 cfm, and is added to the 49,500 cfm total combined flow during Mode 2. Of this 51,500 cfm, a separate volume designated as the "upper cable spreading room", or upper CSR, receives an un-recirculated intake flow of 1319 cfm at Byron, and 2430 cfm at Braidwood (Ref. 9). Because they are un-recirculated, these flows are subtracted from the 51,500 cfm total combined flow, making the Mode 2 adjusted combined flows to the Byron and Braidwood Control Rooms 50,181 cfm and 49,070 cfm, respectively. To then calculate the Mode 2 adjusted make-up flow to the CR volume, the ratios of these adjusted combined flows to the CR volume, over the total combined flow, are multiplied by the 8000 cfm make-up flow. This respectively results in Mode 2 make-up flows of 7795 cfm (±10%) and 7623 cfm (±10%) to the Byron and Braidwood Control Rooms.

Following CR Mode 2 isolation, the credited CR filtration is 99% for the HEPA and 95% for the charcoal filters, and the intake flow rate is 8575 cfm, which is the upper 10% bound of the Byron 7795 cfm make-up flow shown above. The charcoal filtration efficiency of 95% reflects a reduction in the credit taken for filter maintenance requirements. This intake rate is used because, with the specified intake, inleakage, and recirculation flow rates, filter efficiencies, and CR volume, sensitivity analyses have shown for this analysis that it is conservative to maximize the airflow into the Control Room.

The CR intake is assumed to be unfiltered for the Mode 1 first 30 minutes of the accident, to simulate a newly analyzed allowance for manual CR Mode 2 isolation. During this 30-minute period, it is conservative to assume that the possible 2000 cfm of filtered intake does not flow through the Control Room. This is because this filtered flow would act to "clean" the unfiltered air

being brought in by the other unfiltered flows (i.e., normal intake and unfiltered inleakage) during these 30 minutes. Sensitivity analyses using RADTRAD confirmed that such additional filtered intake during Mode 1 would lower the CR dose consequences. Therefore, before CR emergency Mode 2 isolation the adjusted combined flows to the Byron and Braidwood Control Rooms become 48,181 cfm and 47,070 cfm, respectively, and subsequently actual make-up flows become 5840 cfm (±10%) and 5705 cfm (±10%) to Byron and Braidwood, respectively. So, the unfiltered intake flow rate into the CR during this initial 30-minute period is assumed to be 6424 cfm; the upper 10% bound of the Byron 5840 cfm make-up flow shown above.

As the B/B Control Rooms are modeled, a conservatively reduced recirculation train flow rate of 39,150 cfm is used (Refs. 4,9). This recirculation train is filtered by an 80% aerosol particulate (pre-filter) and 90% elemental and organic iodine (charcoal) filters. No reduction in the efficiency of these filters was sought.

For additional conservatism and to allow for margin in future analyses, an unfiltered inleakage rate allowance of 1000 cfm is modeled for the accident duration.

Any air that enters the CR originates from a source that is characterized by a dispersion factor, calculated using ARCON96, in reference 10. The total dose in the Control Room over the 720-hour period is the result of the released activities that enter through the air intake, either filtered or unfiltered.

2.7. Dose Modeling

Dose models for both onsite and offsite are simplified and meet RG 1.183 requirements. Dose conversion factors are based on Federal Guidance Reports 11 and 12 (Ref. 13, 14). RADTRAD uses the following formulations, integrated numerically over the accident duration:

2.7.1. EAB and LPZ

Doses at the EAB and LPZ for the FHA are based on the following formulas:

$$\text{Dose}_{CEDE}\ (\text{rem}) = \text{Release (Curies)} * \frac{\chi}{Q}(\text{sec/m}^3) * \text{Breathing Rate (m}^3\text{/sec)} * \text{Inhalation DCF (rem}_{CEDE}\text{/Ci inhaled)}$$

and

$$\text{Dose}_{EDE}\ (\text{rem}) = \text{Release (Curies)} * \frac{\chi}{Q}(\text{sec/m}^3) * \text{Submersion DCF (rem}_{EDE}\text{-m}^3\text{/Ci-sec)}$$

and finally,

$$Dose_{TEDE}\ (rem) = Dose_{CEDE}\ (rem) + Dose_{EDE}(rem)$$

2.7.2. Control Room

The formulas used by RADTRAD, by time increment, are:

$$\text{Dose}_{CEDE}\ (\text{rem}) = \text{Time Dependent CR Air Concentration (Ci/m}^3) * \text{Time Increment Duration (sec)} * \text{Breathing Rate (m}^3\text{/sec)} * \text{Inhalation DCF (rem}_{CEDE}\text{/Ci inhaled)} * \text{Occupancy Factor of 1}$$

and

$$\text{Dose}_{EDE}\ (\text{rem}) = \text{Time Dependent CR Air Concentration } (\text{Ci/m}^3) * \text{Time Increment Duration (sec)} * \text{Submersion DCF } (\text{rem}_{EDE} - \text{m}^3/\text{Ci} - \text{sec}) * \text{Occupancy Factor of 1} * \text{CR Geometry Factor}$$

and finally,

$$\text{Dose}_{TEDE}\ (\text{rem}) = \text{Dose}_{TEDE}\ (\text{rem}) + \text{Dose}_{EDE}\ (\text{rem})$$

The Time Dependent CR Air Concentration at equilibrium is the product of the release (Ci/sec) and the χ/Q (sec/m^3). RADTRAD accounts for non-equilibrium conditions as well.

2.8. Acceptance Criteria

Radiological doses resulting from a design basis FHA for a control room operator and a person located at EAB or LPZ are to be less than the regulatory dose limits as given in Table 2.

Table 2. Regulatory Dose Limits

Dose Type	Control Room (rem)	EAB and LPZ (rem)
TEDE Dose	5[a]	6.3[b]

Notes:

[a] 10 CFR 50.67 (Ref. 3)

[b] Regulatory Guide 1.183 (Ref. 1)

3. ASSUMPTIONS

Assumptions and bounding analyzed conditions regarding the fuel handling accident scenarios are provided below.

1. Core inventory was based on a DBA power level of 3658.3 MWth, which is 102% of the Rated Thermal Power Level of 3586.6 MWth, to account for measurement uncertainty.

2. Spent fuel source terms are based on reactor core source terms as discussed in Attachment A, with a factor of 2.0 multiplier to account for fuel exceeding 54 GWD/MTU burnup with a maximum linear heat generation rate exceeding the 6.3 kW/ft peak rod average power limit of RG 1.183 footnote 11.

3. The damaged fuel is assumed to be the dropped assembly which had operated at a radial peaking factor of 1.7. The damage is assumed to be the rupture of the cladding of all the fuel rods in the dropped assembly.

4. Movement of fuel will not occur less than 48 hours after the associated reactor shutdown. This establishes a basis for a potential Technical Specification definition of "recently irradiated fuel".

5. A water depth above the damaged fuel of 23 feet as the limiting case, corresponding to the minimum depth of water coverage over the top of irradiated fuel assemblies seated in the spent fuel pool racks within the spent fuel pool

6. No filtration of the radioactive gas released from the pool or automatic isolation of the accident location, with essentially all of the activity reaching the refueling floor airspace exhausted within 2 hours after the accident.

7. Manual isolation of the Control Room and initiation of its Mode 2 filtered make-up (with a charcoal filtration efficiency of 95%) at 30 minutes after the accident, with maximum unfiltered make-up prior to 30 minutes at 6424 cfm, the upper 10% bound of the highest station make-up flow. Mode 2 isolation, intake flow at 8575 cfm, the upper 10% bound of the highest station make-up flow with a conservatively assumed failure scenario of an open damper on the unused make-up train resulting in an additional 2000 cfm of flow.

8. An amount of unfiltered inleakage into the Control Room of 1000 cfm, added continuously throughout the accident duration.

4. DESIGN INPUT

4.1. χ/Q Calculations (Meteorology)

The CR χ/Q values input to RADTRAD were taken from the ARCON96 results of the B/B Design Analyses BYR04-050 & BRW-04-0044-M, as performed by Washington Group International, Inc. (WGII) (Ref. 10). The χ/Q's used are, conservatively, the worst-case combination of values from each Unit of each respective plant; whether it be Byron or Braidwood.

All releases are conservatively considered as from the Plant Vent to the Environment. For the Control Room (CR), activity released during the initial 30 minutes of the accident goes to the normal CR fresh air intake; after this period, when the CR is assumed to have been manually isolated, the emergency air intake located in the Turbine Building is used.

The CR atmospheric relative concentrations used are as follows:

χ/Q =2.22E-03 sec/m^3 (0-0.5 hours) (2-hr limiting CR Fresh Air Intake χ/Q)
χ/Q =2.46E-03 sec/m^3 (0.5-2 hours) (2-hr limiting CR Emergency Air Intake χ/Q)
χ/Q =0.00 sec/m^3 (2-720 hours) (termination of releases after 2 hours)

The EAB and LPZ PAVAN calculated χ/Q values input to RADTRAD were also taken from the results of the B/B Design Analyses BYR04-050 & BRW-04-0044-M, as performed by WGII (Ref. 10). The EAB and LPZ χ/Q's used are as follows:

EAB χ/Q =5.36E-04 sec/m^3 (0-2 hours) (8-hr EAB χ/Q)

LPZ χ/Q =4.50E-05 sec/m^3 (0-8 hours) (8-hr limiting LPZ χ/Q)
χ/Q =3.12E-05 sec/m^3 (8-24 hours) (16-hr limiting LPZ χ/Q)
χ/Q =1.41E-05 sec/m^3 (24-96 hours) (72-hr limiting LPZ χ/Q)
χ/Q =4.54E-06 sec/m^3 (96-720 hours) (624-hr limiting LPZ χ/Q)
(termination of releases is at 2 hours)

4.2. Plant Data

- DBA Power Level (Ref. 4) — 3658.3 MWth
- Refueling Floor Air Space Volume (Ref. 7) — 525,460 ft^3
- Spent Fuel Storage Pool Total Ventilation Exhaust Rate — 12,400 cfm
- Containment Volume (Ref. 4) — 2,650,000 ft^3
- Containment Purge Ventilation Exhaust Rate (Ref. 4) — 40,000 cfm
- Minimum Pool Water Depth Above Damaged Fuel (Ref. 2) — 23 feet

4.3. Control Room Data

- Volume of Control Room, ft^3 (Ref. 8, 4) 200,000
- Control Room Normal Intake Flow, Mode 1, scfm (Ref. 4) 6424
- Control Room Intake Flow, Mode 2, scfm (Ref. 4) 8575
- Control Room Recirculation Flow, scfm (Ref. 4) 39,150
- Assumed Unfiltered In-leakage, scfm (New Design Allowance) 1000

5. REFERENCES

1. USNRC Regulatory Guide 1.183, "Alternative Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors", July 2000.

2. Byron/Braidwood Technical Specifications

3. 10 CFR 50.67, as published in 64 FR (Federal Register) 72001, December 3, 1999.

4. B/B Transmittal of Design Information (TODI) No. BYR-04-020, BRW-2004-0029, "Transmittal of Byron and Braidwood input parameters for use in dose calculations for Alternative Source Term (AST) implementation", Rev. 0.

5. B/B Transmittal of Design Information (TODI) No. DIT_BRW_2004-0017, "Effects of increased filtered intake into the control room", Rev. 0, 6/10/04.

6. Omaha Public Power District Letter LIC-01-0110, "Fort Calhoun Station Unit No. 1 License Amendment Request", December 14, 2001.

7. B/B Calculation Number BB-FH-18, "Dose Rates Due to Fuel Handling Accident", Rev. 0, November, 1985.

8. B/B Design Analysis VC-400, "Control Room Volume", Rev. 2.

9. B/B P&ID M-96-03 BYR, Rev. T & M-96-03 BRW, Rev. U, "Diagram of Control Room HVAC System".

10. B/B Design Analyses BYR04-050 & BRW-04-0044-M, "Calculation of Alternative Source Term Onsite and Offsite Atmospheric Dispersion Coefficients", Rev. 1.

11. B/B P&ID M-95-03 BYR, Rev. H & M-95-03 BRW, Rev. M, "Auxiliary Building HVAC System (VA) Diagram".

12. NUREG/CR-6604, "RADTRAD: A Simplified Model for RADionuclide Transport and Removal And Dose Estimation", April1998, and Supplements 1, June 1999, and 2, October 2002.

13. U.S. Federal Guidance Report No.11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion", 1988.

14. U.S. Federal Guidance Report No.12, "External Exposure to Radionuclides in Air, Water, and Soil", 1993.

6. CALCULATIONS

6.1. Source Term Calculation

For the RADTRAD calculation, the Attachment A list of 60 core isotopic nuclides and their activities were input into the RADTRAD nif file for FHA (see Attachment C) with adjustments as shown for the isotopes Kr-85 and I-131. RADTRAD uses these full-core activities, in curies per megawatt, times the nuclide release fractions rft file (see Attachment D) adjusted for the factor of 2.0 applied to all gap activity fractions combined with the applicable decontamination factors, as per section 2.3, and the specified power of the dropped assembly (32.22 MWth, as per section 2.2) with a 1.7 radial peaking factor, to calculate the pool release source term used.

6.2. Dose Calculations

The RADTRAD v. 3.03 computer code is used to determine B/B Units 1 & 2 FHA accident doses at the three dose points cited in RG 1.183 (Ref. 1); the Exclusion Area Boundary (EAB), Low Population Zone (LPZ), and Control Room. RADTRAD is a simplified model of RADionuclide Transport and Removal And Dose Estimation developed for, and endorsed by, the NRC as an acceptable methodology for reanalysis of the radiological consequences of design basis accidents.

In this analysis RADTRAD is used to estimate the releases using the reference Alternative Source Term source terms and assumptions. The RADTRAD code uses a combination of tables and/or numerical models of source term reduction phenomena to determine the time-dependent dose at user-specified locations for a given accident scenario. The code system also provides the inventory, decay chain, and dose conversion factor tables needed for the dose calculation. The technical basis for the RADTRAD code is documented in NUREG/CR-6604 (Ref. 12).

See Section 2 and subsequent sections for descriptions of the calculational simulations detailed in the tables that follow.

6.2.1. RADTRAD Run Compartment Information

Compartment Number	1	2	3
Name	Containment	Environment	Control Room
Type	Other	Environment	Control Room
Volume (ft^3)	1	0	200,000
Source Term Fraction	1.000	0.000	0.000
Compartment Features	Used to represent the ventilated radionuclide release region above the spent fuel pool in the Fuel Handling Building	Environment	Recirculating Filters: 39,150cfm Flow Rate 0-0.5 hrs - No Filtration (manual initiation time) 0.5-720 hrs - 80% Aerosol, 90% Elemental & Organic
Comments	Actual volume is irrelevant, as the ventilated fraction is used.		Actual Control Room proper volume is smaller, therefore this value is conservative.

6.2.2. RADTRAD Run Transfer Pathway Information

RADTRAD Transfer Pathways				
Pathway Number	1	2	3	4
Name	Containment to Environment	(Unfiltered Mode 1 and Filtered Mode 2 intake) Environment to Control Room	(Unfiltered Inleakage) Environment to Control Room	(Control Room Exhaust) Control Room to Environment
From - To	1 - 2	2 – 3	2 – 3	3 - 2
Transfer Mechanism	Vented at air change rate without credit for filtration	Filter	Filter	Filter
Transfer Mechanism Details	Filter Panel – Flow rate - 0-0.500hrs, 2.36E-02cfm, equal to air change rate for FHB ventilated volume above spent fuel pool; 0.500-2hrs, 0.118 cfm (5 times higher) to assure essentially full release by 2 hours; 2hrs-720hrs, 0 cfm. Filter Efficiency - Efficiency is entered as 0.0% for all chemical forms of iodine, for the accident duration.	Filter Panel – Flow rate - 0-0.5hrs, 6.424E+03cfm; 0.5-720hrs, 6.575E+03cfm. Filter Efficiency - Efficiency is initially entered as 0% during CR Mode 1 operation. Efficiency is then entered as 99% for aerosol activity and 95% for elemental and organic forms of iodine, after CR Mode 2 is manually initiated in 30 min, and then for the duration of the accident. This corresponds to the presence of the HEPA filter, and relaxed charcoal testing requirements analyzed as acceptable by this calculation, respectively.	Filter Panel – Flow rate - 0-0.5hrs, 1.000E+03cfm; 0.5-720hrs, 1.000E+03cfm. Filter Efficiency - Efficiency is entered as 0.0% for all chemical forms of iodine, for the accident duration, because this is an unfiltered path.	Filter Panel – Flow rate - 0-0.5hrs, 7.424E+03cfm; 0.5-720hrs, 9.575E+03cfm. Filter Efficiency - Efficiency is entered as 100.0% for all chemical forms of iodine, for all time periods. This is the exhaust from the control room to the environment; the filtration prevents a double counting of the iodine release. Although RADTRAD 3.03 documentation indicates that this effect has been eliminated, this was still done for completeness.
Comments				

6.2.3. RADTRAD Run Dose Location Information

RADTRAD Dose Locations			
Dose Location Number	1	2	3
Name	Exclusion Area Boundary (EAB)	Low Population Zone (LPZ)	Control Room
In Compartment	Environment (2)	Environment (2)	Control Room (3)
Breathing Rate (m^3/sec)	Worst 2-hour Period: 3.5E-04	0 - 8 hrs: 3.5E-04 8 - 24 hrs: 1.8E-04 24 - 720 hrs: 2.3E-04	0 - 720 hrs: 3.5E-04
Occupancy Fractions	Worst 2-hour Period: 1.0 (0 to 2 hours)	0 - 720 hrs: 1.0	0 - 24 hrs: 1.0 24 - 96 hrs: 0.6 96 - 720 hrs: 0.4
Dispersion Factors	See Section 4.1.	See Section 4.1.	See Section 4.1.

