ATTACHMENT 5

Calculation QDC-0000-N-1267, "Re-analysis of Fuel Handling Accident (FHA) Using Alternative Source Terms," Revision 1

ATTACHMENT 1
Design Analysis Cover Sheet

Design Analysis (Major Revision)		Last Page No.[6] 20 / Att. F-1	
Analysis No.:[1]	QDC-0000-N-1267	Revision:[2]	1
Title:[3]	Re-analysis of Fuel Handling Accident (FHA) Using Alternative Source Terms		
EC/ECR No.:[4]	356379	Revision:[5]	0

Station(s):[7]	Quad Cities	Component(s):[14]	
Unit No.:[8]	1 & 2		
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Descrip. Code/Keyword:[10]	N01, R01, R02 /AST, FHA		
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CONTROLLED DOCUMENT REFERENCES[15]

Document No.:	From/To	Document No.:	From/To
QDC-0000-M-1408, R1	From		
QDC-0000-N-1020, R0	From		
QDC-9400-M-0908, R2	From		
GE-NE-A22-00103-64-01, R0	From		

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

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

This Design Analysis SUPERCEDES:[18] QDC-000-N-1267, Rev. 0 in its entirety.

Description of Revision (list affected pages for partials):[19]

This revision incorporates responses to pertinent NRC Request for Additional Information (RAIs) with respect to all Exelon Nuclear Station Alternative Source Term License Amendment Applications. The primary revision is incorporation of the revised X/Q values from a new calculation, replacing the former values derived in Attachment A of the previous revision of this calculation. Other clarifications and editorial corrections were also incorporated. Finally, additional assumptions from Regulatory Guide 1.183 are included to directly indicate conformance with this Regulatory Guide.

Preparer:[20]	Harold Rothstein	Harold Rothstein	8/12/05
	Print Name	Sign Name	Date
Method of Review:[21]	Detailed Review ☒	Alternate Calculations (attached) ☐	Testing ☐
Reviewer:[22]	Paul Reichert	Paul Reichert	8/12/05
	Print Name	Sign Name	Date
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(For Exelon Approver Only) External Approver:[24]	Harold Rothstein	Harold Rothstein	8/12/05
	Print Name	Sign Name	Date
Exelon Reviewer:[25]	T. J. Mscisz	T. J. Mscisz	8/13/05
	Print Name	Sign Name	Date
Is a Supplemental Review Required?[26]	Yes ☐ No ☒ based on Third Party reviews	If yes, complete Attachment 3	
Exelon Approver:[27]	E. Flick	Elliott Flick	8/13/05
	Print Name	Sign Name	Date

Attachments

1. PURPOSE/OBJECTIVE

The purpose of this calculation is to apply Alternative Source Term (AST) methodology to the analysis of the design basis Fuel Handling Accident (FHA) for Quad Cities 1&2. This calculation is based on normal Reactor Building exhaust through the Reactor Building Exhaust Stack, and no Control Room Emergency Filter System operation. Therefore, this calculation supports changes to the current Quad Cities 1&2 Technical Specifications to consider that the operability of such systems and subsystems previously required to mitigate the radiological consequences of fuel handling accidents may not be necessary after a sufficient post-shutdown decay period has elapsed.

Not having to consider secondary containment and control room integrity and filtration requirements in support of refueling activities has the potential to significantly improve the flexibility and duration of scheduled plant outage activities.

Regulatory Guide 1.183 [2] is the basis for this evaluation. Concerning the FHA, the 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 (RG 1.183 & 10 CFR 50.67(b)(2)(iii)) is applied instead of the SRP 15.7.4 values of 25% of the 10CFR100 limits.
- A control room dose limit of 5-rem TEDE is applied instead of the values of 5 rem whole body, or its equivalent (10 CFR 50 Appendix A (II) GDC 19).
- Design Basis analysis is based on NRC Regulatory Guide 1.183.
- The Control Room, Exclusion Area Boundary (EAB), and Low Population Zone (LPZ) χ/Q was recalculated for the Unit 1&2 Normal Reactor Building Exhaust Stack and the new limiting χ/Q was applied to this analysis.
- Secondary Containment automatic isolation and filtration are not credited.
- Control Room Emergency Filter System (CREFS) operation is not credited.
- Dose Conversion Factors for Immersion and Inhalation are taken from FGRs 12 [5] and 11[4], 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

Analyses of radiological consequences resulting from a design basis Fuel Handling Accident (FHA) are performed using the guidance for application of Alternative Source Terms to this event in RG 1.183.

Analyses of radiation transport and dose assessment is performed using RADTRAD v. 3.03. RADTRAD[3] is a simplified model of RADionuclide Transport and Removal And Dose Estimation developed for the NRC and endorsed by the NRC as an acceptable methodology for reanalysis of the radiological consequences of design basis accidents. The technical basis for the RADTRAD code is documented in Section 2 of NUREG/CR-6604. The methodologies significant to this analysis are the dose consequence analysis (NUREG Section 2.3) and the Radioactive Decay Calculations (NUREG Section 2.4). This version of RADTRAD has been pre-qualified for safety related design analysis by Washington Group International per its 10CFR50 Appendix B QA program.

2.1. Fuel Source Term Model

The fuel source term is based on reactor core source terms used for LOCA dose assessment. The fraction of the core fuel damaged is that historically to be bounding and is based on 111 fuel rods damaged on a 7x7 49 pin bundle basis. With 724 fuel assemblies in the core, the damaged fraction = 111 / (49 * 724) = 0.00313. This fuel is assumed to have been operating at a power level associated will radial peaking limits. Therefore, the associated power = 3016 MWth * 0.00313 * 1.7 = 16.05 MWth.

Movement of recently irradiated fuel will not occur less than 24 hours after the associated reactor shutdown, and therefore, a 24 hour delay period is used.

2.2. Gap Activity

This calculation is applicable to fuel whose burnup and power limits are bounded by those specified in RG 1.183, footnote 11. This allows safe application of the gap activity fractions for LOCA events per RG 1.183, Table 3, which are as follows:

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

RADTRAD LOCA*.nif files are modified for FHA use to accommodate the differential gap activities among halogen and noble gas gap fractions shown above.

2.3. *Pool Decontamination Factor (DF) Model*

Analyzed water depths above damaged fuel are 23 feet and 19 feet. These values correspond to the minimum expected coverage over spent fuel racks, and the Technical Specification limit, respectively. The latter value provides assurance that analyzed coverage accounts for potential dropped fuel that might be positioned lying over the spent fuel racks.

As prescribed in RG 1.183, Appendix B, for the 23 foot water depth, the overall DF of 200 is used.

For the 19 foot water depth, RG 1.183, Appendix B recommends the use of Reference 10 of this calculation as a basis for determined a reduced DF. This reference has been previously used in Reference 8 as the design basis for this adjustment, using the following relationships:

$$DF_{inorg} = (DF_{inorg,0})^{\frac{H}{H_0}}$$

and

$$DF_{eff} = \frac{1}{\frac{\text{fraction of inorganic}}{DF_{inorg}} + \frac{\text{fraction of organic}}{1}}$$

where, per RG 1.183, Appendix B

H_0 = 23 feet of water depth

$DF_{inorg,0}$ = inorganic iodine DF of 500 per RG 1.183, Appendix B

fraction of inorganic iodine in fuel = 0.9985

fraction of organic iodine in fuel = 0.0015

fraction of elemental iodine above the water = 0.57

fraction of organic iodine above the water = 0.43

and, for H = 19 foot water depth:

DF_{inorg} = the associated inorganic iodine DF = 169.66

DF_{eff} = overall iodine DF = 135.4, rounded to 135.

fraction of elemental iodine above the water = 0.80

fraction of organic iodine above the water = 0.20

2.4. *Release Model*

Release modeling uses the RADTRAD computer program. The normal Nuclide Inventory File representing a Quad Cities core is artificially adjusted to account for the higher that average gap fractions for I-131 and Kr-85 as discussed above in allow for their higher gap fractions.

The compartments are the Refuel Floor Air Space, the Environment and the Control Room. The refuel floor exhaust rate is set artificially high at 4 air changes per hour. This results in 99.97% of the contained radioactivity being exhausted within two hours.

2.5. *Dispersion Model*

X/Qs for this release point are determined in Reference 13 based on RG 1.194 methodology as implemented by ARCON96 for onsite locations and on RG. 1.145 methodology as implemented by PAVAN for offsite locations.

2.6. *Control Room Model*

The control room as analyzed for the FHA is unfiltered. The Quad Cities Unit 1 & 2 Control Room is modeled as a closed volume of 58,300 ft^3. Although normal maximum flow into the CR is 2000 cfm + 10%, a Control Room changeover rate of 1 CR Volume per minute is used for conservatism and to allow for any unfiltered inleakage Flow into the CR is therefore assumed to be 58,300 cfm, and to balance the system for analytical purposes, an equal flow of clean air is considered to leave the CR. No credit is taking for any filtration of flows into the CR.

2.7. *Dose Modeling*

Dose models for both onsite and offsite are simplified and meet R.G. 1.183 requirements. Dose conversion factors are based on Federal Guidance Reports 11 and 12. Effectively, 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 MSLB are based on the following formulas:

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

and

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

and finally,

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

2.7.2. Control Room

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

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

and

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

and finally,

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

2.8. Acceptance Criteria

Dose acceptance criteria are per 10CFR50.67 and R.G. 1.183 guidance.

Table 1 lists the regulatory limits for accidental dose to 1) a control room operator, 2) a person at the EAB, and 3) a person at the LPZ boundary.

