Maria Korsnick
Vice President

1503 Lake Road
Ontario, New York 14519-9364
585.771.3494
585.771.3943 Fax
maria.korsnick@constellation.com

Constellation Energy
R.E. Ginna Nuclear Power Plant

July 14, 2004

Mr. Robert L. Clark
Office of Nuclear Regulatory Regulation
U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

Subject: Revised Atmospheric Dispersion Factors (x/Q) and Dose Analysis
R.E. Ginna Nuclear Power Plant
Docket No. 50-244

References: 1. Letter from Robert C. Mecredy (RG&E) to Robert L. Clark (NRC) dated May 21, 2003, License Amendment Request Regarding Revision of Ginna Technical Specification Sections 1.1, 3.3.6, 3.4.16, 3.6.6, 3.7.9, 5.5.10, 5.5.16, and 5.6.7 Resulting From Modification of the Control Room Emergency Air Treatment System and Change in Dose Calculation Methodology to Alternate Source Term.

2. Letter from Robert C. Mecredy (RG&E) to Robert L. Clark (NRC) dated March 8, 2004, Response to Request for Additional Information (RAI) Regarding Proposed CREATS Modification and Change in Dose Calculation Methodology to Alternate Source Term.

Dear Mr. Clark:

In Reference 2 RG&E committed to "Calculate new x/Q data for the control room and off-site doses and recalculate doses using the new x/Q data." These calculations were completed using the most recent five full years of meteorological data and are summarized in Attachment 1. This information should be docketed as an addendum to Reference 1. If you have questions regarding the content of this correspondence please contact Mr. Mike Ruby at (585) 771-3572 or Mr. George Wrobel at (585) 771-3535.

Very truly yours,

Mary G. Korsnick

Mary G. Korsnick

A001

1001078

STATE OF NEW YORK :
: **TO WIT:**
COUNTY OF WAYNE :

I, Mary G. Korsnick, being duly sworn, state that I am Vice President – R.E. Ginna Nuclear Power Plant, LLC (Ginna LLC), and that I am duly authorized to execute and file this response on behalf of Ginna LLC. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other Ginna LLC employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

Mary G. Korsnick

Subscribed and sworn before me, a Notary Public in and for the State of New York and County of Monroe, this 14 day of July, 2004.

WITNESS my Hand and Notarial Seal: Sharon L. Miller
Notary Public

My Commission Expires: 7-14-04
Date

SHARON L MILLER
Notary Public, State of New York
Registration No. 01MI6017755
Monroe County
Commission Expires December 21, 2006

Attachments:

1. Summary of Radiological Analysis, Alternative Source Term and Control Room Emergency Ventilation System Submittal, Revision 2, July 2004.

Cc: Mr. Robert L. Clark (Mail Stop O-8-C2)
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Regulatory Regulation
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Regional Administrator, Region 1
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

U.S. NRC Ginna Senior Resident Inspector

Mr. Peter R. Smith
New York State Energy, Research, and Development Authority
Corporate Plaza West
286 Washington Avenue Extension
Albany, NY 12203-6399

Mr. Paul Eddy
NYS Department of Public Service
3 Empire State Plaza, 10th Floor
Albany, NY 12223

James M. Petro Jr., Esquire
Counsel
Constellation Energy
750 East Pratt Street, 5th Floor
Baltimore, MD 21202

Daniel F. Stenger
Ballard Spahr Andrews & Ingersoll, LLP
601 13th Street, N.W., Suite 1000 South
Washington, DC 20005

Attachment 1

Summary of Radiological Analysis, Alternative Source Term and Control Room Emergency Ventilation System Submittal, Revision 2, July 2004

Rochester Gas and Electric Corporation
89 East Avenue
Rochester, New York 14649

R. E. Ginna Station

Docket Number 50-244

Summary of Radiological Analyses

Alternative Source Term and Control Room Emergency Ventilation System Submittal

Revision 2
July 2004

TABLE OF CONTENTS

1.0 Summary of Radiological Analysis 3

2.0 Atmospheric Dispersion (χ/Q) 4

3.0 Iodine Spiking 41

4.0 General Discussion 44

5.0 Loss-of-Coolant-Accident 46

6.0 Fuel Handling Accident 55

7.0 Main Steam Line Break 62

8.0 Steam Generator Tube Rupture (SGTR) 68

9.0 Locked Rotor Accident 73

10.0 Rod Ejection Accident 77

11.0 Tornado Missile in Spent Fuel Pool 83

12.0 Waste Gas Decay Tank Rupture 91

13.0 References 94

1.0 Summary of Radiological Analysis

Each of the below accidents was analyzed for dose consequences, using the Alternative Source Term Methodology, per Regulatory Guide 1.183. All dose results are expressed in terms of rem TEDE, for comparison with the appropriate limits. The accident consequences were calculated for both the Control Room Operator and the public at the Exclusion Area Boundary (EAB) and the Low Population Zone (LPZ). The following table summarizes the results of the analysis.

TABLE 1.1
ALTERNATE SOURCE TERM DOSE ANALYSIS SUMMARY
Rem TEDE

Accident	EAB Max. 2-hour		LPZ		Control Room	
	Limit	Dose	Limit	Dose	Limit	Dose
LOCA*	25.0	2.69	25.0	1.02	5.0	4.30
FHA - CNMT	6.3	5.07E-1	6.3	5.87E-2	5.0	1.16
FHA-AUX	6.3	1.38E-1	6.3	1.59E-2	5.0	9.85E-2
MSLB[1]	2.5	4.76E-1	2.5	1.27E-1	5.0	6.32E-1
MSLB[2]	25.0	6.96E-2	25.0	2.80E-2	5.0	1.74E-1
SGTR[1]	2.5	9.70E-2	2.5	1.40E-2	5.0	1.40E-1
SGTR[2]	25.0	3.20E-1	25.0	4.30E-2	5.0	8.90E-1
Locked Rotor	2.5	1.0	2.5	3.03E-1	5.0	1.88
Rod Ejection	6.3	6.64E-1	6.3	2.03E-1	5.0	1.06
SFP- TMA	6.3	2.16E-2	6.3	4.79E-3	5.0	3.55**
GDT Rupture	0.5	1.25E-1	0.5	1.45E-2	5.0	1.15E-1

* Includes doses from containment and ECCS leakage

** Max case (CR isolation w/o recirculating filtration)

---

1 Accident Initiated Iodine Spike

2 Pre-Accident Iodine Spike

2.0 Atmospheric Dispersion (χ/Q)

The atmospheric dispersion factors, currently described within the UFSAR, were reviewed as part of the control room ventilation system upgrade. As a result of this review, the atmospheric dispersion factors for the control room intake were recalculated, as described in the sections that follow. The atmospheric dispersion factors for the EAB and LPZ were also recalculated, and these assumptions and results are described in Section 2.8.

The atmospheric dispersion factors, from each on-site source, to the control room intake, were recalculated using the ARCON96 code (Reference 1) combined with the methodology of Regulatory Guide 1.194 (Reference 2).

Meteorological data, collected by a system meeting Regulatory Guide 1.23 guidelines, for the years 1999 through 2003, was used in the calculations. The data covered 43,824 hours, of which 556 hours were missing. This represents approximately 99% data recovery, which is well within the ≥90% recovery parameter of both the Regulatory Guide and ARCON96.

The wind speed statistics are:

Average wind speed:	4.4 m/sec
Maximum:	22.1 m/sec

The stability distribution is:

Stability Class	Duration (hr)
A	4281
B	1447
C	1831
D	13250
E	14315
F	4381
G	3763

Current control room χ/Q calculations include several improvements:

- Five recent years (1999 - 2003) of meteorological data are used, rather than only three years of older data (1992 - 1994).
- Four additional Auxiliary Building leakage sources are assessed.
- The ARCON96 code was used to calculate the dispersion factors for all source receptors.

- Upper-level meteorological data is included. The previous calculation used only lower-level data.

- The building wake is specific to each source-receptor, rather than assuming that all releases are into the containment wake.

The current off-site χ/Q calculations include several improvements:

- Five most recent years of meteorological data (1999 - 2003) in-place-of three years of older data.

- Terrain correction is considered

- Updated wake area, consistent with the Containment Building Facade

2.1 Containment Leakage and Equipment Hatch Roll-up Door

Containment

Dose calculations using this source include:

- LBLOCA, containment leakage
- Rod Ejection, containment leakage

The containment shell is modeled as a diffuse vertical area source. The elevations of the Containment Building and Control Room intake are illustrated on Figure 2.1A.

Cases 1 and 2 are the same, with the exception of the assumed vertical dimension of the source. Case 1 (sensitivity case) assumes the height of the source is from grade elevation to the spring line. Case 2 (Radiological Basis) adds the effective height of the containment dome to the Case 1 source height. The input and results for these cases are summarized in Table 2.1. A plan view showing horizontal and angular dimensions is provided in Figure 2.1B.

The area used in the ARCON96 building wake calculation is conservatively assumed to equal the vertical, cross-sectional area of the Containment Facade (area normal to the source-receptor direction).

Equipment Hatch

Dose calculations using this source include:

- Fuel Handling Accident inside containment

In this case, all leakage is assumed from the containment equipment hatch, a large penetration located in the south-east sector of the Containment perimeter. During refueling, the hatch is removed, and the open penetration is covered by a roll-up door. The source dimensions are based on the face area of the roll-up door. Activity is postulated to leak through the open hatch, and to the environment via the perimeter seals and face of the roll-up door. The input and results for this case are summarized in Table 2.1. A plan view showing horizontal and angular dimensions is provided in Figure 2.1D.

The assumed wake area is also shown in Figure 2.1D. Inspection of the figure, shows that the wake area is dominated by the Containment facade. The height and width of the wake area are assumed to be consistent with those of the containment leakage calculation. The area is 1850 m^2.

TABLE 2.1 CONTAINMENT LEAKAGE INPUT AND RESULTS			
Parameter	Case 1	Case 2	Case 3
Distance to receptor, m	32	32	32
Intake height, m	13.8		
Direction to source, degrees	247	247	227
Release type	ground level, diffuse vertical area		
Release height, m	9.2	15.6	6.7
Building area, m^2	1850		
Sector width constant	4.3		
Surface roughness	0.2		
Initial diffusion coefficients, m σ_{y0} σ_{z0}	5.7 3.1	5.7 5.2	1.2 1.1
Resulting χ/Q, sec/m^3 0-2 hr 2-8 hr 8-24 hr 1-4 days 4-30 days	2.56E-03 1.86E-03 7.13E-04 6.25E-04 5.33E-04	1.77E-03 1.25E-03 4.80E-04 4.24E-04 3.66E-04	5.58E-03 4.66E-03 1.65E-03 1.58E-03 1.32E-03

Case 1 - Containment leakage diffuse vertical area source, initial diffusion coefficients (sensitivity case)

Case 2 - Containment leakage diffuse vertical area source (source height extended to top of dome) This is the Radiological Basis Analysis.

Case 3 - Containment Equipment Hatch roll-up door, diffuse vertical area source

All Cases:
- Lower measurement height: 33 ft (10 meters)
- Upper measurement height: 150 ft (45.7 meters)
- Elevation difference: 0 meters (Both the source and receptor heights are determined relative to the 270 ft grade elevation).

FIGURE 2.1A

Containment and Control Building Elevations

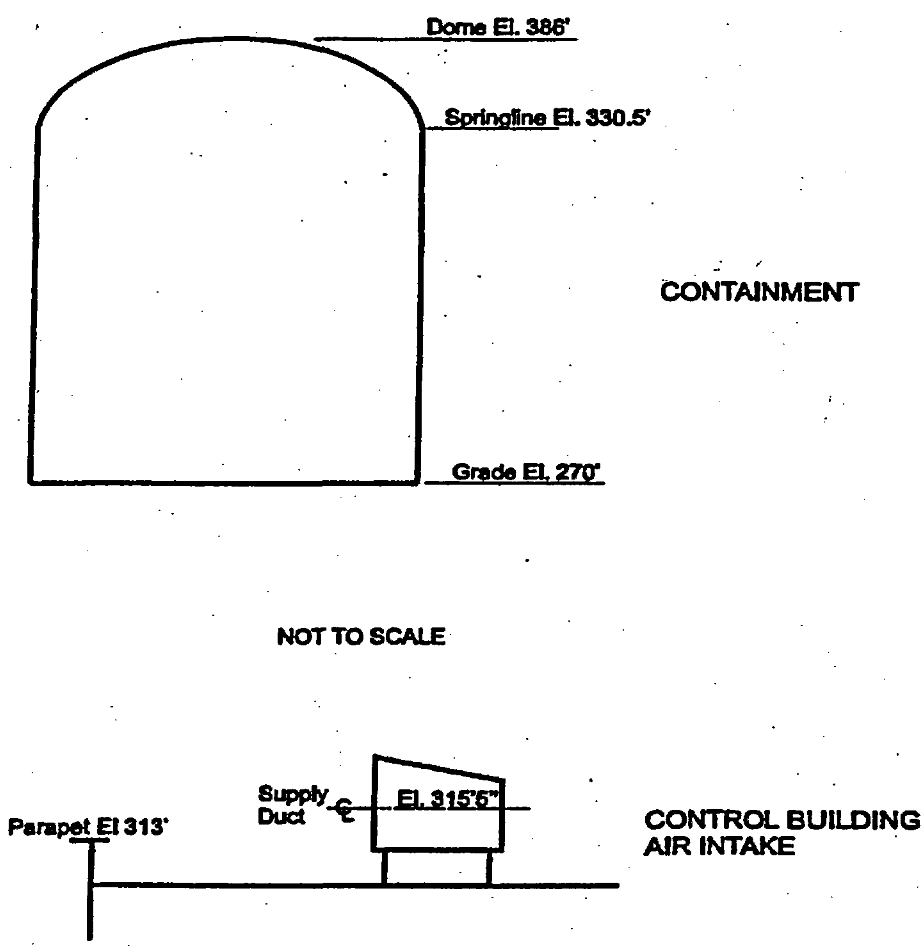


FIGURE 2.1B

Containment Leakage Plan View

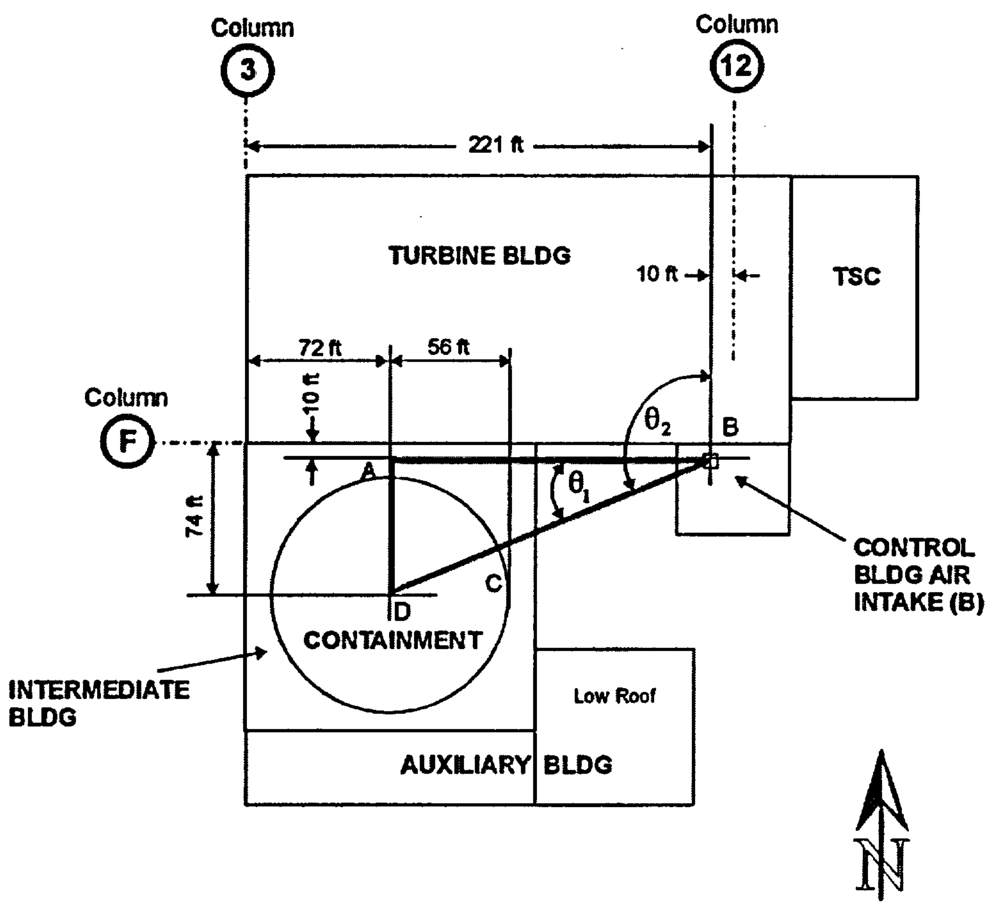
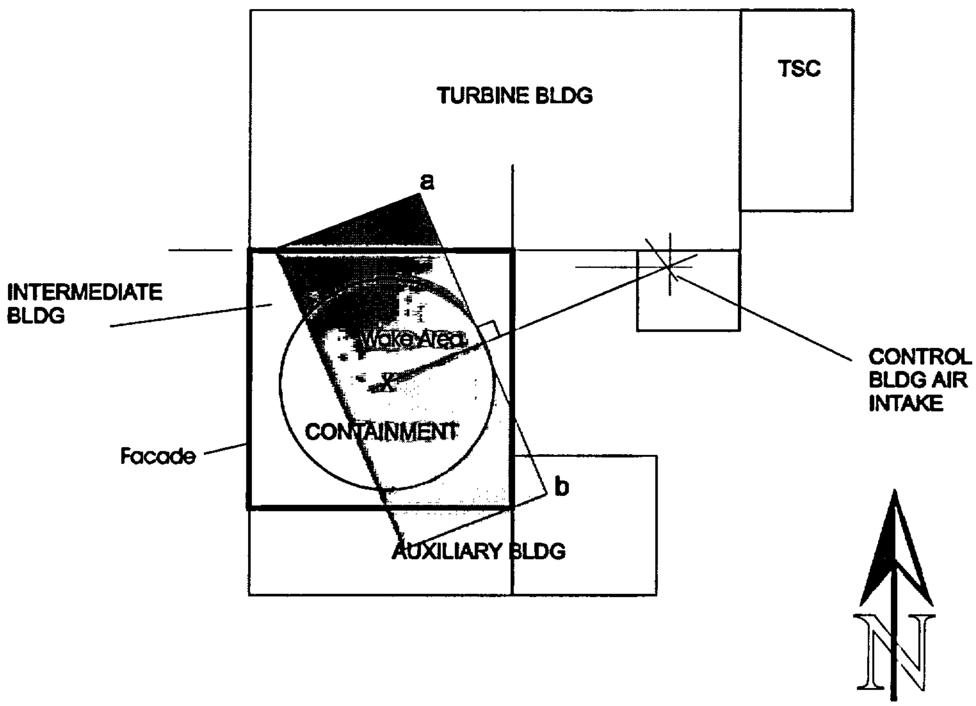