6.2.4. RADTRAD Run Source Term & Dose Conversion Factor Information

RADTRAD Source Term & Dose Conversion Factors		
Core Power	3658.3 MWth (from 193 assemblies; the associated dropped assembly power = 3658.3 MWth * 1.7/193 = 32.22 MWth, where 1.7 is the power peaking factor).	See Section 2.2.
Nuclide Inventory	Attachment A ORIGEN calculated specific B/B core inventory for 60 MACCS isotopes. Inventory, calculated at DBA power shown above, and input into the FHA NIF file with adjustments for Kr-85 and I-131 (Attachment C).	See Attachments A and C.
Release Fractions & Timing	User defined Release Fractions calculated 100% instantaneous, to ensure that release timing is not delayed, consistent with RG 1.183 guidance. Fractions shown in RFT file include factor of 2.0 applied to gap activity fractions combined with the applicable decontamination factors.	See Section 2.3 and Attachment D.
Dose Conversion Factors	RADTRAD Library of FGR 11 & 12 values for 60 MACCS isotopes.	References **Error! Reference source not found.** and 14.
Decay & No Daughter Products	Enabled - Therefore only Decay is considered. Consideration of daughter products is not a recommended, or historical, design basis for this accident.	
Iodine Chemical Fractions	Aerosol: 0.0000 Elemental: 0.9700 Organic: 0.0300	User defined iodine chemical fractions, consistent with RG 1.183 guidance, as manipulated in calculation.

WGI has pre-qualified RADTRAD for application to perform such calculations, as documented in the Computer Disclosure Sheet of Attachment E. The new design basis RADTRAD simulations utilized the design input parameters as provided in Section 4.

Additionally, the Attachment B analyses shows that for Fuel Handling Building post-accident filtration as well as CR filtration being analyzed, six (6) hour decay from shutdown to the beginning of Fuel Handling operations for the dropped fuel assembly is sufficient to prevent post-accident doses from exceeding the acceptance criteria, and that a 15-day decay period is sufficient such that no Fuel Handling Building post-accident filtration or CR filtration is needed to prevent post accident doses from exceeding the acceptance criteria.

7. SUMMARY AND CONCLUSIONS

Table 7.1 provides the results from the design basis case of the unfiltered Fuel Handling Building Fuel Handling Accident simulation modeled using the RADTRAD 3.03 code and the AST assumptions and design input parameters described above.

Table 7.1. RADTRAD Analysis Results

Fuel Handling Accident in Fuel Handling Building RADTRAD Dose Assessment Results		
Control Room (rem TEDE)	**EAB (rem TEDE)**	**LPZ (rem TEDE)**
4.55	4.24	0.356

Using the design basis assumptions, described methodology, and credited margin relaxation of this analysis, the limiting CR dose is **4.55 rem TEDE**. This limiting dose is below the acceptance criteria, so it is verified that this design basis Fuel Handling Accident is sufficiently mitigated at both Byron and Braidwood Generating Stations.

Additionally, the Attachment B analyses shows that for Fuel Handling Building post-accident filtration as well as CR filtration being analyzed, six (6) hour decay from shutdown to the beginning of Fuel Handling operations for the dropped fuel assembly is required to prevent post-accident doses from exceeding the acceptance criteria, and that a 15-day decay period is sufficient such that no Fuel Handling Building post-accident filtration or CR filtration is needed to prevent post-accident doses from exceeding the acceptance criteria.

1.0 PURPOSE

To calculate the bounding isotopic core inventory to be used as input for Alternate Source Term (AST) dose calculations for the four (4) Byron/Braidwood units using the ORIGEN2.1 code based on reactor operation at 3586.6 MW_{th} and an equilibrium 542.9 Effective Full Power Days (EFPD) eighteen month cycle design.

2.0 SUMMARY OF RESULTS

The bounding isotopic core inventory for a 542.9 EFPD eighteen month cycle design at Byron/Braidwood (applicable to all four units) is shown in terms of activity (Curies) and concentration (grams) in Tables 2 and 4, respectively. This bounding isotopic core inventory was determined for a rated thermal power of 3586.6 MW_{th}.

3.0 REFERENCES

3.1 RSIC Code Package CCC-371, "ORIGEN 2.1, Isotope Generation and Depletion Code Matrix Exponential Method," May 1999.

3.2 Exelon Calc Package PNDCN-04-007, Rev. 0, "Byron and Braidwood Alternate Source Term Design Inputs," dated May 21, 2004.

3.3 Memo from R. Jaffa to R. Tropasso, Re: "Installation Verification of ORIGEN2.1 on the IBM PC Platform," dated July 7, 2000.

3.4 ORNL/TM-11018, "Standard- and Extended-Burnup PWR and BWR Reactor Models for the ORIGEN2 Computer Code," S. Ludwig, J. Renier, December 1989.

4.0 ASSUMPTIONS

4.1 The ORIGEN2.1 code [Ref 3.1] was used to calculate isotopic activities based on the cycle design described in Reference 3.2. The ORIGEN2.1 code was run on an IBM-PC and was confirmed to be controlled per Ref. 3.3.

4.2 Batch-average enrichments and exposures from Ref. 3.2 were used to develop input to ORIGEN2.1. This is equivalent to performing individual calculations for each sub-batch.

4.3 For fuel burned in more than one cycle, ORIGEN2.1 runs ignored refueling outages. This has no impact on short-lived isotopes which reach equilibrium concentrations shortly after cycle startup and has a conservative, albeit minimal, impact on long-lived isotopes which continually increase in concentration as a function of exposure; ignoring intermediate decay periods will increase the final concentrations.

4.4 For isotopic activities calculated at Beginning of Cycle (BOC), BOC is defined as 100 days into the cycle to ensure that all short-lived isotopes (half lives < 1 year) are at equilibrium levels.

5.0 DESIGN INPUT

5.1 Batch-average information for an equilibrium Byron/Braidwood eighteen month cycle was developed in Reference 3.2 specifically as input for determining the bounding isotopic core inventory for these units.

5.2 The ORIGEN2.1 cross-section library, PWRUE.LIB (Ref. 3.4), is used in this calculation as this is most representative of current Byron/Braidwood eighteen month cycles. The library is based on an "extended cycle" reactor model where fuel achieves 50 GWd/mtU burnup in three cycles.

5.3 Equilibrium cycle lengths are 542.9 EFPD.

5.4 The power level used for determining exposure data for the equilibrium two-year cycle is 3586.6 MW_{th}, which is the bounding rated thermal power for the four Byron /Braidwood units.

6.0 OVERALL APPROACH AND METHODOLOGY

The isotopic core inventory is a function of the reactor power level and the exposure of the fuel. The bounding Byron/Braidwood isotopic core inventory is calculated using the ORIGEN2.1 code [Ref. 3.1]. A 3586.6 MW_{th}, 542.9 EFPD eighteen month equilibrium cycle design [from Ref. 3.2] is used as the basis for this calculation

6.1 Computer Code Information

The batch file used to execute ORIGEN2.1 (DTSQA Product ID# EX0004724) for this calculation provide the paths and filenames of the executable program and libraries that were called. The batch file used is **by-br_ast.bat**. The PC-based ORIGEN2.1 code used in this calculation was verified to be controlled by comparing the time/date/size stamp of the executable file to that documented in Ref. 3.3 (Note: times shown below are offset by 1 hour from Ref. 3.3 due to the way Windows handles daylight savings time).

```
Volume in drive C is WIN2K
Volume Serial Number is F03D-6EF0
Directory of C:\D-Drive\Origen21\CODE

ORIGEN2  EXE    1,267,348  06-10-96  2:09p ORIGEN2.EXE
```

The time/date/size stamps of the library files used in this calculation were verified against those documented in Ref. 3.3.

```
Volume in drive C is WIN2K
Volume Serial Number is F03D-6EF0
Directory of C:\D-Drive\Origen21\LIBS

PWRUE   LIB        173,676      08-01-91  3:10a
DECAY   LIB        278,636      08-01-91  3:10a
GXUO2BRM LIB       167,526      08-01-91  3:10a
```

7.0 CALCULATION

Equilibrium Eighteen Month Cycle Isotopic Core Inventory

An equilibrium eighteen month cycle design for the four Byron/Braidwood units based on current designs and adjusted for bounding cycle lengths of 542.9 EFPD was developed in Reference 3.2 and is used as the basis for the source term calculation. The resulting batch-average burnups for once-burned, twice-burned and thrice-burned fuel batches are shown below.

Batch	# of FA	Avg. Enr. (w/o U235)	Avg. Burnup per Cycle (MWd/mtU)	Power (MW)	Loading (MTU)	U235 wt. (gms)	U238 wt. (gms)	Oxygen wt. (gms)
1	20	4.519	30823 21512 7109	475.1 331.6 109.6	8.369	378,195.11	7,990,804.89	1,125,201.50
2	88	4.867	30823 21512	2090.7 1459.1	36.824	1,792,224.08	35,031,775.92	4,950,940.38
3	85	4.794	30823	2019.4	35.569	1,705,177.86	33,863,822.14	4,782,207.22

The equilibrium cycle isotopic core inventory is calculated using ORIGEN2.1 and the PWR extended burnup cross-section library PWRUE. The input deck is **by-br_ast.inp** and the batch file is **by-br_ast.bat.**

The specific power for a batch in a given cycle is determined by multiplying the batch average burnup for that cycle by the batch loading and then dividing by the number of EFPD in the cycle. For example, the specific power for Batch 1 in its first cycle of operation is:

$$(30{,}823 * 8.369) / 542.9 = 475.1 \text{ MW}.$$

The grams of U235 and U238 for each batch were determined by the following formulas:

$$\text{U235 (gms)} = \text{Batch loading} * (\text{Avg. Enr.}/100) * 10^6$$

$$\text{U238 (gms)} = \text{Batch loading} * (1 - \text{Avg. Enr.}/100) * 10^6$$

The corresponding weight of oxygen in UO_2 pellets for each batch is:

$$\text{O (gms)} = \text{Total batch U weight (gm U)} / 238 \text{ (gm U/gm atom U)} * 2 \text{ (gm atom O/gm atom U)} * 15.9994 \text{ gm O/gm atom O}$$

The ORIGEN2.1 input deck is set up to deplete each fuel batch and write the 100 EFPD and End of Cycle (EOC) results to temporary storage vectors. Once all batches have been depleted, the results from the temporary vectors are combined to give the results for the entire core. The ORIGEN2.1 core inventory

activity and composition results for the equilibrium eighteen month cycle at 100 EFPD (BOC) and EOC are shown below in Tables 1 and 3, respectively. The maximum of the 100 EFPD and EOC values for each isotope are selected to generate the bounding isotopic core inventory activity and composition results as shown in Tables 2 and 4, respectively.

Table 1
ORIGEN2.1 Isotopic Activity Results for
Byron / Braidwood

Isotope	100 EFPD (Ci)	EOC (Ci)
KR 83M	1.381E+07	1.196E+07
BR 84	2.494E+07	2.076E+07
BR 85	3.047E+07	2.500E+07
KR 85	6.051E+05	1.023E+06
KR 85M	3.083E+07	2.533E+07
RB 86	9.511E+04	2.325E+05
KR 87	6.085E+07	4.871E+07
KR 88	8.583E+07	6.850E+07
RB 88	8.685E+07	6.961E+07
SR 89	1.043E+08	9.414E+07
SR 90	4.716E+06	8.044E+06
Y 90	4.864E+06	8.423E+06
SR 91	1.410E+08	1.154E+08
Y 91	1.275E+08	1.213E+08
SR 92	1.484E+08	1.249E+08
Y 92	1.489E+08	1.255E+08
Y 93	1.659E+08	1.448E+08
ZR 95	1.554E+08	1.636E+08
NB 95	1.405E+08	1.648E+08
ZR 97	1.673E+08	1.611E+08
MO 99	1.794E+08	1.815E+08
TC 99M	1.570E+08	1.589E+08
RU103	1.188E+08	1.469E+08
RU105	7.068E+07	1.004E+08
RH105	6.600E+07	9.156E+07
RU106	2.767E+07	4.978E+07
SB127	8.240E+06	1.022E+07
TE127	8.027E+06	1.009E+07
TE127M	9.485E+05	1.316E+06
SB129	2.685E+07	3.058E+07
TE129	2.633E+07	3.010E+07
TE129M	3.791E+06	4.482E+06
I129	1.710E+00	3.187E+00
TE131M	1.265E+07	1.377E+07
I131	9.203E+07	9.583E+07

Isotope	100 EFPD (Ci)	EOC (Ci)
XE131M	1.024E+06	1.075E+06
TE132	1.334E+08	1.365E+08
I132	1.349E+08	1.386E+08
I133	1.984E+08	1.958E+08
XE133	1.936E+08	1.910E+08
XE133M	6.023E+06	6.103E+06
I134	2.204E+08	2.153E+08
CS134	8.628E+06	1.904E+07
I135	1.851E+08	1.833E+08
XE135	5.497E+07	4.540E+07
XE135M	3.650E+07	3.821E+07
CS136	2.383E+06	5.393E+06
CS137	6.118E+06	1.104E+07
BA137M	5.803E+06	1.047E+07
XE138	1.723E+08	1.621E+08
CS138	1.885E+08	1.794E+08
BA139	1.826E+08	1.752E+08
BA140	1.766E+08	1.700E+08
LA140	1.807E+08	1.781E+08
LA141	1.667E+08	1.594E+08
CE141	1.613E+08	1.614E+08
LA142	1.635E+08	1.543E+08
CE143	1.603E+08	1.484E+08
PR143	1.561E+08	1.448E+08
CE144	9.103E+07	1.225E+08
ND147	6.587E+07	6.435E+07
NP239	1.438E+09	1.858E+09
PU238	1.379E+05	3.686E+05
PU239	1.950E+04	2.762E+04
PU240	1.799E+04	3.219E+04
PU241	7.445E+06	1.273E+07
AM241	5.723E+03	1.407E+04
CM242	1.320E+06	3.984E+06
CM244	1.193E+05	4.339E+05

Table 2
Bounding Isotopic Core Inventory
Byron / Braidwood

Isotope	Isotopic Activity (Ci)
KR 83M	1.381E+07
BR 84	2.494E+07
BR 85	3.047E+07
KR 85	1.023E+06
KR 85M	3.083E+07
RB 86	2.325E+05
KR 87	6.085E+07
KR 88	8.583E+07
RB 88	8.685E+07
SR 89	1.043E+08
SR 90	8.044E+06
Y 90	8.423E+06
SR 91	1.410E+08
Y 91	1.275E+08
SR 92	1.484E+08
Y 92	1.489E+08
Y 93	1.659E+08
ZR 95	1.636E+08
NB 95	1.648E+08
ZR 97	1.673E+08
MO 99	1.815E+08
TC 99M	1.589E+08
RU103	1.469E+08
RU105	1.004E+08
RH105	9.156E+07
RU106	4.978E+07
SB127	1.022E+07
TE127	1.009E+07
TE127M	1.316E+06
SB129	3.058E+07
TE129	3.010E+07
TE129M	4.482E+06
I129	3.187E+00
TE131M	1.377E+07
I131	9.583E+07

Isotope	Isotopic Activity (Ci)
XE131M	1.075E+06
TE132	1.365E+08
I132	1.386E+08
I133	1.984E+08
XE133	1.936E+08
XE133M	6.103E+06
I134	2.204E+08
CS134	1.904E+07
I135	1.851E+08
XE135	5.497E+07
XE135M	3.821E+07
CS136	5.393E+06
CS137	1.104E+07
BA137M	1.047E+07
XE138	1.723E+08
CS138	1.885E+08
BA139	1.826E+08
BA140	1.766E+08
LA140	1.807E+08
LA141	1.667E+08
CE141	1.614E+08
LA142	1.635E+08
CE143	1.603E+08
PR143	1.561E+08
CE144	1.225E+08
ND147	6.587E+07
NP239	1.858E+09
PU238	3.686E+05
PU239	2.762E+04
PU240	3.219E+04
PU241	1.273E+07
AM241	1.407E+04
CM242	3.984E+06
CM244	4.339E+05