Table 1. Regulatory Dose Limits (Rem TEDE)

CR (30 days)	EAB (2 hours)	LPZ (30 days)
5	6.3	6.3

Direct conformance with the relevant sections of the body of Regulatory Guide 1.183 (such as the Acceptance Criteria provided above) and all of the Assumptions in its Appendix B "Assumptions for Evaluating the Radiological Consequences of a BWR Fuel Handling Accident" is provided by this analysis, as shown in the Conformance Matrix Table 2.

Table 2: Conformance with RG 1.183 Appendix B (Fuel Handling Accident)

RG Section	RG Position	Dresden/Quad Cities Analysis	Comments
1	Acceptable assumptions regarding core inventory and the release of radionuclides from the fuel are provided in Regulatory Position 3 of this guide.	Conforms	
1.1	The number of fuel rods damaged during the accident should be based on a conservative analysis that considers the most limiting case. This analysis should consider parameters such as the weight of the dropped heavy load or the weight of a dropped fuel assembly (plus any attached handling grapples), the height of the drop, and the compression, torsion, and shear stresses on the irradiated fuel rods. Damage to adjacent fuel assemblies, if applicable (e.g., events over the reactor vessel), should be considered.	Conforms	
1.2	The fission product release from the breached fuel is based on Regulatory Position 3.2 of this guide and the estimate of the number of fuel rods breached. All the gap activity in the damaged rods is assumed to be instantaneously released. Radionuclides that should be considered include xenons, kryptons, halogens, cesiums, and rubidiums.	Conforms	
1.3	The chemical form of radioiodine released from the fuel to the spent fuel pool should be assumed to be 95% cesium iodide (CsI), 4.85 percent elemental iodine, and 0.15 percent organic iodide. The CsI released from the fuel is assumed to completely dissociate in the pool water. Because of the low pH of the pool water, the iodine re-evolves as elemental iodine. This is assumed to occur instantaneously. The NRC staff will consider, on a case-by-case basis, justifiable mechanistic treatment of the iodine release from the pool.	Conforms	All iodine added to pool is assumed to dissociate.
2	If the depth of water above the damaged fuel is 23 feet or greater, the decontamination factors for the elemental and organic species are 500 and 1, respectively, giving an overall effective decontamination factor of 200 (i.e., 99.5% of the total iodine released from the damaged rods is retained by the water). This difference in decontamination factors for elemental (99.85%) and organic iodine (0.15%) species results in the	Conforms	Two cases were considered in the analyses. The first case assumed a water depth of 19 feet and a decontamination factor of 135. The Technical

Table 2: Conformance with RG 1.183 Appendix B (Fuel Handling Accident)

RG Section	RG Position	Dresden/Quad Cities Analysis	Comments
	iodine above the water being composed of 57% elemental and 43% organic species. If the depth of water is not 23 feet, the decontamination factor will have to be determined on a case-by-case method (Ref. B-1).		Specification 3.7.8 limit for the minimum spent fuel storage pool water level is 19 feet. The second case assumed a water depth of 23 feet and a decontamination factor of 200. The decontamination factors were determined in accordance with RG 1.183.
3	The retention of noble gases in the water in the fuel pool or reactor cavity is negligible (i.e., decontamination factor of 1). Particulate radionuclides are assumed to be retained by the water in the fuel pool or reactor cavity (i.e., infinite decontamination factor).	Conforms	
4.1	The radioactive material that escapes from the fuel pool to the fuel building is assumed to be released to the environment over a 2-hour time period.	Conforms	No credit is taken for the SGT System or its elevated release.
4.2	A reduction in the amount of radioactive material released from the fuel pool by engineered safety feature (ESF) filter systems may be taken into account provided these systems meet the guidance of Regulatory Guide 1.52 and Generic Letter 99-02 (Refs. B-2, B-3). Delays in radiation detection, actuation of the ESF filtration system, or diversion of ventilation flow to the ESF filtration system should be determined and accounted for in the radioactivity release analyses.	Not Applicable	No credit is taken for filtration from the reactor building.
4.3	The radioactivity release from the fuel pool should be assumed to be drawn into the ESF filtration system without mixing or dilution in the fuel building. If mixing can be demonstrated, credit for mixing and dilution may be considered on a case-by-case basis. This evaluation should consider the magnitude of the building volume and exhaust rate, the potential for bypass to the environment, the location of exhaust plenums relative to the surface of the pool, recirculation ventilation systems, and	Not Applicable	Two-hour release to the environment is assumed.

Table 2: Conformance with RG 1.183 Appendix B (Fuel Handling Accident)

RG Section	RG Position	Dresden/Quad Cities Analysis	Comments
	internal walls and floors that impede stream flow between the surface of the pool and the exhaust plenums.		
5.1	If the containment is isolated during fuel handling operations, no radiological consequences need to be analyzed.	Not Applicable	Containment is not isolated.
5.2	If the containment is open during fuel handling operations, but designed to automatically isolate in the event of a fuel handling accident, the release duration should be based on delays in radiation detection and completion of containment isolation. If it can be shown that containment isolation occurs before radioactivity is released to the environment, no radiological consequences need to be analyzed.	Not Applicable	Containment is not isolated.
5.3	If the containment is open during fuel handling operations (e.g., personnel air lock or equipment hatch is open), the radioactive material that escapes from the reactor cavity pool to the containment is released to the environment over a 2-hour time period.	Conforms	
5.4	A reduction in the amount of radioactive material released from the containment by ESF filter systems may be taken into account provided that these systems meet the guidance of Regulatory Guide 1.52 and Generic Letter 99-02 (Refs. B-2 and B-3). Delays in radiation detection, actuation of the ESF filtration system, or diversion of ventilation flow to the ESF filtration system should be determined and accounted for in the radioactivity release analyses.	Not Applicable	No credit is taken for filtration of release from the reactor building.
5.5	Credit for dilution or mixing of the activity released from the reactor cavity by natural or forced convection inside the containment may be considered on a case-by-case basis. Such credit is generally limited to 50% of the containment free volume. This evaluation should consider the magnitude of the containment volume and exhaust rate, the potential for bypass to the environment, the location of exhaust plenums relative to the surface of the reactor cavity, recirculation ventilation systems, and internal walls and floors that impede stream flow between the surface of	Not Applicable	No credit is taken for dilution or mixing of the activity released from the reactor cavity.

Table 2: Conformance with RG 1.183 Appendix B (Fuel Handling Accident)

RG Section	RG Position	Dresden/Quad Cities Analysis	Comments
	the reactor cavity and the exhaust plenums.		

3. ASSUMPTIONS

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

1. Ref. 8 identified that many different fuel designs were evaluated for design basis Fuel Handling Accident scenarios, showing that GE 7x7 fuel has the most limiting radiological consequences following a design basis FHA. Therefore, the scope of this calculation has been limited to an analysis of the GE 7x7 fuel types.
2. Movement of recently irradiated fuel will not occur less than 24 hours after the associated reactor shutdown.
3. Fuel bundle peak burnup will not exceed 62 GWD/MTU.
4. For fuel exceeding 54 GWD/MTU the maximum linear heat generation rate will not exceed 6.3 kw/ft average power.
5. The current design basis bounding fuel damage assessment, which is associated with a drop over the reactor, will continue to be used.
6. Spent fuel source terms are based on reactor core source terms in Reference 12.
7. The damaged fuel is assumed to have operated at a peaking factor of 1.7 [Reference 11].
8. Analyzed water depths above damaged fuel are 23 feet and 19 feet. These values correspond to the minimum expected coverage over spent fuel racks, and the Technical Specification *3.7.8* limit, respectively. The latter value provides assurance that analyzed coverage accounts for potential dropped fuel that might be positioned lying over the spent fuel racks.
9. Activity reaching the refuel floor airspace will essentially be all exhausted within two hours by using an artificially high exhaust rate. This also provides an allowance for uneven mixing in the refuel floor airspace.
10. The exhaust pathway is the worst case one through the normal exhaust to the Reactor Building Exhaust Stack. No credit is taken for filtration by the SBGTS, or resulting elevated release through the station chimney.
11. X/Qs for this release point are determined in Reference 13 based on RG 1.194 methodology as implemented by ARCON96 for onsite locations and on RG. 1.145 methodology as implemented by PAVAN for offsite locations.
12. No credit is taken for the operation of the CREFS during the FHA. Conservatively high intake and outflow are considered.