FIGURE 2.1C

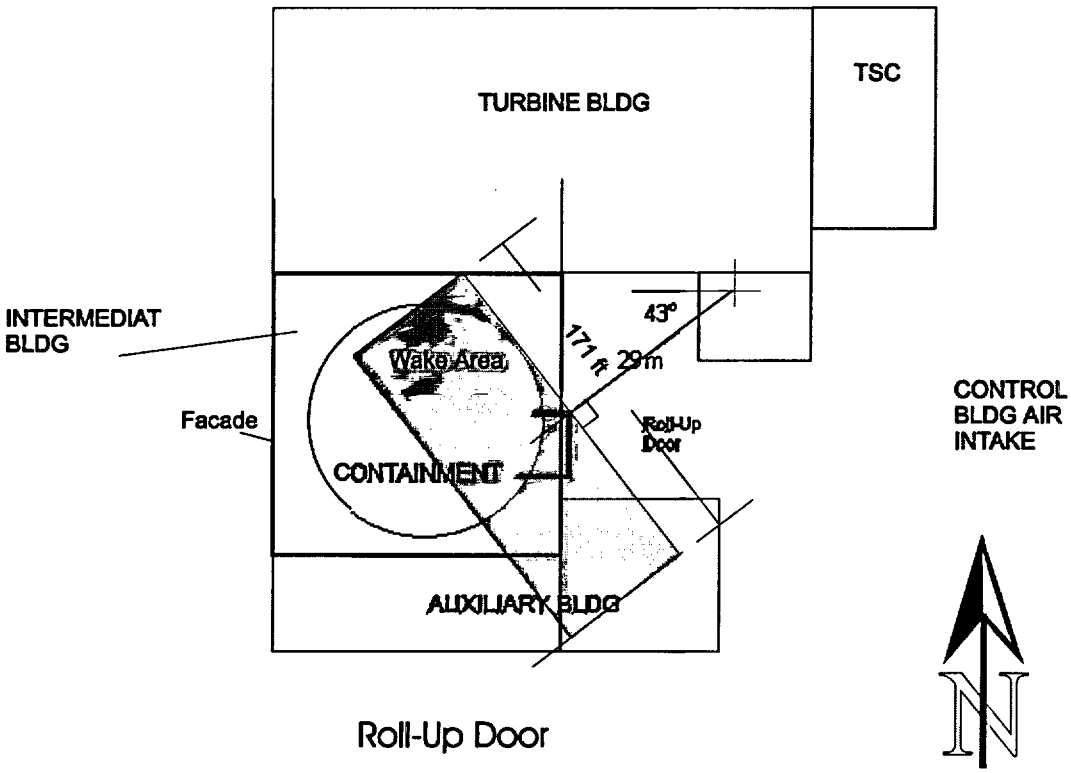
Containment Leakage Wake Area, Cases 1 and 2



Airflow striking the West and South faces of the Facade is expected to flow around (SE and NW edges) and over the facade. The assumed wake area is centered on and normal to the line drawn from the center of the containment source to the Control Building air intake. The width of the source extends from the SE corner of the Facade to a point on the north face of the Facade. The face was not extended to the NW edge of the Facade, to maintain symmetry and a conservatively small wake area. Also, calculations have demonstrated that increasing the wake area beyond 1071 m^2 has little effect on the calculated χ/Q.

Figure 2.1D

Roll-Up Door Plan View; Case 3



Roll-Up Door

Airflow striking the West and South faces of the Facade and Auxiliary Building is expected to flow around (SE and NW edges) and over the facade and the High and Low Roof Auxiliary Buildings. The assumed wake area is centered on and normal to the line drawn from the Roll-up Door to the Control Building air intake. The width of the source extends from the SE corner of the Auxiliary Building to a point on the north face of the Facade. The face was not extended to the NW edge of the Facade, to maintain symmetry. Also, calculations have demonstrated that increasing the wake area beyond 1071 m^2 has little effect on the calculated χ/Q.

2.2 Atmospheric Relief Valves (ARVs)

Dose calculations using this source include:

- Locked Rotor
- Rod Ejection, secondary-side activity release
- SGTR
- Steam Line Break, intact SG

The discharge of the ARV was modeled as a ground-level point source, rather than an elevated vent. Reference 2 advises against using the vent release model, pending further NRC evaluation. The point source option is a conservative alternative. Plan views showing horizontal and angular dimensions are provided in Figures 2.2A and 2.2B. Input and results are summarized in Table 2.2.

There are two groups of ARVs, located inside the intermediate building, behind the facade, near the north wall. Only the "B group" will be analyzed as it is closest to the control room air intake. Further, the "B group" source-receptor distance will based on the distance from the ARV riser that is closest to the control room intake.

The assumed building wake area is shown in Figure 2.2B. The width of the wake area is 137 ft, which was scaled from the original drawing. This dimension is comparable to the width of the east face of the facade. The face of the wake area is centered on the source. One half of the area is assumed to include the facade (ARVs are behind the facade), and one half includes the Turbine Building.

TABLE 2.2
ATMOSPHERIC RELIEF VALVES INPUT AND RESULTS

Parameter	Case 4
Distance to receptor, m	40
Intake height above grade, m	13.8
Direction to source, degrees	273
Release type	ground level, point source
Release height, m	22
Building area, m^2	1324

TABLE 2.2 ATMOSPHERIC RELIEF VALVES INPUT AND RESULTS	
Sector width constant	4.3
Surface roughness	0.2
Initial diffusion coefficients, m σ_{y0} σ_{z0}	 0 0
Resulting χ/Q, sec/m^3 0-2 hr 2-8 hr 8-24 hr 1-4 days 4-30 days	 3.72E-03 2.51E-03 1.15E-03 8.35E-04 6.88E-04

FIGURE 2.2A

ARV Group A Plan View

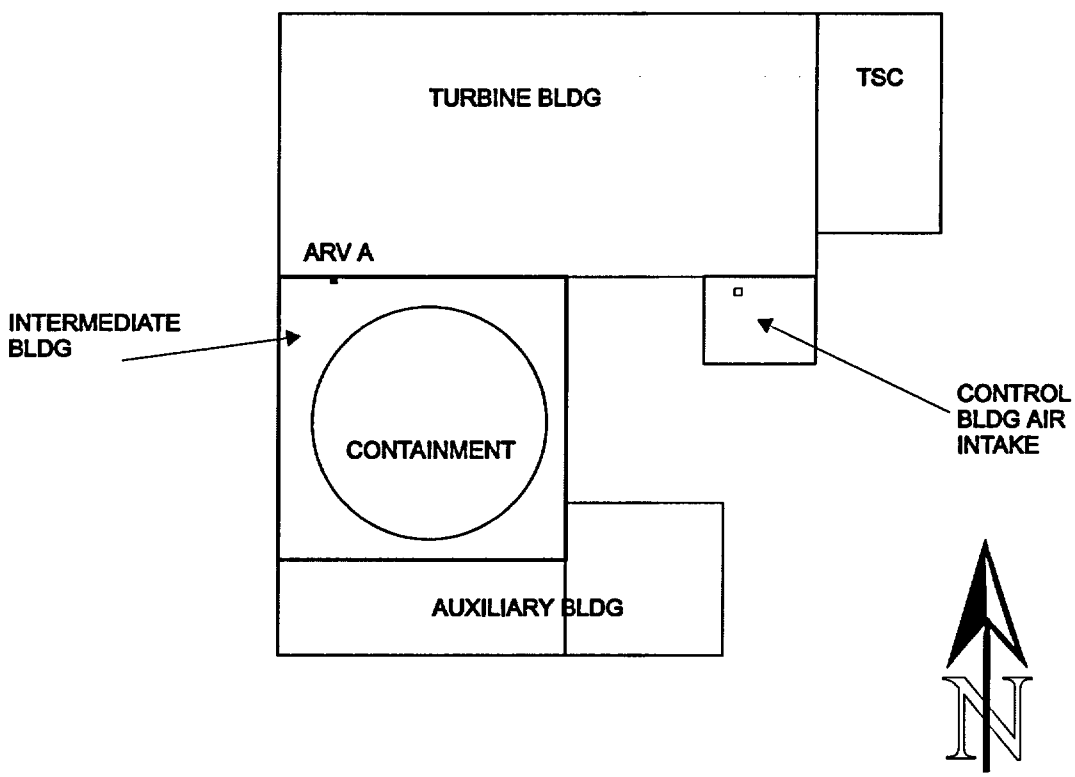
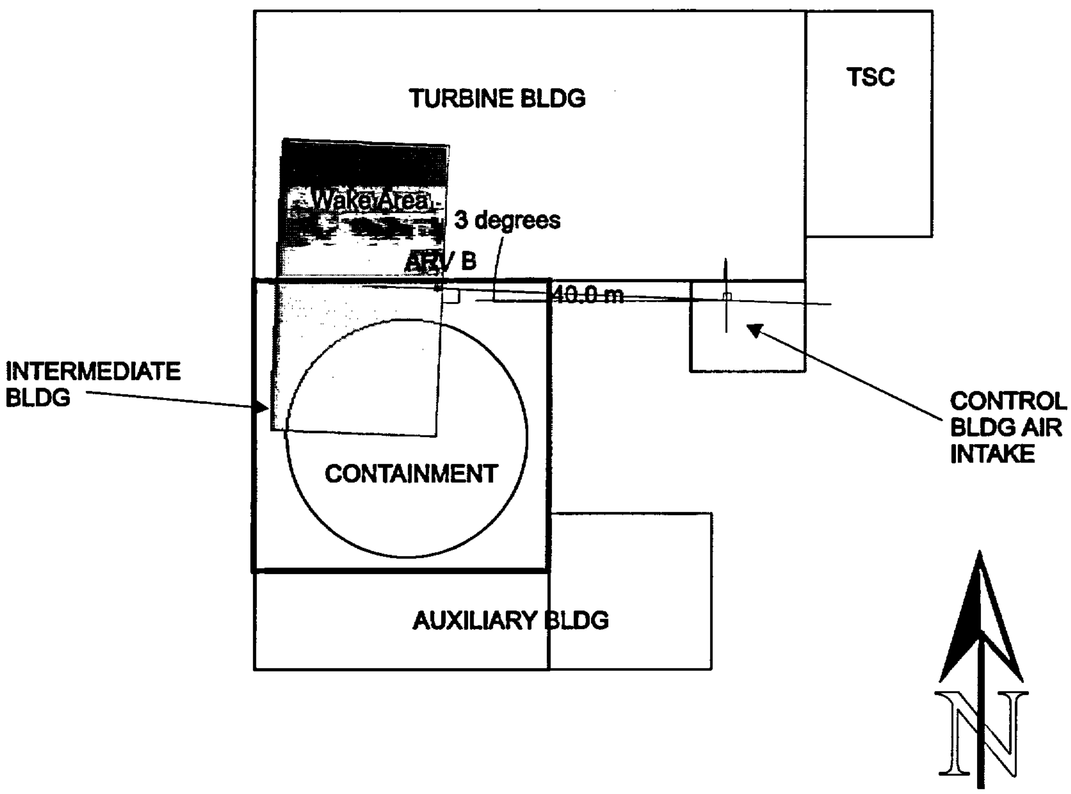


FIGURE 2.2B

ARV Group B Plan View



Airflow striking the West faces of the Facade and Turbine Building is expected to flow around and over the facade and over the Turbine Building. The assumed wake area is centered on and normal to the line drawn from the ARV to the Control Building air intake. The width of the area is conservatively limited to the width of the one side of the Facade. Also, calculations have demonstrated that increasing the wake area beyond 1071 m^2 has little effect on the calculated χ/Q.

2.3 Plant and Containment Vents

Plant Vent (Case 5)

Dose calculations using this source include:

- Fuel Handling Accident in the Spent Fuel Pool

This source is used for releases from a fuel handling accident in the spent fuel pool. The Plant Vent is located inside the Intermediate Building, near the north wall. The vent will be modeled as a horizontal area source, rather than a vent source, based on the guidance of Reference 2, which advises against using the vent release model pending further NRC evaluation. The assumption of an area source is more conservative than the vent source assumption, but less conservative than a point source. A plan view showing horizontal and angular dimensions is provided in Figure 2.3A. Input and results are summarized in Table 2.3.

Containment Vent (Case 6)

Dose calculations using this source include: none

The Containment Vent is located inside the Intermediate Building, near the north wall. The vent will be modeled as a horizontal area source, rather than a vent source, based on the guidance of Reference 2, which advises against using the vent release model pending further NRC evaluation. The assumption of an area source is more conservative than the vent source assumption, but less conservative than a point source. A plan view showing horizontal and angular dimensions is provided in Figure 2.3B. Input and results are summarized in Table 2.3.

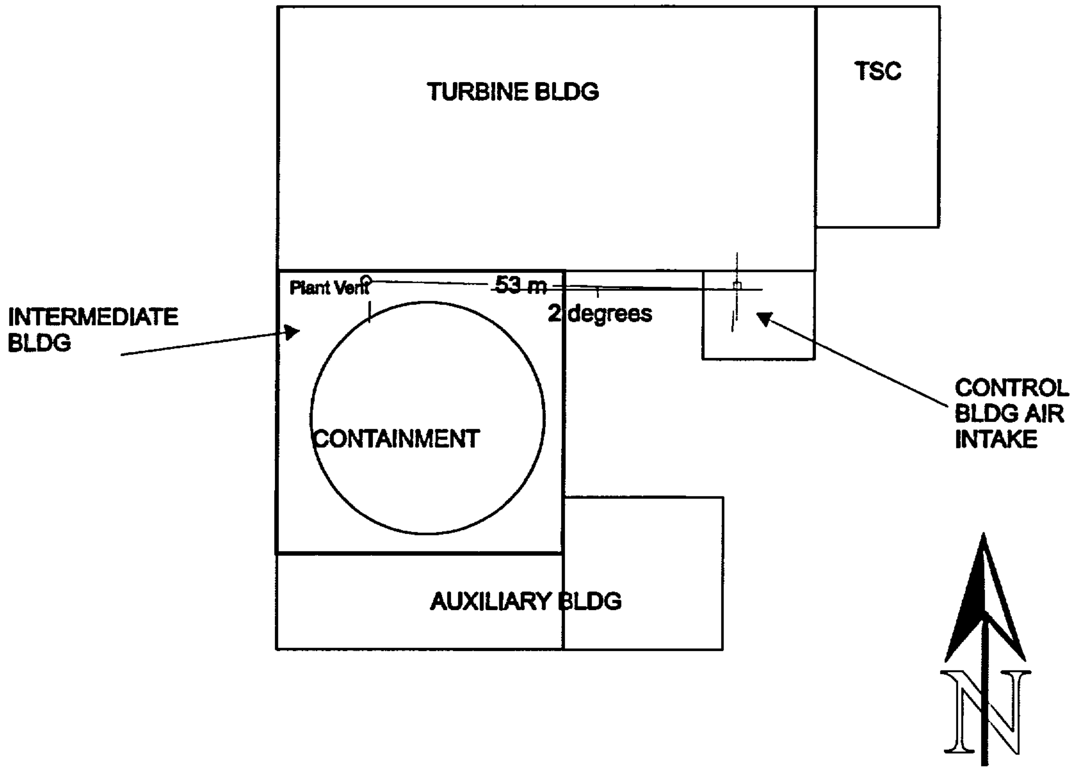
TABLE 2.3
CONTAINMENT AND PLANT VENT INPUT AND RESULTS

Parameter	Case 5 Plant Vent	Case 6 CNMT Vent
Distance to receptor, m	53	51
Intake height, m	13.8	
Direction to source, degrees	272	
Release type	ground level, diffuse horizontal area	

TABLE 2.3 CONTAINMENT AND PLANT VENT INPUT AND RESULTS		
Release height, m	36	
Building area, m^2	1324	
Sector width constant	4.3	
Surface roughness	0.2	
Initial diffusion coefficients, m σ_{y0} σ_{z0}	 0.23 0	 0.14 0
Resulting χ/Q, sec/m^3 0-2 hr 2-8 hr 8-24 hr 1-4 days 4-30 days	 1.99E-03 1.46E-03 6.35E-04 5.01E-04 4.47E-04	 2.05E-03 1.58E-03 6.73E-04 5.38E-04 4.75E-04

FIGURE 2.3A

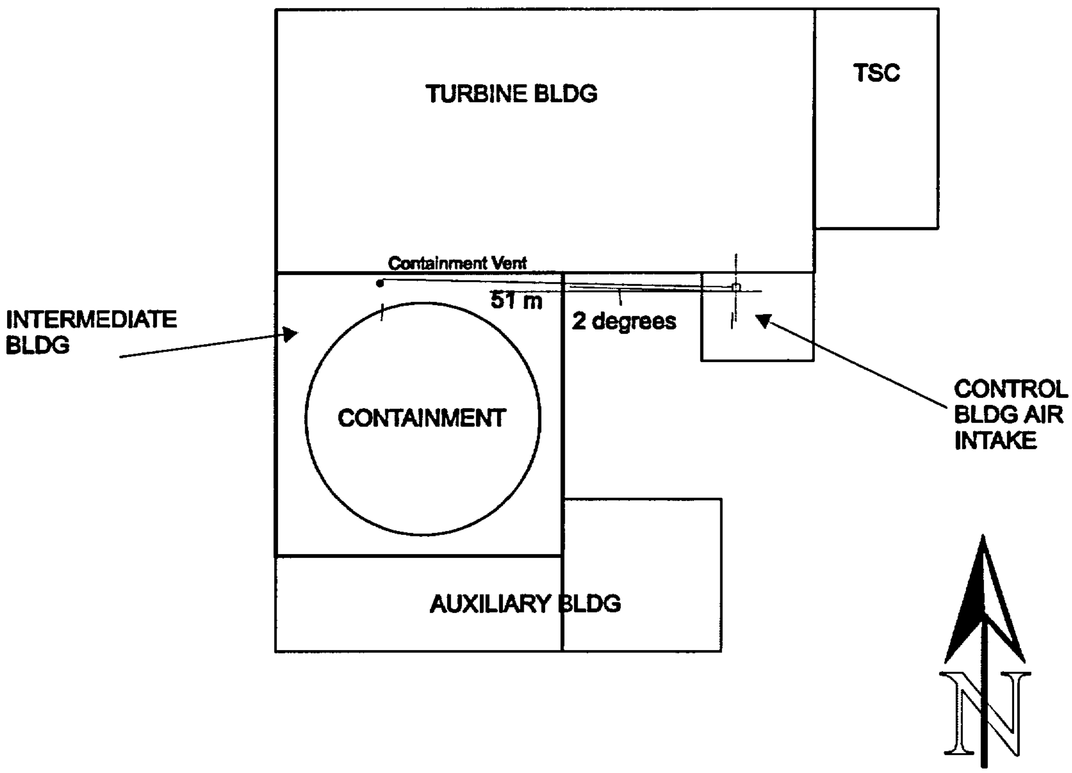
Plant Vent Plan View



The wake area assumed for the Plant Vent source is the same area assumed for ARV, Group B (See Figure 2.2B)

FIGURE 2.3B

Containment Vent Plan View



The wake area assumed for the Containment Vent source is the same area assumed for ARV, Group B (See Figure 2.2B)

2.4 Auxiliary Building Leakage

Dose calculations using this source include:

- LOCA, ECCS leakage
- Gas Decay Tank rupture

The Auxiliary Building source is used to model the activity released from leaking components that handle the recirculating core cooling solution and activity from a Gas Decay Tank rupture. These components are primarily located on the basement level of the Auxiliary Building. Five potential leakage paths from the Auxiliary Building to the environment have been identified. Plan views, showing horizontal and angular dimensions, are provided in Figures 2.4A through 2.4E. Input and results are summarized in Table 2.4.