Table 3
ORIGEN2.1 Isotopic Concentration Results for
Byron / Braidwood

Isotope	100 EFPD (grams)	EOC (grams)
KR 83M	6.691E-01	5.795E-01
BR 84	3.542E-01	2.947E-01
BR 85	3.947E-02	3.238E-02
KR 85	1.542E+03	2.607E+03
KR 85M	3.745E+00	3.077E+00
RB 86	1.168E+00	2.856E+00
KR 87	2.147E+00	1.719E+00
KR 88	6.839E+00	5.458E+00
RB 88	7.232E-01	5.797E-01
SR 89	3.589E+03	3.239E+03
SR 90	3.456E+04	5.895E+04
Y 90	8.937E+00	1.547E+01
SR 91	3.889E+01	3.183E+01
Y 91	5.198E+03	4.943E+03
SR 92	1.180E+01	9.934E+00
Y 92	1.546E+01	1.303E+01
Y 93	4.970E+01	4.338E+01
ZR 95	7.230E+03	7.611E+03
NB 95	3.592E+03	4.212E+03
ZR 97	8.749E+01	8.422E+01
MO 99	3.738E+02	3.783E+02
TC 99M	2.985E+01	3.021E+01
RU103	3.679E+03	4.549E+03
RU105	1.051E+01	1.493E+01
RH105	7.816E+01	1.084E+02
RU106	8.268E+03	1.487E+04
SB127	3.084E+01	3.825E+01
TE127	3.040E+00	3.823E+00
TE127M	1.005E+02	1.394E+02
I127	2.724E+03	5.239E+03
SB129	4.772E+00	5.435E+00
TE129	1.257E+00	1.437E+00
TE129M	1.258E+02	1.487E+02
I129	9.680E+03	1.804E+04
TE131M	1.585E+01	1.726E+01
I131	7.421E+02	7.727E+02

Isotope	100 EFPD (grams)	EOC (grams)
XE131M	1.222E+01	1.282E+01
TE132	4.392E+02	4.494E+02
I132	1.306E+01	1.342E+01
I133	1.751E+02	1.727E+02
XE133	1.034E+03	1.020E+03
XE133M	1.343E+01	1.361E+01
CS133	6.580E+04	1.148E+05
I134	8.260E+00	8.068E+00
CS134	6.666E+03	1.471E+04
I135	5.269E+01	5.218E+01
XE135	2.152E+01	1.777E+01
XE135M	4.005E-01	4.193E-01
CS135	1.959E+04	3.660E+04
CS136	3.250E+01	7.356E+01
CS137	7.031E+04	1.269E+05
BA137M	1.078E-02	1.945E-02
XE138	1.791E+00	1.685E+00
CS138	4.452E+00	4.239E+00
BA139	1.116E+01	1.071E+01
BA140	2.421E+03	2.330E+03
LA140	3.246E+02	3.200E+02
LA141	2.948E+01	2.817E+01
CE141	5.661E+03	5.665E+03
LA142	1.144E+01	1.079E+01
CE143	2.413E+02	2.234E+02
PR143	2.318E+03	2.150E+03
CE144	2.852E+04	3.839E+04
ND147	8.198E+02	8.009E+02
NP239	6.198E+03	8.006E+03
PU238	8.053E+03	2.152E+04
PU239	3.136E+05	4.442E+05
PU240	7.893E+04	1.412E+05
PU241	7.223E+04	1.235E+05
AM241	1.667E+03	4.098E+03
CM242	3.990E+02	1.204E+03
CM244	1.474E+03	5.361E+03

Table 4
Bounding Isotopic Core Inventory
Byron / Braidwood

Isotope	Isotopic Concentration (grams)
KR 83M	6.691E-01
BR 84	3.542E-01
BR 85	3.947E-02
KR 85	2.607E+03
KR 85M	3.745E+00
RB 86	2.856E+00
KR 87	2.147E+00
KR 88	6.839E+00
RB 88	7.232E-01
SR 89	3.589E+03
SR 90	5.895E+04
Y 90	1.547E+01
SR 91	3.889E+01
Y 91	5.198E+03
SR 92	1.180E+01
Y 92	1.546E+01
Y 93	4.970E+01
ZR 95	7.611E+03
NB 95	4.212E+03
ZR 97	8.749E+01
MO 99	3.783E+02
TC 99M	3.021E+01
RU103	4.549E+03
RU105	1.493E+01
RH105	1.084E+02
RU106	1.487E+04
SB127	3.825E+01
TE127	3.823E+00
TE127M	1.394E+02
I127	5.239E+03
SB129	5.435E+00
TE129	1.437E+00
TE129M	1.487E+02
I129	1.804E+04
TE131M	1.726E+01
I131	7.727E+02

Isotope	Isotopic Concentration (grams)
XE131M	1.282E+01
TE132	4.494E+02
I132	1.342E+01
I133	1.751E+02
XE133	1.034E+03
XE133M	1.361E+01
CS133	1.148E+05
I134	8.260E+00
CS134	1.471E+04
I135	5.269E+01
XE135	2.152E+01
XE135M	4.193E-01
CS135	3.660E+04
CS136	7.356E+01
CS137	1.269E+05
BA137M	1.945E-02
XE138	1.791E+00
CS138	4.452E+00
BA139	1.116E+01
BA140	2.421E+03
LA140	3.246E+02
LA141	2.948E+01
CE141	5.665E+03
LA142	1.144E+01
CE143	2.413E+02
PR143	2.318E+03
CE144	3.839E+04
ND147	8.198E+02
NP239	8.006E+03
PU238	2.152E+04
PU239	4.442E+05
PU240	1.412E+05
PU241	1.235E+05
AM241	4.098E+03
CM242	1.204E+03
CM244	5.361E+03

Input Deck by-br_ast.inp

```
-1
-1
-1
BAS     Grams of Heavy Metal per Fuel Batch
RDA     PLACE FUEL into vectors -1, -2 and -3
LIP     0  0  0
LIB     0  1  2  3   604   605   606  9  3  0  1 39
PHO     0 0 0 10
RDA     READ FUEL COMPOSITION FOR BATCH 3
INP     -1  1  -1 -1  1  1
RDA     READ FUEL COMPOSITION FOR BATCH 2
INP     -2  1  -1 -1  1  1
RDA     READ FUEL COMPOSITION FOR BATCH 1
INP     -3  1  -1 -1  1  1
RDA TIT     IRRADIATION OF Byron/Braidwood CYCLE 1 FULL CORE
MOV     -3  1  0  1.0       BATCH 1 FRESH
HED     1    CHARGE
RDA     BATCH 1 BURNUP IN CYCLE 1
BUP
IRP     50.0    475.1    1   2   4 2
IRP    100.0    475.1    2   3   4 0
IRP    150.0    475.1    3   4   4 0
IRP    200.0    475.1    4   5   4 0
IRP    250.0    475.1    5   6   4 0
IRP    300.0    475.1    6   7   4 0
IRP    350.0    475.1    7   8   4 0
IRP    400.0    475.1    8   9   4 0
IRP    450.0    475.1    9  10   4 0
IRP    500.0    475.1   10  11   4 0
IRP    543.0    475.1   11  12   4 0
BUP
OPTL    4*8 5 8 5 17*8
OPTA    4*8 5 8 5 17*8
OPTF    4*8 5 8 5 17*8
OUT    -12  1  -1  0
MOV     12  1  0  1.0       BATCH 1 ONCE BURNED
HED     1    CHARGE
RDA     BATCH 1 BURNUP IN CYCLE 2
BUP
IRP    593.0    331.6    1   2   4 3
IRP    643.0    331.6    2   3   4 0
IRP    693.0    331.6    3   4   4 0
IRP    743.0    331.6    4   5   4 0
IRP    793.0    331.6    5   6   4 0
IRP    843.0    331.6    6   7   4 0
IRP    893.0    331.6    7   8   4 0
IRP    943.0    331.6    8   9   4 0
IRP    993.0    331.6    9  10   4 0
IRP   1043.0    331.6   10  11   4 0
IRP   1086.0    331.6   11  12   4 0
BUP
OUT    -12  1  -1  0
MOV     12  1  0  1.0       BATCH 1 TWICE BURNED
HED     1    CHARGE
```

```
RDA     BATCH 1 BURNUP IN CYCLE 3
BUP
IRP   1136.0    109.6    1   2   4 3
IRP   1186.0    109.6    2   3   4 0
IRP   1236.0    109.6    3   4   4 0
IRP   1286.0    109.6    4   5   4 0
IRP   1336.0    109.6    5   6   4 0
IRP   1386.0    109.6    6   7   4 0
IRP   1436.0    109.6    7   8   4 0
IRP   1486.0    109.6    8   9   4 0
IRP   1536.0    109.6    9  10   4 0
IRP   1586.0    109.6   10  11   4 0
IRP   1629.0    109.6   11  12   4 0
BUP
OUT    -12  1  -1  0
MOV      3 -9   0  1.0       BATCH 1 100 EFPD PLACED IN TEMP VECTOR -9
MOV     12 -10  0  1.0       BATCH 1 EOC3 PLACED IN TEMP VECTOR -10
RDA     BATCH 2 BURNUP IN CYCLE 2
MOV     -2  1  0  1.0       BATCH 2 FRESH
HED     1    CHARGE
RDA     BATCH 2 BURNUP IN CYCLE 2
BUP
IRP     50.0   2090.7    1   2   4 2
IRP    100.0   2090.7    2   3   4 0
IRP    150.0   2090.7    3   4   4 0
IRP    200.0   2090.7    4   5   4 0
IRP    250.0   2090.7    5   6   4 0
IRP    300.0   2090.7    6   7   4 0
IRP    350.0   2090.7    7   8   4 0
IRP    400.0   2090.7    8   9   4 0
IRP    450.0   2090.7    9  10   4 0
IRP    500.0   2090.7   10  11   4 0
IRP    543.0   2090.7   11  12   4 0
BUP
OUT    -12  1  -1  0
MOV     12  1  0  1.0       BATCH 2 ONCE BURNED
HED     1    CHARGE
RDA     BATCH 2  BURNUP IN CYCLE 3
BUP
IRP    593.0   1459.1    1   2   4 3
IRP    643.0   1459.1    2   3   4 0
IRP    693.0   1459.1    3   4   4 0
IRP    743.0   1459.1    4   5   4 0
IRP    793.0   1459.1    5   6   4 0
IRP    843.0   1459.1    6   7   4 0
IRP    893.0   1459.1    7   8   4 0
IRP    943.0   1459.1    8   9   4 0
IRP    993.0   1459.1    9  10   4 0
IRP   1043.0   1459.1   10  11   4 0
IRP   1086.0   1459.1   11  12   4 0
BUP
OUT   -12  1  -1  0
ADD     3 -9   0  1.0       BATCH 2 100 EFPD ADDED TO TEMP VECTOR -9
ADD    12 -10  0  1.0       BATCH 2 EOC3 ADDED TO TEMP VECTOR -10
MOV     -1  1  0  1.0       BATCH 3 FRESH
HED     1    CHARGE
```

```
RDA     BATCH 3  BURNUP IN CYCLE 3
BUP
IRP      50.0   2019.4    1   2   4 2
IRP     100.0   2019.4    2   3   4 0
IRP     150.0   2019.4    3   4   4 0
IRP     200.0   2019.4    4   5   4 0
IRP     250.0   2019.4    5   6   4 0
IRP     300.0   2019.4    6   7   4 0
IRP     350.0   2019.4    7   8   4 0
IRP     400.0   2019.4    8   9   4 0
IRP     450.0   2019.4    9  10   4 0
IRP     500.0   2019.4   10  11   4 0
IRP     543.0   2019.4   11  12   4 0
BUP
OUT    -12  1  -1  0
ADD      3 -9   0  1.0
ADD     12 -10  0  1.0
MOV     -9  1  0  1.0       CYCLE 3 @ 100 EFPD
MOV    -10  2  0  1.0       CYCLE 3 @ EOC
HED      1     100 EFPD
HED      2     EOC
OUT     -2  1  -1  0
END
2  922350  1705177.86   922380  33863822.14       0   0.0                UO2
4  080000  4782207.22        0       0.0                                 UO2
0
2  922350  1792224.08   922380  35031775.92       0   0.0                UO2
4  080000  4950940.38        0       0.0                                 UO2
0
2  922350   378195.11   922380   7990804.89       0   0.0                UO2
4  080000  1125201.50        0       0.0                                 UO2
0
END
```

Job Batch File by-br_ast.bat

```
echo off
echo ********************************************************************************
echo ********************************************************************************
echo **                                                                            **
echo **                                O R I G E N 2                               **
echo **             Oak Ridge Isotope GENeration and Depletion Code                **
echo **                                Version 2.1 (8-1-91)                        **
echo **                                                                            **
echo ********************************************************************************
echo **                                                                            **
echo **   Developed by:  Oak Ridge National Laboratory                             **
echo **                  Chemical Technology Division                              **
echo **                                                                            **
echo **   Technical Contact:  Scott B. Ludwig                                      **
echo **                       (615) 574-7916   FTS 624-7916                        **
echo **                                                                            **
echo **   Distributed by:  Radiation Shielding Information Center (RSIC)           **
echo **                    Oak Ridge National Laboratory                           **
echo **                    P.O. Box 2008                                           **
echo **                    Oak Ridge, TN  37831                                    **
echo **                    (615) 574-6176   FTS 624-6176                          **
echo ********************************************************************************
echo ********************************************************************************
pause
echo ** Execution continuing ...                                                  **
echo ********************************************************************************
echo ********************************************************************************
echo **                                                                            **
echo **     Version 2.1 (8-1-91) for mainframes and 80386 or 80486 PCs             **
echo **                                                                            **
copy by-br_ast.inp tape5.inp >nul
REM  (NOT USED IN THIS CASE) copy samp_2.u3 tape3.inp >nul
copy \d-drive\origen21\libs\decay.lib+\d-drive\origen21\libs\pwrue.lib
tape9.inp >nul
copy \d-drive\origen21\libs\gxuo2brm.lib tape10.inp >nul
\d-drive\origen21\code\origen2
rem  combine and save files from run
copy tape12.out+tape6.out by-br_ast.u6 >nul
copy tape13.out+tape11.out by-br_ast.out >nul
ren tape7.out by-br_ast.pch
ren tape15.out by-br_ast.dbg
ren tape16.out by-br_ast.vxs
ren tape50.out by-br_ast.ech
rem  cleanup files
del tape*.inp
del tape*.out
echo ********************************************************************************
echo ******************** O R I G E N 2 - Version 2.1 ***********************
echo ************************ Execution Completed ***************************
echo ********************************************************************************
echo on
```

```
 ##########################################################################
    RADTRAD Version 3.03 (Spring 2001) run on 11/14/2004  at 22:32:01
 ##########################################################################

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

 Plant file           = C:\Documents and Settings\Aleem Boatright\My Documents\My
Work\Exelon\Byron & Braidwood\FHA\RADTRAD\B-B AST FHA in FHB - 1000cfm CR Unfilt
Inleakage - 95 percent CR Intake Filter Eff.psf
 Inventory file       = c:\program files\radtrad3-03\defaults\byron-braidwood ast
fha source terms.nif
 Release file         = c:\program files\radtrad3-03\defaults\b-b ast-fha.rft
 Dose Conversion file = c:\program files\radtrad3-03\defaults\fgr11&12.inp




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

 Radtrad 3.03 4/15/2001
 B-B AST FHA in FHB - 1000 cfm CR Inleakage, 30 min Filter Delay, 95% EO Intake
Filter Efficiency
 Nuclide Inventory File:
 c:\program files\radtrad3-03\defaults\byron-braidwood ast fha source terms.nif
 Plant Power Level:
  3.2222E+01
 Compartments:
   3
 Compartment 1:
 Containment Volume
   3
  1.0000E+00
   0
   0
   0
   0
   0
 Compartment 2:
 Environment
   2
  0.0000E+00
   0
   0
   0
   0
   0
```

```
Compartment 3:
Control Room
  1
 2.0000E+05
  0
  0
  1
  0
  0
Pathways:
  4
Pathway 1:
Containment Volume to Environment
  1
  2
  2
Pathway 2:
Filtered Intake  Environment to Control Room
  2
  3
  2
Pathway 3:
Unfiltered Inleakage  Environment to Control Room
  2
  3
  2
Pathway 4:
Control Room to  Environment
  3
  2
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:

Source Term:
  1
  1   1.0000E+00
c:\program files\radtrad3-03\defaults\fgr11&12.inp
c:\program files\radtrad3-03\defaults\b-b ast-fha.rft
  4.8000E+01
  0
  0.0000E+00   9.7000E-01   3.0000E-02   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
  3.9150E+04
  3
  4.8000E+01   0.0000E+00   0.0000E+00   0.0000E+00
  4.8500E+01   8.0000E+01   9.0000E+01   9.0000E+01
  7.6800E+02   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
Pathways:
  4
Pathway 1:
  0
  0
  0
  0
  0
  1
  3
  4.8000E+01   2.3600E-02   0.0000E+00   0.0000E+00   0.0000E+00
  4.8500E+01   1.1800E-01   0.0000E+00   0.0000E+00   0.0000E+00
  5.0000E+01   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
  4.8000E+01   6.4240E+03   0.0000E+00   0.0000E+00   0.0000E+00
  4.8500E+01   8.5750E+03   9.9000E+01   9.5000E+01   9.5000E+01
  7.6800E+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
  2
  4.8000E+01   1.0000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  7.6800E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 4:
  0
  0
  0
  0
  0
  1
  3
  4.8000E+01   7.4240E+03   1.0000E+02   1.0000E+02   1.0000E+02
  4.8500E+01   9.5750E+03   1.0000E+02   1.0000E+02   1.0000E+02
  7.6800E+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
  4.8000E+01   5.3600E-04
  5.6000E+01   0.0000E+00
  1
  4
  4.8000E+01   3.5000E-04
  5.6000E+01   1.8000E-04
  7.2000E+01   2.3000E-04
```

```
   7.6800E+02   0.0000E+00
   0
 Location 2:
 LPZ
   2
   1
   5
   4.8000E+01   4.5000E-05
   5.6000E+01   3.1200E-05
   7.2000E+01   1.4100E-05
   1.4400E+02   4.5400E-06
   7.6800E+02   0.0000E+00
   1
   4
   4.8000E+01   3.5000E-04
   5.6000E+01   1.8000E-04
   7.2000E+01   2.3000E-04
   7.6800E+02   0.0000E+00
   0
 Location 3:
 Control Room
   3
   0
   1
   2
   4.8000E+01   3.5000E-04
   7.6800E+02   0.0000E+00
   1
   4
   4.8000E+01   1.0000E+00
   7.2000E+01   6.0000E-01
   1.4400E+02   4.0000E-01
   7.6800E+02   0.0000E+00
 Effective Volume Location:
   1
   3
   4.8000E+01   2.2200E-03
   4.8500E+01   2.4600E-03
   5.0000E+01   0.0000E+00
 Simulation Parameters:
   3
   4.8000E+01   1.0000E-02
   5.2000E+01   1.0000E-01
   5.6000E+01   0.0000E+00
 Output Filename:
 C:\Documents and Settings\Aleem Boatright\My Documents\My Work\Exelon\Byron &
Braidwood\FHA\RADTRAD\B-B AST FHA in FHB - 1000cfm CR Unfilt Inleakage - 95 percent
CR Intake Filter Eff.o0
   1
   1
   1
   0
   1
 End of Scenario File
```

```
########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 11/14/2004  at 22:32:01
########################################################################

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

Number of Nuclides =  60

Inventory Power =   1.0000E+00 MWth
Plant Power Level =   3.2222E+01 MWth

Number of compartments    =   3

Compartment information

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

Compartment number  2
Name: Environment
Compartment type is Environment
Pathways into and out of compartment  2
   Inlet Pathway Number   1: Containment Volume to Environment
   Inlet Pathway Number   4: Control Room to  Environment
   Exit Pathway Number    2: Filtered Intake  Environment to Control Room
   Exit Pathway Number    3: Unfiltered Inleakage  Environment to Control Room

Compartment number  3
Name: Control Room
Compartment volume =   2.0000E+05 (Cubic feet)
Compartment type is Control Room
Removal devices within compartment:
     Filter(s)
Pathways into and out of compartment  3
   Inlet Pathway Number   2: Filtered Intake  Environment to Control Room
   Inlet Pathway Number   3: Unfiltered Inleakage  Environment to Control Room
   Exit Pathway Number    4: Control Room to  Environment

Total number of pathways =   4
```

```
##########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 11/14/2004  at 22:32:01
##########################################################################

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


Time between shutdown and first release =   4.8000E+01 (Hours)

Radioactive Decay is enabled

Release Fractions and Timings
                GAP        EARLY IN-VESSEL  LATE RELEASE     RELEASE MASS
             0.000050 hr     0.0000 hrs       0.0000 hrs          (gm)
NOBLES       1.0000E-01      0.0000E+00       0.0000E+00        5.643E+00
IODINE       5.0000E-04      0.0000E+00       0.0000E+00        6.675E-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 =         32. 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   5.702E+02  3.383E+08   1.190E-16   0.000E+00   0.000E+00
 Kr-85m    1   8.592E+03  1.613E+04   7.480E-15   0.000E+00   0.000E+00
 Kr-87     1   1.696E+04  4.578E+03   4.120E-14   0.000E+00   0.000E+00
 Kr-88     1   2.392E+04  1.022E+04   1.020E-13   0.000E+00   0.000E+00
 I-131     2   4.274E+04  6.947E+05   1.820E-14   2.920E-07   8.890E-09
 I-132     2   3.863E+04  8.280E+03   1.120E-13   1.740E-09   1.030E-10
 I-133     2   5.529E+04  7.488E+04   2.940E-14   4.860E-08   1.580E-09
 I-134     2   6.143E+04  3.156E+03   1.300E-13   2.880E-10   3.550E-11
 I-135     2   5.159E+04  2.380E+04   8.294E-14   8.460E-09   3.320E-10
 Xe-133    1   5.396E+04  4.532E+05   1.560E-15   0.000E+00   0.000E+00
 Xe-135    1   1.532E+04  3.272E+04   1.190E-14   0.000E+00   0.000E+00

Iodine fractions
     Aerosol      =   0.0000E+00
     Elemental    =   9.7000E-01
     Organic      =   3.0000E-02

COMPARTMENT DATA

Compartment number   1: Containment Volume

Compartment number   2: Environment

Compartment number   3: Control Room
```

