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February 24, 1993

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Attached are the recent revisions to the Offsite Dose Calculation Manual's (ODCM) Chapter 10 and Appendix F for Quad Cities Station. Please complete the following manual update:

REMOVE	INSERT
Quad Cities Station Annex Entire Chapter 10. p. 10-i to 10-iii, 10-1 to 10-18	Quad Cities Station Annex Entire Chapter 10 Revision 0.K, Jan. 1993 p. 10-i to 10-v, 10-1 to 10-15
Quad Cities Station Annex Entire Appendix F p. F-i to F-iv, F-1 to F-24	Quad Cities Station Annex Entire Appendix F Includes Rev. 0.K p. F-i to F-iv, F-1 to F-24

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QUAD CITIES ANNEX INDEX

CHAPTER 10

RADIOACTIVE EFFLUENT TREATMENT AND MONITORING

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RADIOACTIVE EFFLUENT TREATMENT AND MONITORING

10.1 AIRBORNE RELEASES

10.1.1 System Description

A simplified gaseous radwaste and gaseous effluent flow diagram is provided in Figure 10-1.

Each airborne release point is classified as stack, vent, or ground level in accordance with the definitions in Section 4.1.4 and the results in Table A-1 of Appendix A. The principal release points for potentially radioactive airborne effluents and their classifications are as follows:

- The ventilation chimney (a stack release point).
- The reactor building ventilation stack (a vent release point).

10.1.1.1 Condenser Offgas Treatment System

The condenser offgas treatment system is designed and installed to reduce radioactive gaseous effluents by collecting non-condensable off-gases from the condenser and providing for holdup to reduce the total radioactivity by radiodecay prior to release to the environment. The daughter products are retained by charcoal and HEPA filters. The system is described in Section 11.3.2.1.1 of the Quad Cities UFSAR.

10.1.1.2 Ventilation Exhaust Treatment System

Ventilation exhaust treatment systems are designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in selected effluent streams by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters prior to release to the environment. Such a system is not considered to have any effect on noble gas effluents. The ventilation exhaust treatment systems are shown in Figure 10-1.

Engineered safety features atmospheric cleanup systems are not considered to be ventilation exhaust treatment system components.

10.1.2 Radiation Monitors

10.1.2.1 Plant Chimney Monitor

Monitors 1(2)-1730A/B continuously monitor the final effluent from the chimney.

The monitor system has isokinetic sampling, gaseous grab sampling, iodine and particulate sampling, and tritium sampling capability.

The chimney effluent is also monitored by a separate particulate, iodine, and noble gas (SPING-4) system and a Victoreen system. The SPING/Victoreen system has high range capabilities to deal with accident conditions including postaccident sampling capability. The Victoreen sampling system automatically begins taking samples after a high signal has been received on the SPING-4 low range noble gas monitor. Output from the SPING/Victoreen system is obtainable in the control room.

No automatic isolation or control functions are performed by these monitors. Pertinent information on these monitors is provided in the Quad Cities UFSAR Section 11.5.2.3.

10.1.2.2 Reactor Building Vent Stack Effluent Monitor

The combined reactor building ventilation is also monitored by a SPING-4. This monitor has high range capabilities to deal with accident conditions. The SPING-4 noble gas detectors have ranges that envelope the range for the reactor building vent effluent trip point.

The vent stack monitor has isokinetic sampling and iodine and particulate sampling capability.

No automatic isolation or control functions are performed by this monitor.

Pertinent information on this monitor is provided in the Quad Cities UFSAR Section 11.5.2.4.

10.1.2.3 Reactor Building Ventilation Monitors

Monitors 1(2)-1735A/B continuously monitor the effluent from the Unit 1(2) reactor building. On high alarm, the monitors automatically initiate closure of valves AO1(2)A-5741, AO1(2)B-5741, AO1(2)A-5742, and AO1(2)B-5742 thus isolating the Unit 1(2) reactor building, and initiate startup of the Unit

1(2) standby gas treatment system, and isolates control room HVAC.

In addition to the above monitors, there is continuous iodine and particulate sampling of the reactor building exhaust.

Pertinent information on these monitors is provided in Quad Cities UFSAR Section 11.5.2.4.

10.1.2.4 Condenser Air Ejector Monitors

Monitors 1(2)-1733A/B continuously monitor gross gamma activity downstream of the steam jet air ejector and prior to release to the main chimney.

On high alarm the monitors automatically activate an interval timer which in turn initiates closure of air operated valve AO1(2)-5406, thus terminating the release.

In addition, monitors 1(2)-1741 continuously monitor the final offgas effluent prior to entering the chimney, and monitors 1(2)-1738 continuously monitor gross gamma activity downstream of the steam jet air ejector. No control device is initiated by these monitors.

Pertinent information on these monitors is found in Quad Cities UFSAR Sections 11.5.2.1 and 11.5.2.2.

10.1.3 Alarm and Trip Setpoints

10.1.3.1 Setpoint Calculations

10.1.3.1.1 Reactor Building Vent Stack Monitors

The setpoint for the reactor building vent stack monitor is conservatively set at 2 mr/hr above background. The reactor building ventilation stack release rate, Q_{tv}, at 2 mr/hr is calculated to be 14,400 μCi/sec. Q_{tv} is then substituted into Equations 10-1 and 10-2 to determine Q_{te}.

10.1.3.1.2 Condenser Air Ejector Monitors

The high-high trip setpoint is established at $\leq$ 100 μCi/Sec per MWt ($\approx$2.5E5μCi/sec) and the high alarm is established at $\leq$ 50μCi/sec per MWt ($\approx$1.25E5μCi/sec).

10.1.3.1.3 Plant Chimney Radiation Monitor

The setpoints for the plant chimney radiation monitor are conservatively set at 34,200 μCi/sec and 68,400 μCi/sec (high and high-high alarms respectively).

At this level the combined release from chimney and vent is approximately 10% of the 10 CFR 20 limit. This is determined by solving Equations 10-1 and 10-2 below.

10.1.3.2 Release Limits

Alarm and trip setpoints of gaseous effluent monitors are established to ensure that the release rate limits of 10 CFR 20 are not exceeded. The release limit Q_{ts} is found by solving Equations 10-1 and 10-2.

$$(1.11)\sum\left(f_i[Q_{ts}\overline{S}_i + Q_{tv}\overline{V}_i]\right) < 500\text{mrem/yr} \qquad (10\text{-}1)$$

$$\sum\left(\overline{L}_i f_i[(X/Q)_s\, Q_{ts}\exp(-\lambda_i R/3600u_s) + (X/Q)_v Q_{tv}\exp(-\lambda_i R/3600u_v)] + (1.11)(f_i)[Q_{ts}S_i + Q_{tv}V_i]\right) < 3000\ \text{mrem/yr} \qquad (10\text{-}2)$$

The summations are over noble gas radionuclides i.

f_i Fractional Radionuclide Composition

The release rate of noble gas radionuclide i divided by the total release rate of all noble gas radionuclides.

Q_{ts} Total Allowed Release Rate, Stack Release [μCi/sec]

The total Allowed release rate of all noble gas radionuclides released as stack releases.

Q_{tv} Total Allowed Release Rate, Vent Release [μCi/sec]

The total allowed release rate of all noble gas radionuclides released as vent releases.

The remaining parameters in Equation 10-1 have the same definitions as in Equation A-8 of Appendix A. The remaining parameters in Equation 10-2 have the same definition as in Equation A-9 of Appendix A.

Equation 10-1 is based on Equation A-8 of Appendix A and the 10 CFR 20 restriction on whole body dose rate (500 mrem/yr) due to noble gases released in gaseous effluents (see Section A.1.3.1 of Appendix A). Equation 10-2 is based on Equation A-9 of Appendix A and the 10 CFR 20 restriction on skin dose rate (3000 mrem/yr) due to noble gases released in gaseous effluents (see Section A.1.3.2 of Appendix A).

The value of Equation 10-1 (2.3×10^6 μCi/sec) is used as the limiting noble gas release rate.

Calibration methods and surveillance frequency for the monitors will be conducted as specified in the RETS.

10.1.3.3 Release Mixture

In the determination of alarm and trip set points the radioactivity mixture in the exhaust air is assumed to be the same as the analysis of a representative sample of noble gases collected at the recombiner during the calendar quarter in which the monitor is recalibrated.

10.1.3.4 Conversion Factors

The conversion factors used to establish gaseous effluent monitor setpoints are obtained as follows.

- Reactor building vent effluent monitor.

  The monitor setpoint is established at 2 mr/hr above background. For the purpose of setpont determination it is assumed that the background is 1 mr/hr. There is sufficient conservatism in the setpoint calculation to accommodate routine variations in the background. However, the isotopic analysis in Section 10.1.3.3 is used to confirm that the setpoint is conservative.

- Condenser air ejector monitor.

  The isotopic analysis in Section 10.1.3.3 and the flow and monitor reading at the time of the analysis are used to establish the conversion factor.

- Plant chimney monitor.

  Calibration of the plant chimney monitor consists of recirculating an amount of off-gas (see 10.1.3.3) through the noble gas monitors and a Marinelli beaker. After readings have stabilized, the Marinelli beaker is removed and gamma isotopic analysis performed. The efficiency is determined from a plot of average gamma energy of the off-gas sample and net monitor readings.