Case 7 - Auxiliary Building North Wall

The assumed source is the northern exposure of the Auxiliary Building. The wall will be modeled as a vertical area source. The assumed wake area is shown in Figure 2.4A.

Case 7a - Back Draft Dampers

The assumed source is the back-draft damper's louver located on the North wall of the Auxiliary Building. The louver is modeled as a vertical area source. The assumed wake area is shown is Figure 2.4B.

Case 7b -Auxiliary Building Vent Intake

The assumed source is the vent intake located on the Auxiliary Building roof, in the South-East corner of the facade. The vent hood is "T" shaped, with the intake area facing downward at approximately 45 degrees. The vent is modeled as a horizontal area source. The assumed wake area is shown in Figure 2.4C.

Case 7c - Steel Door, East Wall

The assumed source is the steel door located on the East Wall of the Auxiliary Building. See Reference 4.30. The door is modeled as a vertical area source.

The assumed wake area is shown in Figure 2.4D. Wake is assumed to be induced by the Auxiliary Building. Inspection of Figure 2.4D shows that the source (on the side of the Auxiliary Building) is south of the control room intake, with no intervening structure. This is a somewhat different situation than for the previous cases, where the assumed wake area is centered on and normal to a line drawn from the source to the receptor. In this case, the structure is located to the side of the source. The assumed wake area is represented by the North face of the low roof Auxiliary Building.

Case 7d - Steel Door, North Wall

The assumed source is the steel door located on the North Wall of the Auxiliary Building. The door is modeled as a vertical area source. A plan view is shown in Figure 2.4E.

TABLE 2.4
AUXILIARY BUILDING LEAKAGE INPUT AND RESULTS

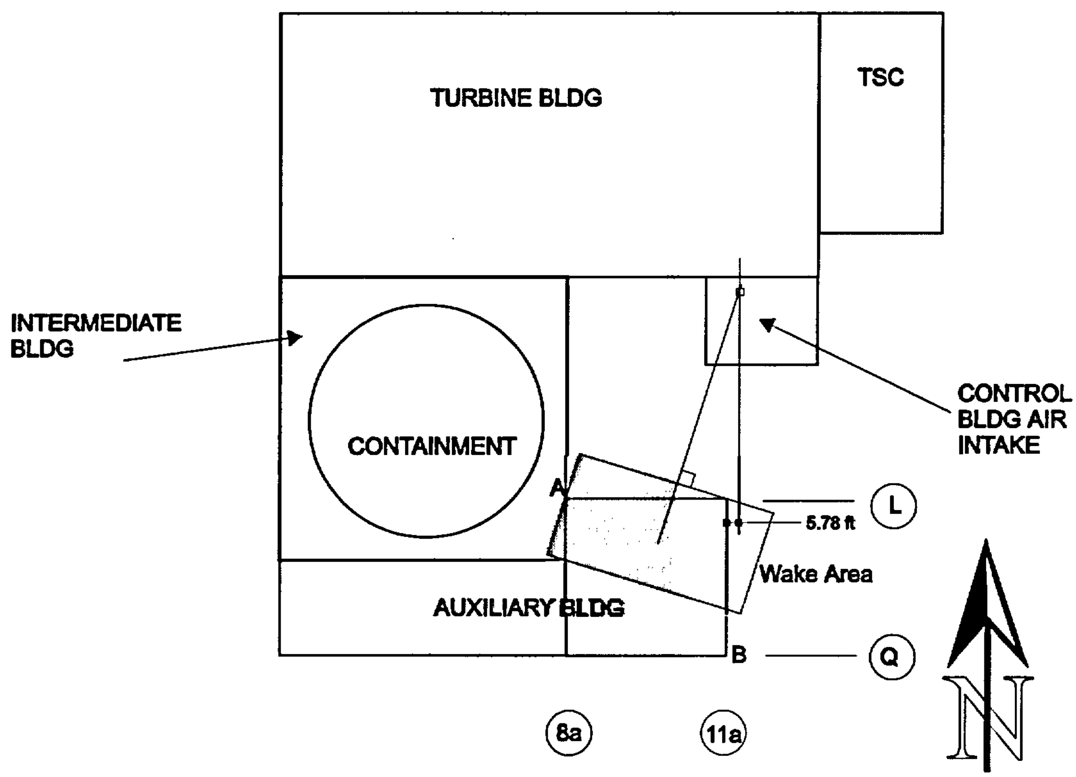
Parameter	Case 7	Case 7a	Case 7b	Case 7c	Case 7d
Distance to receptor, m	30	34.7	39.9	39.2	36.6
Intake height above grade, m	13.8				
Direction to source, degrees	205	212	222	183	216
Release type	ground level, diffuse vertical area		ground level, diffuse horizontal source	ground level, diffuse vertical area	
Release height, m	6.4	8.8	17.7	0.3	0.3
Building area, m^2	444	553	1700	326	553
Sector width constant	4.3				
Surface roughness	0.2				
Initial diffusion coefficients, m σ_{y0} σ_{z0}	 3.9 2.1	 1.1 0.7	 0.7 0	 0.2 0.3	 0.2 0.3

TABLE 2.4 AUXILIARY BUILDING LEAKAGE INPUT AND RESULTS					
Resulting χ/Q, sec/m^3					
0-2 hr	3.76E-03	4.69E-03	4.24E-03	3.62E-03	4.14E-03
2-8 hr	3.01E-03	3.97E-03	3.51E-03	3.11E-03	3.65E-03
8-24 hr	1.02E-03	1.40E-03	1.19E-03	1.14E-03	1.32E-03
1-4 days	9.85E-04	1.32E-03	1.17E-03	9.13E-04	1.21E-03
4-30 days	8.48E-04	1.11E-03	9.87E-04	7.89E-04	1.01E-03

Case 7: Aux Building North wall, area above grade
Case 7a: Aux Building North wall, back draft damper grills (Radiological Basis)
Case 7b: Aux Building Roof, vent intake
Case 7c: Aux Building East wall, steel door
Case 7d: Aux Building North wall, steel door

FIGURE 2.4A

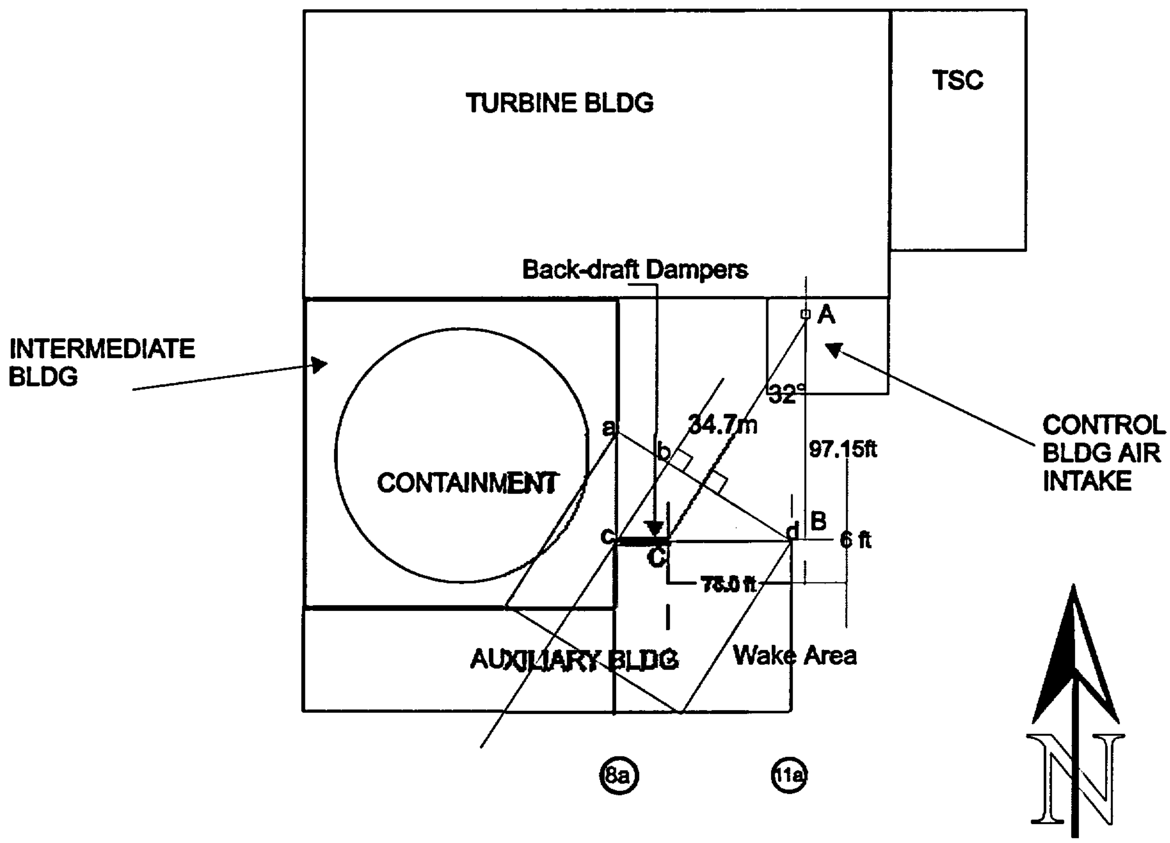
Auxiliary Building Leakage Plan View Case 7, North Exposure, Wall Source



Airflow striking the South faces of the Facade and Auxiliary Buildings is expected to flow around the Facade and Auxiliary Building and over the high and low roof Auxiliary Buildings. The assumed wake area is centered on and normal to the line drawn from the center of the Auxiliary Building source to the Control Building air intake.

FIGURE 2.4B

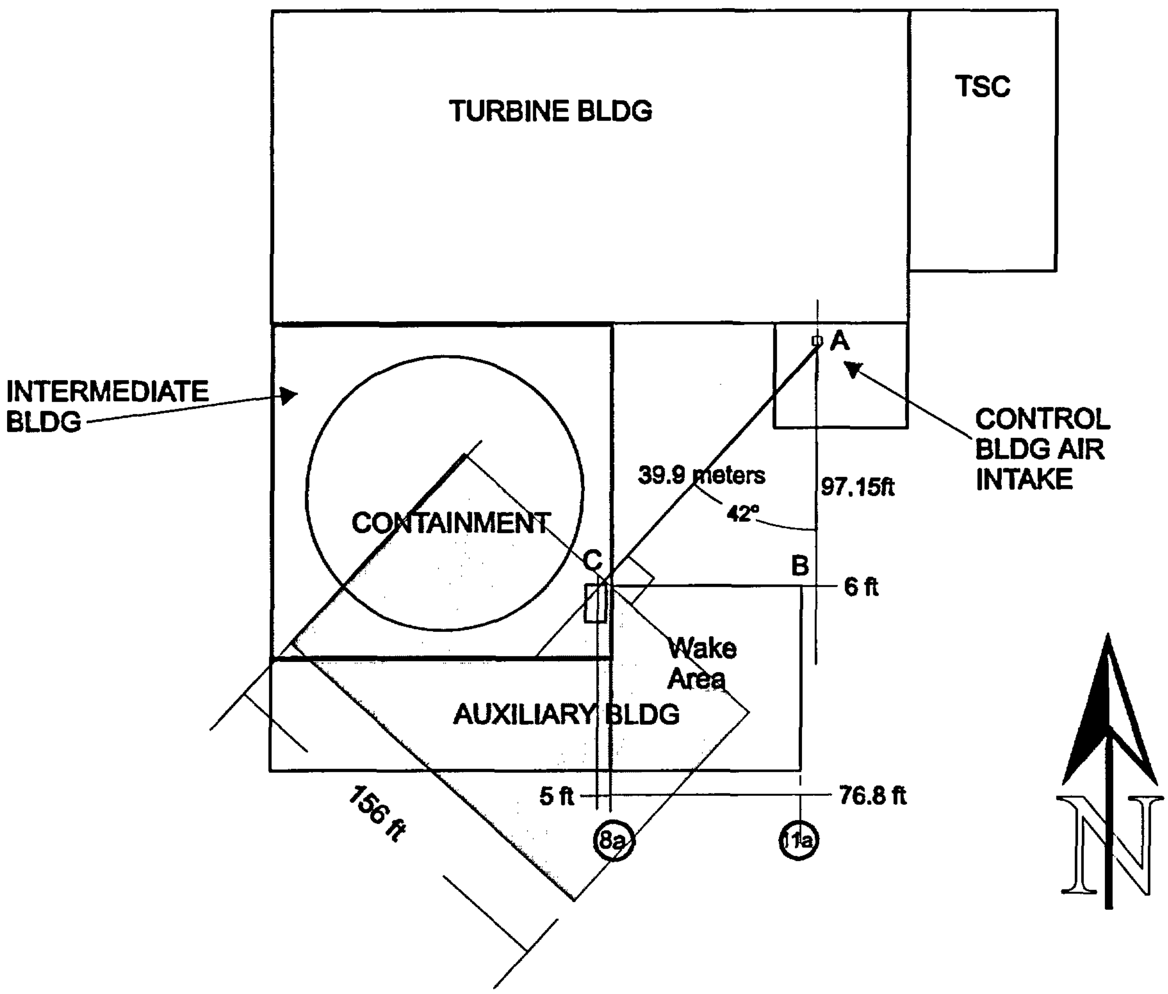
Auxiliary Building Leakage Plan View Case 7a North Wall Back-Draft Damper Source



Airflow striking the South faces of the Facade and South and West faces of Auxiliary Building is expected to flow around the Facade and Auxiliary Building and over the high and low roof Auxiliary Buildings. The assumed wake area is centered on and normal to the line drawn from the dampers to the Control Building air intake.

FIGURE 2.4C

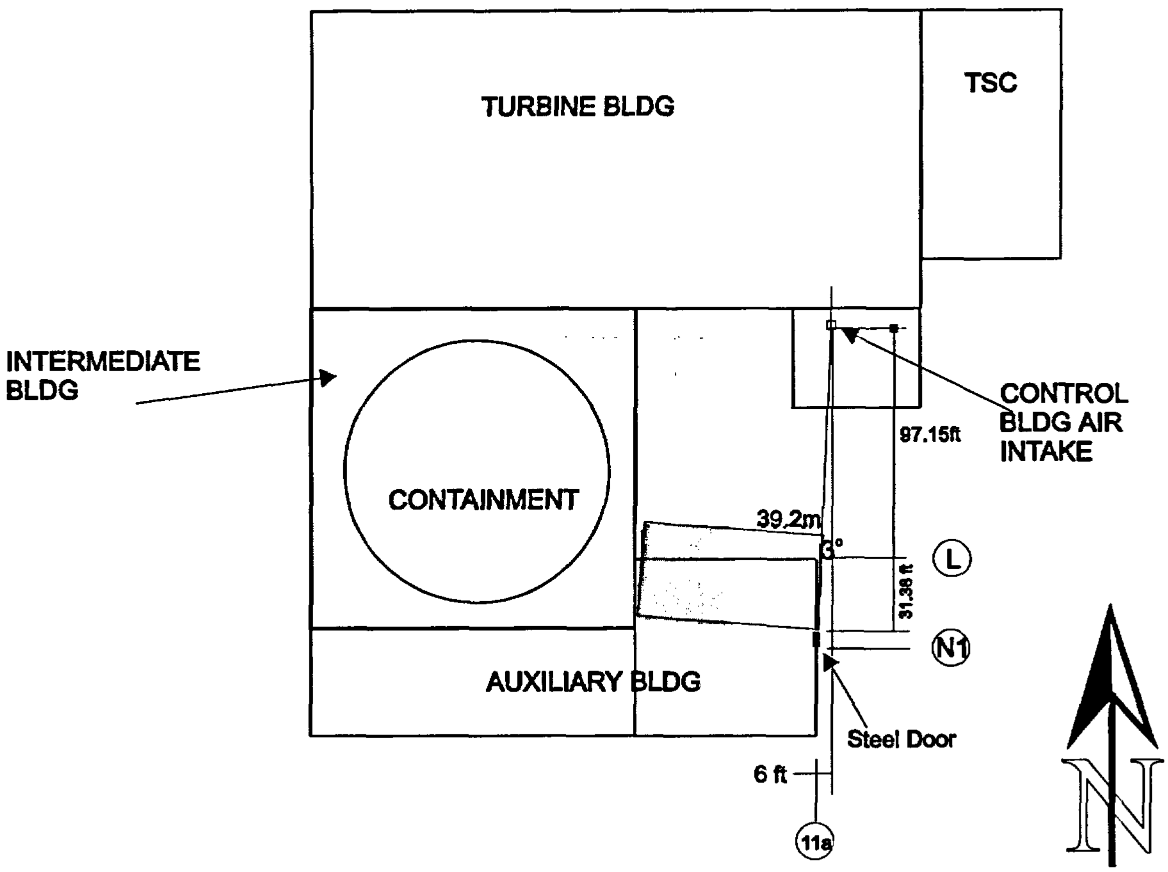
Auxiliary Building Leakage Plan View Case 7b Auxiliary Building Intake Vent Source



Airflow striking the South faces of the Facade and South and West faces of Auxiliary Building is expected to flow around the Facade and Auxiliary Building and over the high and low roof Auxiliary Buildings. The assumed wake area is centered on and normal to the line drawn from the Auxiliary Building air intake to the Control Building air intake.