Compartment Filter Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
4.8000E+01	3.9150E+04	0.0000E+00	0.0000E+00	0.0000E+00
4.8500E+01	3.9150E+04	8.0000E+01	9.0000E+01	9.0000E+01
7.6800E+02	3.9150E+04	0.0000E+00	0.0000E+00	0.0000E+00

PATHWAY DATA

Pathway number 1: Containment Volume to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
4.8000E+01	2.3600E-02	0.0000E+00	0.0000E+00	0.0000E+00
4.8500E+01	1.1800E-01	0.0000E+00	0.0000E+00	0.0000E+00
5.0000E+01	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 2: Filtered Intake Environment to Control Room

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
4.8000E+01	6.4240E+03	0.0000E+00	0.0000E+00	0.0000E+00
4.8500E+01	8.5750E+03	9.9000E+01	9.5000E+01	9.5000E+01
7.6800E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 3: Unfiltered Inleakage Environment to Control Room

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
4.8000E+01	1.0000E+03	0.0000E+00	0.0000E+00	0.0000E+00
7.6800E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 4: Control Room to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
4.8000E+01	7.4240E+03	1.0000E+02	1.0000E+02	1.0000E+02
4.8500E+01	9.5750E+03	1.0000E+02	1.0000E+02	1.0000E+02
7.6800E+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)
4.8000E+01	5.3600E-04
5.6000E+01	0.0000E+00

```
Location Breathing Rate Data
 Time (hr)          Breathing Rate (m^3 * sec^-1)
  4.8000E+01                 3.5000E-04
  5.6000E+01                 1.8000E-04
  7.2000E+01                 2.3000E-04
  7.6800E+02                 0.0000E+00
Location LPZ      is in compartment   2

Location X/Q Data
 Time (hr)          X/Q (s * m^-3)
  4.8000E+01           4.5000E-05
  5.6000E+01           3.1200E-05
  7.2000E+01           1.4100E-05
  1.4400E+02           4.5400E-06
  7.6800E+02           0.0000E+00

Location Breathing Rate Data
 Time (hr)          Breathing Rate (m^3 * sec^-1)
  4.8000E+01                 3.5000E-04
  5.6000E+01                 1.8000E-04
  7.2000E+01                 2.3000E-04
  7.6800E+02                 0.0000E+00
Location Control Room     is in compartment   3

Location X/Q Data
 Time (hr)          X/Q (s * m^-3)
  4.8000E+01           2.2200E-03
  4.8500E+01           2.4600E-03
  5.0000E+01           0.0000E+00

Location Breathing Rate Data
 Time (hr)          Breathing Rate (m^3 * sec^-1)
  4.8000E+01                 3.5000E-04
  7.6800E+02                 0.0000E+00

Location Occupancy Factor Data
 Time (hr)          Occupancy Factor
  4.8000E+01              1.0000E+00
  7.2000E+01              6.0000E-01
  1.4400E+02              4.0000E-01
  7.6800E+02              0.0000E+00

USER SPECIFIED TIME STEP DATA - SUPPLEMENTAL TIME STEPS
     Time            Time step
      0.0000E+00       1.0000E-02
      4.0000E+00       1.0000E-01
      8.0000E+00       0.0000E+00
```

```
##########################################################################
  RADTRAD Version 3.03 (Spring 2001) run on 11/14/2004  at 22:32:01
##########################################################################

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

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

Detailed model information at time (H) =   48.0000

EAB Doses:

Time (h) =  48.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.6852E-05  4.3740E-03  1.5047E-04
Accumulated dose (rem)  1.6852E-05  4.3740E-03  1.5047E-04

LPZ Doses:

Time (h) =  48.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.4148E-06  3.6722E-04  1.2633E-05
Accumulated dose (rem)  1.4148E-06  3.6722E-04  1.2633E-05

Control Room Doses:

Time (h) =  48.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.0509E-10  1.0087E-06  3.1019E-08
Accumulated dose (rem)  2.0509E-10  1.0087E-06  3.1019E-08

Detailed model information at time (H) =   48.5000

EAB Doses:

Time (h) =  48.5000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.4095E-01  6.2617E+01  2.1538E+00
Accumulated dose (rem)  2.4097E-01  6.2621E+01  2.1539E+00

LPZ Doses:

Time (h) =  48.5000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.0229E-02  5.2570E+00  1.8082E-01
Accumulated dose (rem)  2.0231E-02  5.2574E+00  1.8083E-01

Control Room Doses:
```

Time (h) = 48.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.2883E-02	1.1273E+02	3.4666E+00
Accumulated dose (rem)	2.2883E-02	1.1273E+02	3.4666E+00

Detailed model information at time (H) = 50.0000

EAB Doses:

Time (h) = 50.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.3293E-01	6.0675E+01	2.0864E+00
Accumulated dose (rem)	4.7390E-01	1.2330E+02	4.2403E+00

LPZ Doses:

Time (h) = 50.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.9556E-02	5.0940E+00	1.7516E-01
Accumulated dose (rem)	3.9786E-02	1.0351E+01	3.5599E-01

Control Room Doses:

Time (h) = 50.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	7.2792E-02	3.3145E+01	1.0853E+00
Accumulated dose (rem)	9.5675E-02	1.4588E+02	4.5518E+00

Detailed model information at time (H) = 56.0000

EAB Doses:

Time (h) = 56.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.7390E-01	1.2330E+02	4.2403E+00

LPZ Doses:

Time (h) = 56.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	3.9786E-02	1.0351E+01	3.5599E-01

Control Room Doses:

Time (h) = 56.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.4519E-03	2.3994E-04	1.4592E-03
Accumulated dose (rem)	9.7127E-02	1.4588E+02	4.5533E+00

Detailed model information at time (H) = 72.0000

EAB Doses:

Time (h) = 72.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.7390E-01	1.2330E+02	4.2403E+00

LPZ Doses:

Time (h) = 72.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00

Accumulated dose (rem)	3.9786E-02	1.0351E+01	3.5599E-01

Control Room Doses:

Time (h) = 72.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	4.5361E-11	2.4929E-39	4.5361E-11
Accumulated dose (rem)	9.7127E-02	1.4588E+02	4.5533E+00

Detailed model information at time (H) = 144.0000

EAB Doses:

Time (h) = 144.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.7390E-01	1.2330E+02	4.2403E+00

LPZ Doses:

Time (h) = 144.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	3.9786E-02	1.0351E+01	3.5599E-01

Control Room Doses:

Time (h) = 144.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.5202E-30	1.2628-131	1.5202E-30
Accumulated dose (rem)	9.7127E-02	1.4588E+02	4.5533E+00

Detailed model information at time (H) = 768.0000

EAB Doses:

Time (h) = 768.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.7390E-01	1.2330E+02	4.2403E+00

LPZ Doses:

Time (h) = 768.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	3.9786E-02	1.0351E+01	3.5599E-01

Control Room Doses:

Time (h) = 768.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.0162-120	0.0000E+00	1.0162-120
Accumulated dose (rem)	9.7127E-02	1.4588E+02	4.5533E+00

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##
I-131 Summary
##

Time (hr)	Containment Volume I-131 (Curies)	Environment I-131 (Curies)	Control Room I-131 (Curies)
48.000	5.7951E+02	2.0515E-02	1.5956E-04

48.260	4.0068E+02	1.7840E+02	1.0344E+00
48.500	2.8499E+02	2.9379E+02	1.2901E+00
48.750	4.8500E+01	5.3015E+02	1.1601E-01
49.000	8.2537E+00	5.7038E+02	1.6152E-02
49.250	1.4046E+00	5.7722E+02	2.6243E-03
49.500	2.3904E-01	5.7839E+02	4.4229E-04
49.750	4.0679E-02	5.7859E+02	7.5119E-05
50.000	6.9228E-03	5.7862E+02	1.2779E-05
50.250	6.9166E-03	5.7862E+02	4.4314E-07
50.500	6.9104E-03	5.7862E+02	1.5367E-08
50.750	6.9042E-03	5.7862E+02	5.3290E-10
51.000	6.8980E-03	5.7862E+02	1.8480E-11
51.250	6.8918E-03	5.7862E+02	6.4085E-13
51.500	6.8856E-03	5.7862E+02	2.2223E-14
51.750	6.8794E-03	5.7862E+02	7.7067E-16
52.000	6.8732E-03	5.7862E+02	2.6725E-17
52.400	6.8634E-03	5.7862E+02	1.2331E-19
52.700	6.8560E-03	5.7862E+02	2.1830E-21
53.000	6.8486E-03	5.7862E+02	3.8648E-23
53.300	6.8412E-03	5.7862E+02	6.8420E-25
53.600	6.8338E-03	5.7862E+02	1.2113E-26
53.900	6.8265E-03	5.7862E+02	2.1444E-28
54.200	6.8191E-03	5.7862E+02	3.7964E-30
54.500	6.8118E-03	5.7862E+02	6.7209E-32
54.800	6.8044E-03	5.7862E+02	1.1898E-33
55.100	6.7971E-03	5.7862E+02	2.1064E-35
55.400	6.7898E-03	5.7862E+02	3.7292E-37
55.700	6.7825E-03	5.7862E+02	6.6019E-39
56.000	6.7752E-03	5.7862E+02	1.1688E-40
56.300	6.7679E-03	5.7862E+02	2.0692E-42
56.600	6.7606E-03	5.7862E+02	3.6631E-44
56.900	6.7533E-03	5.7862E+02	6.4851E-46
57.200	6.7460E-03	5.7862E+02	1.1481E-47
57.500	6.7388E-03	5.7862E+02	2.0325E-49
57.800	6.7315E-03	5.7862E+02	3.5983E-51
58.100	6.7243E-03	5.7862E+02	6.3703E-53
58.400	6.7170E-03	5.7862E+02	1.1278E-54
72.000	6.3968E-03	5.7862E+02	4.2697-134
144.000	4.9390E-03	5.7862E+02	0.0000E+00
768.000	5.2500E-04	5.7862E+02	0.0000E+00

##

Cumulative Dose Summary

##

	EAB		LPZ		Control Room	
Time (hr)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)
48.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
48.260	3.8031E+01	1.3082E+00	3.1929E+00	1.0983E-01	4.0022E+01	1.2307E+00
48.500	6.2621E+01	2.1539E+00	5.2574E+00	1.8083E-01	1.1273E+02	3.4666E+00
48.750	1.1298E+02	3.8855E+00	9.4849E+00	3.2621E-01	1.4219E+02	4.3933E+00
49.000	1.2154E+02	4.1800E+00	1.0204E+01	3.5093E-01	1.4532E+02	4.5113E+00
49.250	1.2300E+02	4.2301E+00	1.0326E+01	3.5514E-01	1.4578E+02	4.5380E+00
49.500	1.2325E+02	4.2386E+00	1.0347E+01	3.5585E-01	1.4586E+02	4.5467E+00
49.750	1.2329E+02	4.2400E+00	1.0351E+01	3.5597E-01	1.4587E+02	4.5503E+00
50.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5518E+00

50.250	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5526E+00
50.500	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5530E+00
50.750	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5531E+00
51.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5532E+00
51.250	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
51.500	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
51.750	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
52.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
52.400	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
52.700	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
53.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
53.300	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
53.600	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
53.900	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
54.200	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
54.500	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
54.800	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
55.100	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
55.400	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
55.700	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
56.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
56.300	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
56.600	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
56.900	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
57.200	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
57.500	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
57.800	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
58.100	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
58.400	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
72.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
144.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00
768.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.4588E+02	4.5533E+00