4. DESIGN INPUT

The design inputs used for this calculation were extracted from extensive review of Quad Cities Unit 1&2 Licensing documents, UFSAR sections, Quad Cities 1&2 existing calculations, and regulatory guidance documents. These parameters are summarized in the following table:

Parameters Applicable to AST Fuel Handling Accident Dose Considerations for Quad Cities Station

TABLE 2: FHA AST Analysis Parameter or Method for Quad Cities Station	AST Value	Source Documents
Bounding Fuel Assembly Configuration Analyzed	7x7 in a 49 pin bundle	Calc QDC-0000-N-1020
Bounding Fuel Damage Analyzed	111 pins	Calc QDC-0000-N-1020
Peaking Factor	1.7	NEDC-32868P
Allowable Fuel Burnup and non-LOCA gap fractions		RG 1.183, Table 3
FHA Radionuclide Inventory	Based on Appendix D of GE-NE-A22-00103-64-01, Task Report T0802, Rev. 0, "Radiation Sources and Fission Products", for the 60 isotopes forming the standard RADTRAD library, with decay to 24 hours. Gap activities per R.G. 1.183.	GE-NE-A22-00103-64-01, Task Report T0802, Rev. 0, "Radiation Sources and Fission Products"
Underwater Decontamination Factor	Noble Gases: 1 Particulates (cesiums and rubidiums): infinity Iodine: Case 1=200, corresponding to a 23-ft water depth Case 2=135, corresponding to a 19-ft water depth	RG 1.183, and G. Burley, "Evaluation of Fission Product Release and Transport for Fuel Handling Accident"
Iodine chemical distribution	From RG 1.183 (95% CsI, instantaneously dissociating in the pool water and re-evolving as elemental iodine, since the pH of the pool water is not justified mechanistically to be above 7; 4.85% elemental; 0.15% organic)	RG 1.183
Dose Conversion Factors	EPA Federal Guidance Reports 11 and 12	EPA Federal Guidance Reports 11 and 12
Offsite Dose Limit	6.3 rem TEDE after 2 hours	RG 1.183

TABLE 2: FHA AST Analysis Parameter or Method for Quad Cities Station	AST Value	Source Documents
Control Room Dose Limit	5 rem TEDE for the duration of the accident	10CFR50 App. A, GDC 19 and 10CFR50.67
Secondary Containment automatic isolation and filtration	Not credited for all fuel with one day decay time	RG 1.183
Mitigation by CREF system	Not credited for all fuel with one day decay time	RG 1.183
Normal and Emergency Control Room normal fresh air makeup rate and volume	Although normal maximum flow into the CR is 2000 cfm + 10%, a Control Room changeover rate of 1 CR Volume per minute is used for conservatism and to allow for any unfiltered inleakage due to CR envelope maintenance during refueling outages. Volume 58,300 ft3 (control room proper); 184,000 ft3 CR Emergency Zone. Flow into the CR is therefore assumed to be 58,300 cfm. (Smaller volume is used, as the flow rates maximize inhalation doses, and for interior cloud doses, the appropriate volume is the control room proper).	Calc QDC-0000-N-1020
Refuel Floor Normal Ventilation rate and volume	Approximately 4 air changes per hour and 4,700,000 ft^3 (Total Reactor Building Volume)	Calc QDC-0000-N-1020
CR Release Point Basis and Distance to CR Dispersion Factors 0 – 2 hr	 Normal RB exhaust stack and 310 ft 5.82E-04 sec/m^3	Calc QDC-0000-M-1408, Revision 1
EAB Release Point Basis and Distance to EAB Dispersion Factors 0 – 2 hr	 Normal RB exhaust stack and 380 m 1.36E-03 sec/m^3	Calc QDC-0000-M-1408, Revision 1

TABLE 2: FHA AST Analysis Parameter or Method for Quad Cities Station	AST Value	Source Documents
LPZ Release Point Basis and Distance to LPZ Dispersion Factors 0 – 2 hr	 Normal RB exhaust stack and 4828 m 1.04E-04 sec/m^3	Calc QDC-0000-M-1408, Revision 1

5. REFERENCES

1. Quad Cities Unit 1 & 2, UFSAR Revision 7.

2. RG 1.183, Alternative Radiological Source Terms For Evaluating Design Basis Accidents At Nuclear Power Reactors (Draft DG-1081 issued 12/99)

3. NUREG/CR-6604, "RADTRAD: A Simplified Model for RADionuclide Transport and Removal And Dose Estimation", 4/1998. Supplement 1, 6/1999. Supplement 2, 10/2002.

4. Federal Guidance Report No. 11, "Limiting Values of radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion", 1988.

5. Federal Guidance Report No. 12, External exposure to Radionuclides in Air, Water, and Soil", 1993.

6. NUREG-1465, "Accident Source Terms for Light-Water Nuclear power Plants", 1995.

7. Quad Cities 1&2 UFSAR, Loss of Coolant Accident Parameters Tabulated for Postulated Accident Analysis, Revision 4.

8. Calc. QDC-9400-M-0908, "Effect of Reduced Pool Water Level on FHA Radiological Consequences", Revision 0.

9. Calculation QDC-0000-N-1020, "Impact of Extended Power Uprate on Site Boundary and Control room Doses for LOCA and Non-LOCA Events", Revision 0.

10. G. Burley, "Evaluation of Fission Product Release and Transport," Staff Technical Paper, 1971.

11. NEDC-32868P, GE14 GESTAR Compliance Document.

12. GE Task Report No. GE-NE-A22-00103-64-01, Rev. 0, Project Task Report: "Dresden and Quad Cities Asset Enhancement Program - Task T0802: Radiation Sources and Fission Products", Dated August 2000.

13. Calc. QDC-0000-M-1408, "Atmospheric Dispersion Factors (X/Qs) for Accident Release", Revision 01

6. CALCULATIONS

This calculation evaluates the radiological dose to an operator in the Control Room and a person at the EAB and LPZ locations following a design basis FHA involving irradiated fuel that has decayed for 24 hours after shutdown. This analysis uses Alternative Source Term assumptions per guidance in RG 1.183.

The RADTRAD v. 3.02a computer code was used for this Quad Cities 1&2 FHA calculation. RADTRAD [3] is a simplified model of RADionuclide Transport and Removal And Dose Estimation developed for the NRC and endorsed by the NRC as an acceptable methodology for reanalysis of the radiological consequences of design basis accidents. The technical basis for the RADTRAD code is documented in Section 2 of NUREG/CR-6604. The methodologies significant to this analysis are the dose consequence analysis (NUREG Section 2.3) and the Radioactive Decay Calculations (NUREG Section 2.4). Radioactive decay and daughter products are considered in RADTRAD, with this RADTRAD option turned "on".

The RADTRAD inputs are summarized below:

A. Compartments

1. Containment – This compartment represents the Reactor Building Air Space, into which fission products leaving the spent fuel pool are releases.
   a. Compartment type – Other – since it is not the environment or control room.
   b. Volume – 4.7E6 ft^3 – This is the total Reactor Building Volume. Normal Exhaust rates from the volume are ~ set at 4 air changes per hour to ensure that all activity is released within the 2-hour period.
   c. Source term fraction – 1.0
   d. Compartment features – no compartment removal mechanisms selected.

2. Environment
   a. Compartment type – Environment

3. Control Room
   a. Compartment type – Control Room
   b. Volume – 58,300 ft^3 – Proper volume.
   c. Source term fraction – 0.0
   d. Compartment features –none selected

B. Transfer Pathways

1. Filtered Flow, Leak to the Environment
   a. From Compartment 1 – Containment
   b. To Compartment 2 – Environment
   c. Transfer mechanism – "Filter" selected
   d. Filter Efficiency Panel –Flow rate – 313,300 cfm – This is an arbitrary high value that releases moves 99.97% of the from the Reactor Building within 2 hours. This corresponds to 4 air changes per hour and is higher than the design flow rate of 209,000 cfm.
   e. Filter Efficiency Panel – FHA analyses do not credit SBGTS filtration, and so the efficiency used is 0.

f. Active Pathway – Yes

2. Environment to Control Room
   a. From Compartment 2 – Environment
   b. To Compartment 3 – Control Room
   c. Transfer mechanism – "Filter" selected –
   d. Filter Efficiency Panel –Flow rate – 58,300 cfm – Artificially high CR intake flowrate of one air change per minute, to conservatively allow for any unfiltered inleakage, for the duration of the accident.
   e. Filter Efficiency Panel – Filter efficiency is entered as 0.0% for all chemical forms of iodine for the all time.
   f. Active Pathway – Yes

3. Control Room to Environment
   a. From Compartment 3 – Control Room
   b. To Compartment 2 – Environment
   c. Transfer mechanism – "Filter" selected –
   d. Filter Efficiency Panel –Flow rate – 58,300 cfm –. for the duration of the accident.
   e. Filter Efficiency Panel – Filter efficiency is entered as 100.0% iodine chemical for all time periods. This is the exit from the control room to the environment; the filtration prevents a double counting of the iodine release.
   f. Active Pathway – Yes

C. Dose Locations

1. Exclusion Area Boundary
   a. In Compartment 2 – Environment
   b. Breathing Rate Default – not checked
   c. χ/Q – 1.36E-03 sec/m^3 – this is the 0-2 hr accident χ/Q for Quad Cities 1&2 Reactor Building Exhaust Stack (See Reference 13). This value is entered from time 0 to the end of the accident.
   d. Breathing Rate – 3.47E-04 m^3/sec – this is the Reg. Guide 1.183 specified breathing rate, with the traditional three digit accuracy (RADTRAD default).

2. Low Population Zone
   a. In Compartment 2 – Environment
   b. Breathing Rate Default – not checked
   c. χ/Q – 1.04E-04 sec/m^3 – this is the 0-2 hr accident χ/Q for Quad Cities 1&2 Reactor Building Exhaust Stack (See Reference 13). This value is entered from time 0 to the end of the accident.
   d. Breathing Rate – 3.47E-04 m^3/sec. – this is the Reg. Guide 1.183 specified breathing rate, with the traditional three digit accuracy (RADTRAD default).

3. Control Room
   a. In Compartment 3 – Control Room
   b. Breathing Rate - 3.47E-04 m^3/sec.
   e. χ/Q – 5.82E-04 sec/m^3 – this is the 0-2 hr accident χ/Q for Quad Cities 1&2 (Reference 13). This value is entered from time 0 to the end of the accident.
   c. Breathing Rate – 3.47E-04 m^3/sec – this is the Reg. Guide 1.183 specified breathing rate, with the traditional three digit accuracy (RADTRAD default).
   d. Occupancy Factor – 1.0 – this the RG 1.183 value for the first day.