FIGURE 2.4D

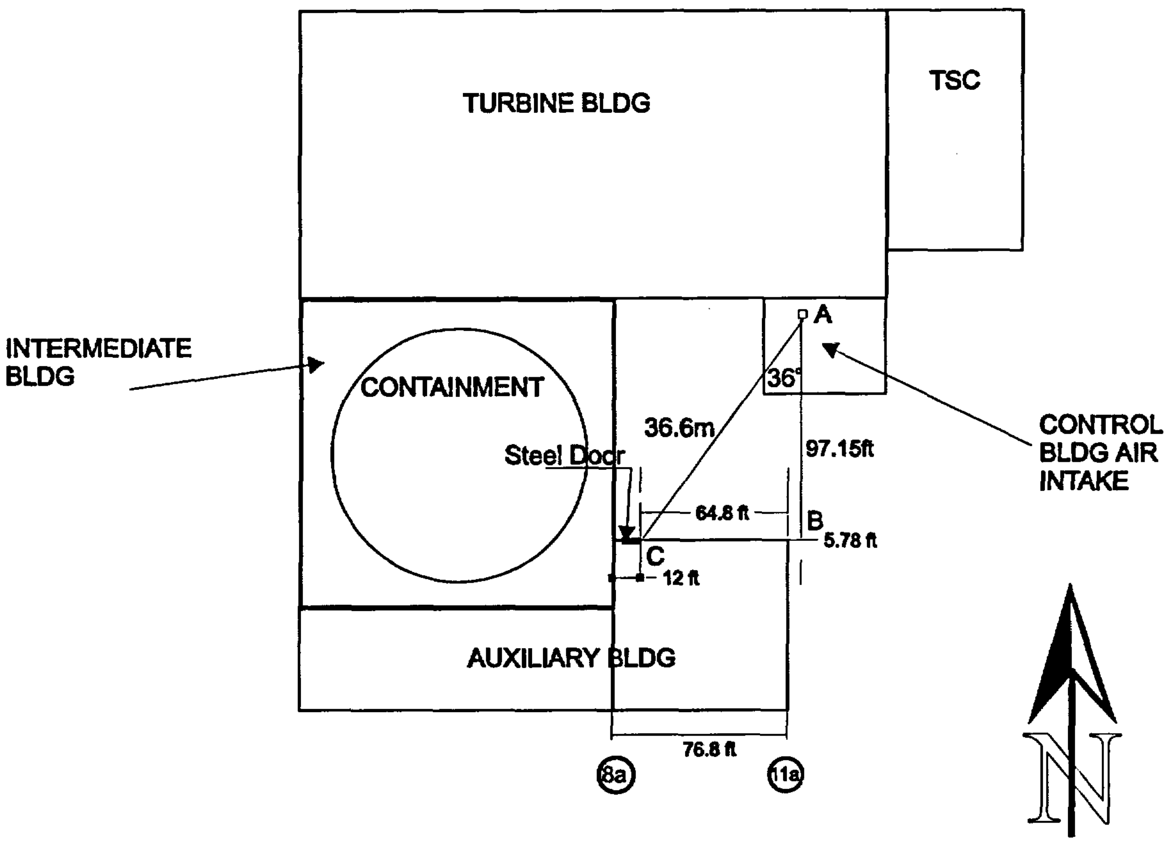
Auxiliary Building Leakage Plan View Case 7c Auxiliary Building Steel Door, East Wall



Airflow striking the South faces of the Facade of Auxiliary Building is expected to flow around the Facade and Auxiliary Building and over the high and low roof Auxiliary Buildings. The assumed wake area is normal to (but not centered on) the line drawn from the door to the Control Building air intake.

FIGURE 2.4E

Auxiliary Building Leakage Plan View Case 7d Auxiliary Building Steel Door, North Wall



The wake area assumed for the North wall steel door source is the same area assumed for the North Wall Back-draft Dampers (See Figure 2.4B)

2.5 Main Steam Header Turbine Building

Dose calculations using this source include:

- Main Steam Line Break outside containment, faulted loop

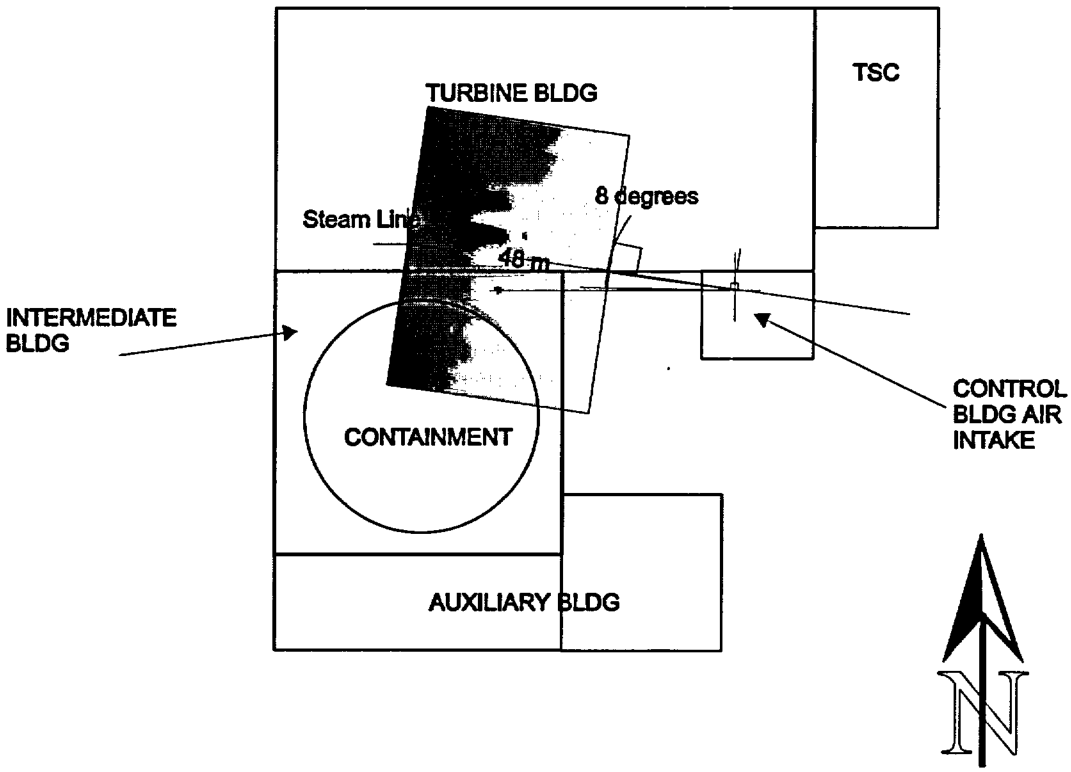
The main steam line source is used to model the activity released from a ruptured main steam line outside Containment. The rupture site is assumed to be in the 36" steam header, which is located inside the Turbine Building, on the Mezzanine level. The release of steam, inside the Turbine Building, is assumed to blow-out the windows (south-east corner) and metal siding. Thus, confinement of the plume, within the Turbine Building, is not considered. The specific geometry of the rupture is not defined, and, as such, it is conservatively modeled as a point source. A plan view showing horizontal and angular dimensions and wake area is provided in Figure 2.5A. Input and results are summarized in Table 2.5.

TABLE 2.5
MAIN STEAM HEADER TURBINE BUILDING INPUTS AND RESULTS

Parameter	Case 8
Distance to receptor, m	48
Intake height, m	13.8
Direction to source, degrees	278
Release type	ground level, point source
Release height, m	4
Building area, m^2	1158
Sector width constant	4.3
Surface roughness	0.2
Initial diffusion coefficients, m σ_{y0} σ_{z0}	 0 0
Resulting X/Q, sec/m^3 0-2 hr 2-8 hr 8-24 hr 1-4 days 4-30 days	 2.59E-03 1.88E-03 8.28E-04 5.90E-04 4.77E-04

FIGURE 2.6

Steam Line Plan View, Case 8



Airflow striking the West faces of the Facade and Turbine Building is expected to flow around and over the facade and over the Turbine Building. The assumed wake area is centered on and normal to the line drawn from the steam line (header) to the Control Building air intake. The width of the area is conservatively limited to the width of the one side of the Facade.

2.6 Case 9 - Tornado Missile

Dose calculations using this source include:

- Tornado Missile Accident

The tornado missile accident assumes that a utility pole, propelled by the wind, penetrates the Auxiliary Building roof, and impacts fuel stored in the Spent Fuel Storage Pool (SFP). Further, sections of siding are predicted to be damaged and blown-off.

The specific location of the impact, within theSFP, cannot be predicted. Thus, the shortest source-receptor distance is conservatively calculated. A specific source geometry has not been defined. As such, the source is conservatively modeled as a point source. A plan view showing horizontal and angular dimensions is provided in Figure 2.6A.

The control room atmospheric dispersion factor, for tornado conditions, was calculated with the ARCON96 code, using a diffuse horizontal area source, based on the surface area of the spent fuel pool. The tornado dispersion factor was extracted from the ARCON96 qa file, for a single hour of data. The tornado dispersion factors for the EAB and LPZ were calculated with the CONHAB module of the HABIT code, and are based on a point source.

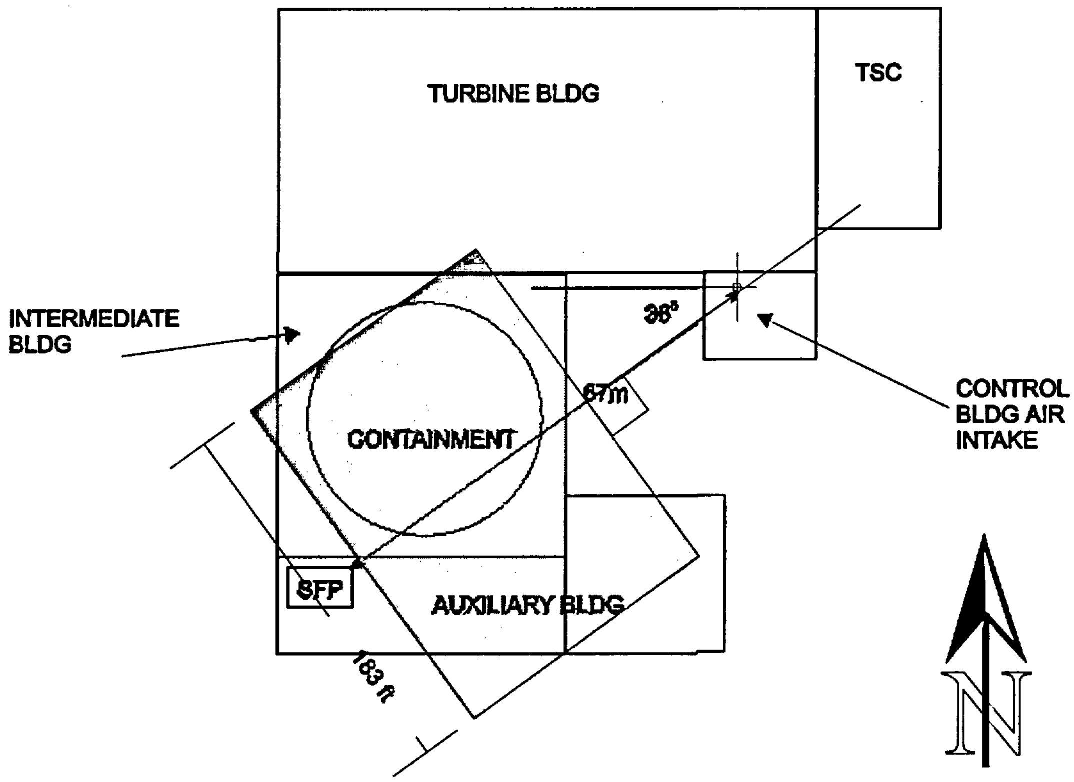
The ARCON96 code was also used to determine the control room dispersion factors for normal atmospheric conditions (Table 2.6B).

TABLE 2.6A TORNADO MISSILE INPUT AND RESULTS			
Parameter	Control Room	EAB	LPZ
Computer Code	ARCON96	CONHAB	
Distance to receptor, m	67	503	4827
Intake height above grade, m	13.8	n/a	
Direction to source, degrees	n/a	n/a	
Release type	ground level diffuse horizontal area	ground level, point source	
Release height, m	2.1		
Building area, m^2	1990		
Sector width constant	4.3	n/a	
Surface roughness length, m	0.2	n/a	
Initial diffusion coefficients, m σ_{y0} σ_{z0}	 1.7 0	n/a	
Stability class	n/a	F	
Resulting χ/Q, sec/m^3 0-2 hours 2-8 8-24 1-4 days 4-30	n/a	n/a	n/a
Resulting tornado χ/Q, for maximum wind speed hour(22.1 m/sec)	5.14E-5	1.87E-6	4.14E-7

TABLE 2.6 B SPENT FUEL POOL INPUT AND RESULTS - NORMAL ATMOSPHERIC CONDITIONS	
Parameter	Case 9
Distance to receptor, m	67
Intake height above grade, m	13.8
Direction to source, degrees	234
Release type	ground level, point source
Release height, m	2.1
Building area, sq m	1990
Sector with constant	4.3
Surface roughness length, m	0.2
Initial diffusion coefficients σ_{y0} σ_{z0}	 0 0
Resulting X/Q, sec/m^3 0-2 hr 2-8 hr 8-24 hr 1-4 days 4-30 days	 1.44E-03 1.22E-03 4.54E-04 4.17E-04 3.38E-04

FIGURE 2.6A

Spent Fuel Pool Plan View; Case 9



Airflow striking the South and West faces of the Facade and Auxiliary Building is expected to flow around the Facade and Auxiliary Building and over the Facade and high and low roof Auxiliary Buildings. The assumed wake area is centered on and normal to the line drawn from the SFP to the Control Building air intake. The face was not extended to the NW edge of the Facade to maintain symmetry and a conservatively small wake area. The width of the wake area is estimated. Also, calculations have determined that increasing the wake area beyond 1071 m^2 has little effect on the calculated χ/Q.

2.7 EAB and LPZ Atmospheric Dispersion Factors

Assumptions:

- The off site χ/Q's were calculated using computer code KRPavan. KRPavan is a PC version of the NRC's Pavan code.

- Meteorological data was used for the years 1999 through 2003. There are a total of 43,824 available hours. Of these, 556 hours are missing (not recorded) and 835 hours were determined to be invalid. The net hours of available data is 42,433. A sample KRPavan output file shows that only 42,430 hours of data were read, i.e., 3 hours were from the joint frequency distribution. No effort was made to recover these 3 hours of missing data.

  The data recovery fraction is 0.968, or about 97%, which exceeds the 90% minimum data recovery suggested in Reference 26. Unlike ARCON96 (used for Control Room χ/Q), KRPavan does not consider missing or invalid data.

- EAB distances, for each of 16 wind speed directions (22.5° sectors), are provided in Reference 3, Table 2.3-20.

- Calm winds are defined as <0.25 meter/sec. Reference 27 recommends that calms be defined as average hourly wind speeds that are below the start speed of either the anemometer or directional vane, which ever is higher. The 33 ft (10 meter) instruments have start speeds of 0.5 mile/hr (0.224 m/sec).

- Activity releases are assumed to be at ground level.

- The height of the lower and upper level wind speed measurement instruments are 10 meters (33 ft) and 45.7 meters (150 ft), respectively. The upper level height is provided for information.

- Calm hours are distributed in the first wind speed category of the joint frequency distribution.

- The vertical cross-section area, conservatively assumed for the building-wake correction, is 1850m . This is the area of the Containment Building Facade assumed for containment leakage (Table 2.1).

  Figure 2.7A shows the plant layout, including activity release points and elevations of the major structure high-points. All activity releases are not necessarily assumed into the containment wake, rather, all releases are assumed into the wake produced by the overall facility. As such, a conservatively small wake area is used.

- Fourteen (14) wind speed categories are assumed. This is the maximum number of categories (Reference 9).
- Wind speed is input in meters/second.

Results:

EAB verification:

The χ/Q vs frequency data, for the limiting sector (direction-dependent calculations), are analyzed in a spread sheet by fitting an equation to the data. The results of the spread sheet analysis are shown in Figure 2.7B. A trend line is fit to the data, and the resulting 0.5% χ/Q value (0 - 2 hours) is determined. The 0.5 percent code and spreadsheet values (sec/m), for the limiting sector (SE), follow.

Code value: 2.17E-4

Spreadsheet value: 2.16E-4

Visual inspection of the data and the trend line (Figure 2.7B) show good agreement. Also, the code and spreadsheet values show good agreement.

Figure 2.7D shows the results of the overall site (direction-independent) calculations and the calculation of the 5th percentile value. This information is provided to verify KRPavan's determination that the 0.5 percentile (direction-dependent) EAB value is limiting. The 5 percentile value is 1.61E-4, which is lower than the direction-dependent value. Thus, the direction-dependent value is limiting.

Only the 0-2 hour χ/Q will be used for calculating the maximum 2-hour dose at the EAB.

LPZ verification:

The code output indicates that the 0.5% value, determined for the NNE sector, is limiting. Inspection of the sector data indicates that the calculated 0-2 hour value of 4.97E-5 is reasonable and conservative. The χ/Q vs. frequency data is plotted in Figures 2.7C.

The 0-2 hour, 0.5 percent code and spreadsheet values, for the limiting sector (NNE), follow.

Code value: 4.97E-5

Equation value: 4.87E-5

The equation value is lower than the value generated by KRPavan. Inspection of Figure 2.7C shows that the trend line closely follows the data. The 0-2 hr code value is reasonable and conservative (over predicting the equation value by about 2%), and the code generated LPZ values will be accepted.