##
Worst Two-Hour Doses
##

EAB

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
48.0	4.7390E-01	1.2330E+02	4.2403E+00

```
 ##############################################################################
    RADTRAD Version 3.03 (Spring 2001) run on 11/15/2004  at  2:18:02
 ##############################################################################

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

 Plant file           = C:\Documents and Settings\Aleem Boatright\My Documents\My
Work\Exelon\Byron & Braidwood\FHA\RADTRAD\Rev 1\B-B AST FHA in FHB - 1000cfm CR
Unfilt Inleakage - 14 Day Decay - No CR Intake Filter Eff.psf
 Inventory file       = c:\program files\radtrad3-03\defaults\byron-braidwood ast
fha source terms.nif
 Release file         = c:\program files\radtrad3-03\defaults\b-b ast-fha.rft
 Dose Conversion file = c:\program files\radtrad3-03\defaults\fgr11&12.inp



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


 Radtrad 3.03 4/15/2001
 Byron/Braidwood AST FHA - in FHB - 336-Hr Decay with No Filtration
 Nuclide Inventory File:
 c:\program files\radtrad3-03\defaults\byron-braidwood ast fha source terms.nif
 Plant Power Level:
  3.2222E+01
 Compartments:
   3
 Compartment 1:
 Containment
   3
  1.0000E+00
   0
   0
   0
   0
   0
 Compartment 2:
 Environment
   2
  0.0000E+00
   0
   0
   0
   0
   0
 Compartment 3:
```

```
Control Room
  1
 2.0000E+05
  0
  0
  1
  0
  0
Pathways:
  4
Pathway 1:
Containment to Environment
  1
  2
  2
Pathway 2:
Filtered Intake Environment to Control Room
  2
  3
  2
Pathway 3:
Unfiltered Inleakage Environment to Control Room
  2
  3
  2
Pathway 4:
Exhaust Control Room to Environment
  3
  2
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:

Source Term:
  1
  1   1.0000E+00
c:\program files\radtrad3-03\defaults\fgr11&12.inp
c:\program files\radtrad3-03\defaults\b-b ast-fha.rft
  3.3600E+02
  0
  0.0000E+00   9.7000E-01   3.0000E-02   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
  3.9150E+04
  3
  3.3600E+02   0.0000E+00   0.0000E+00   0.0000E+00
  3.3650E+02   0.0000E+00   0.0000E+00   0.0000E+00
  1.0560E+03   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
Pathways:
  4
Pathway 1:
  0
  0
  0
  0
  0
  1
  3
  3.3600E+02   2.3600E-02   0.0000E+00   0.0000E+00   0.0000E+00
  3.3650E+02   1.1800E-01   0.0000E+00   0.0000E+00   0.0000E+00
  3.3800E+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
```

```
  3.3600E+02   6.4240E+03   0.0000E+00   0.0000E+00   0.0000E+00
  3.3650E+02   8.5750E+03   0.0000E+00   0.0000E+00   0.0000E+00
  1.0560E+03   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
  2
  3.3600E+02   1.0000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  1.0560E+03   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 4:
  0
  0
  0
  0
  0
  1
  3
  3.3600E+02   7.4240E+03   1.0000E+02   1.0000E+02   1.0000E+02
  3.3650E+02   9.5750E+03   1.0000E+02   1.0000E+02   1.0000E+02
  1.0560E+03   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
  3.3600E+02   5.3600E-04
  3.4400E+02   0.0000E+00
  1
  4
  3.3600E+02   3.5000E-04
  3.4400E+02   1.8000E-04
  3.6000E+02   2.3000E-04
  1.0560E+03   0.0000E+00
```

```
   0
 Location 2:
 LPZ
   2
   1
   5
   3.3600E+02   4.5000E-05
   3.4400E+02   3.1200E-05
   3.6000E+02   1.4100E-05
   4.3200E+02   4.5400E-06
   1.0560E+03   0.0000E+00
   1
   4
   3.3600E+02   3.5000E-04
   3.4400E+02   1.8000E-04
   3.6000E+02   2.3000E-04
   1.0560E+03   0.0000E+00
   0
 Location 3:
 Control Room
   3
   0
   1
   2
   3.3600E+02   3.5000E-04
   1.0560E+03   0.0000E+00
   1
   4
   3.3600E+02   1.0000E+00
   3.6000E+02   6.0000E-01
   4.3200E+02   4.0000E-01
   1.0560E+03   0.0000E+00
 Effective Volume Location:
   1
   3
   3.3600E+02   2.2200E-03
   3.3650E+02   2.2200E-03
   3.3800E+02   0.0000E+00
 Simulation Parameters:
   3
   3.3600E+02   1.0000E-02
   3.4000E+02   1.0000E-01
   3.4400E+02   0.0000E+00
 Output Filename:
 C:\Documents and Settings\Aleem Boatright\My Documents\My Work\Exelon\Byron &
Braidwood\FHA\RADTRAD\Rev 1\B-B AST FHA in FHB - 1000cfm CR Unfilt Inleakage - 14
Day Decay - No CR Intake Filter Eff.o0
   1
   1
   1
   0
   0
 End of Scenario File
```

```
##########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 11/15/2004  at  2:18:02
##########################################################################

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

Number of Nuclides =  60

Inventory Power =    1.0000E+00 MWth
Plant Power Level =    3.2222E+01 MWth

Number of compartments     =    3

Compartment information

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

Compartment number  2
Name: Environment
Compartment type is Environment
Pathways into and out of compartment  2
   Inlet Pathway Number    1: Containment to Environment
   Inlet Pathway Number    4: Exhaust Control Room to Environment
   Exit Pathway Number     2: Filtered Intake Environment to Control Room
   Exit Pathway Number     3: Unfiltered Inleakage Environment to Control Room

Compartment number  3
Name: Control Room
Compartment volume =    2.0000E+05 (Cubic feet)
Compartment type is Control Room
Removal devices within compartment:
     Filter(s)
Pathways into and out of compartment  3
   Inlet Pathway Number    2: Filtered Intake Environment to Control Room
   Inlet Pathway Number    3: Unfiltered Inleakage Environment to Control Room
   Exit Pathway Number     4: Exhaust Control Room to Environment

Total number of pathways =    4
```

```
##########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 11/15/2004  at  2:18:02
##########################################################################

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


Time between shutdown and first release =   3.3600E+02 (Hours)

Radioactive Decay is enabled

Release Fractions and Timings
                GAP          EARLY IN-VESSEL   LATE RELEASE     RELEASE MASS
              0.000050 hr      0.0000 hrs       0.0000 hrs          (gm)
NOBLES        1.0000E-01       0.0000E+00       0.0000E+00        5.643E+00
IODINE        5.0000E-04       0.0000E+00       0.0000E+00        6.675E-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 =         32. 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   5.702E+02  3.383E+08   1.190E-16   0.000E+00   0.000E+00
 Kr-85m    1   8.592E+03  1.613E+04   7.480E-15   0.000E+00   0.000E+00
 Kr-87     1   1.696E+04  4.578E+03   4.120E-14   0.000E+00   0.000E+00
 Kr-88     1   2.392E+04  1.022E+04   1.020E-13   0.000E+00   0.000E+00
 I-131     2   4.274E+04  6.947E+05   1.820E-14   2.920E-07   8.890E-09
 I-132     2   3.863E+04  8.280E+03   1.120E-13   1.740E-09   1.030E-10
 I-133     2   5.529E+04  7.488E+04   2.940E-14   4.860E-08   1.580E-09
 I-134     2   6.143E+04  3.156E+03   1.300E-13   2.880E-10   3.550E-11
 I-135     2   5.159E+04  2.380E+04   8.294E-14   8.460E-09   3.320E-10
 Xe-133    1   5.396E+04  4.532E+05   1.560E-15   0.000E+00   0.000E+00
 Xe-135    1   1.532E+04  3.272E+04   1.190E-14   0.000E+00   0.000E+00

Iodine fractions
     Aerosol      =   0.0000E+00
     Elemental    =   9.7000E-01
     Organic      =   3.0000E-02

COMPARTMENT DATA

Compartment number   1: Containment

Compartment number   2: Environment

Compartment number   3: Control Room
```

Compartment Filter Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
3.3600E+02	3.9150E+04	0.0000E+00	0.0000E+00	0.0000E+00
3.3650E+02	3.9150E+04	0.0000E+00	0.0000E+00	0.0000E+00
1.0560E+03	3.9150E+04	0.0000E+00	0.0000E+00	0.0000E+00

PATHWAY DATA

Pathway number 1: Containment to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
3.3600E+02	2.3600E-02	0.0000E+00	0.0000E+00	0.0000E+00
3.3650E+02	1.1800E-01	0.0000E+00	0.0000E+00	0.0000E+00
3.3800E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 2: Filtered Intake Environment to Control Room

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
3.3600E+02	6.4240E+03	0.0000E+00	0.0000E+00	0.0000E+00
3.3650E+02	8.5750E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.0560E+03	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 3: Unfiltered Inleakage Environment to Control Room

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
3.3600E+02	1.0000E+03	0.0000E+00	0.0000E+00	0.0000E+00
1.0560E+03	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 4: Exhaust Control Room to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
3.3600E+02	7.4240E+03	1.0000E+02	1.0000E+02	1.0000E+02
3.3650E+02	9.5750E+03	1.0000E+02	1.0000E+02	1.0000E+02
1.0560E+03	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)
3.3600E+02	5.3600E-04
3.4400E+02	0.0000E+00

```
      Location Breathing Rate Data
       Time (hr)          Breathing Rate (m^3 * sec^-1)
        3.3600E+02                 3.5000E-04
        3.4400E+02                 1.8000E-04
        3.6000E+02                 2.3000E-04
        1.0560E+03                 0.0000E+00
      Location LPZ      is in compartment    2

      Location X/Q Data
       Time (hr)          X/Q (s * m^-3)
        3.3600E+02            4.5000E-05
        3.4400E+02            3.1200E-05
        3.6000E+02            1.4100E-05
        4.3200E+02            4.5400E-06
        1.0560E+03            0.0000E+00

      Location Breathing Rate Data
       Time (hr)          Breathing Rate (m^3 * sec^-1)
        3.3600E+02                 3.5000E-04
        3.4400E+02                 1.8000E-04
        3.6000E+02                 2.3000E-04
        1.0560E+03                 0.0000E+00
      Location Control Room     is in compartment    3

      Location X/Q Data
       Time (hr)          X/Q (s * m^-3)
        3.3600E+02            2.2200E-03
        3.3650E+02            2.2200E-03
        3.3800E+02            0.0000E+00

      Location Breathing Rate Data
       Time (hr)          Breathing Rate (m^3 * sec^-1)
        3.3600E+02                 3.5000E-04
        1.0560E+03                 0.0000E+00

      Location Occupancy Factor Data
       Time (hr)          Occupancy Factor
        3.3600E+02              1.0000E+00
        3.6000E+02              6.0000E-01
        4.3200E+02              4.0000E-01
        1.0560E+03              0.0000E+00

USER SPECIFIED TIME STEP DATA - SUPPLEMENTAL TIME STEPS
      Time             Time step
       0.0000E+00       1.0000E-02
       4.0000E+00       1.0000E-01
       8.0000E+00       0.0000E+00
```

```
##########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 11/15/2004  at  2:18:02
##########################################################################
```

```
  ####   #    #  #####  #####   #    #  #####
 #    #  #    #    #    #    #  #    #    #
 #    #  #    #    #    #    #  #    #    #
 #    #  #    #    #    #####   #    #    #
 #    #  #    #    #    #       #    #    #
 #    #  #    #    #    #       #    #    #
  ####    ####     #    #        ####     #
```

```
##########################################################################
                              Dose Output
##########################################################################
```

EAB Doses:

Time (h) = 336.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.2721E-06	1.4777E-03	4.8261E-05
Accumulated dose (rem)	3.2721E-06	1.4777E-03	4.8261E-05

LPZ Doses:

Time (h) = 336.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.7471E-07	1.2406E-04	4.0518E-06
Accumulated dose (rem)	2.7471E-07	1.2406E-04	4.0518E-06

Control Room Doses:

Time (h) = 336.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.9823E-11	3.4077E-07	1.0415E-08
Accumulated dose (rem)	3.9823E-11	3.4077E-07	1.0415E-08

EAB Doses:

Time (h) = 336.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	4.6840E-02	2.1161E+01	6.9110E-01
Accumulated dose (rem)	4.6843E-02	2.1163E+01	6.9115E-01

LPZ Doses:

Time (h) = 336.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.9325E-03	1.7766E+00	5.8021E-02
Accumulated dose (rem)	3.9327E-03	1.7767E+00	5.8025E-02

Control Room Doses:

Time (h) = 336.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	4.4503E-03	3.8102E+01	1.1645E+00
Accumulated dose (rem)	4.4503E-03	3.8102E+01	1.1645E+00

EAB Doses:

Time (h) = 338.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	4.5382E-02	2.0518E+01	6.7005E-01
Accumulated dose (rem)	9.2226E-02	4.1680E+01	1.3612E+00

LPZ Doses:

Time (h) = 338.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.8101E-03	1.7226E+00	5.6254E-02
Accumulated dose (rem)	7.7428E-03	3.4993E+00	1.1428E-01

Control Room Doses:

Time (h) = 338.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.4090E-02	1.2076E+02	3.6907E+00
Accumulated dose (rem)	1.8540E-02	1.5886E+02	4.8552E+00

EAB Doses:

Time (h) = 344.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	9.2226E-02	4.1680E+01	1.3612E+00

LPZ Doses:

Time (h) = 344.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	7.7428E-03	3.4993E+00	1.1428E-01

Control Room Doses:

Time (h) = 344.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.8178E-04	2.4210E+00	7.3991E-02
Accumulated dose (rem)	1.8822E-02	1.6128E+02	4.9291E+00

EAB Doses:

Time (h) = 360.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	9.2226E-02	4.1680E+01	1.3612E+00

LPZ Doses:

Time (h) = 360.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	7.7428E-03	3.4993E+00	1.1428E-01

Control Room Doses:

Time (h) = 360.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	8.9949E-12	7.8086E-08	2.3863E-09
Accumulated dose (rem)	1.8822E-02	1.6128E+02	4.9291E+00

EAB Doses:

Time (h) = 432.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	9.2226E-02	4.1680E+01	1.3612E+00

LPZ Doses:

Time (h) = 432.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	7.7428E-03	3.4993E+00	1.1428E-01

Control Room Doses:

Time (h) = 432.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.1044E-31	2.7691E-27	8.4615E-29
Accumulated dose (rem)	1.8822E-02	1.6128E+02	4.9291E+00

EAB Doses:

Time (h) =1056.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	9.2226E-02	4.1680E+01	1.3612E+00

LPZ Doses:

Time (h) =1056.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	7.7428E-03	3.4993E+00	1.1428E-01

Control Room Doses:

Time (h) =1056.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.1328-121	2.1514-117	6.5712-119
Accumulated dose (rem)	1.8822E-02	1.6128E+02	4.9291E+00

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##

I-131 Summary

##

Time (hr)	Containment I-131 (Curies)	Environment I-131 (Curies)	Control Room I-131 (Curies)
336.000	2.0595E+02	7.2907E-03	5.6707E-05
336.260	1.4240E+02	6.3399E+01	3.6761E-01
336.500	1.0128E+02	1.0441E+02	4.5849E-01
336.750	1.7236E+01	1.8841E+02	7.6545E-01
337.000	2.9332E+00	2.0270E+02	4.6520E-01
337.250	4.9918E-01	2.0514E+02	2.4236E-01
337.500	8.4950E-02	2.0555E+02	1.2075E-01
337.750	1.4457E-02	2.0562E+02	5.9290E-02
338.000	2.4603E-03	2.0563E+02	2.8965E-02
338.250	2.4581E-03	2.0563E+02	1.4113E-02
338.500	2.4559E-03	2.0563E+02	6.8760E-03
338.750	2.4537E-03	2.0563E+02	3.3502E-03
339.000	2.4514E-03	2.0563E+02	1.6323E-03
339.250	2.4492E-03	2.0563E+02	7.9530E-04
339.500	2.4470E-03	2.0563E+02	3.8749E-04

339.750	2.4449E-03	2.0563E+02	1.8880E-04
340.000	2.4427E-03	2.0563E+02	9.1988E-05
340.400	2.4392E-03	2.0563E+02	2.9114E-05
340.700	2.4365E-03	2.0563E+02	1.2285E-05
341.000	2.4339E-03	2.0563E+02	5.1839E-06
341.300	2.4313E-03	2.0563E+02	2.1874E-06
341.600	2.4287E-03	2.0563E+02	9.2303E-07
341.900	2.4260E-03	2.0563E+02	3.8949E-07
342.200	2.4234E-03	2.0563E+02	1.6435E-07
342.500	2.4208E-03	2.0563E+02	6.9351E-08
342.800	2.4182E-03	2.0563E+02	2.9264E-08
343.100	2.4156E-03	2.0563E+02	1.2348E-08
343.400	2.4130E-03	2.0563E+02	5.2106E-09
343.700	2.4104E-03	2.0563E+02	2.1987E-09
344.000	2.4078E-03	2.0563E+02	9.2778E-10
344.300	2.4052E-03	2.0563E+02	3.9149E-10
344.600	2.4026E-03	2.0563E+02	1.6520E-10
344.900	2.4000E-03	2.0563E+02	6.9708E-11
345.200	2.3975E-03	2.0563E+02	2.9414E-11
345.500	2.3949E-03	2.0563E+02	1.2412E-11
345.800	2.3923E-03	2.0563E+02	5.2374E-12
346.100	2.3897E-03	2.0563E+02	2.2100E-12
346.400	2.3871E-03	2.0563E+02	9.3256E-13
360.000	2.2733E-03	2.0563E+02	9.5998E-30
432.000	1.7552E-03	2.0563E+02	1.1188-119
1056.000	1.8658E-04	2.0563E+02	0.0000E+00