D. Source Term and Release Fraction Treatment

a. The file *"dres qdc source terms for fha.nif"* file reflect the Quad Cities core activities with the I-131 value multiplied by 1.6 and the Kr-85 value multiplied by 2.0. These changes are made so that the RG 1.183, Table 3 differentiation in release fraction can be made.

b. The power level of 16.05 MW is per section 2.1 above and reflects the fraction of the core damaged and the radial peaking factor applied to that fuel.

c. The 24 hour delay time reflects the minimum time after shutdown that fuel movement is expected.

d. The RADTRAD radioactive decay and daughter products option is turned "on".

e. The files *"dresden-quad cities ast fha (df135 19ft).rft"* and *"dresden-quad cities ast fha (df200 23ft).rft"* are designed to reflect gap activity fractions per RG 1.183, Table 3, with the adjustment describe in for the "nif" file described above.

E. Dose Conversion Factors

The default FGR-11 and FGR-12 dose conversion factors provided with RADTRAD are used.

7. SUMMARY AND CONCLUSIONS

The RADTRAD code was used to examine the effect of the alternative source term release on offsite and CR doses. Shown below are the results, as well as the dose acceptance criteria.

- The two cases analyzed are that of the worst case drop over the core with a nominally expected minimum water level at 23 ft. over the damage fuel, and Technical Specification water level at 19 ft.

Location	Case 1 (23 feet water coverage) Dose (rem TEDE)	Case 2 (19 feet water coverage) Dose (rem TEDE)
LIMITS	CR 5.0; EAB&LPZ 6.3	CR 5.0; EAB&LPZ 6.3
EAB	3.84	5.24
LPZ	0.294	0.401
CR	1.22	1.80

These results indicated that the calculated consequences of a design basis Fuel Handling Accident will be within regulatory limits without the requirement for release filtration by SBGTS or elevated release through the station chimney. Furthermore, Control Room emergency filtration is not required to maintain operator doses within regulatory limits.

8. OWNER'S ACCEPTANCE REVIEW CHECKLIST FOR EXTERNAL DESIGN ANALYSIS

DESIGN ANALYSIS NO. QDC-0000-N-1267 REV: 1

		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 inputs and analysis methodology used meet current technical requirements 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 has since 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. Mscisz [signature] DATE: 8/13/05
Print / Sign

```
 ######################################################################
    RADTRAD Version 3.03 (Spring 2001) run on  8/12/2005  at  8:38:30
 ######################################################################

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

 Plant file           = P:\Users\Nuc\Exelon EOC\Discipline Files\Process\AST\Dresden &
Quad Cities AST\QDC FHA\QDC_7x7_1day_NoFilters (DF200 23 ft) (1CR airchange per min).psf
 Inventory file       = p:\users\nuc\exelon eoc\discipline files\process\ast\dresden &
quad cities ast\dre fha\dres qdc source terms for fha.nif
 Release file         = p:\users\nuc\exelon eoc\discipline files\process\ast\dresden &
quad cities ast\dre fha\dresden-quad cities ast fha df200.rft
 Dose Conversion file = c:\program files\radtrad3-03\defaults\fgr11&12.inp



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


 Radtrad 3.03 4/15/2001
 QDC-FHA RBStack to CR Intake and Grnd Release to EAB & LPZ 1 day Delay (DF200 23ft) (1CR
airchange per min)
 Nuclide Inventory File:
 p:\users\nuc\exelon eoc\discipline files\process\ast\dresden & quad cities ast\dre
fha\dres qdc source terms for fha.nif
 Plant Power Level:
  1.6050E+01
 Compartments:
   3
 Compartment 1:
 Containment
   3
  4.7000E+06
   0
   0
   0
   0
   0
 Compartment 2:
 Environment
   2
  0.0000E+00
   0
   0
   0
   0
```

```
  0
Compartment 3:
Control Room
  1
 5.8300E+04
  0
  0
  0
  0
  0
Pathways:
  3
Pathway 1:
Leak to Environment
  1
  2
  2
Pathway 2:
Environment to  Control Room
  2
  3
  2
Pathway 3:
Control Room to  Environment Exhaust
  3
  2
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:
ACCEPT\TEST1.PMF
Source Term:
  1
  1   1.0000E+00
c:\program files\radtrad3-03\defaults\fgr11&12.inp
p:\users\nuc\exelon eoc\discipline files\process\ast\dresden & quad cities ast\dre
fha\dresden-quad cities ast fha df200.rft
  2.4000E+01
  1
  0.0000E+00   5.7000E-01   4.3000E-01   1.0000E+00
Overlying Pool:
  0
  0.0000E+00
  0
  0
  0
  0
Compartments:
  3
Compartment 1:
  0
  1
  0
  0
  0
  0
```

```
  0
  0
  0
Compartment 2:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 3:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Pathways:
  3
Pathway 1:
  0
  0
  0
  0
  0
  1
  1
  2.4000E+01   3.1330E+05   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 2:
  0
  0
  0
  0
  0
  1
  1
  2.4000E+01   5.8300E+04   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 3:
  0
```

```
  0
  0
  0
  0
  1
  1
  2.4000E+01   5.8300E+04   1.0000E+02   1.0000E+02   1.0000E+02
  0
  0
  0
  0
  0
  0
Dose Locations:
  3
Location 1:
Exclusion Area Bndry
  2
  1
  2
  2.4000E+01   1.3600E-03
  2.6000E+01   0.0000E+00
  1
  2
  2.4000E+01   3.4700E-04
  2.6000E+01   0.0000E+00
  0
Location 2:
Low Population Zone
  2
  1
  2
  2.4000E+01   1.0400E-04
  2.6000E+01   0.0000E+00
  1
  2
  2.4000E+01   3.4700E-04
  2.6000E+01   0.0000E+00
  0
Location 3:
Control Room
  3
  0
  1
  2
  2.4000E+01   3.4700E-04
  4.8000E+01   0.0000E+00
  1
  2
  2.4000E+01   1.0000E+00
  4.8000E+01   0.0000E+00
Effective Volume Location:
  1
  2
  2.4000E+01   5.8200E-04
  2.6000E+01   0.0000E+00
Simulation Parameters:
```

```
   5
   2.4000E+01   1.0000E-03
   2.4010E+01   1.0000E-02
   2.4100E+01   1.0000E-01
   2.6000E+01   1.0000E+00
   4.8000E+01   0.0000E+00
 Output Filename:
 P:\Users\Nuc\Exelon EOC\Discipline Files\Process\AST\Dresden & Quad Cities AST\QDC
FHA\QDC_7x7_1day_NoFilters (DF200 23 ft) (1CR airchange per min).o0
   1
   1
   1
   0
   0
 End of Scenario File
```

QDC 7x7_1day_NoFilters (DF200 23 ft)

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  8/12/2005  at  8:38:30
#######################################################################

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

Number of Nuclides =  60

Inventory Power =   1.0000E+00 MWth
Plant Power Level =   1.6050E+01 MWth

Number of compartments  =   3

Compartment information

Compartment number  1  (Source term fraction =   1.0000E+00
)
Name: Containment
Compartment volume =   4.7000E+06 (Cubic feet)
Compartment type is Normal
Pathways into and out of compartment  1
   Exit Pathway Number    1: Leak to Environment

Compartment number  2
Name: Environment
Compartment type is Environment
Pathways into and out of compartment  2
   Inlet Pathway Number   1: Leak to Environment
   Inlet Pathway Number   3: Control Room to  Environment Exhaust
   Exit Pathway Number    2: Environment to  Control Room

Compartment number  3
Name: Control Room
Compartment volume =   5.8300E+04 (Cubic feet)
Compartment type is Control Room
Pathways into and out of compartment  3
   Inlet Pathway Number   2: Environment to  Control Room
   Exit Pathway Number    3: Control Room to  Environment Exhaust

Total number of pathways =   3
```

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  8/12/2005  at  8:38:30
#######################################################################

#######################################################################
                      Scenario Description
#######################################################################
```

Time between shutdown and first release = 2.4000E+01 (Hours)

Radioactive Decay is enabled
Calculation of Daughters is enabled

Release Fractions and Timings

	GAP	EARLY IN-VESSEL	LATE RELEASE	RELEASE MASS
	0.000001 hr	0.0000 hrs	0.0000 hrs	(gm)
NOBLES	5.0000E-02	0.0000E+00	0.0000E+00	2.021E+00
IODINE	2.5000E-04	0.0000E+00	0.0000E+00	1.682E-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 = 16. MWt

Nuclide Name	Group	Specific Inventory (Ci/MWt)	half life (s)	Whole Body DCF (Sv-m3/Bq-s)	Inhaled Thyroid (Sv/Bq)	Inhaled Effective (Sv/Bq)
Kr-85	1	8.729E+02	3.383E+08	1.190E-16	0.000E+00	0.000E+00
Kr-85m	1	6.772E+03	1.613E+04	7.480E-15	0.000E+00	0.000E+00
Kr-87	1	1.291E+04	4.578E+03	4.120E-14	0.000E+00	0.000E+00
Kr-88	1	1.815E+04	1.022E+04	1.020E-13	0.000E+00	0.000E+00
I-131	2	4.337E+04	6.947E+05	1.820E-14	2.920E-07	8.890E-09
I-132	2	3.914E+04	8.280E+03	1.120E-13	1.740E-09	1.030E-10
I-133	2	5.501E+04	7.488E+04	2.940E-14	4.860E-08	1.580E-09
I-134	2	6.035E+04	3.156E+03	1.300E-13	2.880E-10	3.550E-11
I-135	2	5.157E+04	2.380E+04	8.294E-14	8.460E-09	3.320E-10
Xe-133	1	5.282E+04	4.532E+05	1.560E-15	0.000E+00	0.000E+00
Xe-135	1	2.144E+04	3.272E+04	1.190E-14	0.000E+00	0.000E+00