10.1.3.5 HVAC Flow Rates

The HVAC exhaust flow rates may be obtained from the process computers, indication in the control room, or fan combinations. Setpoints were calculated using the following values:

Chimney Air Flow	350,000 cfm
Combined Reactor Vent* (1 fan)	48,000 cfm
Combined Reactor Vent* (2 fans)	96,000 cfm

* per unit

10.1.4 Allocation of Effluents from Common Release Points

Radioactive gaseous effluents released from the main chimney are comprised of contributions from both units. Under normal operating conditions, it is difficult to allocate the radioactivity between units due to fuel performance, in-plant leakage, power history, and other variables. Consequently, allocation is normally made evenly between the units. During extended unit shutdowns or periods of known differences, the apportionment is adjusted accordingly. The allocation of effluents is estimated on a monthly basis.

10.1.5 Dose Projections

Because the gaseous releases are continuous, the doses are routinely calculated in accordance with the RETS.

10.2 LIQUID RELEASES

10.2.1 System Description

Simplified liquid radwaste and liquid effluent flow diagrams are provided in Figures 10-2 and 10-3.

The liquid radwaste treatment system is designed and installed to reduce radioactive liquid effluents by collecting the liquids, providing for retention or holdup, and providing for treatment by demineralizer for the purpose of reducing the

total radioactivity prior to release to the environment. The system is described in Section 11.2 of the Quad Cities UFSAR.

10.2.1.1 River Discharge Tank

There is one river discharge tank (65,000 gallons capacity) which receives water for discharge to the Mississippi River. This is the only release path in use.

10.2.2 Radiation Monitors

10.2.2.1 Liquid Radwaste Effluent Monitor

Monitor 1/2-1799-01 is used to monitor all releases from the river discharge tank. On high alarm the release is terminated manually.

Pertinent information on the monitor and associated control devices is provided in Quad Cities UFSAR Sections 11.5.2 and 11.5.3.

10.2.2.2 Service Water Effluent Monitors

Monitors 1(2)-1779-01 continuously monitor the service water effluent. No control device is initiated by these monitors.

Pertinent information on these monitors is provided in Quad Cities UFSAR 11.5.3.

10.2.3 Alarm and Trip Setpoints

10.2.3.1 Setpoint Calculations

Alarm and trip setpoints of liquid effluent monitors at the principal release points are established to ensure that the limits of 10 CFR 20 are not exceeded in the unrestricted area.

Currently these setpoints are based on the most conservative releases during the previous 18 months. If it is determined that this is no longer conservative, the setpoints are reevaluated.

10.2.3.1.1 Liquid Radwaste Effluent Monitor

The monitor setpoint is found by solving equation 10-3 for the total isotopic activity.

$$P \leq (K) \times \left(\sum C_i^T / \sum C_i^T / MPC_i\right) \times \left((0.5\ F_{AVG}^d + F'_{max})/F'_{max}\right) + B \quad (10\text{-}3)$$

P	Release Setpoint	[cpm]
C_i^T	Concentration of radionuclide i in the release tank.	[μCi/mℓ]
F'_{max}	Maximum Release Tank Discharge Flow Rate	[gpm]

The flow rate from the radwaste discharge tank.

K	Calibration constant	[cpm/μCi/mℓ]
MPC_i	Maximum Permissible Concentration of radionuclide i	[μCi/mℓ]
F^d_{AVG}	Average dilution flow of initial dilution stream	[gpm]
B	Background Count Rate	[cpm]

10.2.3.1.2 Service Water Effluent Monitors

The monitor setpoint is found by solving equation 10-4.

$$P \leq (K) \times \left(\sum C_i / \sum C_i / MPC_i\right) \times \left((F^d_{AVG} + F'_{max})/F'_{max}\right) + B \qquad (10\text{-}4)$$

C_i = concentration of radionuclide i in service water

If there is no detectable activity then $\Sigma C_i/\Sigma C_i/MPC_i$ is assumed to be 2×10^{-5} μCi/mℓ.

F'_{max} = Maximum discharge rate of service water for one unit. [gpm]

All other terms are as defined in equation 10-3.

10.2.3.2 Discharge Flow Rates

10.2.3.2.1 Release Tank Discharge Flow Rate

Prior to each batch release, a grab sample is obtained.

The results of the analysis of the sample determine the discharge rate of each batch as follows:

$$F'_{max} = 0.1 \left(0.5\ F^d / \sum (C_i / MPC_i)\right) \qquad (10\text{-}5)$$

The summation is over radionuclides i.

0.1 Reduction factor for conservatism.

F'_{max} Maximum Permitted Discharge Flow Rate [gpm]

The maximum permitted flow rate from the radwaste discharge tank.

F^d Dilution Flow [gpm]

C_i Concentration of Radionuclide i in the Release Tank [μCi/mℓ]

The concentration of radioactivity in the radwaste discharge tank based on measurements of a sample drawn from the tank.

MPC_i Maximum Permissible Concentration of Radionuclide i [μCi/mℓ]

10.2.3.3 Release Limits

Release limits are determined from 10 CFR 20. Calculated maximum permissible discharge rates are divided by 10 and dilution flows are divided by 2 to ensure that releases are well below applicable maximum permissible concentrations (MPC). (The factor of 2 used in the dilution flows accounts for discharging the RDT tank to the south diffuser pipe).

10.2.3.4 Release Mixture

For the liquid radwaste effluent monitor the release mixture used for the setpoint determination is the radionuclide mix identified in the grab sample isotopic analysis plus four additional radionuclides. The additional radionuclides are H-3, Fe-55, Sr-89, and Sr-90. The quantities to be added are determined using scaling factors derived from station release data for the previous six months.

10.2.3.5 Conversion Factors

The readout for the liquid radwaste effluent monitor is in CPM. The calibration constant is based on the detector sensitivity to Cs-137.

10.2.3.6 Liquid Dilution Flow Rates

The dilution flow is determined using Equation 10-6 below.

$$F^{d} = (N^{cw} \times F^{cw} + N^{sw} \times F^{sw} - F^{ICE}) \quad (10\text{-}6)$$

F^{d} = Dilution flow [gpm]
N^{cw} = Number of circulating water pumps on.
F^{cw} = 157000 gpm
Flow with one circulating water pump on.
N^{sw} = Number of service water pumps on
F^{sw} = 13800 gpm
Flow with one service water pump on
F^{ICE} = Deicing flow

10.2.4 Allocation of Effluents from Common Release Points

Radioactive liquid effluent released from the release tank is comprised of contributions from both units.

Allocation of waste is achieved by comparing the pump timer totals for each unit's floor drain and equipment drain pumps to the amount of waste sent to the river discharge tank from the floor drain and waste collector storage tanks. Liquid effluents from laundry and chemical waste are allocated evenly between units. During extended unit shutdown or periods of significant plant input differences, the apportionment is adjusted accordingly. The allocation of the effluents is made on a monthly basis.

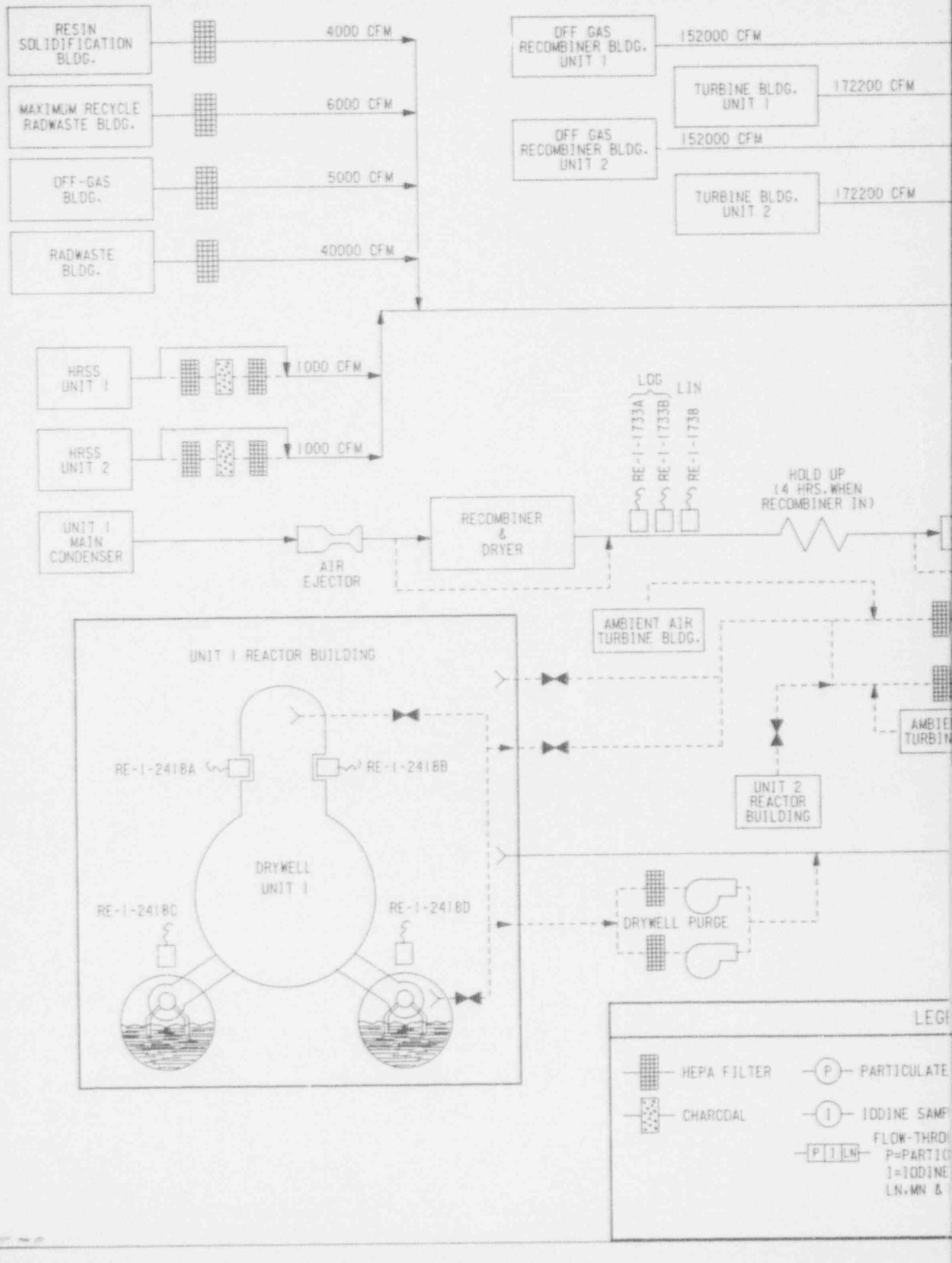
10.2.5 Projected Concentrations for Releases