##

Cumulative Dose Summary

##

	EAB		LPZ		Control Room	
Time (hr)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)
336.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
336.260	1.2851E+01	4.1969E-01	1.0789E+00	3.5235E-02	1.3524E+01	4.1333E-01
336.500	2.1163E+01	6.9115E-01	1.7767E+00	5.8025E-02	3.8102E+01	1.1645E+00
336.750	3.8189E+01	1.2472E+00	3.2062E+00	1.0471E-01	8.2865E+01	2.5325E+00
337.000	4.1087E+01	1.3418E+00	3.4494E+00	1.1265E-01	1.1995E+02	3.6658E+00
337.250	4.1580E+01	1.3579E+00	3.4908E+00	1.1400E-01	1.4061E+02	4.2973E+00
337.500	4.1664E+01	1.3607E+00	3.4979E+00	1.1423E-01	1.5112E+02	4.6186E+00
337.750	4.1678E+01	1.3611E+00	3.4991E+00	1.1427E-01	1.5632E+02	4.7774E+00
338.000	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.5886E+02	4.8552E+00
338.250	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6010E+02	4.8931E+00
338.500	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6071E+02	4.9116E+00
338.750	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6100E+02	4.9206E+00
339.000	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6115E+02	4.9250E+00
339.250	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6122E+02	4.9271E+00
339.500	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6125E+02	4.9281E+00
339.750	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6127E+02	4.9287E+00
340.000	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9289E+00
340.400	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
340.700	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
341.000	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
341.300	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
341.600	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
341.900	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00

342.200	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
342.500	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
342.800	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
343.100	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
343.400	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
343.700	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
344.000	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
344.300	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
344.600	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
344.900	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
345.200	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
345.500	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
345.800	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
346.100	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
346.400	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
360.000	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
432.000	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00
1056.000	4.1680E+01	1.3612E+00	3.4993E+00	1.1428E-01	1.6128E+02	4.9291E+00

##
Worst Two-Hour Doses
##

EAB

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
336.0	9.2226E-02	4.1680E+01	1.3612E+00

```
 ##############################################################################
    RADTRAD Version 3.03 (Spring 2001) run on 11/22/2004  at 10:08:34
 ##############################################################################

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

 Plant file           = C:\Documents and Settings\x9081\My Documents\B-B AST FHA in
FHB - 1000cfm CR Unfilt Inleakage - No Decay with FHB Filtration 6hrs.psf
 Inventory file       = C:\Documents and Settings\x9081\My Documents\Byron-
Braidwood AST FHA Source Terms.nif
 Release file         = C:\Documents and Settings\x9081\My Documents\B-B AST-
FHA.rft
 Dose Conversion file = c:\program files\radtrad3.03\defaults\fgr11&12.inp




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


 Radtrad 3.03 4/15/2001
 Byron/Braidwood AST FHA - in FHB - No Decay with FHB Filtration
 Nuclide Inventory File:
 C:\Documents and Settings\x9081\My Documents\Byron-Braidwood AST FHA Source
Terms.nif
 Plant Power Level:
  3.2222E+01
 Compartments:
   3
 Compartment 1:
 Containment
   3
  1.0000E+00
   0
   0
   0
   0
   0
 Compartment 2:
 Environment
   2
  0.0000E+00
   0
   0
   0
   0
```

```
  0
Compartment 3:
Control Room
  1
 2.0000E+05
  0
  0
  1
  0
  0
Pathways:
  4
Pathway 1:
Containment to Environment
  1
  2
  2
Pathway 2:
Filtered Intake Environment to Control Room
  2
  3
  2
Pathway 3:
Unfiltered Inleakage Environment to Control Room
  2
  3
  2
Pathway 4:
Exhaust Control Room to Environment
  3
  2
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:

Source Term:
  1
  1   1.0000E+00
c:\program files\radtrad3.03\defaults\fgr11&12.inp
C:\Documents and Settings\x9081\My Documents\B-B AST-FHA.rft
  6.0000E+00
  0
  0.0000E+00   9.7000E-01   3.0000E-02   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
  3.9150E+04
  3
  6.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  6.5000E+00   8.0000E+01   9.0000E+01   9.0000E+01
  7.2600E+02   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
Pathways:
  4
Pathway 1:
  0
  0
  0
  0
  0
  1
  3
  6.0000E+00   2.3600E-02   9.9000E+01   9.0000E+01   9.0000E+01
  6.5000E+00   1.1800E-01   9.9000E+01   9.0000E+01   9.0000E+01
  8.0000E+00   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
  6.0000E+00   6.4240E+03   0.0000E+00   0.0000E+00   0.0000E+00
  6.5000E+00   8.5750E+03   9.9000E+01   9.5000E+01   9.5000E+01
  7.2600E+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
  2
  6.0000E+00   1.0000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  7.2600E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 4:
  0
  0
  0
  0
  0
  1
  3
  6.0000E+00   7.4240E+03   1.0000E+02   1.0000E+02   1.0000E+02
  6.5000E+00   9.5750E+03   1.0000E+02   1.0000E+02   1.0000E+02
  7.2600E+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
  6.0000E+00   5.3600E-04
  1.4000E+01   0.0000E+00
  1
  4
  6.0000E+00   3.5000E-04
  1.4000E+01   1.8000E-04
```

```
   3.0000E+01    2.3000E-04
   7.2600E+02    0.0000E+00
   0
 Location 2:
 LPZ
   2
   1
   5
   6.0000E+00    4.5000E-05
   1.4000E+01    3.1200E-05
   3.0000E+01    1.4100E-05
   1.0200E+02    4.5400E-06
   7.2600E+02    0.0000E+00
   1
   4
   6.0000E+00    3.5000E-04
   1.4000E+01    1.8000E-04
   3.0000E+01    2.3000E-04
   7.2600E+02    0.0000E+00
   0
 Location 3:
 Control Room
   3
   0
   1
   2
   6.0000E+00    3.5000E-04
   7.2600E+02    0.0000E+00
   1
   4
   6.0000E+00    1.0000E+00
   3.0000E+01    6.0000E-01
   1.0200E+02    4.0000E-01
   7.2600E+02    0.0000E+00
 Effective Volume Location:
   1
   3
   6.0000E+00    2.2200E-03
   6.5000E+00    2.4600E-03
   8.0000E+00    0.0000E+00
 Simulation Parameters:
   3
   6.0000E+00    1.0000E-02
   1.0000E+01    1.0000E-01
   1.4000E+01    0.0000E+00
 Output Filename:
 C:\Documents and Settings\x9081\My Documents\B-B AST FHA in FHB - 1000cfm CR
Unfilt Inleakage - No Decay with FHB Filtration 6hrs.o0
   1
   1
   1
   0
   0
 End of Scenario File
```

```
##############################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 11/22/2004  at 10:08:34
##############################################################################

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

Number of Nuclides =  60

Inventory Power =   1.0000E+00 MWth
Plant Power Level =   3.2222E+01 MWth

Number of compartments    =   3

Compartment information

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

Compartment number  2
Name: Environment
Compartment type is Environment
Pathways into and out of compartment  2
   Inlet Pathway Number   1: Containment to Environment
   Inlet Pathway Number   4: Exhaust Control Room to Environment
   Exit Pathway Number    2: Filtered Intake Environment to Control Room
   Exit Pathway Number    3: Unfiltered Inleakage Environment to Control Room

Compartment number  3
Name: Control Room
Compartment volume =   2.0000E+05 (Cubic feet)
Compartment type is Control Room
Removal devices within compartment:
     Filter(s)
Pathways into and out of compartment  3
   Inlet Pathway Number   2: Filtered Intake Environment to Control Room
   Inlet Pathway Number   3: Unfiltered Inleakage Environment to Control Room
   Exit Pathway Number    4: Exhaust Control Room to Environment

Total number of pathways =   4
```

```
##########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 11/22/2004  at 10:08:34
##########################################################################

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

Time between shutdown and first release =   6.0000E+00 (Hours)

Radioactive Decay is enabled

Release Fractions and Timings
                GAP          EARLY IN-VESSEL  LATE RELEASE     RELEASE MASS
             0.000050 hr       0.0000 hrs       0.0000 hrs          (gm)
NOBLES       1.0000E-01        0.0000E+00       0.0000E+00        5.643E+00
IODINE       5.0000E-04        0.0000E+00       0.0000E+00        6.675E-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 =         32. 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   5.702E+02  3.383E+08   1.190E-16   0.000E+00   0.000E+00
 Kr-85m    1   8.592E+03  1.613E+04   7.480E-15   0.000E+00   0.000E+00
 Kr-87     1   1.696E+04  4.578E+03   4.120E-14   0.000E+00   0.000E+00
 Kr-88     1   2.392E+04  1.022E+04   1.020E-13   0.000E+00   0.000E+00
 I-131     2   4.274E+04  6.947E+05   1.820E-14   2.920E-07   8.890E-09
 I-132     2   3.863E+04  8.280E+03   1.120E-13   1.740E-09   1.030E-10
 I-133     2   5.529E+04  7.488E+04   2.940E-14   4.860E-08   1.580E-09
 I-134     2   6.143E+04  3.156E+03   1.300E-13   2.880E-10   3.550E-11
 I-135     2   5.159E+04  2.380E+04   8.294E-14   8.460E-09   3.320E-10
 Xe-133    1   5.396E+04  4.532E+05   1.560E-15   0.000E+00   0.000E+00
 Xe-135    1   1.532E+04  3.272E+04   1.190E-14   0.000E+00   0.000E+00

Iodine fractions
     Aerosol      =   0.0000E+00
     Elemental    =   9.7000E-01
     Organic      =   3.0000E-02

COMPARTMENT DATA

Compartment number   1: Containment

Compartment number   2: Environment

Compartment number   3: Control Room
```

Compartment Filter Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
6.0000E+00	3.9150E+04	0.0000E+00	0.0000E+00	0.0000E+00
6.5000E+00	3.9150E+04	8.0000E+01	9.0000E+01	9.0000E+01
7.2600E+02	3.9150E+04	0.0000E+00	0.0000E+00	0.0000E+00

PATHWAY DATA

Pathway number 1: Containment to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
6.0000E+00	2.3600E-02	9.9000E+01	9.0000E+01	9.0000E+01
6.5000E+00	1.1800E-01	9.9000E+01	9.0000E+01	9.0000E+01
8.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 2: Filtered Intake Environment to Control Room

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
6.0000E+00	6.4240E+03	0.0000E+00	0.0000E+00	0.0000E+00
6.5000E+00	8.5750E+03	9.9000E+01	9.5000E+01	9.5000E+01
7.2600E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 3: Unfiltered Inleakage Environment to Control Room

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
6.0000E+00	1.0000E+03	0.0000E+00	0.0000E+00	0.0000E+00
7.2600E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 4: Exhaust Control Room to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
6.0000E+00	7.4240E+03	1.0000E+02	1.0000E+02	1.0000E+02
6.5000E+00	9.5750E+03	1.0000E+02	1.0000E+02	1.0000E+02
7.2600E+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)
6.0000E+00	5.3600E-04
1.4000E+01	0.0000E+00

```
Location Breathing Rate Data
 Time (hr)          Breathing Rate (m^3 * sec^-1)
  6.0000E+00                 3.5000E-04
  1.4000E+01                 1.8000E-04
  3.0000E+01                 2.3000E-04
  7.2600E+02                 0.0000E+00
Location LPZ      is in compartment   2

Location X/Q Data
 Time (hr)          X/Q (s * m^-3)
  6.0000E+00           4.5000E-05
  1.4000E+01           3.1200E-05
  3.0000E+01           1.4100E-05
  1.0200E+02           4.5400E-06
  7.2600E+02           0.0000E+00

Location Breathing Rate Data
 Time (hr)          Breathing Rate (m^3 * sec^-1)
  6.0000E+00                 3.5000E-04
  1.4000E+01                 1.8000E-04
  3.0000E+01                 2.3000E-04
  7.2600E+02                 0.0000E+00
Location Control Room     is in compartment   3

Location X/Q Data
 Time (hr)          X/Q (s * m^-3)
  6.0000E+00           2.2200E-03
  6.5000E+00           2.4600E-03
  8.0000E+00           0.0000E+00

Location Breathing Rate Data
 Time (hr)          Breathing Rate (m^3 * sec^-1)
  6.0000E+00                 3.5000E-04
  7.2600E+02                 0.0000E+00

Location Occupancy Factor Data
 Time (hr)          Occupancy Factor
  6.0000E+00              1.0000E+00
  3.0000E+01              6.0000E-01
  1.0200E+02              4.0000E-01
  7.2600E+02              0.0000E+00

USER SPECIFIED TIME STEP DATA - SUPPLEMENTAL TIME STEPS
     Time            Time step
      0.0000E+00       1.0000E-02
      4.0000E+00       1.0000E-01
      8.0000E+00       0.0000E+00
```

```
##########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 11/22/2004  at 10:08:34
##########################################################################


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

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

EAB Doses:

Time (h) =   6.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.8448E-04  5.8026E-04  2.0242E-04
Accumulated dose (rem)  1.8448E-04  5.8026E-04  2.0242E-04

LPZ Doses:

Time (h) =   6.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.5488E-05  4.8716E-05  1.6994E-05
Accumulated dose (rem)  1.5488E-05  4.8716E-05  1.6994E-05

Control Room Doses:

Time (h) =   6.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.2452E-09  1.3381E-07  6.3823E-09
Accumulated dose (rem)  2.2452E-09  1.3381E-07  6.3823E-09

EAB Doses:

Time (h) =   6.5000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.5325E+00  8.2983E+00  2.7890E+00
Accumulated dose (rem)  2.5327E+00  8.2989E+00  2.7892E+00

LPZ Doses:

Time (h) =   6.5000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.1262E-01  6.9668E-01  2.3415E-01
Accumulated dose (rem)  2.1263E-01  6.9673E-01  2.3417E-01

Control Room Doses:

Time (h) =   6.5000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.3659E-01  1.4934E+01  6.9817E-01
Accumulated dose (rem)  2.3659E-01  1.4934E+01  6.9817E-01
```

EAB Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.2624E+00	8.0251E+00	2.5104E+00
Accumulated dose (rem)	4.7951E+00	1.6324E+01	5.2996E+00

LPZ Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.8994E-01	6.7375E-01	2.1076E-01
Accumulated dose (rem)	4.0258E-01	1.3705E+00	4.4493E-01

Control Room Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	7.1490E-01	4.3844E+00	8.5039E-01
Accumulated dose (rem)	9.5149E-01	1.9318E+01	1.5486E+00

EAB Doses:

Time (h) = 14.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.7951E+00	1.6324E+01	5.2996E+00

LPZ Doses:

Time (h) = 14.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.0258E-01	1.3705E+00	4.4493E-01

Control Room Doses:

Time (h) = 14.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.1168E-02	3.1533E-05	1.1169E-02
Accumulated dose (rem)	9.6266E-01	1.9318E+01	1.5597E+00

EAB Doses:

Time (h) = 30.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.7951E+00	1.6324E+01	5.2996E+00

LPZ Doses:

Time (h) = 30.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.0258E-01	1.3705E+00	4.4493E-01

Control Room Doses:

Time (h) = 30.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.5598E-10	3.2041E-40	1.5598E-10
Accumulated dose (rem)	9.6266E-01	1.9318E+01	1.5597E+00

EAB Doses:

Time (h) = 102.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.7951E+00	1.6324E+01	5.2996E+00

LPZ Doses:

Time (h) = 102.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.0258E-01	1.3705E+00	4.4493E-01

Control Room Doses:

Time (h) = 102.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.4390E-30	1.5609-132	2.4390E-30
Accumulated dose (rem)	9.6266E-01	1.9318E+01	1.5597E+00

EAB Doses:

Time (h) = 726.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.7951E+00	1.6324E+01	5.2996E+00

LPZ Doses:

Time (h) = 726.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.0258E-01	1.3705E+00	4.4493E-01

Control Room Doses:

Time (h) = 726.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.2821-120	0.0000E+00	1.2821-120
Accumulated dose (rem)	9.6266E-01	1.9318E+01	1.5597E+00

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##
I-131 Summary
##

Time (hr)	Containment I-131 (Curies)	Environment I-131 (Curies)	Control Room I-131 (Curies)
6.000	6.7388E+02	2.3856E-03	1.8555E-05
6.260	4.6593E+02	2.0745E+01	1.2028E-01
6.500	3.3140E+02	3.4163E+01	1.5002E-01
6.750	5.6398E+01	6.1649E+01	1.3490E-02
7.000	9.5977E+00	6.6326E+01	1.8783E-03
7.250	1.6333E+00	6.7122E+01	3.0517E-04
7.500	2.7796E-01	6.7258E+01	5.1432E-05
7.750	4.7304E-02	6.7281E+01	8.7352E-06
8.000	8.0502E-03	6.7285E+01	1.4860E-06
8.250	8.0429E-03	6.7285E+01	5.1530E-08
8.500	8.0357E-03	6.7285E+01	1.7870E-09
8.750	8.0285E-03	6.7285E+01	6.1968E-11
9.000	8.0213E-03	6.7285E+01	2.1489E-12
9.250	8.0141E-03	6.7285E+01	7.4521E-14
9.500	8.0069E-03	6.7285E+01	2.5842E-15