Nuclide	Daughter	Fraction	Daughter	Fraction	Daughter	Fraction
Kr-85m	Kr-85	0.21	none	0.00	none	0.00
Kr-87	Rb-87	1.00	none	0.00	none	0.00
Kr-88	Rb-88	1.00	none	0.00	none	0.00
Sr-90	Y-90	1.00	none	0.00	none	0.00
Sr-91	Y-91m	0.58	Y-91	0.42	none	0.00
Sr-92	Y-92	1.00	none	0.00	none	0.00
Y-93	Zr-93	1.00	none	0.00	none	0.00
Zr-95	Nb-95m	0.01	Nb-95	0.99	none	0.00
Zr-97	Nb-97m	0.95	Nb-97	0.05	none	0.00
Mo-99	Tc-99m	0.88	Tc-99	0.12	none	0.00
Tc-99m	Tc-99	1.00	none	0.00	none	0.00

Ru-103	Rh-103m	1.00	none	0.00	none	0.00
Ru-105	Rh-105	1.00	none	0.00	none	0.00
Ru-106	Rh-106	1.00	none	0.00	none	0.00
Sb-127	Te-127m	0.18	Te-127	0.82	none	0.00
Sb-129	Te-129m	0.22	Te-129	0.77	none	0.00
Te-127m	Te-127	0.98	none	0.00	none	0.00
Te-129	I-129	1.00	none	0.00	none	0.00
Te-129m	Te-129	0.65	I-129	0.35	none	0.00
Te-131m	Te-131	0.22	I-131	0.78	none	0.00
Te-132	I-132	1.00	none	0.00	none	0.00
I-131	Xe-131m	0.01	none	0.00	none	0.00
I-133	Xe-133m	0.03	Xe-133	0.97	none	0.00
I-135	Xe-135m	0.15	Xe-135	0.85	none	0.00
Xe-135	Cs-135	1.00	none	0.00	none	0.00
Cs-137	Ba-137m	0.95	none	0.00	none	0.00
Ba-140	La-140	1.00	none	0.00	none	0.00
La-141	Ce-141	1.00	none	0.00	none	0.00
Ce-143	Pr-143	1.00	none	0.00	none	0.00
Ce-144	Pr-144m	0.02	Pr-144	0.98	none	0.00
Nd-147	Pm-147	1.00	none	0.00	none	0.00
Np-239	Pu-239	1.00	none	0.00	none	0.00
Pu-238	U-234	1.00	none	0.00	none	0.00
Pu-239	U-235	1.00	none	0.00	none	0.00
Pu-240	U-236	1.00	none	0.00	none	0.00
Pu-241	U-237	0.00	Am-241	1.00	none	0.00
Am-241	Np-237	1.00	none	0.00	none	0.00
Cm-242	Pu-238	1.00	none	0.00	none	0.00
Cm-244	Pu-240	1.00	none	0.00	none	0.00

Iodine fractions

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

COMPARTMENT DATA

Compartment number 1: Containment

Compartment number 2: Environment

Compartment number 3: Control Room

PATHWAY DATA

Pathway number 1: Leak to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
2.4000E+01	3.1330E+05	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 2: Environment to Control Room

Pathway Filter: Removal Data

Time (hr) Flow Rate Filter Efficiencies (%)

```
                        (cfm)        Aerosol     Elemental    Organic
   2.4000E+01     5.8300E+04   0.0000E+00   0.0000E+00   0.0000E+00

Pathway number  3: Control Room to  Environment Exhaust

     Pathway Filter: Removal Data

       Time (hr)      Flow Rate          Filter Efficiencies (%)
                        (cfm)        Aerosol     Elemental    Organic
       2.4000E+01     5.8300E+04   1.0000E+02   1.0000E+02   1.0000E+02

LOCATION DATA
     Location Exclusion Area Bndry     is in compartment   2

     Location X/Q Data
      Time (hr)          X/Q (s * m^-3)
       2.4000E+01           1.3600E-03
       2.6000E+01           0.0000E+00

     Location Breathing Rate Data
      Time (hr)          Breathing Rate (m^3 * sec^-1)
       2.4000E+01                 3.4700E-04
       2.6000E+01                 0.0000E+00
     Location Low Population Zone     is in compartment   2

     Location X/Q Data
      Time (hr)          X/Q (s * m^-3)
       2.4000E+01           1.0400E-04
       2.6000E+01           0.0000E+00

     Location Breathing Rate Data
      Time (hr)          Breathing Rate (m^3 * sec^-1)
       2.4000E+01                 3.4700E-04
       2.6000E+01                 0.0000E+00
     Location Control Room     is in compartment   3

     Location X/Q Data
      Time (hr)          X/Q (s * m^-3)
       2.4000E+01           5.8200E-04
       2.6000E+01           0.0000E+00

     Location Breathing Rate Data
      Time (hr)          Breathing Rate (m^3 * sec^-1)
       2.4000E+01                 3.4700E-04
       4.8000E+01                 0.0000E+00

     Location Occupancy Factor Data
      Time (hr)          Occupancy Factor
       2.4000E+01            1.0000E+00
       4.8000E+01            0.0000E+00

USER SPECIFIED TIME STEP DATA - SUPPLEMENTAL TIME STEPS
     Time             Time step
      0.0000E+00        1.0000E-03
      1.0000E-02        1.0000E-02
      1.0000E-01        1.0000E-01
      2.0000E+00        1.0000E+00
```

QDC 7x7_1day_NoFilters (DF200 23 ft)

2.4000E+01	0.0000E+00

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  8/12/2005  at  8:38:30
#######################################################################
```

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

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

Exclusion Area Bndry Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.1407E-06	1.8168E-04	7.7339E-06
Accumulated dose (rem)	2.1407E-06	1.8168E-04	7.7339E-06

Low Population Zone Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.6370E-07	1.3893E-05	5.9142E-07
Accumulated dose (rem)	1.6370E-07	1.3893E-05	5.9142E-07

Control Room Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	9.5617E-13	2.3324E-09	7.2761E-11
Accumulated dose (rem)	9.5617E-13	2.3324E-09	7.2761E-11

Exclusion Area Bndry Doses:

Time (h) = 26.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.0538E+00	9.0666E+01	3.8442E+00
Accumulated dose (rem)	1.0538E+00	9.0666E+01	3.8442E+00

Low Population Zone Doses:

Time (h) = 26.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	8.0586E-02	6.9333E+00	2.9397E-01
Accumulated dose (rem)	8.0586E-02	6.9333E+00	2.9397E-01

Control Room Doses:

Time (h) = 26.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.5799E-02	3.9107E+01	1.2194E+00
Accumulated dose (rem)	1.5799E-02	3.9107E+01	1.2194E+00

Exclusion Area Bndry Doses:

Time (h) = 48.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	1.0538E+00	9.0666E+01	3.8442E+00

Low Population Zone Doses:

Time (h) = 48.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	8.0586E-02	6.9333E+00	2.9397E-01

Control Room Doses:

Time (h) = 48.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.0065E-06	2.7688E-03	8.6055E-05
Accumulated dose (rem)	1.5800E-02	3.9110E+01	1.2194E+00

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##
I-131 Summary
##

Time (hr)	Containment I-131 (Curies)	Environment I-131 (Curies)	Control Room I-131 (Curies)
24.000	1.6041E+02	3.2080E-04	5.1369E-06
24.400	3.2346E+01	1.2794E+02	3.6994E-02
24.700	9.7333E+00	1.5053E+02	1.1132E-02
25.000	2.9288E+00	1.5732E+02	3.3497E-03
25.300	8.8131E-01	1.5937E+02	1.0079E-03
25.600	2.6519E-01	1.5998E+02	3.0330E-04
25.900	7.9798E-02	1.6017E+02	9.1265E-05
26.000	5.3474E-02	1.6020E+02	6.1157E-05
26.300	1.6091E-02	1.6023E+02	9.3031E-13
26.600	4.8418E-03	1.6024E+02	1.4152E-20
26.900	1.4569E-03	1.6025E+02	2.1527E-28
27.200	4.3840E-04	1.6025E+02	3.2747E-36
27.500	1.3192E-04	1.6025E+02	4.9814E-44
27.800	3.9696E-05	1.6025E+02	7.5776E-52
28.100	1.1945E-05	1.6025E+02	1.1527E-59
28.400	3.5943E-06	1.6025E+02	1.7534E-67
28.700	1.0815E-06	1.6025E+02	2.6673E-75
29.000	3.2545E-07	1.6025E+02	4.0575E-83
29.300	9.7930E-08	1.6025E+02	6.1721E-91
29.600	2.9468E-08	1.6025E+02	9.3889E-99
29.900	8.8671E-09	1.6025E+02	1.4282-106
30.200	2.6682E-09	1.6025E+02	2.1726-114
30.500	8.0288E-10	1.6025E+02	3.3049-122
30.800	2.4159E-10	1.6025E+02	5.0274-130
31.100	7.2697E-11	1.6025E+02	7.6475-138
31.400	2.1875E-11	1.6025E+02	1.1633-145
31.700	6.5824E-12	1.6025E+02	1.7696-153
32.000	1.9807E-12	1.6025E+02	2.6919-161
32.300	5.9601E-13	1.6025E+02	4.0949-169
32.600	1.7934E-13	1.6025E+02	6.2291-177

32.900	5.3966E-14	1.6025E+02	9.4756-185
33.200	1.6239E-14	1.6025E+02	1.4414-192
33.500	4.8864E-15	1.6025E+02	2.1926-200
33.800	1.4704E-15	1.6025E+02	3.3354-208
34.100	4.4244E-16	1.6025E+02	5.0737-216
34.400	1.3314E-16	1.6025E+02	7.7181-224
48.000	3.0197E-40	1.6025E+02	0.0000E+00

##
Cumulative Dose Summary
##

	Exclusion Area Bndry		Low Population Zone		Control Room	
Time	Thyroid	TEDE	Thyroid	TEDE	Thyroid	TEDE
(hr)	(rem)	(rem)	(rem)	(rem)	(rem)	(rem)
24.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
24.400	7.2437E+01	3.0766E+00	5.5393E+00	2.3527E-01	3.0637E+01	9.5548E-01
24.700	8.5208E+01	3.6156E+00	6.5159E+00	2.7649E-01	3.6571E+01	1.1404E+00
25.000	8.9047E+01	3.7767E+00	6.8095E+00	2.8881E-01	3.8355E+01	1.1959E+00
25.300	9.0201E+01	3.8249E+00	6.8977E+00	2.9249E-01	3.8891E+01	1.2126E+00
25.600	9.0547E+01	3.8393E+00	6.9242E+00	2.9359E-01	3.9052E+01	1.2176E+00
25.900	9.0652E+01	3.8436E+00	6.9322E+00	2.9392E-01	3.9100E+01	1.2191E+00
26.000	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9107E+01	1.2194E+00
26.300	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
26.600	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
26.900	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
27.200	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
27.500	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
27.800	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
28.100	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
28.400	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
28.700	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
29.000	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
29.300	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
29.600	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
29.900	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
30.200	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
30.500	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
30.800	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
31.100	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
31.400	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
31.700	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
32.000	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
32.300	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
32.600	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
32.900	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
33.200	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
33.500	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
33.800	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
34.100	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
34.400	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00
48.000	9.0666E+01	3.8442E+00	6.9333E+00	2.9397E-01	3.9110E+01	1.2194E+00

##
Worst Two-Hour Doses
##

Exclusion Area Bndry

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
24.0	1.0538E+00	9.0666E+01	3.8442E+00

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  8/12/2005  at  8:34:04
#######################################################################

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

 Plant file           = P:\Users\Nuc\Exelon EOC\Discipline Files\Process\AST\Dresden &
Quad Cities AST\QDC FHA\QDC_7x7_1day_NoFilters (DF135 19 ft)(1CR airchange per min).psf
 Inventory file       = p:\users\nuc\exelon eoc\discipline files\process\ast\dresden &
quad cities ast\dre fha\dres qdc source terms for fha.nif
 Release file         = p:\users\nuc\exelon eoc\discipline files\process\ast\dresden &
quad cities ast\dre fha\dresden-quad cities ast fha (df135 19ft).rft
 Dose Conversion file = c:\program files\radtrad3-03\defaults\fgr11&12.inp
```