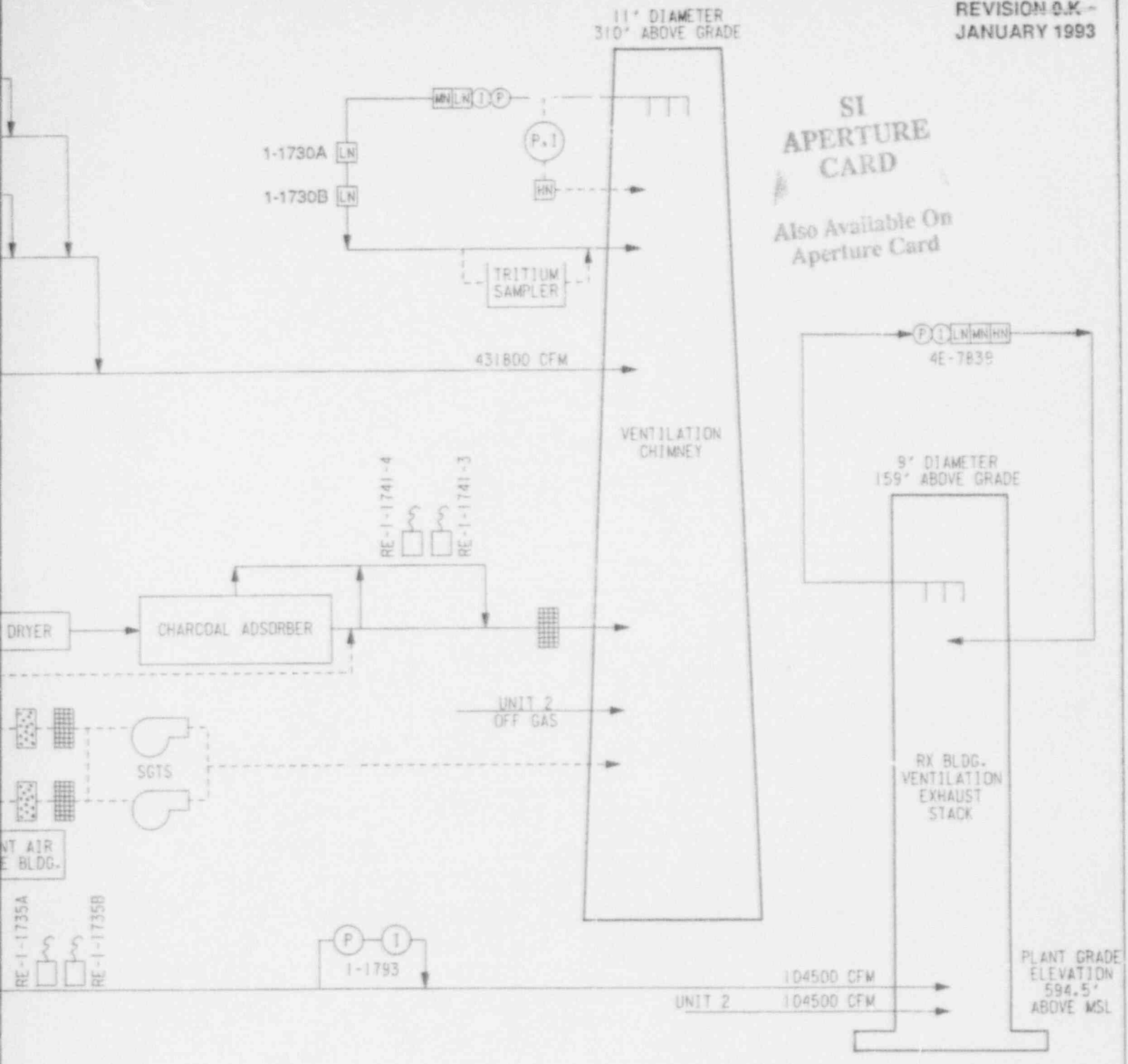
If total MPC is greater than 25, the projected dose due to liquid effluent releases is calculated. Otherwise, the releases from the previous month are used to estimate the projected dose for the coming month using the methodology in Section A.2 of Appendix A. (See Section A.2.1 of Appendix A).

10.3 SOLIDIFICATION OF WASTE/PROCESS CONTROL PROGRAM

The process control program (PCP) contains the sampling, analysis, and formulation determination by which solidification of radioactive wastes from liquid systems is ensured.

Figure 10-4 is a simplified diagram of solid radwaste processing.


RESIN SOLIDIFICATION BLDG.
4000 CFM
MAXIMUM RECYCLE RADWASTE BLDG.
6000 CFM
OFF-GAS BLDG.
5000 CFM
RADWASTE BLDG.
40000 CFM
OFF GAS RECOMBINER BLDG. UNIT 1
152000 CFM
TURBINE BLDG. UNIT 1
172200 CFM
OFF GAS RECOMBINER BLDG. UNIT 2
152000 CFM
TURBINE BLDG. UNIT 2
172200 CFM
HRSS UNIT 1
1000 CFM
HRSS UNIT 2
1000 CFM
LOG
LIN
RE-1-1733A
RE-1-1733B
RE-1-1738
HOLD UP (4 HRS. WHEN RECOMBINER IN)
UNIT 1 MAIN CONDENSER
AIR EJECTOR
RECOMBINER & DRYER
AMBIENT AIR TURBINE BLDG.
UNIT 1 REACTOR BUILDING
RE-1-2418A
RE-1-2418B
DRYWELL UNIT 1
RE-1-2418C
RE-1-2418D
UNIT 2 REACTOR BUILDING
DRYWELL PURGE
HEPA FILTER
CHARCOAL
P
PARTICULATE
I
IODINE SAMP
P I LN
FLOW-THRO
P=PARTIC
I=IODINE
LN, MN &



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ND AND NOTES

SAMPLE

E

GH RADIATION MONITOR:
LATE

HN=LOW, MEDIUM & HIGH
RANGE NOBLE GAS

RADIATION DETECTOR

NORMALLY CONTINUOUS FLOW PATH DURING POWER GENERATION

OCCASIONAL FLOW PATH

FE FE FLOW ELEMENT

NOTE: ALL FLOW RATES ARE DESIGN FLOW RATES, NOT ACTUAL

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FIGURE 10-1

SIMPLIFIED GASEOUS RADWASTE AND GASEOUS EFFLUENT FLOW DIAGRAM

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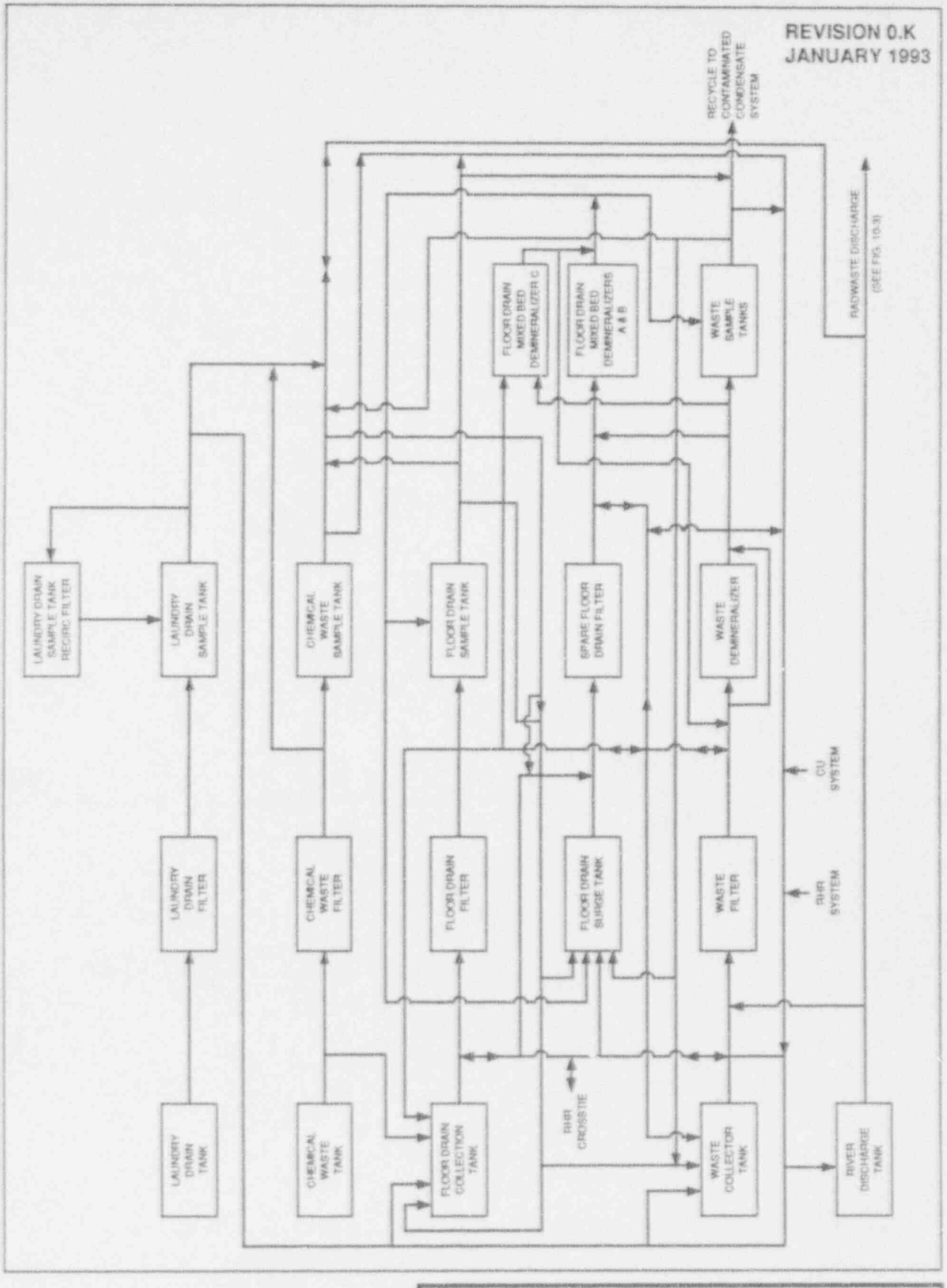