Result Summary:

The χ/Q values (sec/m^3) are:

Table 2.7
Summary of Off-site x/Q Values

Boundary	0-2 hr	0-8 hr	8-24 hr	24-96 hr	96-720 hr
EAB	2.17E-4	-	-	-	-
LPZ	4.97E-5	2.51E-5	1.78E-5	8.50E-6	2.93E-6

Figure 2.7A

Site Plan, Activity Release Points and Elevations

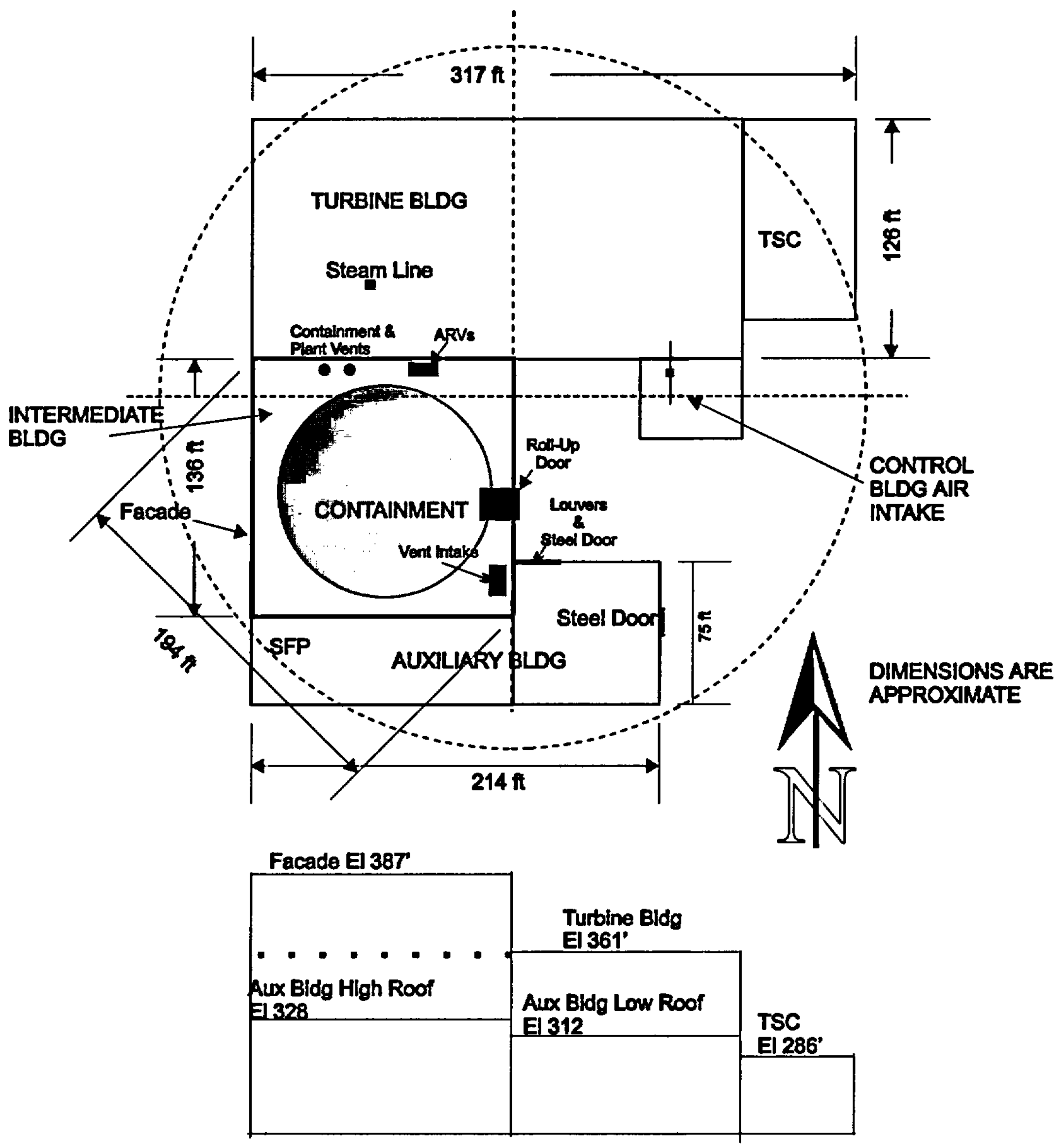
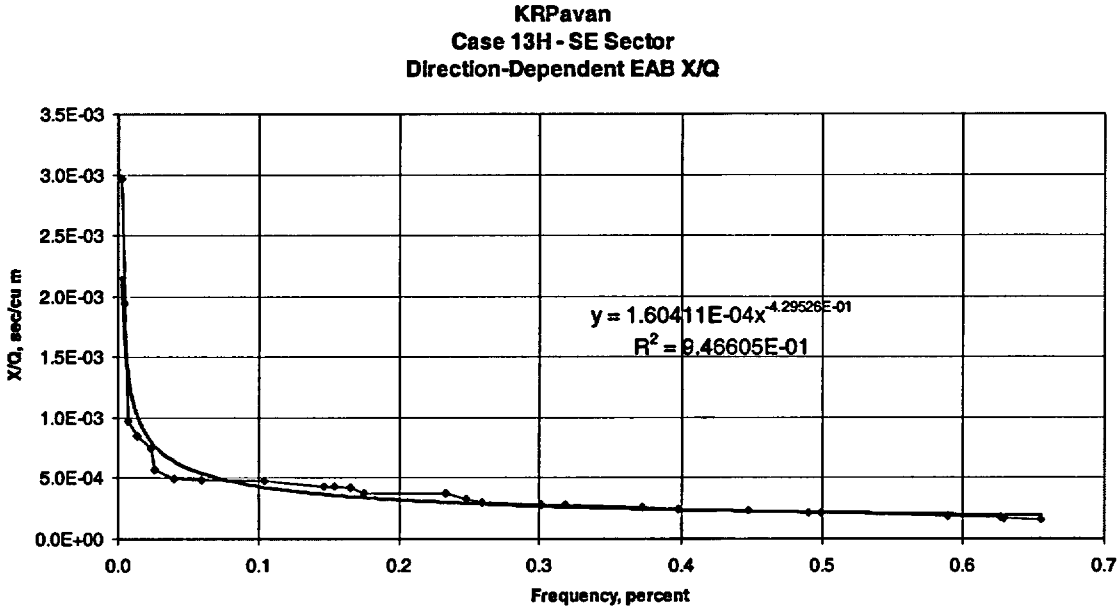


Figure 2.7B

Spreadsheet Analysis EAB χ/Q Data



The 0-2 hour, 0.5 percent EAB value:

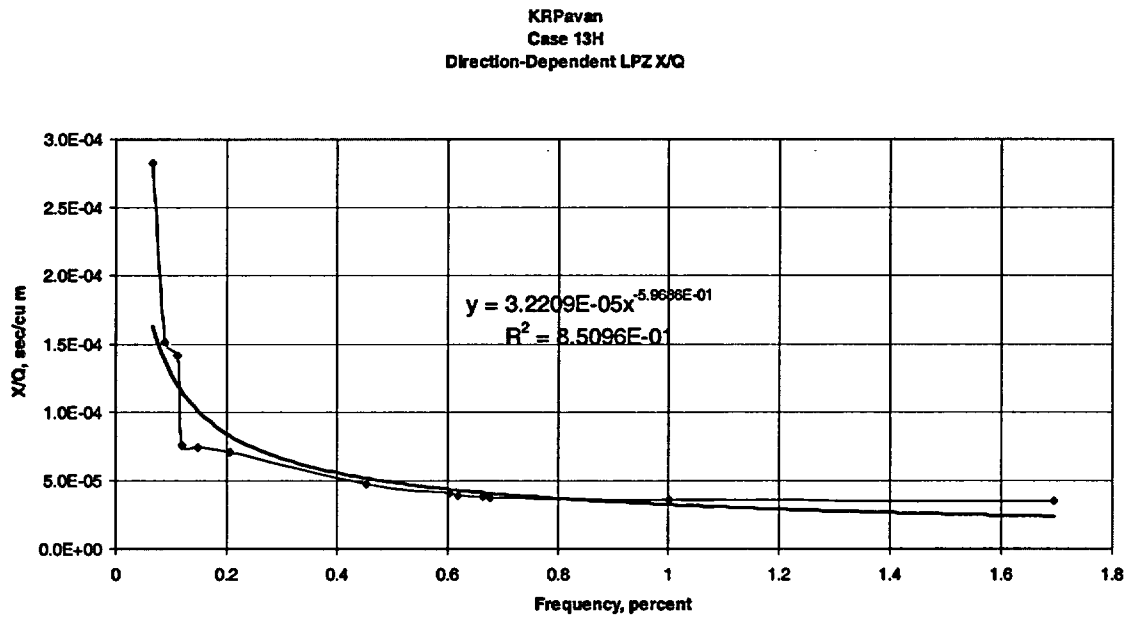
$x := 0.5$

$y := 1.60411 \cdot 10^{-4} \cdot x^{-0.429526}$

$y = 2.160 \times 10^{-4}$

Figure 2.7C

Spreadsheet Analysis of LPZ χ/Q Data



The 0-2 hour, 0.5 percent LPZ value:

$x := 0.5$

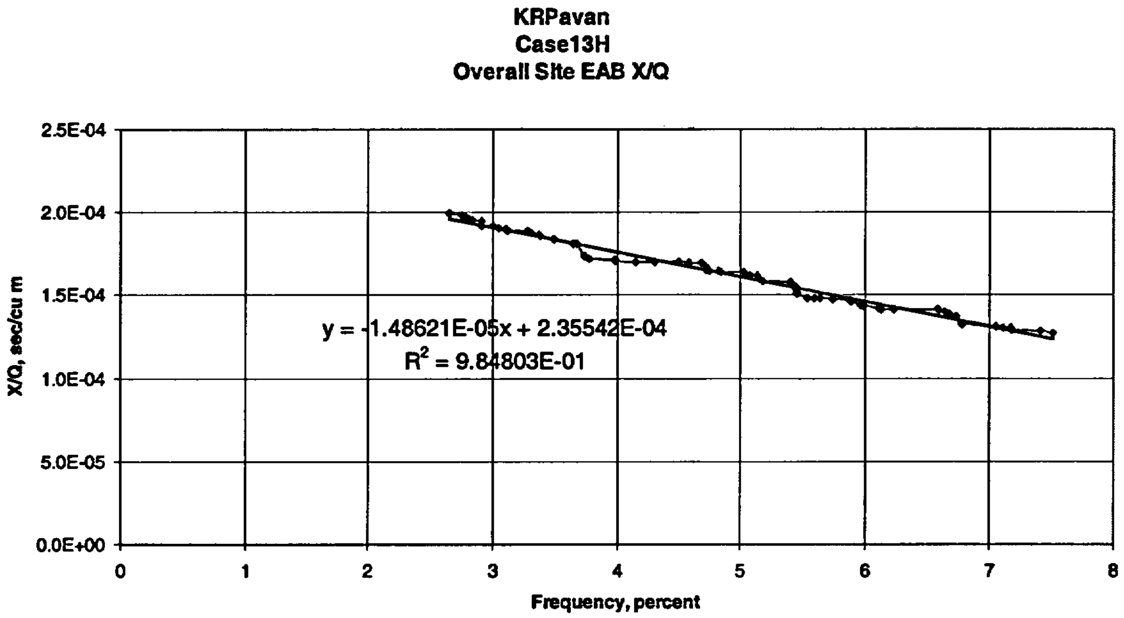
$y := 3.2209 \cdot 10^{-5} \cdot x^{-0.59686}$

$y = 4.871 \times 10^{-5}$

The resulting χ/Q is rounded to 4.87E-5 sec/m^3

Figure 2.7D

Spreadsheet Analysis of 5% Overall Site EAB χ/Q



The 0 - 2 hour, 5% EAB value:

$x := 5$

$y := -1.48621 \cdot 10^{-5} \cdot x + 2.35542 \cdot 10^{-4}$

$y = 1.612 \times 10^{-4}$

The resulting χ/Q is rounded to 1.61E-4 sec/m^3

The 0.5% (direction-dependent) value is bounding. See Figure 2.7B.

3.0 Iodine Spiking

For events where no fuel failure is postulated, iodine spiking is assumed. Two cases of iodine spiking are considered.

1. Accident Initiated Spike
2. Pre-Accident Spike

3.1 Accident Initiated Spike

The primary system transient causes an iodine spike in the primary system. The appearance rate is based on an equilibrium concentration of 1.0 µCi/gm Dose Equivalent I-131. The spike rate multiplier is event dependent. The following inputs are used in the calculation of the appearance rate.

TABLE 3.1 ACCIDENT INITIATED SPIKE INPUTS AND RESULTS		
Reactor coolant system volume, ft^3 rcs pzr (nominal minus 5% uncertainty)	 5506 436	
Letdown purification flow rate, gpm	60 + 10%	
Reactor coolant iodine concentrations @1 μCi/gram of DE 1-131, μCi/gram I-131 I-132 I-133 I-134 I-135	 0.786 4.54 E-3 0.192 1.55 E-4 0.018	
Mixed-bed demineralizer DF	100	
Identified primary coolant leak rate, gpm	10	
Unidentified primary coolant leak rate, gpm	1	
Primary-to-secondary leak rate, gpd per SG	150	
Letdown conditions: Pressure, psia Temperature, °F	 15 127	
Reactor coolant conditions: Pressure, psia Temperature, °F	 2250 559	
Spike multiplier: SGTR non-SGTR	 335 500	
Spike duration, hours	8	
Spike appearance rates, Ci/hr	SGTR	non-SGTR
I-131	4.64E+3	6.93E+3
I-132	8.33E+1	1.24E+2
I-133	1.37E+3	2.05E+3
I-134	6.01E+0	8.97E+0
I-135	1.80E+2	2.69E+2

3.2 Pre-Accident Spike - This assumes a transient has occurred prior to the event and has raised the primary coolant iodine concentration to the maximum full power value. This analysis assumes a value of 60 μCi/gm DE I-131. The resulting concentrations and inventories are:

Nuclide	Concentration μCi/gm	Inventory Ci
I-131	4.71 E+1	5.88 E+3
I-132	2.72 E-1	3.39 E+1
I-133	1.15 E+1	1.43 E+3
I-134	9.32 E-3	1.16 E+0
I-135	1.07 E+0	1.33 E+2

4.0 General Discussion

4.1 The control room dose calculations use the same χ/Q for both pre-isolated outside air and unfiltered inleakage. Pre-isolated outside air enters the control room intake. Ginna does not have dual air intakes. Unfiltered inleakage may enter the control room envelope from doors, penetrations, and air recirculating/filtration equipment. These identified inleakage points are all indirect, i.e., they are inside structures contiguous to the control room boundary, which is predicted to provide additional dilution. Thus, leakage-point-specific χ/Qs would be less than that for the control room intake. The control room intake χ/Qs are assumed to be bounding for all control room dose calculations.

4.2 The nuclide data base used for all calculations is from ORIGEN2 (Reference 12). The nuclides are for a Ginna-specific representative 18 Month Fuel Cycle at end of life. The iodine nuclide inventories were increased by 2% over the calculated values.

4.3 All dose calculations assume the FGR11 and FGR12 dose conversion factors (References 10 and 11).

4.4 No credit is taken for elemental or organic iodine removal by the containment CRFC charcoal adsorbers. This is indicated by assuming 0% efficiency as an input parameter. Credit is taken for particulate removal by the CRFC HEPA filters.

4.5 Filter Loading - The RADTRAD code (Reference 8) was used to calculate the inside containment HEPA filter particulate loading. The calculation was done for the conditions associated with a LBLOCA. The calculation assumed the filters operate for the duration of the calculation (720 hr.) which essentially removed all particulate from containment atmosphere. The filter loading was approximately 1 oz/ft^2, which is judged to be well within the holding capability of the filters.

4.6 The following NRC Staff issues were addressed by the latest revision to the calculations and reflect in this summary.

- The Locked Rotor Accident failed fuel assumption was re-evaluated and reset to 50% (Reference 29, question 4).
- Developed new χ/Q data for all control room and off site dose calculations using recent 5 years of data (Reference 29, question 6).
- Extended all control room dose calculations to 30 days, for consistency.
- The stability data utilizes temperature gradients derived from Ginna's weather tower instrumentation at the 33' and 150' elevations (Reference

29, question 7).

- The revised meteorological and data χ/Q calculations resolve ARCON96 input file and wind direction frequency distribution issues (Reference 29, questions 8, 9 and 10).

- Additional Auxiliary Building leakage paths were identified, and the most limiting was chosen for dose calculations involving leakage from that source (Reference 29, question 11).

- Tornado Missile assumptions were developed per Section 11 of this summary and TMA doses were revised (Reference 29, question 12).

- The LOCA ECCS leakage calculation was revised to use 2%, versus 1% iodine partitioning, for time beyond 18 hours (Reference 30, item 5).

- A puff release case was included for Gas Decay Tank Rupture (Reference 30, item 23).

- The revised meteorological data and χ/Q calculations resolve issues relative to meteorological data, control room atmospheric dispersion factors, and off-site atmospheric factors (Reference 31, items 1 through 7).

5.0 Loss-of-Coolant-Accident

5.1 Analysis

The analysis uses the alternative source term (AST) as defined in Reg. Guide 1.183 (Reference 5). The AST assumptions are listed on Table 5.1 and are consistent with Reg. Guide 1.183. The analysis is performed with the HABIT code version 1.1 (Reference 6) and the nuclide data base discussed in Section 4.2. The LBLOCA analysis consists of two parts: 1) Containment Leakage and 2) ECCS continuous leakage outside Containment. The resulting doses are summarized on Table 5.4

The airborne fraction (flashing fraction) used in the analysis is piece-wise time dependent and bounds the values based on sump water (ECCS leakage) temperature from a Ginna-specific calculation. The values used in the analysis are illustrated in Figure 5.1.

The flashing fraction is estimated as follows:

$$FF = \frac{H_{exit} - H_l}{H_v - H_l}$$

Where:

FF = flashing fraction
H_{exit} = enthalpy of the relieved fluid (sump conditions)
H_l = enthalpy of liquid at 15 psia, saturated
H_v = enthalpy of vapor at 15 psia, 212°F.

Sump water temperature varies from about 260°F at 1 hr. into the LOCA to about 180°F at 24 hr. Sump pH is maintained greater than 7.0, upon the start of recirculation cooling.

To determine the airborne fraction, a number of points were selected along the flashing curve, and then the curve was converted into a conservative step function. The value of each step is approximately 0.01 above the calculated flashed fraction. Even though the curve predicts no flashing after about 15 hours, the minimum airborne fraction is maintained at 0.02 out to 30 days (only 30 hours shown in Fig 5.1).

Note that the airborne fraction, for time > 18 hours, was previously assumed equal to 0.01, and, as the result of NRC comments during the review of the analysis, the airborne fraction was increased to 0.02 for time >18 hours.