9.750	7.9997E-03	6.7285E+01	8.9617E-17
10.000	7.9925E-03	6.7285E+01	3.1077E-18
10.400	7.9810E-03	6.7285E+01	1.4339E-20
10.700	7.9725E-03	6.7285E+01	2.5386E-22
11.000	7.9639E-03	6.7285E+01	4.4941E-24
11.300	7.9553E-03	6.7285E+01	7.9562E-26
11.600	7.9467E-03	6.7285E+01	1.4085E-27
11.900	7.9382E-03	6.7285E+01	2.4936E-29
12.200	7.9296E-03	6.7285E+01	4.4146E-31
12.500	7.9211E-03	6.7285E+01	7.8154E-33
12.800	7.9125E-03	6.7285E+01	1.3836E-34
13.100	7.9040E-03	6.7285E+01	2.4495E-36
13.400	7.8955E-03	6.7285E+01	4.3364E-38
13.700	7.8870E-03	6.7285E+01	7.6771E-40
14.000	7.8785E-03	6.7285E+01	1.3591E-41
14.300	7.8700E-03	6.7285E+01	2.4061E-43
14.600	7.8615E-03	6.7285E+01	4.2597E-45
14.900	7.8531E-03	6.7285E+01	7.5412E-47
15.200	7.8446E-03	6.7285E+01	1.3351E-48
15.500	7.8362E-03	6.7285E+01	2.3635E-50
15.800	7.8277E-03	6.7285E+01	4.1843E-52
16.100	7.8193E-03	6.7285E+01	7.4077E-54
16.400	7.8109E-03	6.7285E+01	1.3114E-55
30.000	7.4385E-03	6.7285E+01	4.9650-135
102.000	5.7433E-03	6.7285E+01	0.0000E+00
726.000	6.1049E-04	6.7285E+01	0.0000E+00

##

Cumulative Dose Summary

##

	EAB		LPZ		Control Room	
Time (hr)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)
6.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
6.260	5.0424E+00	1.7235E+00	4.2333E-01	1.4470E-01	5.3053E+00	2.5031E-01
6.500	8.2989E+00	2.7892E+00	6.9673E-01	2.3417E-01	1.4934E+01	6.9817E-01
6.750	1.4960E+01	4.8905E+00	1.2560E+00	4.1058E-01	1.8830E+01	1.0945E+00
7.000	1.6092E+01	5.2329E+00	1.3510E+00	4.3933E-01	1.9244E+01	1.3298E+00
7.250	1.6285E+01	5.2888E+00	1.3672E+00	4.4402E-01	1.9306E+01	1.4504E+00
7.500	1.6317E+01	5.2979E+00	1.3699E+00	4.4479E-01	1.9316E+01	1.5085E+00
7.750	1.6323E+01	5.2994E+00	1.3704E+00	4.4491E-01	1.9318E+01	1.5358E+00
8.000	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5486E+00
8.250	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5545E+00
8.500	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5573E+00
8.750	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5586E+00
9.000	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5592E+00
9.250	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5595E+00
9.500	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5596E+00
9.750	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
10.000	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
10.400	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
10.700	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
11.000	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
11.300	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
11.600	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
11.900	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00

12.200	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
12.500	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
12.800	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
13.100	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
13.400	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
13.700	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
14.000	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
14.300	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
14.600	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
14.900	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
15.200	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
15.500	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
15.800	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
16.100	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
16.400	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
30.000	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
102.000	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00
726.000	1.6324E+01	5.2996E+00	1.3705E+00	4.4493E-01	1.9318E+01	1.5597E+00

##
Worst Two-Hour Doses
##

EAB

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
6.0	4.7951E+00	1.6324E+01	5.2996E+00

```
Nuclide Inventory Name:  Source Terms per this calculation
Byron and Braidwood Plants (B-B) AST - in Ci/MW - FHA
Power Level:
 0.1000E+01
Nuclides:
 60
Nuclide 001:
Co-58
  7
 0.6117120000E+07
 0.5800E+02
 0.2553E+03
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 002:
Co-60
  7
 0.1663401096E+09
 0.6000E+02
 0.1953E+03
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 003:
Kr-85
  1
 0.3382974720E+09
 0.8500E+02
 0.5702E+03                          {2 times LOCA value}
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 004:
Kr-85m
  1
 0.1612800000E+05
 0.8500E+02
 0.8592E+04
Kr-85     0.2100E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 005:
Kr-87
  1
 0.4578000000E+04
 0.8700E+02
 0.1696E+05
Rb-87     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 006:
Kr-88
  1
 0.1022400000E+05
 0.8800E+02
 0.2392E+05
```

```
Rb-88     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 007:
Rb-86
  3
 0.1612224000E+07
 0.8600E+02
 0.6480E+02
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 008:
Sr-89
  5
 0.4363200000E+07
 0.8900E+02
 0.2907E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 009:
Sr-90
  5
 0.9189573120E+09
 0.9000E+02
 0.2242E+04
Y-90      0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 010:
Sr-91
  5
 0.3420000000E+05
 0.9100E+02
 0.3930E+05
Y-91m     0.5800E+00
Y-91      0.4200E+00
none      0.0000E+00
Nuclide 011:
Sr-92
  5
 0.9756000000E+04
 0.9200E+02
 0.4136E+05
Y-92      0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 012:
Y-90
  9
 0.2304000000E+06
 0.9000E+02
 0.2347E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
```

```
Nuclide 013:
Y-91
  9
 0.5055264000E+07
 0.9100E+02
 0.3553E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 014:
Y-92
  9
 0.1274400000E+05
 0.9200E+02
 0.4150E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 015:
Y-93
  9
 0.3636000000E+05
 0.9300E+02
 0.4624E+05
Zr-93     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 016:
Zr-95
  9
 0.5527872000E+07
 0.9500E+02
 0.4560E+05
Nb-95m    0.7000E-02
Nb-95     0.9900E+00
none      0.0000E+00
Nuclide 017:
Zr-97
  9
 0.6084000000E+05
 0.9700E+02
 0.4663E+05
Nb-97m    0.9500E+00
Nb-97     0.5300E-01
none      0.0000E+00
Nuclide 018:
Nb-95
  9
 0.3036960000E+07
 0.9500E+02
 0.4593E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 019:
Mo-99
  7
```

```
 0.2376000000E+06
 0.9900E+02
 0.5058+05
Tc-99m    0.8800E+00
Tc-99     0.1200E+00
none      0.0000E+00
Nuclide 020:
Tc-99m
  7
 0.2167200000E+05
 0.9900E+02
 0.4429E+05
Tc-99     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 021:
Ru-103
  7
 0.3393792000E+07
 0.1030E+03
 0.4094E+05
Rh-103m   0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 022:
Ru-105
  7
 0.1598400000E+05
 0.1050E+03
 0.2798E+05
Rh-105    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 023:
Ru-106
  7
 0.3181248000E+08
 0.1060E+03
 0.1387E+05
Rh-106    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 024:
Rh-105
  7
 0.1272960000E+06
 0.1050E+03
 0.2552E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 025:
Sb-127
  4
 0.3326400000E+06
 0.1270E+03
 0.2848E+04
```

```
Te-127m  0.1800E+00
Te-127   0.8200E+00
none     0.0000E+00
Nuclide 026:
Sb-129
  4
 0.1555200000E+05
 0.1290E+03
 0.8523E+04
Te-129m  0.2200E+00
Te-129   0.7700E+00
none     0.0000E+00
Nuclide 027:
Te-127
  4
 0.3366000000E+05
 0.1270E+03
 0.2812E+04
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 028:
Te-127m
  4
 0.9417600000E+07
 0.1270E+03
 0.3668E+03
Te-127   0.9800E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 029:
Te-129
  4
 0.4176000000E+04
 0.1290E+03
 0.8389E+04
I-129    0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 030:
Te-129m
  4
 0.2903040000E+07
 0.1290E+03
 0.1249E+04
Te-129   0.6500E+00
I-129    0.3500E+00
none     0.0000E+00
Nuclide 031:
Te-131m
  4
 0.1080000000E+06
 0.1310E+03
 0.3838E+04
Te-131   0.2200E+00
I-131    0.7800E+00
none     0.0000E+00
```

```
Nuclide 032:
Te-132
  4
 0.2815200000E+06
 0.1320E+03
 0.3804E+05
I-132     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 033:
I-131
  2
 0.6946560000E+06
 0.1310E+03
 0.4274E+05                          (1.6 times LOCA value)
Xe-131m   0.1100E-01
none      0.0000E+00
none      0.0000E+00
Nuclide 034:
I-132
  2
 0.8280000000E+04
 0.1320E+03
 0.3863E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 035:
I-133
  2
 0.7488000000E+05
 0.1330E+03
 0.5529E+05
Xe-133m   0.2900E-01
Xe-133    0.9700E+00
none      0.0000E+00
Nuclide 036:
I-134
  2
 0.3156000000E+04
 0.1340E+03
 0.6143E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 037:
I-135
  2
 0.2379600000E+05
 0.1350E+03
 0.5159E+05
Xe-135m   0.1500E+00
Xe-135    0.8500E+00
none      0.0000E+00
Nuclide 038:
Xe-133
  1
```

```
 0.4531680000E+06
 0.1330E+03
 0.5396E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 039:
Xe-135
  1
 0.3272400000E+05
 0.1350E+03
 0.1532E+05
Cs-135    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 040:
Cs-134
  3
 0.6507177120E+08
 0.1340E+03
 0.5306E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 041:
Cs-136
  3
 0.1131840000E+07
 0.1360E+03
 0.1503E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 042:
Cs-137
  3
 0.9467280000E+09
 0.1370E+03
 0.3077E+04
Ba-137m   0.9500E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 043:
Ba-139
  6
 0.4962000000E+04
 0.1390E+03
 0.5089E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 044:
Ba-140
  6
 0.1100736000E+07
 0.1400E+03
 0.4922E+05
```

```
La-140    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 045:
La-140
  9
 0.1449792000E+06
 0.1400E+03
 0.5036E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 046:
La-141
  9
 0.1414800000E+05
 0.1410E+03
 0.4646E+05
Ce-141    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 047:
La-142
  9
 0.5550000000E+04
 0.1420E+03
 0.4557E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 048:
Ce-141
  8
 0.2808086400E+07
 0.1410E+03
 0.4498E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 049:
Ce-143
  8
 0.1188000000E+06
 0.1430E+03
 0.4468E+05
Pr-143    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 050:
Ce-144
  8
 0.2456352000E+08
 0.1440E+03
 0.3414E+05
Pr-144m   0.1800E-01
Pr-144    0.9800E+00
none      0.0000E+00
```

```
Nuclide 051:
Pr-143
  9
 0.1171584000E+07
 0.1430E+03
 0.4350E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 052:
Nd-147
  9
 0.9486720000E+06
 0.1470E+03
 0.1836E+05
Pm-147    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 053:
Np-239
  8
 0.2034720000E+06
 0.2390E+03
 0.5178E+06
Pu-239    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 054:
Pu-238
  8
 0.2768863824E+10
 0.2380E+03
 0.1027E+03
U-234     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 055:
Pu-239
  8
 0.7594336440E+12
 0.2390E+03
 0.7698E+01
U-235     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 056:
Pu-240
  8
 0.2062920312E+12
 0.2400E+03
 0.8971E+01
U-236     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 057:
Pu-241
  8
```

```
 0.4544294400E+09
 0.2410E+03
 0.3548E+04
U-237     0.2400E-04
Am-241    0.1000E+01
none      0.0000E+00
Nuclide 058:
Am-241
   9
 0.1363919472E+11
 0.2410E+03
 0.3921E+01
Np-237    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 059:
Cm-242
   9
 0.1406592000E+08
 0.2420E+03
 0.1110E+04
Pu-238    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 060:
Cm-244
   9
 0.5715081360E+09
 0.2440E+03
 0.1209E+03
Pu-240    0.1000E+01
none      0.0000E+00
none      0.0000E+00
End of Nuclear Inventory File
```

```
Release Fraction and Timing Name:
PWR, NUREG-1465, Tables 3.12 & 3.13, June 1992
Duration (h):  Design Basis Accident
 0.5000E-04  0.0000E+00  0.0000E+00  0.0000E+00
Noble Gases:
 0.1000E+00  0.0000E+00  0.0000E+00  0.0000E+00
Iodine:
 0.5000E-03  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 E
Demonstration that Smaller Control Room Volume Used in Analysis Bounds Actual Byron and Braidwood Control Room Volumes

I. Purpose

The purpose of this attachment is to demonstrate that using a smaller value of 200,000 ft^3 to bound both the Byron and Braidwood Control Room (CR) volumes of 230,830 ft^3 and 232,872 ft^3, respectively, provides the conservative approach to modeling of CR doses in this accident analysis.

II. Approach

Shown in this attachment is a re-evaluation of this worst-case design basis accident using a Control Room volume of 240,000 ft^3 instead of the 200,000 ft^3 volume used in the analysis. It is intended to show that the implementation of the larger Control Room volume leads to a lower end-of-accident dose consequence than that which is calculated when using the smaller volume.

III. Results

Shown below is a table comparing the dose from the bounding design basis accident case as compared to the test case of this attachment that uses the larger Control Room volume.

It is clearly shown that the CR dose assessment using a smaller volume of 200,000 ft^3 is more conservative than that using the larger volume of 240,000 ft^3.

Sensitivity Run Description	Control Room Dose (rem TEDE)
DBA-FHA in the FHB using a CR Volume of 200,000 ft^3 for Dose Analysis	4.5533
DBA-FHA in the FHB using a CR Volume of 240,000 ft^3 for Dose Analysis	4.2149

```
 ##########################################################################
    RADTRAD Version 3.03 (Spring 2001) run on 11/15/2004  at  0:55:48
 ##########################################################################

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

 Plant file           = C:\Documents and Settings\Aleem Boatright\My Documents\My
Work\Exelon\Byron & Braidwood\FHA\RADTRAD\Rev 1\(Larger CR Volume Test) B-B AST FHA
in FHB - 1000cfm CR Unfilt Inleakage - 95 percent CR Intake Filter Eff.psf
 Inventory file       = c:\program files\radtrad3-03\defaults\byron-braidwood ast
fha source terms.nif
 Release file         = c:\program files\radtrad3-03\defaults\b-b ast-fha.rft
 Dose Conversion file = c:\program files\radtrad3-03\defaults\fgr11&12.inp




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


 Radtrad 3.03 4/15/2001
 B-B AST FHA in FHB - Test to Show Smaller CR Volume Bounds - 1000 cfm CR
Inleakage, 30 min Filter Delay, 95% EO Intake Filter Efficiency
 Nuclide Inventory File:
 c:\program files\radtrad3-03\defaults\byron-braidwood ast fha source terms.nif
 Plant Power Level:
  3.2222E+01
 Compartments:
   3
 Compartment 1:
 Containment Volume
   3
  1.0000E+00
   0
   0
   0
   0
   0
 Compartment 2:
 Environment
   2
  0.0000E+00
   0
   0
   0
   0
   0
```

```
Compartment 3:
Control Room
  1
 2.4000E+05
  0
  0
  1
  0
  0
Pathways:
  4
Pathway 1:
Containment Volume to Environment
  1
  2
  2
Pathway 2:
Filtered Intake  Environment to Control Room
  2
  3
  2
Pathway 3:
Unfiltered Inleakage  Environment to Control Room
  2
  3
  2
Pathway 4:
Control Room to  Environment
  3
  2
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:

Source Term:
  1
  1   1.0000E+00
c:\program files\radtrad3-03\defaults\fgr11&12.inp
c:\program files\radtrad3-03\defaults\b-b ast-fha.rft
  4.8000E+01
  0
  0.0000E+00   9.7000E-01   3.0000E-02   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
  3.9150E+04
  3
  4.8000E+01   0.0000E+00   0.0000E+00   0.0000E+00
  4.8500E+01   8.0000E+01   9.0000E+01   9.0000E+01
  7.6800E+02   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
Pathways:
  4
Pathway 1:
  0
  0
  0
  0
  0
  1
  3
  4.8000E+01   2.3600E-02   0.0000E+00   0.0000E+00   0.0000E+00
  4.8500E+01   1.1800E-01   0.0000E+00   0.0000E+00   0.0000E+00
  5.0000E+01   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
  4.8000E+01   6.4240E+03   0.0000E+00   0.0000E+00   0.0000E+00
  4.8500E+01   8.5750E+03   9.9000E+01   9.5000E+01   9.5000E+01
  7.6800E+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
  2
  4.8000E+01   1.0000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  7.6800E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 4:
  0
  0
  0
  0
  0
  1
  3
  4.8000E+01   7.4240E+03   1.0000E+02   1.0000E+02   1.0000E+02
  4.8500E+01   9.5750E+03   1.0000E+02   1.0000E+02   1.0000E+02
  7.6800E+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
  4.8000E+01   5.3600E-04
  5.6000E+01   0.0000E+00
  1
  4
  4.8000E+01   3.5000E-04
  5.6000E+01   1.8000E-04
  7.2000E+01   2.3000E-04
```