OFFSITE DOSE CALCULATION MANUAL
QUAD-CITIES STATION

FIGURE 10-2

SIMPLIFIED LIQUID RADWASTE
PROCESSING DIAGRAM

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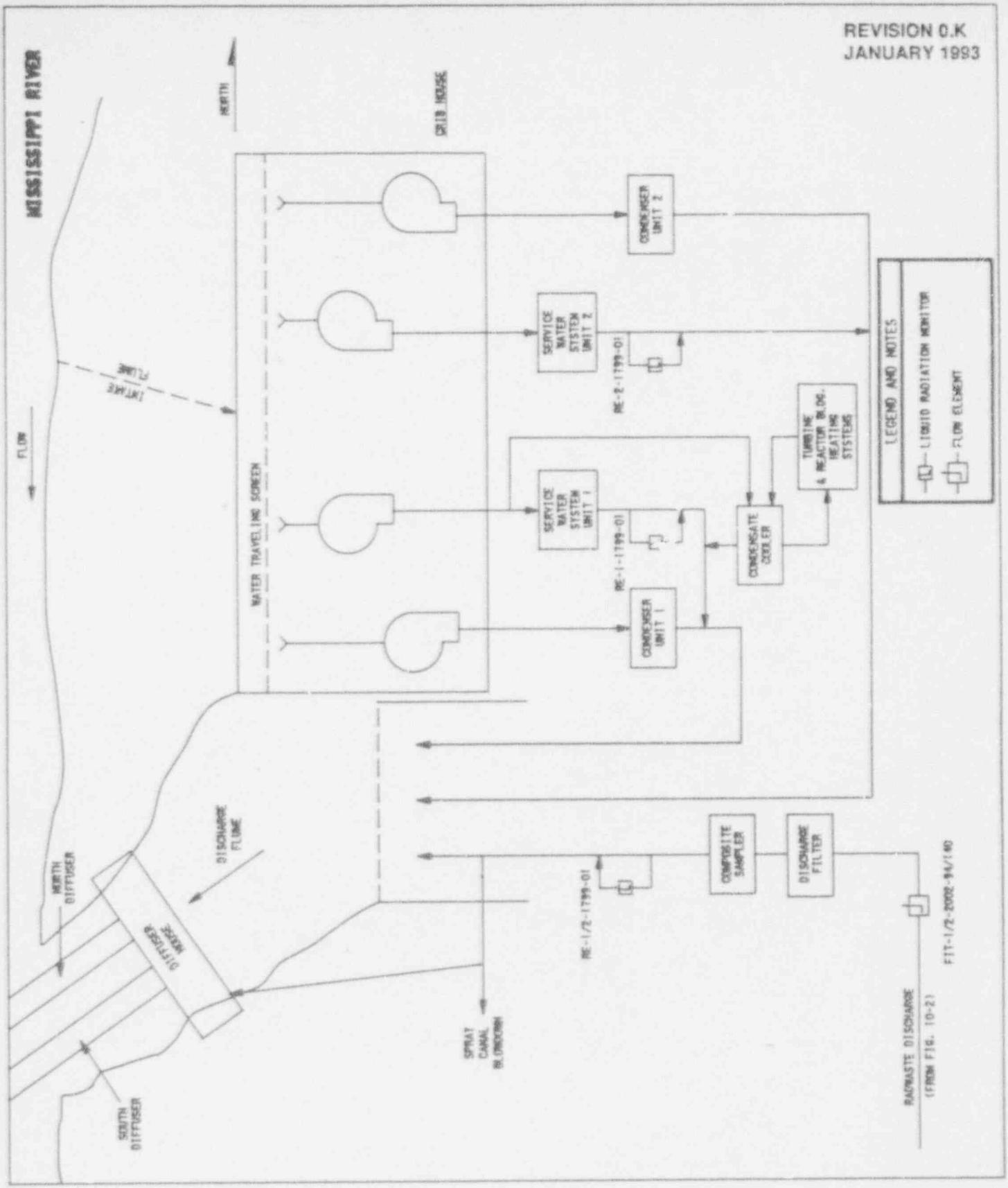

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QUAD-CITIES STATION

FIGURE 10-3

SIMPLIFIED LIQUID EFFLUENT
FLOW DIAGRAM

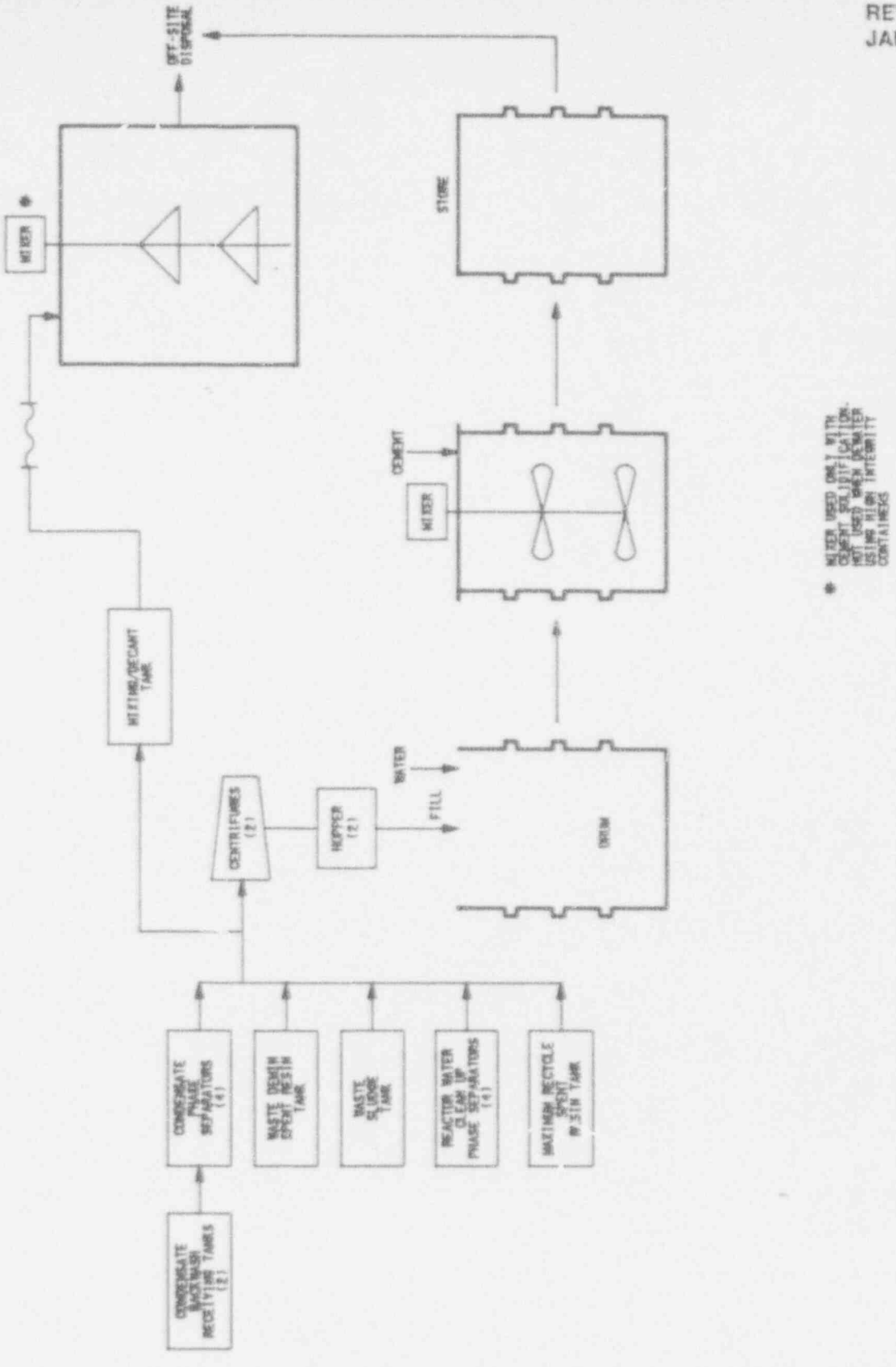

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FIGURE 10-4

SIMPLIFIED SOLID RADWASTE PROCESSING DIAGRAM

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APPENDIX F

STATION-SPECIFIC DATA FOR QUAD-CITIES UNITS 1 and 2

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STATION-SPECIFIC DATA FOR QUAD-CITIES UNITS 1 and 2

F.1 INTRODUCTION

This appendix contains data relevant to the Quad-Cities site. Included are a diagram of the unrestricted area boundary and tables of values of parameters used in offsite dose assessment.