Although these calculated values are not as conservative as the fixed value of

0.10 suggested in the Reference 5, they are consistent with the intent of the Reference, which is to use a conservative approximation.

5.2 Assumptions

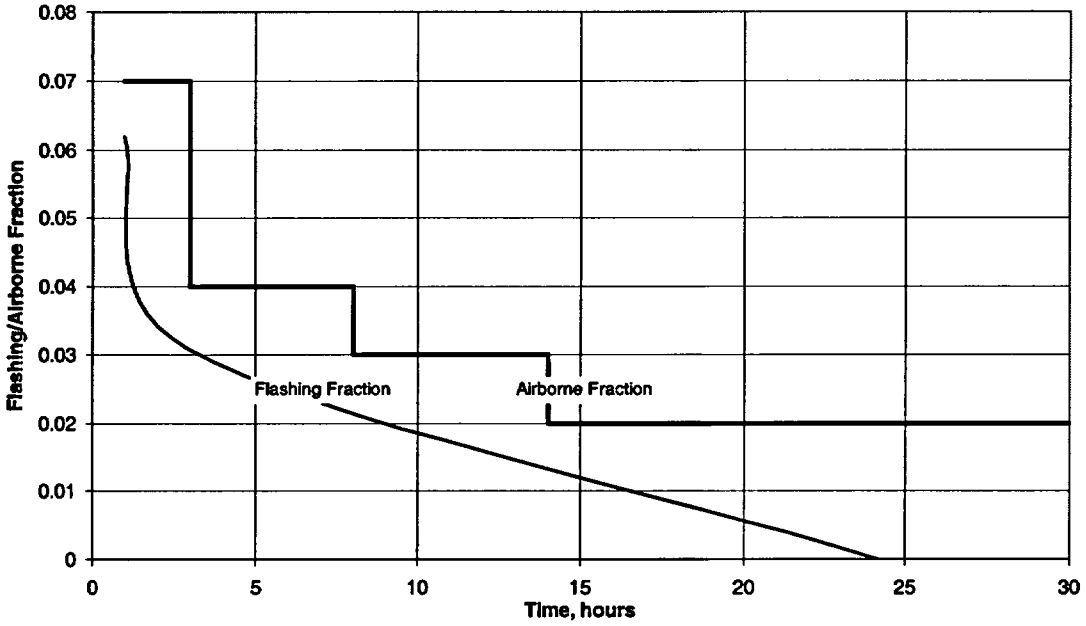
- A Large-Break-Loss-of-Coolant Accident (LBLOCA) occurs inside Containment.
- One train of emergency power is assumed to fail, concurrent with the LOCA. This results in only one operating train of Containment Recirculation Fan Coolers (CRFCs) and one train of Containment Spray.
- At 52 minutes, Containment Spray is stopped, and at 1 hour, sump recirculation is started and continues for the duration of the calculation.
- At 4 hours, particulate removal by the CRFCs is arbitrarily stopped.
- The Control Room is assumed isolated at 60 seconds and CREATS is up and operating at 70 seconds. An isolation signal, from the radiation monitors and/or safety injection, would occur well before the 60 seconds assumed in the analysis.
- The ECCS leakage rate is 4 gph. A passive ECCS failure of 50 gpm for 30 minutes, as identified in the Ginna UFSAR is not assumed in this analysis.

The analyses uses the source term parameters in Table 5.1 and the Containment leakage parameters on Table 5.2. The Control Room parameters are listed on Tables 5.3 and 5.4.

5.3 Results

The results are provided in Table 5.5.

FIGURE 5.1 - AIRBORNE FRACTION



Note: Due to NRC comments during the review process, a minimum airborne fraction of 0.02 is maintained for the duration of the accident.

TABLE 5.1 ALTERNATE SOURCE TERM (REFERENCE 5) Core Inventory Fraction Released Into Containment			
Nuclide Group	Gap Release Phase	Early In-Vessel Phase	Total[1]
Halogens	0.05	0.35	0.4
Noble Gases	0.05	0.95	1.0
Alkali Metals	0.05	0.25	0.3
Tellurium	0	0.05	0.05
Ba, Sr	0	0.02	0.02
Noble Metals	0	0.0025	0.0025
Cerium	0	0.0005	0.0005
Lanthanides	0	0.0002	0.0002

Timing of LOCA Core Inventory Release Phases		
Release Phase	Onset	Duration
Gap Release	30 sec	0.5 hr[2]
Early In-Vessel	0.5 hr	1.3 hr

Nuclide Groups	
Halogens	I
Noble Gases	Kr, Xe
Alkali Metals	Cs, Rb
Tellurium Group	Te, Sb, Se, Ba, Sr
Noble Metals	Ru, Rh, Pd, Mo, Tc. Co
Lanthanides	La, Zr, Nd, Eu, Nb, Pm, Pr, Sm, Y, Cm, Am
Cerium	Ce, Pu, Np

[1]Fractions apply to both containment and ECCS leakage

[2]The duration of the gap release, specified in Reference 5, is 0.5 hr. The specified start of the gap release is modeled as 0.5hr - 30 sec=0.492 hr, rather than 0.5 hr.

TABLE 5.1 - continued Nuclide Composition, fraction		
Form	In Containment Atmosphere	In ECC Solution
Iodine elemental organic particulate	 0.0485 0.0015 0.95	 0.97 0.03 0
All other nuclides particulate	 1.0	 1.0

TABLE 5.2 CONTAINMENT/ECCS LEAKAGE PARAMETERS	
Parameter	**Value**
Reactor power, Mwt (including 2% uncertainty)	1550
Containment net free volume, ft3	1.0E6
Containment sprayed fraction	0.78
Containment leak rate, %/day 0-24 hours > 24 hours	 0.2 0.1
Containment fan cooler flow and operation number of operating units (per train) flow rate per unit, cfm total filtered flow rate, cfm HEPA (2 units) initiation delay, sec. termination of iodine removal, hours	 2 30,000 60,000[1] 50 4
Containment fan cooler iodine removal efficiency, % Elemental Organic Particulate	 0 0 95
Containment injection spray flow rate, gpm (per train) initiation delay, sec termination (end of spray injection), min	 1300 80 52
Iodine and particulate removal by spray, hr-1 elemental particulate	 20 3.5[2]
Containment sump volume, ft^3	264,700

[1] 12,000 cfm is recirculated within the lower containment volume (unsprayed region)

[2] Represents the 10^{th} percentile value calculated using the Powers model (Reference 7)

TABLE 5.2 CONTAINMENT/ECCS LEAKAGE PARAMETERS	
Parameter	**Value**
ECCS leakage	
Continuous leakage rate, gal/hr	4
Start time, hr	1
Termination time, hr	720
Airborne fraction	
0-3 hr	0.07
3-8 hr	0.04
8-14 hr	0.03
14-720 hr	0.02
Atmospheric dispersion χ/Q, sec/m^3	
EAB 0-2 hr	2.17E-4
LPZ 0-8 hr	2.51E-5
8-24 hr	1.78E-5
24-96 hr	8.50E-6
96-720 hr	2.93E-6
Breathing rates, m^3/sec	
EAB & LPZ 0-8 hr	3.47E-4
8-24 hr	1.75E-4
24-720 hr	2.32E-4

TABLE 5.3 CONTROL ROOM PARAMETERS		
Parameter	**Value**	
Habitable volume, ft^3	36,211	
Normal Operating Mode make-up air flow rate, cfm	2000+10%	
Accident Operating Mode Recirculating air iodine removal efficiency,% elemental organic particulate	 90 70 98	
flow rate, cfm	6000-10%	
Unfiltered in-leakage, cfm	300	
Breathing rate, m^3/sec	3.47E-4	
Occupancy factors 0-24 hr 24-96 96-720	 1 0.6 0.4	
Atmospheric dispersion χ/Q sec/m^3	Containment Leakage	ECCS Leakage
0-2 hr	1.77E-3	4.69E-3
2-8	1.25E-3	3.97E-3
8-24	4.80E-4	1.40E-3
24-96	4.24E-4	1.32E-3
96-720	3.66E-4	1.11E-3

Table 5.4 **Flow Rate and Iodine Removal Schedule**				
Time, hours	Inleakage		Recirculation	
	cfm	iodine removal efficiency, %[1]	cfm	iodine removal efficiency, %[1]
0-0.0167[2]	2200	0/0/0	0	0/0/0
[3]0.0167-0.0194	300	0/0/0	0	0/0/0
>0.0194	300	0/0/0	5400	90/70/98

TABLE 5.5 **LBLOCA DOSE SUMMARY, REM TEDE**			
	EAB Max. 2-hour	LPZ 720 hour	Control Room 720 hour
Containment Leakage	2.478	0.819	2.329
ECCS Leakage	0.215	0.199	1.970
Total	2.69	1.02	4.30
Acceptance Criteria	25	25	5

[1]Elemental/Organic/Particulate
[2]0 to 60 seconds
[3]60 to 70 seconds

6.0 Fuel Handling Accident

6.1 Analysis

This calculation determines the offsite and Control Room doses (rem TEDE) for a fuel handling accident (FHA). The analysis uses the alternate source term and accompanying TEDE methodology and conservative control room χ/Q values that are calculated with the ARCON96 code. Two cases were evaluated:

- FHA inside Containment
- FHA in the Spent Fuel Pool (SFP)

The AST defined in Reference 5 is used. The HABIT code (Reference 6) and Ginna-specific nuclide data base, as discussed in Section 4.2, are used. The χ/Q values used are from References 13 and 14. The duration of the release is only 2 hours, but the Control Room dose calculation is extended to 30 days to account for activity remaining within the Control Room. The resulting doses are presented on Table 6.4.

6.2 Assumptions

- Both cases assume that fuel rods in one equivalent fuel assembly fail.

- Activity from the damaged fuel rods is assumed to be instantaneously released to the pool water.

- There is a minimum of 23 feet of water above the fuel.

- The rate of activity release, to the environment, is independent of the actual ventilation flow rate. All radioactive material, that escapes from the reactor cavity or spent fuel pool is, released to the environment over a two hour period.

- The activity, from a FHA in Containment, is assumed to be released from Containment to the environment via the perimeter seals and face of the Equipment Hatch roll-up door. No filtration or adsorption of iodine is assumed.

- The activity from an FHA in the spent fuel pool, is assumed to be released from the pool area to the environment via the plant vent.

  Note: The Technical Specifications require operation of the Auxiliary Building Ventilation System during irradiated fuel movement within the Auxiliary Building when one or more fuel assemblies in the Auxiliary Building has decayed < 60 days since being irradiated. Therefore, the system is credited in the dose analysis.

The FHA dose analysis assumptions are listed on Table 6.1. The Control Room assumptions are listed on Table 6.2.

The Control Room is assumed to be isolated within 60 seconds via the radiation monitors. A comparison of the nuclide concentration in the Control Room intake, for the FHA to the radiation monitor response, showed that a Control Room isolation signal will occur before 60 seconds.

Fission product inventories and activities released from the SFP are shown in Table 6.3.

TABLE 6.1 FHA DOSE ANALYSIS ASSUMPTIONS	
Parameter	**Value**
Reactor power, Mwt (including 2% uncertainty)	1550
Power Peaking Factor	1.75
Number of damaged fuel assemblies	1
Fission product inventory in damaged assemblies after decay	Values shown in Table 6.3
Time after reactor shutdown, hr	100
Fuel rod gap fractions I-131 other halogens Kr-85 other noble gases alkali metals	 0.08 0.05 0.1 0.05 0.12
Iodine species above water elemental iodine organic iodide	 0.57 0.43
Pool DF elemental iodine organic iodide particulate Overall Pool DF	 500 1 ∞ 200
Containment net free volume, ft^3	1E6
Exhaust flow rate, cfm	7.68E4
Duration of activity release, hr	2
Iodine removal efficiency Containment FHA (all iodine forms) Fuel Pool FHA elemental iodine organic iodide	 0 0.9 0.7

TABLE 6.1 FHA DOSE ANALYSIS ASSUMPTIONS	
Parameter	**Value**
Atmospheric dispersion, χ/Q, sec/m^3 EAB 0-2 hr	 2.17E-4
LPZ 0-8 hr 8-24 24-96 96-720	2.51E-5 1.78E-5 8.50E-6 2.93E-6
Breathing rate, m^3/sec EAB & LPZ 0-8 hr	 3.47 E-4

TABLE 6.2 CONTROL ROOM PARAMETERS		
Habitable volume, ft^3		36,211
Normal Operating Mode make-up air flow rate, cfm		 2000+10%
Accident Operating Mode Recirculating air iodine removal efficiency, % elemental organic particulate Flow rate, cfm Unfiltered in-leakage, cfm		 90 70 98 6000-10% 300
Breathing rate, m^3/sec		3.47 E-4
Occupancy factor 0-24hr 24-96 96-720		 1 0.6 0.4
Atmospheric dispersion, χ/Q, sec/m^3	FHA Containment	FHA Spent Fuel Pool
0-2 hr	5.58E-3	1.99E-3
2-8	4.66E-3	1.46E-3
8-24	1.65E-3	6.35E-4
24-96	1.58E-3	5.01E-4
96-720	1.32E-3	4.47E-4

Flow Rate and Iodine Removal Schedule				
Time, hours	Inleakage		Recirculation	
	cfm	iodine removal efficiency, %	cfm	iodine removal efficiency, %
0 - 0.0167[1]	2200	0/0/0	0	0/0/0
[2]0.0167 - 0.0194	300	0/0/0	0	0/0/0
>0.0194	300	0/0/0	5400	90/70/98[3]

[1] 0 to 60 seconds

[2] 60 to 70 seconds

[3] Elemental/organic/particulate

TABLE 6.3 FISSION PRODUCT INVENTORY AND ACTIVITY RELEASED FROM POOL						
Nuclide	Total Core Activity - 100 hours decay, Ci(A)	Core Damage Fraction (F)	Gap Fraction (G)	Peaking Factor (P)	Overall Pool DF	Activity Released from Pool, Ci (A)
I-131	2.98E+07	0.008264	0.08	1.75	200	1.76E+02
I-132	2.52E+07	0.008264	0.05	1.75	200	9.29E+01
I-133	3.12E+06	0.008264	0.05	1.75	200	1.15E+01
I-134	0.00E+00	0.008264	0.05	1.75	200	0.00E+00
I-135	2.23E+03	0.008264	0.05	1.75	200	8.22E-03
Kr-85m	2.15E+00	0.008264	0.05	1.75	1	1.55E-03
Kr-85	4.98E+05	0.008264	0.1	1.75	1	7.20E+02
Kr-87	4.58E-17	0.008264	0.05	1.75	1	3.31E-20
Kr-88	7.48E-04	0.008264	0.05	1.75	1	5.41E-07
Xe-131m	4.42E+05	0.008264	0.05	1.75	1	3.20E+02
Xe-133m	1.10E+060	0.008264	0.05	1.75	1	7.95E+02
Xe-133	5.71E+07	0.008264	0.05	1.75	1	4.13E+04
Xe-135m	3.57E+02	0.008264	0.05	1.75	1	2.58E-01
Xe-135	1.09E+05	0.008264	0.05	1.75	1	7.88E+01

Core damage fraction is 1/121 = 0.008264. The total number of fuel assemblies in the core is 121.

The activity released from the pool (A) is calculated as follows:

$$A = \frac{A_c * F * G * P}{DF}$$

TABLE 6.4 FHA DOSE, REM TEDE			
	EAB Max - 2 hr	LPZ, 2 hr	Control Room 30 Days
FHA - inside Containment via roll-up door	5.07E-1	5.87E-2	1.16E0
FHA - Spent Fuel Pool	1.38E-1	1.59E-2	9.85E-2
Acceptance Criteria	6.3	6.3	5

7.0 Main Steam Line Break

7.1 Analysis

This calculation determines the offsite and Control Room doses (rem TEDE) for the Main Steam Line Break (MSLB) outside the Containment. The analysis uses the alternate source term and the accompanying TEDE methodology and conservative control room χ/Q values that are calculated with the ARCON96 code. The MSLB analysis includes the following cases:

- MSLB with accident initiated iodine spike
- MSLB with pre-accident iodine spike

The AST defined in Reference 5 is used. The HABIT code (Reference 6) and Ginna-specific nuclide data base, as discussed in Section 4.2, are used. No fuel failures are postulated for the MSLB.

7.2 Assumptions

- As a result of an augmented inspection program, breaks between the Containment penetrations and inside the Intermediate Building are limited to connection pipes only, with the largest pipe being 6" (UFSAR Section 3.6.2.4.5.2). Larger pipe breaks can only be postulated downstream of the Intermediate Building, i.e., inside the Turbine Building. Therefore, the break is assumed to occur in the 36" header inside the Turbine Building. This is the largest pipe break that can occur outside Containment. The break area is limited to 1.4 ft^2 because of a flow restrictor in the SG outlet nozzle.

- The scenario consists of a header break. The single failure is assumed to be a failure of the main steam isolation valve on the faulted SG. Initially the break is fed by both SGs. Following steam line isolation, the break is fed only by the faulted SG. At approximately 10 minutes the faulted SG is isolated by operator action. The intact SG is then used for cooldown, where steam is released to the atmosphere through the intact SG Atmospheric Relief Valve until the releases are stopped (assumed to be 8 hr) .

- A primary-to-secondary leakage of one gpm to each SG is assumed for the duration of the event (8 hr). The faulted SG is assumed to steam dry, within 10 minutes, and remain dry for the duration of the event. The intact SG is isolated from the break within the first minute and auxiliary feedwater maintains SG level for the duration of the event.

- All of the initial iodine inventory in the faulted SG is assumed released to the environment by 10 minutes. The iodine from the primary-to-secondary leakage into the faulted SG is released directly to the environment with no credit for retention. The initial iodine inventory in the intact SG is mixed with the primary-to-secondary leakage into the SG and released to the environment assuming an iodine partition of 100. The steam release from the intact SG is based on a LOFTRAN simulation of the MSLB followed by an energy balance to simulate the cooldown to RHR conditions. All noble gas activity carried over to the SGs is assumed to be immediately released to the environment.

- Initially the Control Room HVAC is operating normally with a nominal 2200 cfm of makeup air. Isolation is assumed to occur at 60 sec and CREATS is operating at 70 sec, assuming a minimum 5400 cfm recirculation flow. Since isolation is caused by a safety injection signal, the Control Room would be isolated well before the 60 sec. assumed in the analysis. Following isolation, 300 cfm of unfiltered inleakage is assumed for the duration of the calculation.