```
  7.6800E+02   0.0000E+00
  0
 Location 2:
 LPZ
  2
  1
  5
  4.8000E+01   4.5000E-05
  5.6000E+01   3.1200E-05
  7.2000E+01   1.4100E-05
  1.4400E+02   4.5400E-06
  7.6800E+02   0.0000E+00
  1
  4
  4.8000E+01   3.5000E-04
  5.6000E+01   1.8000E-04
  7.2000E+01   2.3000E-04
  7.6800E+02   0.0000E+00
  0
 Location 3:
 Control Room
  3
  0
  1
  2
  4.8000E+01   3.5000E-04
  7.6800E+02   0.0000E+00
  1
  4
  4.8000E+01   1.0000E+00
  7.2000E+01   6.0000E-01
  1.4400E+02   4.0000E-01
  7.6800E+02   0.0000E+00
 Effective Volume Location:
  1
  3
  4.8000E+01   2.2200E-03
  4.8500E+01   2.4600E-03
  5.0000E+01   0.0000E+00
 Simulation Parameters:
  3
  4.8000E+01   1.0000E-02
  5.2000E+01   1.0000E-01
  5.6000E+01   0.0000E+00
 Output Filename:
 C:\Documents and Settings\Aleem Boatright\My Documents\My Work\Exelon\Byron &
Braidwood\FHA\RADTRAD\Rev 1\(Larger CR Volume Test) B-B AST FHA in FHB - 1000cfm CR
Unfilt Inleakage - 95 percent CR Intake Filter Eff.o0
  1
  1
  1
  0
  1
 End of Scenario File
```

```
##############################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 11/15/2004  at  0:55:48
##############################################################################

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

Number of Nuclides =  60

Inventory Power =   1.0000E+00 MWth
Plant Power Level =   3.2222E+01 MWth

Number of compartments    =   3

Compartment information

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

Compartment number  2
Name: Environment
Compartment type is Environment
Pathways into and out of compartment  2
   Inlet Pathway Number   1: Containment Volume to Environment
   Inlet Pathway Number   4: Control Room to  Environment
   Exit Pathway Number    2: Filtered Intake  Environment to Control Room
   Exit Pathway Number    3: Unfiltered Inleakage  Environment to Control Room

Compartment number  3
Name: Control Room
Compartment volume =   2.4000E+05 (Cubic feet)
Compartment type is Control Room
Removal devices within compartment:
    Filter(s)
Pathways into and out of compartment  3
   Inlet Pathway Number   2: Filtered Intake  Environment to Control Room
   Inlet Pathway Number   3: Unfiltered Inleakage  Environment to Control Room
   Exit Pathway Number    4: Control Room to  Environment

Total number of pathways =   4
```

```
##########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 11/15/2004  at  0:55:48
##########################################################################

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


Time between shutdown and first release =   4.8000E+01 (Hours)

Radioactive Decay is enabled

Release Fractions and Timings
                GAP          EARLY IN-VESSEL  LATE RELEASE     RELEASE MASS
             0.000050 hr       0.0000 hrs       0.0000 hrs          (gm)
NOBLES       1.0000E-01        0.0000E+00       0.0000E+00        5.643E+00
IODINE       5.0000E-04        0.0000E+00       0.0000E+00        6.675E-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 =         32. 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   5.702E+02  3.383E+08   1.190E-16   0.000E+00   0.000E+00
 Kr-85m    1   8.592E+03  1.613E+04   7.480E-15   0.000E+00   0.000E+00
 Kr-87     1   1.696E+04  4.578E+03   4.120E-14   0.000E+00   0.000E+00
 Kr-88     1   2.392E+04  1.022E+04   1.020E-13   0.000E+00   0.000E+00
 I-131     2   4.274E+04  6.947E+05   1.820E-14   2.920E-07   8.890E-09
 I-132     2   3.863E+04  8.280E+03   1.120E-13   1.740E-09   1.030E-10
 I-133     2   5.529E+04  7.488E+04   2.940E-14   4.860E-08   1.580E-09
 I-134     2   6.143E+04  3.156E+03   1.300E-13   2.880E-10   3.550E-11
 I-135     2   5.159E+04  2.380E+04   8.294E-14   8.460E-09   3.320E-10
 Xe-133    1   5.396E+04  4.532E+05   1.560E-15   0.000E+00   0.000E+00
 Xe-135    1   1.532E+04  3.272E+04   1.190E-14   0.000E+00   0.000E+00

Iodine fractions
     Aerosol      =   0.0000E+00
     Elemental    =   9.7000E-01
     Organic      =   3.0000E-02

COMPARTMENT DATA

Compartment number   1: Containment Volume

Compartment number   2: Environment

Compartment number   3: Control Room
```

Compartment Filter Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
4.8000E+01	3.9150E+04	0.0000E+00	0.0000E+00	0.0000E+00
4.8500E+01	3.9150E+04	8.0000E+01	9.0000E+01	9.0000E+01
7.6800E+02	3.9150E+04	0.0000E+00	0.0000E+00	0.0000E+00

PATHWAY DATA

Pathway number 1: Containment Volume to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
4.8000E+01	2.3600E-02	0.0000E+00	0.0000E+00	0.0000E+00
4.8500E+01	1.1800E-01	0.0000E+00	0.0000E+00	0.0000E+00
5.0000E+01	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 2: Filtered Intake Environment to Control Room

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
4.8000E+01	6.4240E+03	0.0000E+00	0.0000E+00	0.0000E+00
4.8500E+01	8.5750E+03	9.9000E+01	9.5000E+01	9.5000E+01
7.6800E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 3: Unfiltered Inleakage Environment to Control Room

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
4.8000E+01	1.0000E+03	0.0000E+00	0.0000E+00	0.0000E+00
7.6800E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 4: Control Room to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
4.8000E+01	7.4240E+03	1.0000E+02	1.0000E+02	1.0000E+02
4.8500E+01	9.5750E+03	1.0000E+02	1.0000E+02	1.0000E+02
7.6800E+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)
4.8000E+01	5.3600E-04
5.6000E+01	0.0000E+00

```
Location Breathing Rate Data
 Time (hr)          Breathing Rate (m^3 * sec^-1)
  4.8000E+01                 3.5000E-04
  5.6000E+01                 1.8000E-04
  7.2000E+01                 2.3000E-04
  7.6800E+02                 0.0000E+00
Location LPZ      is in compartment    2

Location X/Q Data
 Time (hr)          X/Q (s * m^-3)
  4.8000E+01           4.5000E-05
  5.6000E+01           3.1200E-05
  7.2000E+01           1.4100E-05
  1.4400E+02           4.5400E-06
  7.6800E+02           0.0000E+00

Location Breathing Rate Data
 Time (hr)          Breathing Rate (m^3 * sec^-1)
  4.8000E+01                 3.5000E-04
  5.6000E+01                 1.8000E-04
  7.2000E+01                 2.3000E-04
  7.6800E+02                 0.0000E+00
Location Control Room     is in compartment    3

Location X/Q Data
 Time (hr)          X/Q (s * m^-3)
  4.8000E+01           2.2200E-03
  4.8500E+01           2.4600E-03
  5.0000E+01           0.0000E+00

Location Breathing Rate Data
 Time (hr)          Breathing Rate (m^3 * sec^-1)
  4.8000E+01                 3.5000E-04
  7.6800E+02                 0.0000E+00

Location Occupancy Factor Data
 Time (hr)          Occupancy Factor
  4.8000E+01              1.0000E+00
  7.2000E+01              6.0000E-01
  1.4400E+02              4.0000E-01
  7.6800E+02              0.0000E+00

USER SPECIFIED TIME STEP DATA - SUPPLEMENTAL TIME STEPS
Time              Time step
 0.0000E+00        1.0000E-02
 4.0000E+00        1.0000E-01
 8.0000E+00        0.0000E+00
```

```
##########################################################################
   RADTRAD Version 3.03 (Spring 2001) run on 11/15/2004  at  0:55:48
##########################################################################


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


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

Detailed model information at time (H) =   48.0001

EAB Doses:

Time (h) =  48.0001    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.6852E-05  4.3740E-03  1.5047E-04
Accumulated dose (rem)  1.6852E-05  4.3740E-03  1.5047E-04

LPZ Doses:

Time (h) =  48.0001    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.4148E-06  3.6722E-04  1.2633E-05
Accumulated dose (rem)  1.4148E-06  3.6722E-04  1.2633E-05

Control Room Doses:

Time (h) =  48.0001    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.8178E-10  8.4056E-07  2.5860E-08
Accumulated dose (rem)  1.8178E-10  8.4056E-07  2.5860E-08

Detailed model information at time (H) =   48.5000

EAB Doses:

Time (h) =  48.5000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.4095E-01  6.2617E+01  2.1538E+00
Accumulated dose (rem)  2.4097E-01  6.2621E+01  2.1539E+00

LPZ Doses:

Time (h) =  48.5000    Whole Body   Thyroid       TEDE
Delta dose (rem)        2.0229E-02  5.2570E+00  1.8082E-01
Accumulated dose (rem)  2.0231E-02  5.2574E+00  1.8083E-01

Control Room Doses:
```

Time (h) = 48.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.1429E-02	9.9261E+01	3.0536E+00
Accumulated dose (rem)	2.1429E-02	9.9261E+01	3.0536E+00

Detailed model information at time (H) = 50.0000

EAB Doses:

Time (h) = 50.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.3293E-01	6.0675E+01	2.0864E+00
Accumulated dose (rem)	4.7390E-01	1.2330E+02	4.2403E+00

LPZ Doses:

Time (h) = 50.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.9556E-02	5.0940E+00	1.7516E-01
Accumulated dose (rem)	3.9786E-02	1.0351E+01	3.5599E-01

Control Room Doses:

Time (h) = 50.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	7.8068E-02	3.5363E+01	1.1583E+00
Accumulated dose (rem)	9.9497E-02	1.3462E+02	4.2119E+00

Detailed model information at time (H) = 56.0000

EAB Doses:

Time (h) = 56.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.7390E-01	1.2330E+02	4.2403E+00

LPZ Doses:

Time (h) = 56.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	3.9786E-02	1.0351E+01	3.5599E-01

Control Room Doses:

Time (h) = 56.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.9631E-03	3.7067E-04	2.9744E-03
Accumulated dose (rem)	1.0246E-01	1.3462E+02	4.2149E+00

Detailed model information at time (H) = 72.0000

EAB Doses:

Time (h) = 72.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	4.7390E-01	1.2330E+02	4.2403E+00

LPZ Doses:

Time (h) = 72.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00

```
Accumulated dose (rem)  3.9786E-02  1.0351E+01  3.5599E-01

Control Room Doses:

Time (h) =  72.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        1.6336E-09  2.5536E-33  1.6336E-09
Accumulated dose (rem)  1.0246E-01  1.3462E+02  4.2149E+00

Detailed model information at time (H) =  144.0000

EAB Doses:

Time (h) = 144.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  4.7390E-01  1.2330E+02  4.2403E+00

LPZ Doses:

Time (h) = 144.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  3.9786E-02  1.0351E+01  3.5599E-01

Control Room Doses:

Time (h) = 144.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        9.7059E-26  4.1537-110  9.7059E-26
Accumulated dose (rem)  1.0246E-01  1.3462E+02  4.2149E+00

Detailed model information at time (H) =  768.0000

EAB Doses:

Time (h) = 768.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  4.7390E-01  1.2330E+02  4.2403E+00

LPZ Doses:

Time (h) = 768.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        0.0000E+00  0.0000E+00  0.0000E+00
Accumulated dose (rem)  3.9786E-02  1.0351E+01  3.5599E-01

Control Room Doses:

Time (h) = 768.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)        6.0614-101  0.0000E+00  6.0614-101
Accumulated dose (rem)  1.0246E-01  1.3462E+02  4.2149E+00

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

           Containment Volume        Environment          Control Room
Time (hr)    I-131 (Curies)        I-131 (Curies)       I-131 (Curies)
  48.000       5.7951E+02            2.0515E-02           1.5957E-04
```

48.260	4.0068E+02	1.7840E+02	1.0841E+00
48.500	2.8499E+02	2.9379E+02	1.4087E+00
48.750	4.8500E+01	5.3015E+02	1.7440E-01
49.000	8.2537E+00	5.7038E+02	2.5713E-02
49.250	1.4046E+00	5.7722E+02	4.1350E-03
49.500	2.3904E-01	5.7839E+02	6.8907E-04
49.750	4.0679E-02	5.7859E+02	1.1638E-04
50.000	6.9228E-03	5.7862E+02	1.9751E-05
50.250	6.9166E-03	5.7862E+02	1.1993E-06
50.500	6.9104E-03	5.7862E+02	7.2816E-08
50.750	6.9042E-03	5.7862E+02	4.4212E-09
51.000	6.8980E-03	5.7862E+02	2.6844E-10
51.250	6.8918E-03	5.7862E+02	1.6299E-11
51.500	6.8856E-03	5.7862E+02	9.8965E-13
51.750	6.8794E-03	5.7862E+02	6.0089E-14
52.000	6.8732E-03	5.7862E+02	3.6485E-15
52.400	6.8634E-03	5.7862E+02	4.1249E-17
52.700	6.8560E-03	5.7862E+02	1.4302E-18
53.000	6.8486E-03	5.7862E+02	4.9586E-20
53.300	6.8412E-03	5.7862E+02	1.7192E-21
53.600	6.8338E-03	5.7862E+02	5.9609E-23
53.900	6.8265E-03	5.7862E+02	2.0668E-24
54.200	6.8191E-03	5.7862E+02	7.1658E-26
54.500	6.8118E-03	5.7862E+02	2.4845E-27
54.800	6.8044E-03	5.7862E+02	8.6142E-29
55.100	6.7971E-03	5.7862E+02	2.9867E-30
55.400	6.7898E-03	5.7862E+02	1.0355E-31
55.700	6.7825E-03	5.7862E+02	3.5904E-33
56.000	6.7752E-03	5.7862E+02	1.2449E-34
56.300	6.7679E-03	5.7862E+02	4.3161E-36
56.600	6.7606E-03	5.7862E+02	1.4965E-37
56.900	6.7533E-03	5.7862E+02	5.1886E-39
57.200	6.7460E-03	5.7862E+02	1.7990E-40
57.500	6.7388E-03	5.7862E+02	6.2373E-42
57.800	6.7315E-03	5.7862E+02	2.1626E-43
58.100	6.7243E-03	5.7862E+02	7.4981E-45
58.400	6.7170E-03	5.7862E+02	2.5997E-46
72.000	6.3968E-03	5.7862E+02	1.6854-112
144.000	4.9390E-03	5.7862E+02	0.0000E+00
768.000	5.2500E-04	5.7862E+02	0.0000E+00

##
Cumulative Dose Summary
##

	EAB		LPZ		Control Room	
Time (hr)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)
48.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
48.260	3.8031E+01	1.3082E+00	3.1929E+00	1.0983E-01	3.4379E+01	1.0577E+00
48.500	6.2621E+01	2.1539E+00	5.2574E+00	1.8083E-01	9.9261E+01	3.0536E+00
48.750	1.1298E+02	3.8855E+00	9.4849E+00	3.2621E-01	1.2984E+02	4.0137E+00
49.000	1.2154E+02	4.1800E+00	1.0204E+01	3.5093E-01	1.3388E+02	4.1603E+00
49.250	1.2300E+02	4.2301E+00	1.0326E+01	3.5514E-01	1.3450E+02	4.1934E+00
49.500	1.2325E+02	4.2386E+00	1.0347E+01	3.5585E-01	1.3460E+02	4.2045E+00
49.750	1.2329E+02	4.2400E+00	1.0351E+01	3.5597E-01	1.3462E+02	4.2094E+00
50.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2119E+00

50.250	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2133E+00
50.500	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2140E+00
50.750	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2144E+00
51.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2147E+00
51.250	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2148E+00
51.500	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2148E+00
51.750	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
52.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
52.400	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
52.700	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
53.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
53.300	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
53.600	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
53.900	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
54.200	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
54.500	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
54.800	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
55.100	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
55.400	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
55.700	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
56.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
56.300	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
56.600	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
56.900	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
57.200	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
57.500	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
57.800	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
58.100	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
58.400	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
72.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
144.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00
768.000	1.2330E+02	4.2403E+00	1.0351E+01	3.5599E-01	1.3462E+02	4.2149E+00

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

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
48.0	4.7390E-01	1.2330E+02	4.2403E+00

Computer Disclosure Sheet

Discipline Nuclear

Client:	Exelon Corporation	Date:	November 2004
Project:	Byron/Braidwood Stations FHA AST	Job No.	26760-NCS0023.CALC

Program(s) used:	Rev No.	Rev Date	Calculation Set No.: BYR04-047, BRW-04-0041-M, Rev. 1
RADTRAD 3.03 (Attachments B&E)	0	12/23/2002	Status [ ] Prelim. [X] Final [ ] Void

WGI Prequalification [X] Yes [ ] No

Run No. Description:

Analysis Description: RADTRAD output files, where applied to calculations of FHA dose assessments, as described in calculation.

The attached computer output has been reviewed, the input data checked, And the results approved for release. Input criteria for this analysis were established.

By: On: 11/2004

Run by: A. Boatright

Checked by: P. Reichert

Approved by: H. Rothstein

Remarks: The RADTRAD computer code is applied in a manner fitting its intended purpose, and well within its operating parameters. All outputs were hand checked. Attachments C & D included the Nuclide Information File and Release Fraction and Timing File used by the RADTRAD code and generated specifically for the Byron/Braidwood Station FHA analyses. Both were also hand checked for accuracy.