F.2 REFERENCES

1. Sargent & Lundy, Nuclear Safeguards and Licensing Division, Quad-Cities Calculation No. QC-01-86, Rev. 0.

2. Sargent & Lundy, Nuclear Safeguards and Licensing Division, Quad-Cities Calculation No. QC-3-88, Rev. 0.

Table F-1
Aquatic Environment Dose Parameters

Parameter[a]	Value
$1/M^w$	1
$1/M^f$	1
F^w, cfs	4.7E4
F^f, cfs	4.7E3
t^f, hr[b]	24
t^w, hr[c]	8

Limits on Radioactivity in Unprotected Outdoor Tanks[e]

Not Applicable

(see Section A.2.4 of Appendix A)

[a] The parameters are defined in Section A.2.1 of Appendix A.

[b] t^f (hr) = 24 hr (all stations) for the fish ingestion pathway

[c] t^w (hr) = 8 hr (Distance to E. Moline is 16 miles; flow rate of 2 mph assumed)

Table F-2
Station Characteristics

Station: Quad-Cities Nuclear Power Station

Location: Cordova, Illinois

Characteristics of Elevated Release Point

1) Release Height = 94.49 m[a] 2) Diameter = 3.35 m

3) Exit Speed = 20.05 m s^{-1}[a] 4) Heat Content = 0 kCal s^{-1}[a]

Characteristics of Vent Stack Release Point

1) Release Height = 48.77 m[a] 2) Diameter = 2.74 m

3) Exit Speed = 8.38 m s^{-1}[a]

Characteristics of Ground Level Release

1) Release Height = 0 m

2) Building Factor (D) = 44.72 m[a]

Meterological Data

A 296 ft Tower is Located 1623 m SSE of Elevated Release Point

---

Tower Data Used in Calculations

Release Point	Wind Speed and Direction	Differential Temperature
Elevated	296 ft	296-33 ft
Vent	196 ft	196-33 ft
Ground	33 ft	196-33 ft

[a]Used in calculating the meteorological and dose factors in Tables F-5, F-6, and F7. See Sections B.3 through B.6 of Appendix B.

Table F-3
Critical Ranges

Direction	Practical Site Boundary[a] (m)	Nearest Resident[b] (m)	Nearest Dairy Farm Within 5 Miles[c] (m)
N	864	966	None
NNE	1029	1600	None
NE	1212	2100	None
ENE	1367	4500	None
E	1170	3700	None
ESE	1170	3200	None
SE	1189	1600	None
SSE	1422	1800	None
S	1198	1300	None
SSW	2140	4800	None
SW	1372	4500	None
WSW	823	3200	None
W	713	4000	None
WNW	713	4000	None
NW	823	3200	None
NNW	1481	3200	None

[a]Nearest land in unrestricted area.

[b]1990 annual survey, Teledyne Isotopes Midwest Laboratories. Used in establishing the characteristics of the individual maximally exposed to N-16 skyshine (see Section A.3.2 of Appendix A and Table F-8).

[c]1988 annual survey, Teledyne Isotopes Midwest Laboratories. Used in calculating the D/Q values in Tables F-6.

Table F-4

Average Wind Speeds

Downwind Direction	Average Wind Speed (m/sec)[a] Elevated	Mixed Mode	Ground Level
N	6.9	5.0	2.6
NNE	6.2	4.6	2.8
NE	5.3	3.7	2.4
ENE	6.0	4.4	2.8
E	6.9	5.0	3.2
ESE	7.1	5.2	3.7
SE	6.5	4.9	3.6
SSE	5.7	4.5	3.5
S	5.6	4.4	3.4
SSW	5.6	4.4	3.3
SW	5.8	4.6	3.0
WSW	6.0	4.7	3.4
W	6.1	4.8	3.1
WNW	6.0	4.5	2.6
NW	5.9	4.4	2.4
NNW	6.5	4.7	2.5

[a]Based on Quad-Cities site meteorological data (1980-1987 data for elevated release analysis, 1982-1987 data for ground level and mixed mode release analyses). Calculated in Reference 1 of Section F.2 using formulas in Section B.1.3 of Appendix B.

Table F-5

X/Q and D/Q Maxima at or Beyond the Unrestricted Area Boundary

Downwind Direction	Elevated(Stack) Release				Mixed Mode(Vent) Release			Ground Level Release		
	Radius (meters)	X/Q (sec/m**3)	Radius (meters)	D/Q (1/m**2)	Radius (meters)	X/Q (sec/m**3)	D/Q (1/m**2)	Radius (meters)	X/Q (sec/m**3)	D/Q (1/m**2)
N	4400.	1.344E-08	864.	9.642E-10	864.	3.427E-07	2.869E-09	864.	3.817E-06	1.105E-08
NNE	4023.	1.703E-08	1029.	1.407E-09	1029.	2.219E-07	3.049E-09	1029.	2.597E-06	1.052E-08
NE	4828.	1.287E-08	1212.	7.019E-10	1212.	1.321E-07	1.299E-09	1212.	2.249E-06	6.701E-09
ENE	4400.	1.091E-08	1367.	6.723E-10	1367.	1.213E-07	1.319E-09	1367.	1.446E-06	4.806E-09
E	3600.	1.513E-08	1170.	1.139E-09	1170.	2.215E-07	2.811E-09	1170.	2.212E-06	9.318E-09
ESE	3600.	2.126E-08	1170.	1.536E-09	1170.	2.332E-07	3.437E-09	1170.	2.094E-06	1.047E-08
SE	4023.	1.758E-08	1189.	1.082E-09	1189.	1.439E-07	2.384E-09	1189.	1.255E-06	6.450E-09
SSE	4023.	1.259E-08	1422.	6.915E-10	1422.	8.279E-08	1.167E-09	1422.	6.885E-07	3.222E-09
S	4400.	1.005E-08	1500.	4.437E-10	1198.	6.887E-08	9.516E-10	1198.	8.371E-07	3.350E-09
SSW	4400.	8.621E-09	2140.	3.110E-10	2140.	5.104E-08	4.693E-10	2140.	4.296E-07	1.380E-09
SW	4400.	1.102E-08	1500.	4.856E-10	1372.	1.006E-07	1.116E-09	1372.	1.224E-06	3.856E-09
WSW	4400.	1.123E-08	1500.	4.674E-10	823.	2.158E-07	2.298E-09	823.	2.968E-06	1.093E-08
W	4828.	1.139E-08	1500.	4.704E-10	713.	3.445E-07	2.737E-09	713.	5.271E-06	1.522E-08
WNW	4828.	9.486E-09	1500.	4.025E-10	713.	5.025E-07	2.816E-09	713.	7.554E-06	1.788E-08
NW	4828.	9.752E-09	823.	5.475E-10	823.	2.981E-07	2.009E-09	823.	4.739E-06	1.144E-08
NNW	4400.	1.045E-08	1481.	6.126E-10	1481.	1.712E-07	1.202E-09	1481.	1.928E-06	4.543E-09

Quad Cities Site Meteorological Data 1/78 - 12/87

Note: Based on Reference 1 of Section F.2 and the formulas in Sections B.3 and B.4 of Appendix B.

[a]Used for beta air, beta skin, and inhalation dose pathways. See Sections A.1.2, A.1.3, and A.1.4.2 of Appendix A.

[b]Used for produce and leafy vegetable pathways. See Section A.1.4 of Appendix A.