- The releases from the steam break are assumed to stop at 8 hr. The Control Room calculation is continued until 720 hr to ensure all dose contributions are accounted for.

- Accident - Initiated Iodine Spike: A spike factor of 500 with a duration of 8 hours is assumed. The initial appearance rates are listed on Table 3.1.

- Pre-Accident Iodine Spike: The iodine concentrations are based on 60 μCi/gm DE I-131 and listed in Section 3.2.

Additional assumptions are listed in Table 7.1.

The Control Room parameters are listed on Table 7.2 and 7.3.

7.3 Results

The results for the MSLB are shown in Table 7.4.

TABLE 7.1
MSLB DOSE ANALYSIS ASSUMPTIONS

Parameter	Value
Reactor power, Mwt (including 2% uncertainty)	1550
Initial reactor coolant activity, pre-accident iodine spike iodine μCi/gm of D.E. I-131 noble gas fuel defect level, %	 60 1.0
Initial reactor coolant activity, accident initiated iodine spike iodine μCi/gm of D.E. I-131 noble gas fuel defect level, %	 1.0 1.0
Accident-initiated iodine spike factor	500
Duration of accident-initiated iodine spike, hours	8
Initial secondary coolant iodine activity μCi/gm of D.E. I-131 Concentration, Ci I-131 I-132 I-133 I-134 I-135	 0.1 4.57 E+0 2.64 E-2 1.12 E+0 9.04 E-4 1.03 E-1
Primary-to-secondary leakage (post accident) to SGs gpm per SG (cold conditions) duration of leakage, hours	 1 8
Mass of primary coolant, gm	1.247 E+8
Initial mass of secondary coolant, gm faulted SG intact SG	 5.817 E+7 5.817 E+7

TABLE 7.1 MSLB DOSE ANALYSIS ASSUMPTIONS	
Parameter	**Value**
Steam Releases	
faulted SG	
0 - 610 sec	128,237 lb
610 sec - 8 hr	0 lb
intact SG	
0 - 610 sec	37,780 lb
610 sec - 8 hr	755,097 lb
Steam generator iodine partition coefficients (mass-based)	
Activity release from faulted SG	
elemental	1
organic	1
Activity release from intact SG	
elemental	100
organic	1
Noble gas, all SG	1
Iodine fractions assumed in the reactor coolant and SG water	
elemental iodine	0.97
organic iodide	0.03
Atmospheric dispersion X/Q sec/m^3	
EAB 0-2 hr	2.17E-4
LPZ 0-8 hr	2.51E-5
8-24	1.78E-5
24-96	8.50E-6
96-720	2.93E-6
Breathing rate m^3/sec	
EAB & LPZ	
0-8 hr	3.47 E-4
8-24	1.75 E-4
24-720	2.32 E-4

TABLE 7.2 CONTROL ROOM PARAMETERS	
Parameter	**Value**
Habitable volume, ft^3	36,211
Normal Operating Mode make-up air flow rate, cfm	 2000+10%
Accident Operating Mode Recirculating air iodine removal efficiency, % elemental organic particulate flow rate, cfm Unfiltered in-leakage, cfm	 90 70 98 6000-10% 300
Breathing rate, m^3/sec	3.47 E-4
Occupancy factor 0-24 hr 24-96 96-720	 1 0.6 0.4
Atmospheric dispersion, χ/Q, sec/m^3 0-2 hr 2-8 8-24 24-96 96-720	 2.59 E-3 1.88 E-3 8.28 E-4 5.90 E-4 4.77 E-4

Table 7.3 Flow Rate and Iodine Removal Schedule				
Time, hours	Inleakage		Recirculation	
	cfm	iodine removal efficiency, %	cfm	iodine removal efficiency, %
0 - 0.0167[1]	2200	0/0/0	0	0/0/0
0.0167 - 0.0194[2]	300	0/0/0	0	0/0/0
>0.0194	300	0/0/0	5400	90/70/98[3]

TABLE 7.4 RESULTS FOR MAIN STEAM LINE BREAK, REM TEDE			
	EAB Max - 2 hr	LPZ, 8 hr	Control Room 30 days
Accident Initiated Iodine Spike	4.76E-1	1.27E-1	6.32E-1
Acceptance Criteria	2.5	2.5	5
Pre-Accident Iodine Spike	6.96E-2	2.80E-2	1.74E-1
Acceptance Criteria	25	25	5

[1] 0 to 60 seconds
[2] 60 to 70 seconds
[3] Elemental/organic/particulate

8.0 Steam Generator Tube Rupture (SGTR)

8.1 Analysis

This calculation determines the offsite and Control Room doses for the SGTR accident. The analysis uses alternate source term and accompanying TEDE methodology and conservative Control Room χ/Q values, that are calculated with the ARCON96 code.

The SGTR analysis includes the following cases:

- SGTR with accident-initiated spike
- SGTR with pre-accident iodine spike

The AST defined in Reference 5 is used. The HABIT code (Reference 6) and Ginna-specific nuclide data base, discussed in Section 4.2, are used.

8.2 Assumptions

Analysis parameters are summarized in Tables 8.1and 8.2 and below.

- The break flow and steam release data for the ruptured SG, and steam release data for the intact SG is taken from the analysis described in Section 15.6 of Reference 3 and listed in Table 8.2.

- Accident-Initiated Iodine Spike:

  The initial appearance rates are listed on Table 3.1. The input parameters are listed on Table 8.1 and the results are presented on Table 8.5.

- Pre-Accident Iodine Spike:

  The iodine concentrations are based on 60 µCi/gm DE I-131 and listed in Section 3.2. The input parameters are listed on Table 8.1, and results are presented on Table 8.5.

The Control Room parameters are summarized in Table 8.3.

- Control Room isolation is assumed at 6 minutes which bounds the safety injection signal generation time for the Reference 3, Section 15.6 SGTR. The ARV is the source point for the Control Room χ/Q.

TABLE 8.1 SGTR DOSE ANALYSIS ASSUMPTIONS	
Parameter	**Value**
Reactor power, Mwt (including 2% uncertainty)	1550
Initial reactor coolant activity, pre-accident iodine spike iodine, µCi/gm of DE I-131 noble gas fuel defect level, %	 60 1.0
Initial reactor coolant activity, accident initiated iodine spike iodine, µCi/gm of DE I-131 noble gas fuel defect level, %	 1.0 1.0
Concurrent iodine spike factor	335
Duration of concurrent iodine spike, hours	8
Initial secondary coolant iodine activity, µCi/gm of DE I-131	0.1
Primary-to-secondary leakage to intact SG leak rate (cold conditions) duration of leakage, hours	 150 gal/day 8
Mass of primary coolant, gm	1.247×10^8
Initial mass of secondary coolant, gm faulted SG intact SG	 3.27×10^7 3.27×10^7
Steam generator elemental iodine partition coefficients (mass-based) Activity release from faulted SG via boiling of bulk water via flashed break flow Activity release from intact SG	 100 1.0 100
Steam generator partition coefficient for organic iodide and noble gas release	1.0
Iodine species assumed in the reactor coolant and SG water elemental iodine organic iodide	 0.97 0.03

TABLE 8.1 SGTR DOSE ANALYSIS ASSUMPTIONS	
Parameter	**Value**
Atmospheric dispersion, X/Q, sec/m^3	
EAB 0-2 hr	2.17 E-4
LPZ 0-8	2.51 E-5
8-24	1.78 E-5
24-96	8.50 E-6
96-720	2.93 E-6
Breathing Rates, m^3/sec	
EAB & LPZ	
0-8 hr	3.47E-4
8-24	1.75E-5
24-720	2.32E-4

Table 8.2 Steam Releases and Rupture Flow				
	Time periods, seconds			
Mass, 1000 lb_m	0-49 sec	49 sec- 3492 sec	3492 sec- 2 hours	2 hrs - 8 hrs
Ruptured SG to:				
Condenser[1]	45.5	-	-	-
Atmosphere	-	62.4	0	31.6
Intact SG to:				
Condenser	45.2	-	-	-
Atmosphere	-	60.0	147.5	459.9
Rupture flow	2.9	107.4	-	-

49 sec: Reactor trip.
3492 sec: SG and RC pressures are equal, rupture flow is terminated.
8 hrs: RHR operating conditions are achieved, steaming to the environment is terminated.

[1]The analysis conservatively treats steam released to the condenser the same as a direct release to the atmosphere, i.e., elemental iodine partition is 100.

TABLE 8.3 CONTROL ROOM PARAMETERS	
Parameter	**Value**
Habitable volume, ft^3	36,211
Normal Operating Mode make-up air flow rate, cfm	 2000+10%
Accident Operating Mode recirculating air iodine removal efficiency, % elemental organic particulate flow rate, cfm unfiltered in-leakage, cfm	 90 70 98 6000-10% 300
Breathing rate, m^3/sec	3.47E-4
Occupancy factor 0-24 hr 24-96 96-720	 1 0.6 0.4
Atmospheric dispersion, X/Q, sec/m^3 0-2 hr 2-8 8-24 24-96 96-720	 3.72E-3 2.51E-3 1.15E-3 8.35E-4 6.88E-4

Table 8.4 Flow Rate and Iodine Removal Schedule				
Time, hours	Inleakage		Recirculation	
	cfm	iodine removal efficiency, %	cfm	iodine removal efficiency, %
0-0.1[2]	2200	0/0/0	0	0/0/0
[3]0.1-0.103	300	0/0/0	0	0/0/0
>0.103	300	0/0/0	5400	90/70/98

TABLE 8.5 RESULTS FOR SGTR, REM TEDE			
	EAB Max 2 hr	LPZ, 8 hr	Control Room 30 days
Accident Initiated Iodine Spike	9.7E-2	1.4E-2	1.4E-1
Acceptance Criteria	2.5	2.5	5
Pre-Accident Iodine Spike	3.2E-1	4.3E-2	8.9E-1
Acceptance Criteria	25	25	5

[2] 0 to 360 seconds
[3] 360 to 370 seconds

9.0 Locked Rotor Accident

This calculation determines the offsite and Control Room doses for the LR accident. The analysis uses alternate source term and accompanying TEDE methodology and conservative Control Room χ/Q values, that are calculated with the ARCON96 code.

The AST defined in Reference 5 is used. The HABIT code (Reference 6) and Ginna-specific nuclide data base, discussed in Section 4.2, are used.

9.1 Assumptions

Input parameters are listed in Table 9.1 and 9.2 below.

- Revision 0 of this analysis conservatively assumed 100% of the fuel rods experience DNB and are therefore assumed to release their gap activity into the reactor coolant system. However, subsequent evaluation and conversations with the staff have determined that 50% fuel failure is a more appropriate assumption (see Reference 28).
- The initial reactor coolant iodine activity is based on a pre-accident spike discussed in Section 3.2. The concentrations are based on 60 uCi/gm of DE I-131. The noble gas activity is based on 1% fuel defects.
- The initial secondary coolant iodine activity is based on 0.1 uCi of DE I-131.
- The assumed post-accident primary-to-secondary leak rate is 500 gal/day per SG. This bounds the current limit of 144 gpd/SG and a future Technical Specification limit of 150 gpd/SG.
- A partition coefficient of 100 is assumed for elemental iodine in the secondary coolant. No partitioning is assumed for organic iodide or noble gas. No particulates are assumed to be released to the atmosphere with the secondary side steam.
- The steam release from the SGs is based on a LOFTRAN simulation of the LR followed by an energy balance to simulate the cooldown to RHR conditions. RHR System is assumed to be placed into service for heat removal 8 hours after the initiation of the LR.
- Initially the Control Room HVAC is operating normally with a nominal 2200 cfm of makeup air. Isolation is assumed to occur at 60 sec. via the radiation monitors. A comparison of the nuclide concentration in the Control Room intake for the LR to the radiation monitor response showed a Control Room isolation signal would occur before the 60 sec. assumed in the calculations. CREATS is assumed to be operating at 70 sec., assuming a minimum 5400 cfm recirculation

flow.

TABLE 9.1 LR Dose Analysis Assumptions	
Parameter	**Value**
Reactor power, Mwt (including 2% uncertainty)	1550
Failed Fuel, %	50
Initial reactor coolant activity, pre-accident iodine spike iodine, uCi/gm of DE I-131 noble gas fuel defect level, %	 60 1.0
Initial secondary coolant iodine activity, uCi/gm of DE I-131	0.1
Primary-to-secondary leakage (post accident) to SGs leak rate (cold conditions) per SG, gpd duration of leakage, hours	 500 8
Mass of primary coolant, gm	1.247×10^8
Initial mass of secondary coolant in 2 SGs, gm	8.501E+7
Steam Releases (2 SGs), lb 0-10 min. 10-30 min. 0.5-8 hr.	 54,620 14,446 685,229
Steam generator iodine partition coefficients (mass-based) elemental organic	 100 1
Iodine fractions in the reactor coolant and SG water elemental iodine organic iodide	 0.97 0.03
Atmospheric dispersion χ/Q sec/m^3 EAB 0-2 hr LPZ 0-8 hr	 2.17E-4 2.51E-5
Breathing rate m^3/sec EAB & LPZ 0-8 hr 8-24	 3.47E-4 1.75E-4

TABLE 9.2 CONTROL ROOM PARAMETERS	
Parameter	**Value**
Habitable volume, ft^3	36,211
Normal Operating Mode make-up air flow rate, cfm	 2000+10%
Accident Operating Mode Recirculating air iodine removal efficiency, % elemental organic particulate flow rate, cfm Unfiltered in-leakage, cfm	 90 70 98 6000-10% 300
Breathing rate, m^3/sec	3.47 E-4
Occupancy factor 0-24 hr 24-96 96-720	 1 0.6 0.4
Atmospheric dispersion, χ/Q, sec/m^3 0-2 hr 2-8 8-24 24-96 96- 720	 3.72E-3 2.51E-3 1.15E-3 8.35E-4 6.88E-4

Table 9.3 Flow Rate and Iodine Removal Schedule				
Time, hours	Inleakage		Recirculation	
	cfm	iodine removal efficiency, %	cfm	iodine removal efficiency, %[1]
0 - 0.0167[2]	2200	0/0/0	0	0/0/0
[3]0.0167 - 0.0194	300	0/0/0	0	0/0/0
>0.0194	300	0/0/0	5400	90/70/98

TABLE 9.4 RESULTS FOR LOCKED ROTOR			
	EAB Max - 2 hr rem TEDE	LPZ, 8 hr rem TEDE	Control Room 30 days, rem TEDE
Elemental iodide	4.19E-1	1.15E-1	6.92E-1
Organic iodide	3.73E-1	1.39E-1	1.07
Noble gas	2.11E-1	4.93E-2	1.17E-1
Total	1.0	3.03E-1	1.88
Acceptance criteria	2.5	2.5	5

[2] 0 to 60 seconds

[3] 60 to 70 seconds

10.0 Rod Ejection Accident

This calculation determines the offsite and Control Room doses (TEDE) for Rod Ejection Accident (REA). The analysis uses the alternate source term and the accompanying TEDE methodology and conservative control room χ/Q values that are calculated with the ARCON96 code. The REA analysis includes the following cases:

- Containment leakage
- Primary-to-secondary leakage with SG activity release.
- Doses are calculated for the following receptors:

  1. Exclusion Area Boundary (EAB), maximum 2 hour dose
  2. Outer boundary of the Low Population Zone (LPZ), 30 day dose (8 hr for secondary side transport)
  3. Control Room, 30 day dose

The AST defined in Reference 5 is used. The HABIT code (Reference 6) and HABIT nuclide data base described in Section 4.2 are used. Ten percent of the core is assumed to fail. This is based on a Ginna specific calculation (Reference 3, Section 15.4.5.3.5). The release fraction used in the analysis is the product of the core damage, the peaking factor, and the gap fraction. The input parameters are listed on Table 10.1.

10.1 Containment Leakage

- Activity is instantaneously released from the core to containment atmosphere.

- No credit is taken for removal of elemental or organic iodine by the CRFC charcoal adsorbers. The CRFCs remove particulate iodine by the associated HEPA filters.

- The CRFCs are assumed to be operating at 53 seconds based on a 3 inch SBLOCA. Particulate removal by the CRFCs is arbitrarily terminated after four hours.

- No containment spray removal of activity

- Particulate removal is assumed by natural deposition. The removal coefficient is based on the correlations provided in Reference 8, Table 2.2.2.1-1. Only the smallest calculated value is used, and is held constant for the duration of the calculation.

10.2 Primary-to-Secondary Leakage

- The initial reactor coolant iodine activity is based on a pre-accident spike discussed in Section 3.2. The concentrations are based on 60µCi/gm of DE I-131.
- The initial reactor coolant noble gas activity is based on 1% fuel defects.
- Gap activity (10% failed fuel rods) is released instantaneously and homogeneously mixed in the reactor coolant. The activity release fraction is the product of core damage, the peaking factor, and gap fraction.
- The initial secondary coolant iodine activity is based on 0.1µi of DE I-131.
- The assumed post-accident primary-to-secondary leak rate is 500 gal/day per SG. This bounds the current limit of 144 gpd/SG and a future Technical Specification limit of 150 gpd/SG.
- A partition coefficient of 100 is assumed for steaming release of elemental iodine in the secondary coolant. No partitioning is assumed for organic iodine or noble gas. No particulates are assumed to be released to the atmosphere with the secondary side steam.
- The steam release from the SGs is based on a LOFTRAN simulation of the REA followed by an energy balance to simulate the cooldown to RHR conditions. RHR system is assumed to be placed into service for heat removal 8 hours after the initiation of the REA.
- Initially the Control Room HVAC is operating normally with a nominal 2200 cfm of makeup air. Isolation is assumed to occur at 60 sec. via the radiation monitors. A comparison of the nuclide concentration in the Control Room intake, for the REA, to the radiation monitor response showed a Control Room isolation signal would occur before the 60 sec. assumed in the calculations. CREATS is assumed operating at 70 sec. assuming a minimum 5400 cfm recirculation flow.