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

```
 Radtrad 3.03 4/15/2001
 QDC-FHA RBStack to CR Intake and Grnd Release to EAB & LPZ 1 day Delay (DF135 19ft) (1CR
airchange per min)
 Nuclide Inventory File:
 p:\users\nuc\exelon eoc\discipline files\process\ast\dresden & quad cities ast\dre
fha\dres qdc source terms for fha.nif
 Plant Power Level:
  1.6050E+01
 Compartments:
   3
 Compartment 1:
 Containment
   3
  4.7000E+06
   0
   0
   0
   0
   0
 Compartment 2:
 Environment
   2
  0.0000E+00
   0
   0
   0
   0
```

```
  0
Compartment 3:
Control Room
  1
 5.8300E+04
  0
  0
  0
  0
  0
Pathways:
  3
Pathway 1:
Leak to Environment
  1
  2
  2
Pathway 2:
Environment to  Control Room
  2
  3
  2
Pathway 3:
Control Room to  Environment Exhaust
  3
  2
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:
ACCEPT\TEST1.PMF
Source Term:
  1
  1   1.0000E+00
c:\program files\radtrad3-03\defaults\fgr11&12.inp
p:\users\nuc\exelon eoc\discipline files\process\ast\dresden & quad cities ast\dre
fha\dresden-quad cities ast fha (df135 19ft).rft
  2.4000E+01
  1
  0.0000E+00   8.0000E-01   2.0000E-01   1.0000E+00
Overlying Pool:
  0
  0.0000E+00
  0
  0
  0
  0
Compartments:
  3
Compartment 1:
  0
  1
  0
  0
  0
  0
```

```
  0
  0
  0
Compartment 2:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 3:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Pathways:
  3
Pathway 1:
  0
  0
  0
  0
  0
  1
  1
  2.4000E+01   3.1330E+05   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 2:
  0
  0
  0
  0
  0
  1
  1
  2.4000E+01   5.8300E+04   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 3:
  0
```

```
  0
  0
  0
  0
  1
  1
  2.4000E+01   5.8300E+04   1.0000E+02   1.0000E+02   1.0000E+02
  0
  0
  0
  0
  0
  0
Dose Locations:
  3
Location 1:
Exclusion Area Bndry
  2
  1
  2
  2.4000E+01   1.3600E-03
  2.6000E+01   0.0000E+00
  1
  2
  2.4000E+01   3.4700E-04
  2.6000E+01   0.0000E+00
  0
Location 2:
Low Population Zone
  2
  1
  2
  2.4000E+01   1.0400E-04
  2.6000E+01   0.0000E+00
  1
  2
  2.4000E+01   3.4700E-04
  2.6000E+01   0.0000E+00
  0
Location 3:
Control Room
  3
  0
  1
  2
  2.4000E+01   3.4700E-04
  4.8000E+01   0.0000E+00
  1
  2
  2.4000E+01   1.0000E+00
  4.8000E+01   0.0000E+00
Effective Volume Location:
  1
  2
  2.4000E+01   5.8200E-04
  2.6000E+01   0.0000E+00
Simulation Parameters:
```

```
   5
   2.4000E+01   1.0000E-03
   2.4010E+01   1.0000E-02
   2.4100E+01   1.0000E-01
   2.6000E+01   1.0000E+00
   4.8000E+01   0.0000E+00
 Output Filename:
 P:\Users\Nuc\Exelon EOC\Discipline Files\Process\AST\Dresden & Quad Cities AST\QDC
FHA\QDC_7x7_1day_NoFilters (DF135 19 ft)(1CR airchange per min).o0
   1
   1
   1
   0
   0
 End of Scenario File
```

QDC_7x7_1day_NoFilter (DF135 19 ft)

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  8/12/2005  at  8:34:04
#######################################################################

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

Number of Nuclides =  60

Inventory Power =   1.0000E+00 MWth
Plant Power Level =   1.6050E+01 MWth

Number of compartments    =   3

Compartment information

Compartment number  1  (Source term fraction =   1.0000E+00
)
Name: Containment
Compartment volume =   4.7000E+06 (Cubic feet)
Compartment type is Normal
Pathways into and out of compartment  1
   Exit Pathway Number    1: Leak to Environment

Compartment number  2
Name: Environment
Compartment type is Environment
Pathways into and out of compartment  2
   Inlet Pathway Number   1: Leak to Environment
   Inlet Pathway Number   3: Control Room to  Environment Exhaust
   Exit Pathway Number    2: Environment to  Control Room

Compartment number  3
Name: Control Room
Compartment volume =   5.8300E+04 (Cubic feet)
Compartment type is Control Room
Pathways into and out of compartment  3
   Inlet Pathway Number   2: Environment to  Control Room
   Exit Pathway Number    3: Control Room to  Environment Exhaust

Total number of pathways =   3
```

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  8/12/2005  at  8:34:04
#######################################################################

#######################################################################
                    Scenario Description
#######################################################################
```

Time between shutdown and first release = 2.4000E+01 (Hours)

Radioactive Decay is enabled
Calculation of Daughters is enabled

Release Fractions and Timings

	GAP	EARLY IN-VESSEL	LATE RELEASE	RELEASE MASS
	0.000001 hr	0.0000 hrs	0.0000 hrs	(gm)
NOBLES	5.0000E-02	0.0000E+00	0.0000E+00	2.021E+00
IODINE	3.7037E-04	0.0000E+00	0.0000E+00	2.491E-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 = 16. MWt

Nuclide Name	Group	Specific Inventory (Ci/MWt)	half life (s)	Whole Body DCF (Sv-m3/Bq-s)	Inhaled Thyroid (Sv/Bq)	Inhaled Effective (Sv/Bq)
Kr-85	1	8.729E+02	3.383E+08	1.190E-16	0.000E+00	0.000E+00
Kr-85m'	1	6.772E+03	1.613E+04	7.480E-15	0.000E+00	0.000E+00
Kr-87	1	1.291E+04	4.578E+03	4.120E-14	0.000E+00	0.000E+00
Kr-88	1	1.815E+04	1.022E+04	1.020E-13	0.000E+00	0.000E+00
I-131	2	4.337E+04	6.947E+05	1.820E-14	2.920E-07	8.890E-09
I-132	2	3.914E+04	8.280E+03	1.120E-13	1.740E-09	1.030E-10
I-133	2	5.501E+04	7.488E+04	2.940E-14	4.860E-08	1.580E-09
I-134	2	6.035E+04	3.156E+03	1.300E-13	2.880E-10	3.550E-11
I-135	2	5.157E+04	2.380E+04	8.294E-14	8.460E-09	3.320E-10
Xe-133	1	5.282E+04	4.532E+05	1.560E-15	0.000E+00	0.000E+00
Xe-135	1	2.144E+04	3.272E+04	1.190E-14	0.000E+00	0.000E+00

Nuclide	Daughter	Fraction	Daughter	Fraction	Daughter	Fraction
Kr-85m	Kr-85	0.21	none	0.00	none	0.00
Kr-87	Rb-87	1.00	none	0.00	none	0.00
Kr-88	Rb-88	1.00	none	0.00	none	0.00
Sr-90	Y-90	1.00	none	0.00	none	0.00
Sr-91	Y-91m	0.58	Y-91	0.42	none	0.00
Sr-92	Y-92	1.00	none	0.00	none	0.00
Y-93	Zr-93	1.00	none	0.00	none	0.00
Zr-95	Nb-95m	0.01	Nb-95	0.99	none	0.00
Zr-97	Nb-97m	0.95	Nb-97	0.05	none	0.00
Mo-99	Tc-99m	0.88	Tc-99	0.12	none	0.00
Tc-99m	Tc-99	1.00	none	0.00	none	0.00