Table F-6

D/Q at the Nearest Milk Cow and Meat Animal Locations Within 5 Miles

Downwind Direction	Nearest Milk Cow D/Q(1/m**2)				Nearest Meat Animal D/Q(1/m**2)			
	Radius (meters)	Elevated Release	Mixed Release	Ground Release	Radius (meters)	Elevated Release	Mixed Release	Ground Release
N	8047.	1.009E-10	1.068E-10	2.325E-10	8047.	1.009E-10	1.068E-10	2.325E-10
NNE	8047.	1.341E-10	1.460E-10	2.946E-10	8047.	1.341E-10	1.460E-10	2.946E-10
NE	8047.	9.249E-11	9.284E-11	2.462E-10	4828.	1.989E-10	2.115E-10	6.138E-10
ENE	8047.	8.978E-11	9.695E-11	2.164E-10	8047.	8.978E-11	9.695E-11	2.164E-10
E	8047.	1.351E-10	1.604E-10	3.226E-10	3219.	4.759E-10	7.057E-10	.e42E-09
ESE	8047.	1.958E-10	1.992E-10	3.624E-10	8047.	1.958E-10	1.992E-10	3.624E-10
SE	8047.	1.527E-10	1.440E-10	2.295E-10	3219.	5.260E-10	6.268E-10	1.168E-09
SSE	8047.	1.016E-10	9.211E-11	1.551E-10	8047.	1.016E-10	9.211E-11	1.551E-10
S	8047.	7.575E-11	6.459E-11	1.207E-10	3219.	2.534E-10	2.735E-10	6.142E-10
SSW	8047.	6.552E-11	6.240E-11	1.337E-10	8047.	6.552E-11	6.240E-11	1.337E-10
SW	8047.	8.337E-11	8.655E-11	1.747E-10	8047.	8.337E-11	8.655E-11	1.747E-10
WSW	8047.	8.371E-11	9.916E-11	2.123E-10	8047.	8.371E-11	9.916E-11	2.123E-10
W	8047.	8.126E-11	9.450E-11	2.349E-10	8047.	8.126E-11	9.450E-11	2.349E-10
WNW	8047.	6.695E-11	8.631E-11	2.759E-10	8047.	6.695E-11	8.631E-11	2.759E-10
NW	8047.	6.978E-11	7.690E-11	2.225E-10	8047.	6.978E-11	7.690E-11	2.225E-10
NNW	8047.	7.862E-11	8.992E-11	2.344E-10	8047.	7.862E-11	8.992E-11	2.344E-10

Quad Cities Site Meteorological Data 1/78 - 12/87

Note: Based on Reference 1 of Section F.2 of Appendix F and the formulas in Section of Appendix B.

Table F-7

Site Boundary Finite Plume Gamma Dose Factors for Kr-83m

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Mixed Mode(Vent) Release Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Ground Level Release Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	1.193E-06	2.900E-07	864.	4.094E-05	9.948E-06	864.	3.885E-04	9.440E-05
NNE	1029.	1029.	1.785E-06	4.339E-07	1029.	2.796E-05	6.794E-06	1029.	2.651E-04	6.442E-05
NE	1212.	1212.	9.747E-07	2.368E-07	1212.	1.639E-05	3.983E-06	1212.	2.162E-04	5.253E-05
ENE	1367.	1367.	9.035E-07	2.195E-07	1367.	1.409E-05	3.425E-06	1367.	1.373E-04	3.337E-05
E	1170.	1170.	1.378E-06	3.349E-07	1170.	2.602E-05	6.323E-06	1170.	2.220E-04	5.395E-05
ESE	1170.	1170.	1.775E-06	4.312E-07	1170.	2.752E-05	6.688E-06	1170.	2.113E-04	5.134E-05
SE	1189.	1189.	1.286E-06	3.125E-07	1189.	1.748E-05	4.248E-06	1189.	1.248E-04	3.032E-05
SSE	1422.	1422.	9.303E-07	2.261E-07	1422.	9.663E-06	2.348E-06	1422.	6.648E-05	1.615E-05
S	1198.	1198.	4.932E-07	1.199E-07	1198.	8.591E-06	2.088E-06	1198.	8.157E-05	1.982E-05
SSW	2140.	2140.	6.664E-07	1.619E-07	2140.	5.469E-06	1.329E-06	2140.	3.670E-05	8.918E-06
SW	1372.	1372.	6.134E-07	1.491E-07	1372.	1.175E-05	2.856E-06	1372.	1.164E-04	2.828E-05
WSW	823.	823.	4.376E-07	1.063E-07	823.	2.665E-05	6.476E-06	823.	3.016E-04	7.329E-05
W	713.	713.	4.936E-07	1.199E-07	713.	4.059E-05	9.863E-06	713.	5.263E-04	1.279E-04
WNW	713.	713.	4.839E-07	1.176E-07	713.	5.484E-05	1.333E-05	713.	7.361E-04	1.789E-04
NW	823.	823.	8.023E-07	1.950E-07	823.	3.493E-05	8.488E-06	823.	4.707E-04	1.144E-04
NNW	1481.	1481.	9.575E-07	2.327E-07	1481.	1.950E-05	4.738E-06	1481.	1.814E-04	4.409E-05

Quad Cities Site Meteorological Data 1/78 - 12/87

Note: Based on Reference 1 of Section F.2 of Appendix F and the formulas in Sections B.5 and B.6 of Appendix B.

Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Kr-85m

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Mixed Mode(Vent) Release Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Ground Level Release Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	1.266E-04	1.077E-04	864.	4.908E-04	4.116E-04	864.	2.089E-03	1.716E-03
NNE	1029.	1029.	1.322E-04	1.123E-04	1029.	4.358E-04	3.670E-04	1029.	1.591E-03	1.312E-03
NE	1212.	1212.	8.448E-05	7.183E-05	1212.	2.793E-04	2.353E-04	1212.	1.383E-03	1.142E-03
ENE	1367.	1367.	5.783E-05	4.913E-05	1367.	2.056E-04	1.730E-04	1367.	9.249E-04	7.648E-04
E	1170.	1170.	8.118E-05	6.895E-05	1170.	3.308E-04	2.777E-04	1170.	1.393E-03	1.151E-03
ESE	1170.	1170.	1.067E-04	9.066E-05	1170.	3.662E-04	3.077E-04	1170.	1.337E-03	1.105E-03
SE	1189.	1189.	9.118E-05	7.749E-05	1189.	2.618E-04	2.203E-04	1189.	8.091E-04	6.688E-04
SSE	1422.	1422.	5.797E-05	4.924E-05	1422.	1.518E-04	1.278E-04	1422.	4.523E-04	3.743E-04
S	1198.	1198.	5.611E-05	4.773E-05	1198.	1.469E-04	1.238E-04	1198.	5.192E-04	4.287E-04
SSW	2140.	2140.	3.024E-05	2.566E-05	2140.	7.862E-05	6.610E-05	2140.	2.775E-04	2.299E-04
SW	1372.	1372.	5.402E-05	4.593E-05	1372.	1.697E-04	1.427E-04	1372.	7.514E-04	6.204E-04
WSW	823.	823.	8.767E-05	7.463E-05	823.	3.499E-04	2.939E-04	823.	1.633E-03	1.342E-03
W	713.	713.	1.112E-04	9.462E-05	713.	4.644E-04	3.893E-04	713.	2.573E-03	2.107E-03
WNW	713.	713.	1.000E-04	8.513E-05	713.	5.046E-04	4.213E-04	713.	3.454E-03	2.824E-03
NW	823.	823.	9.794E-05	8.332E-05	823.	3.993E-04	3.346E-04	823.	2.406E-03	1.972E-03
NNW	1481.	1481.	6.223E-05	5.287E-05	1481.	2.449E-04	2.055E-04	1481.	1.147E-03	9.460E-04

Quad Cities Site Meteorological Data 1/78 - 12/87

Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Kr-85

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Mixed Mode(Vent) Release Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Ground Level Release Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	1.753E-06	1.479E-06	864.	5.814E-06	4.907E-06	864.	2.347E-05	1.981E-05
NNE	1029.	1029.	1.834E-06	1.548E-06	1029.	5.237E-06	4.420E-06	1029.	1.792E-05	1.512E-05
NE	1212.	1212.	1.185E-06	1.000E-06	1212.	3.399E-06	2.869E-06	1212.	1.595E-05	1.346E-05
ENE	1367.	1367.	8.083E-07	6.822E-07	1367.	2.473E-06	2.087E-06	1367.	1.072E-05	9.049E-06
E	1170.	1170.	1.116E-06	9.420E-07	1170.	3.908E-06	3.298E-06	1170.	1.578E-05	1.331E-05
ESE	1170.	1170.	1.461E-06	1.233E-06	1170.	4.335E-06	3.659E-06	1170.	1.510E-05	1.274E-05
SE	1189.	1189.	1.259E-06	1.062E-06	1189.	3.118E-06	2.632E-06	1189.	9.186E-06	7.753E-06
SSE	1422.	1422.	8.057E-07	6.800E-07	1422.	1.829E-06	1.544E-06	1422.	5.211E-06	4.398E-06
S	1198.	1198.	7.916E-07	6.681E-07	1198.	1.774E-06	1.497E-06	1198.	5.956E-06	5.027E-06
SSW	2140.	2140.	4.230E-07	3.570E-07	2140.	9.632E-07	8.129E-07	2140.	3.375E-06	2.849E-06
SW	1372.	1372.	7.572E-07	6.390E-07	1372.	2.039E-06	1.721E-06	1372.	8.743E-06	7.379E-06
WSW	823.	823.	1.239E-06	1.045E-06	823.	4.157E-06	3.509E-06	823.	1.828E-05	1.543E-05
W	713.	713.	1.570E-06	1.325E-06	713.	5.481E-06	4.626E-06	713.	2.847E-05	2.402E-05
WNW	713.	713.	1.414E-06	1.193E-06	713.	5.906E-06	4.985E-06	713.	3.816E-05	3.221E-05
NW	823.	823.	1.372E-06	1.158E-06	823.	4.734E-06	3.996E-06	823.	2.700E-05	2.278E-05
NNW	1481.	1481.	8.575E-07	7.237E-07	1481.	2.931E-06	2.474E-06	1481.	1.350E-05	1.139E-05

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Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Kr-87