TABLE 10.1 REA CONTAINMENT PARAMETERS	
Parameter	**Value**
Reactor power, MwT(including 2% uncertainty)	1550
Failed Fuel, % of core Gap fraction Peaking factor, fraction	10 0.10 1.75
Initial primary coolant activity iodine noble gas	 60μCi/gm of DE I-131 1% fuel defects
Iodine forms particulate elemental organic	 0.95 0.0485 0.0015
Containment net free volume, ft^3	1E6
Containment leak rate, %/day 0-24 hr >24 hr	 0.2 0.1
Containment fan cooler flow and operation number of operating units flow rate per unit, cfm total filtered flow rate, cfm HEPA (2 units) initiation delay CRFCs (HEPA) termination of particulate iodine removal, hours	 2 30,000 60,000 53 sec 4
Containment fan cooler iodine removal efficiency, % elemental organic particulate	 0 0 95
Natural deposition coefficient, 1/hr	0.023

TABLE 10.1 REA CONTAINMENT PARAMETERS	
Parameter	**Value**
Atmospheric dispersion, X/Q, sec/m^3	
EAB 0-2 hr	2.17E-4
LPZ 0-8	2.51E-5
8-24	1.78E-5
24-96	8.50E-6
96-720	2.93E-6
Breathing rate, m^3/sec	
EAB & LPZ	
0-8 hr	3.47 E-4
8-24	1.75 E-4
24-720	2.32 E-4

TABLE 10.2 PARAMETERS FOR REA SECONDARY SIDE ACTIVITY RELEASE	
Parameter	**Value**
Reactor power, Mwt (including 2% uncertainty)	1550
Failed fuel, % of core	10
gap fraction	0.10
peaking factor, fraction	1.75
Initial secondary coolant iodine activity, ci/gm of DE I-131	0.1
Primary-to-secondary leakage	
leak rate, gpd per SG	500
duration, hr	8
Mass of primary coolant, gm	1.247E8
Initial mass of secondary coolant, gm per 2 SGs	8.5E7
Steam released from S.S. to environment, gm/min	
0-10 min	2.478E6
10-30 min	3.276E5
30 min - 8 hr	6.907E5

TABLE 10.2 PARAMETERS FOR REA SECONDARY SIDE ACTIVITY RELEASE	
Steam generator iodine partition coefficient (mass-based) elemental organic	 100 1
Iodine species assumed in the SG water elemental iodine organic iodide	 0.97 0.03

TABLE 10.3 CONTROL ROOM PARAMETERS		
Habitable volume, ft^3		36,211
Normal operating Mode make-0up air flow rate, cfm		 2000+10%
Accident Operating Mode Recirculating air iodine removal efficiency, % elemental organic particulate flow rate, cfm Unfiltered in-leakage,cfm		 90 70 98 6000-10% 300
Breathing rate, m^3/sec		3.47E-4
Occupancy factors 0-24 hr 24-96 96-720		 1 0.6 0.4
Atmospheric dispersion χ/Q, sec/m^3		
	Containment Leakage	ARV
0-2 hr	1.77E-3	3.72E-3
2-8	1.25E-3	2.51E-3
8-24	4.80E-4	1.15E-3
24-96	4.24E-4	8.35E-4
96-720	3.66E-4	6.88E-4

Table 10.4 Control Room Flow Rate and Iodine Removal Schedule for REA				
Time, hours	Inleakage		Recirculation	
	cfm	iodine removal efficiency, %	cfm	iodine removal efficiency, %[1]
0-0.0167[2]	2200	0/0/0	0	0/0/0
0.0167-0.0194[3]	300	0/0/0	0	0/0/0
>0.0194	300	0/0/0	5400	90/70/98

TABLE 10.5 REA DOSE SUMMATION, rem TEDE			
	EAB, max -2 hour	LPZ, 30 days (CNMT), 8 hours (secondary side)	Control Room, 30 days
Containment Leakage	1.29E-01	4.33E-02	1.48E-01
Secondary Side, Elemental Iodine	2.05E-01	5.66E-02	3.23E-01
Secondary Side, Noble Gas	1.48E-01	3.45E-02	8.235E-02
Secondary Side, Organic Iodide	1.82E-01	6.907E-02	5.09E-01
TOTAL	6.64E-01	2.03E-01	1.06E+00
Acceptance Criteria	6.3	6.3	5

[1] Elemental/Organic/Particulate
[2] 0 to 60 seconds
[3] 60 to 70 seconds

11.0 Tornado Missile in Spent Fuel Pool

11.1 This calculation determines the offsite and Control Room doses (TEDE) for a tornado missile accident (TMA). The analysis uses the alternate source term and accompanying TEDE methodology and conservative Control Room χ/Q values calculated as discussed in Section 2.

The AST defined in Reference 5 is used. The HABIT code (Reference 6) and HABIT nuclide data base as discussed in Section 4.2 are used. The analysis assumes 9 fuel assemblies are damaged (5 fuel assemblies decayed for 100 hours and four fuel assemblies decayed for 60 days) based on the size of a telephone pole missile. The nuclide inventory in the damaged assemblies is estimated by applying a power peaking factor of 1.75 to the average assembly inventory. Activity from the damaged assemblies is assumed to be instantaneously released to the pool water. After applying decontamination factors of the pool water, the resulting elemental and organic fractions above the water are 0.57 and 0.43. The activity above the pool is assumed to be released to the environment, with no filtration. Several assumptions used in this analysis were discussed in a conference call with the NRC staff on 5/20/2004. The NRC stated that since Ginna was quite unique in postulating a TMA, there is no branch position on the assumptions that go into the analysis. However they agreed that the following approach is reasonable and acceptable.

- This accident was previously modeled similar to the Fuel Handling Accident (FHA), in that building remained in tact and the release duration was assumed to occur over a two-hour period. However, the nature of the accident dictates that the Auxiliary Building would be damaged in the TMA scenario, and that assuming a "puff" release was acceptable.

- Since the release would occur in extremely unsettled atmospheric conditions, it is also reasonable to assume a "tornado χ/Q" based on recorded meteorological conditions using the maximum recorded wind speed (~22 m/s wind speed). The NRC further added that this could be extracted from ARCON96 using a single hour of recorded data.

- It is acceptable to use a diffused area source based on the surface area of the Spent Fuel Pool (SFP) in place of a point source.

- A one minute tornado duration assumption is appropriate.

The TMA dose analysis assumptions are listed on Table 11.1. The activity released from the pool is listed on Table 11.5. The Control Room assumptions are listed on Table 11.2. The Control Room is assumed to be isolated within 60 seconds via the radiation monitors. A comparison of the nuclide concentration in the Control Room intake for the TMA to the radiation monitor response showed a

Control Room isolation signal would occur before the 60 seconds assumed in the calculation. The resulting doses are presented on Table 11.4.

TABLE 11.1 TMA DOSE ANALYSIS ASSUMPTIONS	
Parameter	**Value**
Reactor power, Mwt (including 2% uncertainty)	1550
Power Peaking Factor	1.75
Number of damaged fuel assemblies Hot Cold	 5 4
Fission product inventory in damaged assemblies after decay	Values calculated
Time after reactor shutdown hot assemblies cold assemblies	 100 hours 60 days
Fuel rod gap fractions I-131 other halogens Kr-85 other noble gases	 0.08 0.05 0.1 0.05
Iodine species above water elemental iodine organic iodine	 0.57 0.43
Pool DF elemental iodine organic iodide particulate Overall Pool DF	 500 1 ∞ 200
Exhaust flow rate, cfm 1-hour activity release 2 -hour activity release	 1.545E5 7.685E4
Iodine removal efficiency for all forms	0

TABLE 11.1 TMA DOSE ANALYSIS ASSUMPTIONS	
Parameter	**Value**
Atmospheric dispersion (off site), χ/Q, sec/m^3	
Tornado conditions:	
EAB (0-1 min)	1.87E-6
LPZ (0-1 min)	4.14E-7
Normal atmospheric conditions:	
EAB (1 min - 2 hr)	2.17E-4
LPZ	
1 min - 8 hr	2.51E-5
8 hr - 24	1.78E-5
24 hr - 96	8.50E-6
96 hr -720	2.93E-6
Breathing rate, m^3/sec	
EAB and LPZ, 0-8 hr	3.47E-4

TABLE 11.2 CONTROL ROOM PARAMETERS	
Parameter	**Value**
Habitable volume, ft^3	36,211
Normal Operating Mode make-up air flow rate, cfm	 2000+10%
Accident Operating Mode Recirculating air iodine removal efficiency, % elemental organic particulate flow rate, cfm Unfiltered in-leakage, cfm	 90 70 98 6000-10% 300
Breathing rate, m^3/sec	3.47E-4
Occupancy factor 0-24 hr 24-96 96-720	 1 0.6 0.4
Atmospheric dispersion, χ/Q, sec/m^3 (area source) Tornado conditions (0 - 1 min) Normal conditions 1 min - 2 hr 2 - 8 8 - 24 24 - 96 96 - 720	 5.14E-5 1.44E-3 1.22E-3 4.54E-4 4.17E-4 3.38E-4

Table 11.3 Flow Rate and Iodine Removal Schedule				
Time, hours	Inleakage		Recirculation	
	cfm	iodine removal efficiency, %	cfm	iodine removal efficiency, %[1]
0-0.0167[2]	2200	0/0/0	0	0/0/0
0.0167-0.0194[3]	300	0/0/0	0	0/0/0
>0.0194	300	0/0/0	5400	90/70/98

TABLE 11.4 TMA DOSE, Rem TEDE			
TMA	EAB, 2 hours	LPZ, 720 hrs	Control Room, 30 days
CR isolation and recirc	2.16E-2	4.79E-3	2.77E-1
No CR isolation & no recirc			5.14E-1
CR isolation & no recirc			3.55
Acceptance Criteria	6.3	6.3	5

[1] Elemental/Organic/Particulate

[2] 0 to 60 seconds

[3] 60 to 70 seconds

TABLE 11.5
Spent Fuel Pool Activity

	A_{100}, Ci	A_{60d}, Ci	n	Xgap	Xpeak	DF	$A_{released}$, Ci
1-131	2.98E+07	2.432E+05	121	0.08	1.75	200	8.676E+02
1-132	2.52E+07	0.000E+00	121	0.05	1.75	200	4.557E+02
1-133	3.12E+06	1.261E-13	121	0.05	1.75	200	5.640E+01
1-134	0.00E+00	0.00E-0	121	0.05	1.75	200	0.0
1-135	2.23E+03	0.00	121	0.05	1.75	200	4.028E-02
Kr-85m	2.15E+00	0.00	121	0.05	1.75	1	7.774E-03
Kr-85	4.98E+05	4.934E+05	121	0.1	1.75	1	6.456E+03
Kr-87	4.58E-17	0.0	121	0.05	1.75	1	1.656E-19
Kr-88	7.48E-04	0.0	121	0.05	1.75	1	2.705E-06
Xe-131m	4.42E+05	3.084E+04	121	0.05	1.75	1	1.687E+03
Xe-133m	1.10E+06	2.416E-02	121	0.05	1.75	1	3.977E+03
Xe-133	5.71E+07	3.662E+04	121	0.05	1.75	1	2.066+05
Xe-135m	3.57E+02	0.0	121	0.05	1.75	1	1.291E+00
Xe-135	1.09E+05	0.0	121	0.05	1.75	1	3.941E+02
Xe-138	0.00E+00	0.0	121	0.05	1.75	1	0.0

Total core activity @ 100 hours (A_{100}): Ci

Total core activity @ 60 days (A_{60d}): Ci

Core assemblies (n)

Gap Fraction (Xgap)

Peaking factor (Xpeak)

Overall pool DF

Activity released from the pool to the environment ($A_{released}$):

$$A_{hot}:\ A_{hot} = \frac{A_{100}}{n} * 5$$

$$A_{cold}:\ A_{cold} = \frac{A_{60d}}{n} * 13$$

$$A_{total}:\ A_{total} = A_{hot} + A_{cold}$$

$$A_{total}: = \frac{A_{total} * X_{gap} * X_{peak}}{DF}$$

12.0 Waste Gas Decay Tank Rupture

12.1 Analysis

This analysis calculates the Control Room and off-site doses for a release of a Gas Decay Tank (GDT) into the Auxiliary Building Atmosphere

12.2 Assumptions

- The source term is 100,000 Ci of equivalent Xe-133. The assumed source is 100,000 Ci of actual Xe-133.
- Activity, from the ruptured tank, is released to the environment, considering two different release rates:

  Two hour release
  puff-release

- The 2-hour activity release assumption is consistent with that of the Fuel Handling Accident. The puff-release was incorporated in response to a NRC Staff concern.
- Activity from the ruptured tank is released into the Auxiliary Building and assumed to diffuse from the building to the environment. As such, the Control Room dose calculation uses χ/Qs for the Auxiliary Building area source.

Table 12.1
Atmospheric Dispersion (sec/m^3)

Off-site					
	0 - 2 hr	0 - 8 hr	8 - 24 hr	24 - 96 hr	96 - 720 hr
EAB	2.17E-4	-	-	-	-
LPZ	-	2.51E-5	1.78E-5	8.50E-6	2.93E-6

Control Room				
0 - 2 h	2 - 8 hr	8 - 24 hr	24 - 96 hr	96 - 720 hr
4.69E-3	3.97E-3	1.40E-3	1.32E-3	1.11E-3

Table 12.2
Control Room Parameters

Parameter	Value
Habitable volume, ft^3	36,211
Normal Operating Mode make-up air flow rate, cfm	 2000+10%
Accident Operating Mode This analysis considers only noble gas, as such, iodine removal efficiencies and recirculation flow have no effect on the calculated doses. Unfiltered in-leakage, cfm	 300

Table 12.3
Flow Rate and Iodine Removal Schedule

Time, hours	Inleakage		Recirculation	
	cfm	iodine removal efficiency, % [1]	cfm	iodine removal efficiency, % [1]
0 - 0.0167[2]	2200	0/0/0	0	0/0/0
0.0167 - 0.0194[3]	300	0/0/0	0	0/0/0
>0.0194	300	0/0/0	0	0/0/0

Note: The isolation and recirculation times, shown above, are consistent with those provided for other accidents (excluding SGTR).

The iodine removal efficiencies and recirculation flow rates are not applicable to the GDT rupture, which assumes only Xe-133 in the source term (no iodine).

Table 12.4
Offsite and Control Room Doses

	rem, TEDE		
	EAB Max. 2-hour	LPZ 30 days	Control Room 30 days
2-hour release without CR isolation	1.25E-1	1.45E-2	8.00E-2
2-hour release with CR isolation	1.25E-1	1.45E-2	1.15E-1
Puff release without CR isolation	1.25E-1	1.45E-2	8.03E-2
Acceptance Criteria	0.5	0.5	5

[1] Elemental/Organic/Particulate
[2] 0 to 60 seconds
[3] 60 to 70 seconds

13.0 References

1. NUREG/CR-6331, Rev. 1 "Atmospheric Relative Concentrations in Building Wakes", J. V. Ramsdell, C. A. Simonen, Pacific Northwest National Laboratory, 1997

2. Regulatory Guide 1.194, Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments, June 2003.

3. Ginna UFSAR, Revision 17, 10/02

4. NUREG - 1465, "Accident Source Terms for Light-Water Nuclear Power Plants", February 1995

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

6. HABIT Version 1.1, "Computer Codes for Evaluation of Control Room Habitability", TACT5 and CONHAB Modules, NUREG/CR-6210, Supplement 1

7. NUREG/CR-5966, "A simplified Model of Aerosol Removal by Containment Sprays", D. A. Powers, et al., Sandia National Laboratories, June 1993

8. NUREG/CR-6604, "RADTRAD: A Simplified Model for RADionuclide Transport and Removal And Dose Estimation", S.L. Humphreys, et. al., Sandia National Laboratories, April 1998. (See Section 10)

9. NUREG/CR-2858, "PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations", T.J. Bander, USNRC, 1982

10. Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion", Keith F. Eckerman, et al., Oak Ridge National Laboratory, 1988

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

12. A. G. Croff, "A User's Manual for the ORIGEN2 Computer Code", ORNL/TM-7175, Oak Ridge National Laboratory, July 1980

13. RG&E Design Analysis DA-NS-2001-060, Atmospheric Dispersion Factors for the Control Room Intake, Rev 1

14. RG&E Design Analysis DA-NS-2003-004, Atmospheric Dispersion Factors for the

Exclusion Boundary and Low Population Zone, Rev 1

15. RG&E Design Analysis DA-NS-2001-063, Iodine and Noble Gas Activity in the Primary Coolant and Iodine Activity in the Secondary Coolant, Rev 1

16. RG&E Design Analysis DA-NS-2001-064, Iodine Appearance Rates, Rev 1

17. RG&E Design Analysis DA-NS-2001-087, Large Break LOCA Offsite And Control Room Doses, Rev 2

18. RG&E Design Analysis DA-NS-2002-004, Fuel Handling Accident Offsite and Control Room Doses, Rev 2

19. RG&E Design Analysis DA-NS-2002-007, Main Steam Line Break Offsite and Control Room Doses, Rev 3

20. RG&E Design Analysis DA-NS-2001-084, Steam Generator Tube Rupture Offsite and Control Room Doses, Rev 2

21. RG&E Design Analysis DA-NS-2002-054, Locked Rotor Offsite and Control Room Doses, Rev 1

22. RG&E Design Analysis DA-NS-2002-050, Control Rod Ejection Accident Offsite and Control Room Doses, Rev 1

23. RG&E Design Analysis DA-NS-2002-019, Tornado Missile Accident Offsite and Control Room Doses, Rev 2

24. RG&E Design Analysis DA-NS-2000-057, Gas Decay Tank Rupture Offsite and Control Room Doses, Rev 2

25. RG&E Design Analysis DA-NS-2002-037, HABIT Code Nuclear Data Library, Rev 0

26. Regulatory Guide 1.23 (Safety Guide 23), Onsite Meteorological Programs, February 17. 1972

27. Regulatory Guide 1.145, Atmospheric Dispersion Models for Potential Accident Consequences Assessments at Nuclear Power Plants, Rev 1

28. Letter from Robert C. Mecredy (RG&E) to Robert L. Clark (NRC), Detailed Design Information for Proposed CREATS Modification and Locked Rotor Failed Fuel Estimation, February 16, 2004.

29. Letter from Robert Clark (NRC) to Robert C. Mecredy (RG&E), Request for

Additional Information Regarding R.E. Ginna Nuclear Power Plant License Amendment Request Relating to the Control Room Emergency Air Treatment System Modification (TAC No. MB9123), dated January 20, 2004.

30. Letter from Robert C. Mecredy (RG&E) to Robert L. Clark (NRC), Summary of Public Meeting Between RG&E and NRC Staff held on August 19, 2003, dated September 30, 2003.

31. Letter from Robert Clark (NRC) to Robert C. Mecredy (RG&E), Request for Additional Information Regarding R.E. Ginna Nuclear Power Plant License Amendment Request Relating to the Control Room Emergency Air Treatment System Modification (TAC No. MB9123), dated June 9, 2004.