Ru-103	Rh-103m	1.00	none	0.00	none	0.00
Ru-105	Rh-105	1.00	none	0.00	none	0.00
Ru-106	Rh-106	1.00	none	0.00	none	0.00
Sb-127	Te-127m	0.18	Te-127	0.82	none	0.00
Sb-129	Te-129m	0.22	Te-129	0.77	none	0.00
Te-127m	Te-127	0.98	none	0.00	none	0.00
Te-129	I-129	1.00	none	0.00	none	0.00
Te-129m	Te-129	0.65	I-129	0.35	none	0.00
Te-131m	Te-131	0.22	I-131	0.78	none	0.00
Te-132	I-132	1.00	none	0.00	none	0.00
I-131	Xe-131m	0.01	none	0.00	none	0.00
I-133	Xe-133m	0.03	Xe-133	0.97	none	0.00
I-135	Xe-135m	0.15	Xe-135	0.85	none	0.00
Xe-135	Cs-135	1.00	none	0.00	none	0.00
Cs-137	Ba-137m	0.95	none	0.00	none	0.00
Ba-140	La-140	1.00	none	0.00	none	0.00
La-141	Ce-141	1.00	none	0.00	none	0.00
Ce-143	Pr-143	1.00	none	0.00	none	0.00
Ce-144	Pr-144m	0.02	Pr-144	0.98	none	0.00
Nd-147	Pm-147	1.00	none	0.00	none	0.00
Np-239	Pu-239	1.00	none	0.00	none	0.00
Pu-238	U-234	1.00	none	0.00	none	0.00
Pu-239	U-235	1.00	none	0.00	none	0.00
Pu-240	U-236	1.00	none	0.00	none	0.00
Pu-241	U-237	0.00	Am-241	1.00	none	0.00
Am-241	Np-237	1.00	none	0.00	none	0.00
Cm-242	Pu-238	1.00	none	0.00	none	0.00
Cm-244	Pu-240	1.00	none	0.00	none	0.00

Iodine fractions
Aerosol = 0.0000E+00
Elemental = 8.0000E-01
Organic = 2.0000E-01

COMPARTMENT DATA

Compartment number 1: Containment

Compartment number 2: Environment

Compartment number 3: Control Room

PATHWAY DATA

Pathway number 1: Leak to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
2.4000E+01	3.1330E+05	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 2: Environment to Control Room

Pathway Filter: Removal Data

Time (hr) Flow Rate Filter Efficiencies (%)

```
                        (cfm)        Aerosol     Elemental    Organic
     2.4000E+01     5.8300E+04   0.0000E+00   0.0000E+00   0.0000E+00

Pathway number  3: Control Room to  Environment Exhaust

     Pathway Filter: Removal Data

       Time (hr)       Flow Rate          Filter Efficiencies (%)
                        (cfm)        Aerosol     Elemental    Organic
     2.4000E+01     5.8300E+04   1.0000E+02   1.0000E+02   1.0000E+02

LOCATION DATA
     Location Exclusion Area Bndry     is in compartment   2

     Location X/Q Data
      Time (hr)          X/Q (s * m^-3)
       2.4000E+01           1.3600E-03
       2.6000E+01           0.0000E+00

     Location Breathing Rate Data
      Time (hr)          Breathing Rate (m^3 * sec^-1)
       2.4000E+01                  3.4700E-04
       2.6000E+01                  0.0000E+00
     Location Low Population Zone     is in compartment   2

     Location X/Q Data
      Time (hr)          X/Q (s * m^-3)
       2.4000E+01           1.0400E-04
       2.6000E+01           0.0000E+00

     Location Breathing Rate Data
      Time (hr)          Breathing Rate (m^3 * sec^-1)
       2.4000E+01                  3.4700E-04
       2.6000E+01                  0.0000E+00
     Location Control Room     is in compartment   3

     Location X/Q Data
      Time (hr)          X/Q (s * m^-3)
       2.4000E+01           5.8200E-04
       2.6000E+01           0.0000E+00

     Location Breathing Rate Data
      Time (hr)          Breathing Rate (m^3 * sec^-1)
       2.4000E+01                  3.4700E-04
       4.8000E+01                  0.0000E+00

     Location Occupancy Factor Data
      Time (hr)          Occupancy Factor
       2.4000E+01            1.0000E+00
       4.8000E+01            0.0000E+00

USER SPECIFIED TIME STEP DATA - SUPPLEMENTAL TIME STEPS
     Time              Time step
      0.0000E+00        1.0000E-03
      1.0000E-02        1.0000E-02
      1.0000E-01        1.0000E-01
      2.0000E+00        1.0000E+00
```

QDC_7x7_1day_NoFilter (DF135 19 ft)

2.4000E+01	0.0000E+00

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  8/12/2005  at  8:34:04
#######################################################################
```

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

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

Exclusion Area Bndry Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.2464E-06	2.6916E-04	1.0533E-05
Accumulated dose (rem)	2.2464E-06	2.6916E-04	1.0533E-05

Low Population Zone Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.7178E-07	2.0583E-05	8.0543E-07
Accumulated dose (rem)	1.7178E-07	2.0583E-05	8.0543E-07

Control Room Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.0034E-12	3.4554E-09	1.0738E-10
Accumulated dose (rem)	1.0034E-12	3.4554E-09	1.0738E-10

Exclusion Area Bndry Doses:

Time (h) = 26.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.1044E+00	1.3432E+02	5.2383E+00
Accumulated dose (rem)	1.1044E+00	1.3432E+02	5.2383E+00

Low Population Zone Doses:

Time (h) = 26.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	8.4452E-02	1.0272E+01	4.0058E-01
Accumulated dose (rem)	8.4452E-02	1.0272E+01	4.0058E-01

Control Room Doses:

Time (h) = 26.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.6555E-02	5.7936E+01	1.7996E+00
Accumulated dose (rem)	1.6555E-02	5.7936E+01	1.7996E+00

Exclusion Area Bndry Doses:

Time (h) = 48.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	1.1044E+00	1.3432E+02	5.2383E+00

Low Population Zone Doses:

Time (h) = 48.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	8.4452E-02	1.0272E+01	4.0058E-01

Control Room Doses:

Time (h) = 48.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.0450E-06	4.1020E-03	1.2704E-04
Accumulated dose (rem)	1.6556E-02	5.7940E+01	1.7997E+00

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##
I-131 Summary
##

Time (hr)	Containment I-131 (Curies)	Environment I-131 (Curies)	Control Room I-131 (Curies)
24.000	2.3765E+02	4.7525E-04	7.6103E-06
24.400	4.7920E+01	1.8954E+02	5.4806E-02
24.700	1.4420E+01	2.2300E+02	1.6492E-02
25.000	4.3390E+00	2.3307E+02	4.9624E-03
25.300	1.3056E+00	2.3610E+02	1.4932E-03
25.600	3.9288E-01	2.3701E+02	4.4933E-04
25.900	1.1822E-01	2.3729E+02	1.3521E-04
26.000	7.9220E-02	2.3733E+02	9.0603E-05
26.300	2.3838E-02	2.3738E+02	1.3782E-12
26.600	7.1730E-03	2.3740E+02	2.0965E-20
26.900	2.1584E-03	2.3740E+02	3.1892E-28
27.200	6.4949E-04	2.3741E+02	4.8514E-36
27.500	1.9544E-04	2.3741E+02	7.3798E-44
27.800	5.8808E-05	2.3741E+02	1.1226E-51
28.100	1.7696E-05	2.3741E+02	1.7077E-59
28.400	5.3248E-06	2.3741E+02	2.5977E-67
28.700	1.6023E-06	2.3741E+02	3.9516E-75
29.000	4.8214E-07	2.3741E+02	6.0111E-83
29.300	1.4508E-07	2.3741E+02	9.1439E-91
29.600	4.3656E-08	2.3741E+02	1.3910E-98
29.900	1.3136E-08	2.3741E+02	2.1159-106
30.200	3.9529E-09	2.3741E+02	3.2186-114
30.500	1.1894E-09	2.3741E+02	4.8961-122
30.800	3.5791E-10	2.3741E+02	7.4479-130
31.100	1.0770E-10	2.3741E+02	1.1330-137
31.400	3.2408E-11	2.3741E+02	1.7234-145
31.700	9.7517E-12	2.3741E+02	2.6217-153
32.000	2.9344E-12	2.3741E+02	3.9880-161
32.300	8.8298E-13	2.3741E+02	6.0665-169
32.600	2.6570E-13	2.3741E+02	9.2283-177

32.900	7.9950E-14	2.3741E+02	1.4038-184
33.200	2.4058E-14	2.3741E+02	2.1354-192
33.500	7.2391E-15	2.3741E+02	3.2483-200
33.800	2.1783E-15	2.3741E+02	4.9413-208
34.100	6.5547E-16	2.3741E+02	7.5166-216
34.400	1.9724E-16	2.3741E+02	1.1434-223
48.000	4.4737E-40	2.3741E+02	0.0000E+00

##
Cumulative Dose Summary
##

	Exclusion Area Bndry		Low Population Zone		Control Room	
Time	Thyroid	TEDE	Thyroid	TEDE	Thyroid	TEDE
(hr)	(rem)	(rem)	(rem)	(rem)	(rem)	(rem)
24.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
24.400	1.0731E+02	4.1913E+00	8.2063E+00	3.2051E-01	4.5389E+01	1.4101E+00
24.700	1.2623E+02	4.9262E+00	9.6532E+00	3.7671E-01	5.4179E+01	1.6831E+00
25.000	1.3192E+02	5.1461E+00	1.0088E+01	3.9352E-01	5.6821E+01	1.7650E+00
25.300	1.3363E+02	5.2119E+00	1.0219E+01	3.9856E-01	5.7616E+01	1.7897E+00
25.600	1.3414E+02	5.2316E+00	1.0258E+01	4.0006E-01	5.7854E+01	1.7971E+00
25.900	1.3430E+02	5.2375E+00	1.0270E+01	4.0051E-01	5.7926E+01	1.7993E+00
26.000	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7936E+01	1.7996E+00
26.300	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
26.600	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
26.900	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
27.200	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
27.500	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
27.800	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
28.100	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
28.400	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
28.700	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
29.000	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
29.300	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
29.600	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
29.900	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
30.200	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
30.500	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
30.800	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
31.100	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
31.400	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
31.700	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
32.000	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
32.300	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
32.600	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
32.900	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
33.200	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
33.500	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
33.800	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
34.100	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
34.400	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00
48.000	1.3432E+02	5.2383E+00	1.0272E+01	4.0058E-01	5.7940E+01	1.7997E+00

##
Worst Two-Hour Doses
##

QDC_7x7_1day_NoFilter (DF135 19 ft)

Exclusion Area Bndry

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
24.0	1.1044E+00	1.3432E+02	5.2383E+00