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release			Mixed Mode(Vent) Release			Ground Level Release		
		Radius (meters)	S	SBAR	Radius (meters)	V	VBAR	Radius (meters)	G	GBAR
			(mrad/yr)/(uCi/sec)			(mrad/yr)/(uCi/sec)			(mrad/yr)/(uCi/sec)	
N	864.	864.	6.162E-04	5.335E-04	864.	1.698E-03	1.467E-03	864.	5.808E-03	5.012E-03
NNE	1029.	1029.	6.389E-04	5.531E-04	1029.	1.557E-03	1.345E-03	1029.	4.508E-03	3.891E-03
NE	1212.	1212.	4.118E-04	3.566E-04	1212.	9.907E-04	8.562E-04	1212.	3.742E-03	3.230E-03
ENE	1367.	1367.	2.753E-04	2.384E-04	1367.	7.128E-04	6.159E-04	1367.	2.504E-03	2.162E-03
E	1170.	1170.	3.853E-04	3.336E-04	1170.	1.146E-03	9.902E-04	1170.	3.929E-03	3.391E-03
ESE	1170.	1170.	5.023E-04	4.348E-04	1170.	1.270E-03	1.098E-03	1170.	3.806E-03	3.285E-03
SE	1189.	1189.	4.324E-04	3.743E-04	1189.	9.253E-04	7.995E-04	1189.	2.291E-03	1.978E-03
SSE	1422.	1422.	2.723E-04	2.357E-04	1422.	5.290E-04	4.571E-04	1422.	1.256E-03	1.084E-03
S	1198.	1198.	2.704E-04	2.342E-04	1198.	5.202E-04	4.495E-04	1198.	1.424E-03	1.229E-03
SSW	2140.	2140.	1.354E-04	1.172E-04	2140.	2.615E-04	2.260E-04	2140.	7.068E-04	6.101E-04
SW	1372.	1372.	2.581E-04	2.234E-04	1372.	5.872E-04	5.073E-04	1372.	2.001E-03	1.727E-03
WSW	823.	823.	4.379E-04	3.792E-04	823.	1.238E-03	1.070E-03	823.	4.588E-03	3.959E-03
W	713.	713.	5.602E-04	4.851E-04	713.	1.632E-03	1.410E-03	713.	7.313E-03	6.311E-03
WNW	713.	713.	5.039E-04	4.364E-04	713.	1.729E-03	1.494E-03	713.	9.810E-03	8.465E-03
NW	823.	823.	4.859E-04	4.207E-04	823.	1.388E-03	1.199E-03	823.	6.654E-03	5.743E-03
NNW	1481.	1481.	2.903E-04	2.513E-04	1481.	8.192E-04	7.077E-04	1481.	2.955E-03	2.550E-03

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Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Kr-88

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Mixed Mode(Vent) Release Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Ground Level Release Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	1.594E-03	1.394E-03	864.	4.220E-03	3.680E-03	864.	1.481E-02	1.285E-02
NNE	1029.	1029.	1.665E-03	1.457E-03	1029.	3.885E-03	3.390E-03	1029.	1.143E-02	9.929E-03
NE	1212.	1212.	1.083E-03	9.474E-04	1212.	2.515E-03	2.195E-03	1212.	9.828E-03	8.537E-03
ENE	1367.	1367.	7.271E-04	6.360E-04	1367.	1.805E-03	1.575E-03	1367.	6.599E-03	5.733E-03
E	1170.	1170.	1.002E-03	8.765E-04	1170.	2.853E-03	2.488E-03	1170.	1.001E-02	8.698E-03
ESE	1170.	1170.	1.301E-03	1.138E-03	1170.	3.165E-03	2.760E-03	1170.	9.639E-03	8.373E-03
SE	1189.	1189.	1.124E-03	9.832E-04	1189.	2.307E-03	2.012E-03	1189.	5.837E-03	5.071E-03
SSE	1422.	1422.	7.148E-04	6.251E-04	1422.	1.340E-03	1.169E-03	1422.	3.258E-03	2.831E-03
S	1198.	1198.	7.126E-04	6.233E-04	1198.	1.312E-03	1.145E-03	1198.	3.701E-03	3.215E-03
SSW	2140.	2140.	3.636E-04	3.179E-04	2140.	6.814E-04	5.944E-04	2140.	1.963E-03	1.707E-03
SW	1372.	1372.	6.784E-04	5.934E-04	1372.	1.485E-03	1.295E-03	1372.	5.313E-03	4.615E-03
WSW	823.	823.	1.144E-03	1.001E-03	823.	3.068E-03	2.676E-03	823.	1.160E-02	1.007E-02
W	713.	713.	1.459E-03	1.277E-03	713.	4.024E-03	3.508E-03	713.	1.827E-02	1.584E-02
WNW	713.	713.	1.313E-03	1.148E-03	713.	4.274E-03	3.723E-03	713.	2.451E-02	2.125E-02
NW	823.	823.	1.265E-03	1.106E-03	823.	3.452E-03	3.009E-03	823.	1.699E-02	1.474E-02
NNW	1481.	1481.	7.588E-04	6.636E-04	1481.	2.083E-03	1.817E-03	1481.	8.020E-03	6.964E-03

Quad Cities Site Meteorological Data 1/78 - 12/87

Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Kr-89

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release			Mixed Mode(Vent) Release			Ground Level Release		
		Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	7.380E-04	6.399E-04	864.	1.425E-03	1.234E-03	864.	2.034E-03	1.759E-03
NNE	1029.	1029.	6.261E-04	5.429E-04	1029.	1.149E-03	9.943E-04	1029.	1.603E-03	1.386E-03
NE	1212.	1212.	3.167E-04	2.746E-04	1212.	5.081E-04	4.398E-04	1212.	7.323E-04	6.766E-04
ENE	1367.	1367.	2.047E-04	1.775E-04	1367.	3.701E-04	3.203E-04	1367.	5.059E-04	4.376E-04
E	1170.	1170.	3.698E-04	3.206E-04	1170.	8.126E-04	7.034E-04	1170.	1.310E-03	1.133E-03
ESE	1170.	1170.	5.046E-04	4.375E-04	1170.	9.740E-04	8.431E-04	1170.	1.566E-03	1.355E-03
SE	1189.	1189.	4.116E-04	3.569E-04	1189.	6.659E-04	5.765E-04	1189.	9.264E-04	8.012E-04
SSE	1422.	1422.	2.003E-04	1.736E-04	1422.	2.810E-04	2.433E-04	1422.	3.822E-04	3.306E-04
S	1198.	1198.	2.189E-04	1.898E-04	1198.	3.175E-04	2.748E-04	1198.	4.622E-04	3.998E-04
SSW	2140.	2140.	5.751E-05	4.985E-05	2140.	7.519E-05	6.508E-05	2140.	8.761E-05	7.579E-05
SW	1372.	1372.	1.914E-04	1.659E-04	1372.	3.241E-04	2.806E-04	1372.	4.441E-04	3.841E-04
WSW	823.	823.	4.790E-04	4.154E-04	823.	1.113E-03	9.632E-04	823.	2.203E-03	1.905E-03
W	713.	713.	6.760E-04	5.862E-04	713.	1.569E-03	1.358E-03	713.	3.460E-03	2.992E-03
WNW	713.	713.	6.075E-04	5.269E-04	713.	1.513E-03	1.310E-03	713.	4.161E-03	3.598E-03
NW	823.	823.	5.447E-04	4.724E-04	823.	1.114E-03	9.643E-04	823.	2.198E-03	1.901E-03
NNW	1481.	1481.	2.270E-04	1.968E-04	1481.	3.806E-04	3.294E-04	1481.	3.958E-04	3.423E-04

Quad Cities Site Meteorological Data 1/78 - 12/87

Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Kr-90

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Mixed Mode(Vent) Release Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Ground Level Release Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	1.025E-04	8.835E-05	864.	1.001E-04	8.617E-05	864.	3.226E-05	2.770E-05
NNE	1029.	1029.	4.953E-05	4.269E-05	1029.	4.309E-05	3.708E-05	1029.	1.549E-05	1.330E-05
NE	1212.	1212.	1.210E-05	1.043E-05	1212.	7.167E-06	6.166E-06	1212.	2.958E-06	2.540E-06
ENE	1367.	1367.	8.572E-06	7.387E-06	1367.	7.121E-06	6.124E-06	1367.	3.357E-06	2.883E-06
E	1170.	1170.	2.876E-05	2.479E-05	1170.	3.061E-05	2.633E-05	1170.	1.687E-05	1.449E-05
ESE	1170.	1170.	4.141E-05	3.569E-05	1170.	3.846E-05	3.308E-05	1170.	2.748E-05	2.360E-05
SE	1189.	1189.	2.685E-05	2.314E-05	1189.	2.120E-05	1.823E-05	1189.	1.306E-05	1.122E-05
SSE	1422.	1422.	5.661E-06	4.879E-06	1422.	4.092E-06	3.520E-06	1422.	2.460E-06	2.113E-06
S	1198.	1198.	9.811E-06	8.457E-06	1198.	7.891E-06	6.788E-06	1198.	6.776E-06	5.819E-06
SSW	2140.	2140.	5.194E-07	4.474E-07	2140.	2.996E-07	2.577E-07	2140.	1.827E-07	1.569E-07
SW	1372.	1372.	6.788E-06	5.850E-06	1372.	6.147E-06	5.287E-06	1372.	3.347E-06	2.874E-06
WSW	823.	823.	5.697E-05	4.912E-05	823.	8.167E-05	7.026E-05	823.	8.406E-05	7.216E-05
W	713.	713.	1.054E-04	9.086E-05	713.	1.550E-04	1.334E-04	713.	1.486E-04	1.276E-04
WNW	713.	713.	9.367E-05	8.076E-05	713.	1.286E-04	1.106E-04	713.	1.211E-04	1.039E-04
NW	823.	823.	6.316E-05	5.445E-05	823.	6.467E-05	5.565E-05	823.	3.606E-05	3.096E-05
NNW	1481.	1481.	8.234E-06	7.096E-06	1481.	6.106E-06	5.254E-06	1481.	1.127E-06	9.682E-07