```
Nuclide Inventory Name:
 Source Document Calc. #GE-NE-A22-00103-64-01 Appendix D for Dresden and Quad
Cities
 Power Level:
  0.1000E+01
 Nuclides:
  60
 Nuclide 001:
 Co-58
   7
  0.6117120000E+07
  0.5800E+02
  0.1529E+03
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 002:
 Co-60
   7
  0.1663401096E+09
  0.6000E+02
  0.1830E+03
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 003:
 Kr-85
   1
  0.3382974720E+09
  0.8500E+02
  4.3644E+02
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 004:
 Kr-85m
   1
  0.1612800000E+05
  0.8500E+02
  6.7720E+03
 Kr-85     0.2100E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 005:
 Kr-87
   1
  0.4578000000E+04
  0.8700E+02
  1.2910E+04
 Rb-87     0.1000E+01
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 006:
 Kr-88
   1
  0.1022400000E+05
  0.8800E+02
  1.8150E+04
 Rb-88     0.1000E+01
```

```
none      0.0000E+00
none      0.0000E+00
Nuclide 007:
Rb-86
  3
 0.1612224000E+07
 0.8600E+02
 7.096E+01
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 008:
Sr-89
  5
 0.4363200000E+07
 0.8900E+02
 2.4284E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 009:
Sr-90
  5
 0.9189573120E+09
 0.9000E+02
 3.5283E+03
Y-90      0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 010:
Sr-91
  5
 0.3420000000E+05
 0.9100E+02
 3.0810E+04
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
 3.3620E+04
Y-92      0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 012:
Y-90
  9
 0.2304000000E+06
 0.9000E+02
 3.6249E+03
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 013:
Y-91
  9
```

```
 0.5055264000E+07
 0.9100E+02
 3.1549E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 014:
Y-92
  9
 0.1274400000E+05
 0.9200E+02
 3.3767E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 015:
Y-93
  9
 0.3636000000E+05
 0.9300E+02
 3.9417E+04
Zr-93     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 016:
Zr-95
  9
 0.5527872000E+07
 0.9500E+02
 4.4427E+04
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
 4.4971E+04
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
 4.4637E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 019:
Mo-99
  7
 0.2376000000E+06
 0.9900E+02
 5.1210E+04
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
 4.4837E+04
Tc-99     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 021:
Ru-103
  7
 0.3393792000E+07
 0.1030E+03
 4.3107E+04
Rh-103m   0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 022:
Ru-105
  7
 0.1598400000E+05
 0.1050E+03
 3.0337E+04
Rh-105    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 023:
Ru-106
  7
 0.3181248000E+08
 0.1060E+03
 1.8366E+04
Rh-106    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 024:
Rh-105
  7
 0.1272960000E+06
 0.1050E+03
 2.8824E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 025:
Sb-127
  4
 0.3326400000E+06
 0.1270E+03
 2.9994E+03
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
 8.8770E+03
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
 2.9857E+03
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 028:
Te-127m
  4
 0.9417600000E+07
 0.1270E+03
 4.0597E+02
Te-127   0.9800E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 029:
Te-129
  4
 0.4176000000E+04
 0.1290E+03
 8.7350E+03
I-129    0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 030:
Te-129m
  4
 0.2903040000E+07
 0.1290E+03
 1.3004E+03
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
 3.9549E+03
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
 3.8497E+04
I-132    0.1000E+01
none     0.0000E+00
none     0.0000E+00
```

```
Nuclide 033:
I-131
  2
 0.6946560000E+06
 0.1310E+03
 2.7104E+04
Xe-131m  0.1100E-01
none     0.0000E+00
none     0.0000E+00
Nuclide 034:
I-132
  2
 0.8280000000E+04
 0.1320E+03
 3.9136E+04
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 035:
I-133
  2
 0.7488000000E+05
 0.1330E+03
 5.5010E+04
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
 6.0353E+04
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 037:
I-135
  2
 0.2379600000E+05
 0.1350E+03
 5.1570E+04
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
 5.2821E+04
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 039:
Xe-135
  1
 0.3272400000E+05
 0.1350E+03
```

```
 2.1437E+04
Cs-135    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 040:
Cs-134
  3
 0.6507177120E+08
 0.1340E+03
 8.0091E+03
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 041:
Cs-136
  3
 0.1131840000E+07
 0.1360E+03
 2.3791E+03
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 042:
Cs-137
  3
 0.9467280000E+09
 0.1370E+03
 4.9283E+03
Ba-137m   0.9500E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 043:
Ba-139
  6
 0.4962000000E+04
 0.1390E+03
 4.8879E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 044:
Ba-140
  6
 0.1100736000E+07
 0.1400E+03
 4.7141E+04
La-140    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 045:
La-140
  9
 0.1449792000E+06
 0.1400E+03
 5.0553E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 046:
```

```
La-141
  9
 0.1414800000E+05
 0.1410E+03
 4.4469E+04
Ce-141    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 047:
La-142
  9
 0.5550000000E+04
 0.1420E+03
 4.2864E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 048:
Ce-141
  8
 0.2808086400E+07
 0.1410E+03
 4.4650E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 049:
Ce-143
  8
 0.1188000000E+06
 0.1430E+03
 4.1011E+04
Pr-143    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 050:
Ce-144
  8
 0.2456352000E+08
 0.1440E+03
 3.6823E+04
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
 3.9634E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 052:
Nd-147
  9
 0.9486720000E+06
 0.1470E+03
 1.7999E+04
```

```
Pm-147    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 053:
Np-239
  8
 0.2034720000E+06
 0.2390E+03
 5.5866E+05
Pu-239    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 054:
Pu-238
  8
 0.2768863824E+10
 0.2380E+03
 1.7677E+02
U-234     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 055:
Pu-239
  8
 0.7594336440E+12
 0.2390E+03
 1.4743E+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
 2.0014E+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
 6.6999E+03
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
 9.8566E+00
Np-237    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 059:
Cm-242
```

```
  9
 0.1406592000E+08
 0.2420E+03
 2.2847E+03
Pu-238    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 060:
Cm-244
  9
 0.5715081360E+09
 0.2440E+03
 1.6212E+02
Pu-240    0.1000E+01
none      0.0000E+00
none      0.0000E+00
End of Nuclear Inventory File
```

Release Fraction and Timing Name:
Dresden & Quad Cities FHA, 7x7 bundle Nobles=I=5% & pool I DF=200, Cs DF=infinity
Duration (h):
0.1000E-05 0.0000E+00 0.0000E+00 0.0000E+00
Noble Gases:
5.0000E-02 0.0000E+00 0.0000E+00 0.0000E+00
Iodine:
2.5000E-04 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

```
Release Fraction and Timing Name:
 Dresden & Quad Cities FHA, 7x7 bundle Nobles=I=5% & pool I DF=135, Cs
DF=infinity
 Duration (h):
  0.1000E-05  0.0000E+00  0.0000E+00  0.0000E+00
 Noble Gases:
  5.0000E-02  0.0000E+00  0.0000E+00  0.0000E+00
 Iodine:
  3.7037E-04  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
```

Computer Disclosure Sheet

Discipline Nuclear

Client: Exelon
Project: Quad Cities

Date: August 2005
Job No. 21359-27003.CALC

Program(s) used:	Rev No.	Rev Date
RADTRAD 3.03 Runs in Att. A and B	0	January 2003 (Prequalification Date)
RADTRAD 3.03 NIF File in Att. C	0	1/2003
RADTRAD 3.03 RFT File in Att. D and E	0	1/2003

Calculation Set No. QDC-0000-N-1267, Rev. 1

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: 8/2005

Run by: H. Rothstein Harold Rothstein

Checked by: P. Reichert P. Reichert

Approved by: H. Rothstein Harold Rothstein

Remarks: WGI Form for Computer Software Control
The RADTRAD computer code is applied in a manner fitting its intended purpose, and well within it's operating parameters. All outputs were hand checked. Attachments D, E and F include the Nuclide Information File and Release Fraction and Timing Files used by the RADTRAD code and generated specifically for the Quad Cities Nuclear Power Station. Both were also hand checked for accuracy.