Quad Cities Site Meteorological Data 1/78 - 12/87

Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Xe-131m

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Mixed Mode(Vent) Release Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Ground Level Release Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	3.647E-06	2.529E-06	864.	4.407E-05	1.701E-05	864.	3.834E-04	1.200E-04
NNE	1029.	1029.	4.237E-06	2.748E-06	1029.	3.179E-05	1.335E-05	1029.	2.633E-04	8.447E-05
NE	1212.	1212.	2.587E-06	1.731E-06	1212.	1.947E-05	8.366E-06	1212.	2.279E-04	7.360E-05
ENE	1367.	1367.	1.965E-06	1.234E-06	1367.	1.602E-05	6.563E-06	1367.	1.466E-04	4.788E-05
E	1170.	1170.	2.839E-06	1.744E-06	1170.	2.808E-05	1.107E-05	1170.	2.237E-04	7.240E-05
ESE	1170.	1170.	3.680E-06	2.280E-06	1170.	2.997E-05	1.200E-05	1170.	2.118E-04	6.872E-05
SE	1189.	1189.	2.967E-06	1.907E-06	1189.	1.963E-05	8.144E-06	1189.	1.267E-04	4.127E-05
SSE	1422.	1422.	1.993E-06	1.242E-06	1422.	1.114E-05	4.681E-06	1422.	6.993E-05	2.294E-05
S	1198.	1198.	1.599E-06	1.123E-06	1198.	1.013E-05	4.368E-06	1198.	8.492E-05	2.744E-05
SSW	2140.	2140.	1.206E-06	6.935E-07	2140.	6.337E-06	2.579E-06	2140.	4.359E-05	1.443E-05
SW	1372.	1372.	1.650E-06	1.107E-06	1372.	1.332E-05	5.441E-06	1372.	1.252E-04	4.041E-05
WSW	823.	823.	2.220E-06	1.681E-06	823.	2.888E-05	1.151E-05	823.	2.959E-04	9.279E-05
W	713.	713.	2.761E-06	2.115E-06	713.	4.243E-05	1.624E-05	713.	4.991E-04	1.538E-04
WNW	713.	713.	2.521E-06	1.912E-06	713.	5.524E-05	1.985E-05	713.	6.941E-04	2.122E-04
NW	823.	823.	2.732E-06	1.936E-06	823.	3.710E-05	1.414E-05	823.	4.622E-04	1.431E-04
NNW	1481.	1481.	2.099E-06	1.322E-06	1481.	2.184E-05	8.495E-06	1481.	1.999E-04	6.400E-05

Quad Cities Site Meteorological Data 1/78 - 12/87

Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Xe-133m

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release			Mixed Mode(Vent) Release			Ground Level Release		
		Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	1.894E-05	1.553E-05	864.	1.039E-04	6.717E-05	864.	6.441E-04	3.346E-04
NNE	1029.	1029.	2.025E-05	1.635E-05	1029.	8.483E-05	5.799E-05	1029.	4.614E-04	2.481E-04
NE	1212.	1212.	1.285E-05	1.045E-05	1212.	5.369E-05	3.721E-05	1212.	4.033E-04	2.188E-04
ENE	1367.	1367.	9.011E-06	7.220E-06	1367.	4.123E-05	2.777E-05	1367.	2.642E-04	1.453E-04
E	1170.	1170.	1.267E-05	1.010E-05	1170.	6.835E-05	4.489E-05	1170.	3.977E-04	2.163E-04
ESE	1170.	1170.	1.660E-05	1.325E-05	1170.	7.460E-05	4.949E-05	1170.	3.783E-04	2.065E-04
SE	1189.	1189.	1.402E-05	1.130E-05	1189.	5.149E-05	3.495E-05	1189.	2.278E-04	1.250E-04
SSE	1422.	1422.	9.051E-06	7.237E-06	1422.	2.975E-05	2.035E-05	1422.	1.270E-04	7.029E-05
S	1198.	1198.	8.431E-06	6.935E-06	1198.	2.808E-05	1.950E-05	1198.	1.505E-04	8.171E-05
SSW	2140.	2140.	4.938E-06	3.860E-06	2140.	1.613E-05	1.082E-05	2140.	8.011E-05	4.484E-05
SW	1372.	1372.	8.224E-06	6.697E-06	1372.	3.413E-05	2.294E-05	1372.	2.212E-04	1.199E-04
WSW	823.	823.	1.283E-05	1.071E-05	823.	7.137E-05	4.720E-05	823.	4.990E-04	2.600E-04
W	713.	713.	1.619E-05	1.355E-05	713.	9.876E-05	6.345E-05	713.	8.170E-04	4.144E-04
WNW	713.	713.	1.461E-05	1.220E-05	713.	1.166E-04	7.106E-05	713.	1.121E-03	5.613E-04
NW	823.	823.	1.457E-05	1.201E-05	823.	8.573E-05	5.490E-05	823.	7.625E-04	3.899E-04
NNW	1481.	1481.	9.664E-06	7.749E-06	1481.	5.202E-05	3.383E-05	1481.	3.480E-04	1.866E-04

Quad Cities Site Meteorological Data 1/78 - 12/87

Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Xe-133

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Mixed Mode(Vent) Release Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Ground Level Release Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	1.741E-05	1.474E-05	864.	1.161E-04	8.362E-05	864.	7.126E-04	4.422E-04
NNE	1029.	1029.	1.886E-05	1.576E-05	1029.	9.493E-05	7.104E-05	1029.	5.171E-04	3.298E-04
NE	1212.	1212.	1.186E-05	9.968E-06	1212.	5.974E-05	4.508E-05	1212.	4.541E-04	2.917E-04
ENE	1367.	1367.	8.561E-06	7.111E-06	1367.	4.602E-05	3.407E-05	1367.	2.989E-04	1.940E-04
E	1170.	1170.	1.214E-05	1.004E-05	1170.	7.658E-05	5.576E-05	1170.	4.478E-04	2.882E-04
ESE	1170.	1170.	1.606E-05	1.331E-05	1170.	8.356E-05	6.126E-05	1170.	4.264E-04	2.751E-04
SE	1189.	1189.	1.340E-05	1.119E-05	1189.	5.757E-05	4.286E-05	1189.	2.572E-04	1.666E-04
SSE	1422.	1422.	8.767E-06	7.277E-06	1422.	3.309E-05	2.475E-05	1422.	1.438E-04	9.373E-05
S	1198.	1198.	7.778E-06	6.603E-06	1198.	3.131E-05	2.367E-05	1198.	1.695E-04	1.089E-04
SSW	2140.	2140.	4.975E-06	4.063E-06	2140.	1.790E-05	1.319E-05	2140.	9.115E-05	5.988E-05
SW	1372.	1372.	7.778E-06	6.550E-06	1372.	3.803E-05	2.810E-05	1372.	2.491E-04	1.599E-04
WSW	823.	823.	1.135E-05	9.753E-06	823.	7.956E-05	5.815E-05	823.	5.527E-04	3.439E-04
W	713.	713.	1.419E-05	1.223E-05	713.	1.096E-04	7.842E-05	713.	8.936E-04	5.436E-04
WNW	713.	713.	1.281E-05	1.102E-05	713.	1.283E-04	8.836E-05	713.	1.218E-03	7.329E-04
NW	823.	823.	1.308E-05	1.111E-05	823.	9.513E-05	6.794E-05	823.	8.374E-04	5.128E-04
NNW	1481.	1481.	9.317E-06	7.751E-06	1481.	5.833E-05	4.219E-05	1481.	3.907E-04	2.487E-04

Quad Cities Site Meteorological Data 1/78 - 12/87

Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Xe-135m

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Mixed Mode(Vent) Release Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Ground Level Release Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	2.899E-04	2.446E-04	864.	8.530E-04	7.164E-04	864.	2.453E-03	2.044E-03
NNE	1029.	1029.	2.877E-04	2.426E-04	1029.	7.645E-04	6.427E-04	1029.	1.941E-03	1.620E-03
NE	1212.	1212.	1.756E-04	1.481E-04	1212.	4.447E-04	3.740E-04	1212.	1.382E-03	1.154E-03
ENE	1367.	1367.	1.163E-04	9.810E-05	1367.	3.217E-04	2.704E-04	1367.	9.117E-04	7.617E-04
E	1170.	1170.	1.741E-04	1.468E-04	1170.	5.632E-04	4.730E-04	1170.	1.662E-03	1.388E-03
ESE	1170.	1170.	2.308E-04	1.946E-04	1170.	6.317E-04	5.307E-04	1170.	1.681E-03	1.404E-03
SE	1189.	1189.	1.959E-04	1.652E-04	1189.	4.536E-04	3.812E-04	1189.	1.003E-03	8.379E-04
SSE	1422.	1422.	1.166E-04	9.832E-05	1422.	2.398E-04	2.016E-04	1422.	5.084E-04	4.248E-04
S	1198.	1198.	1.163E-04	9.809E-05	1198.	2.423E-04	2.037E-04	1198.	5.714E-04	4.771E-04
SSW	2140.	2140.	5.156E-05	4.346E-05	2140.	1.028E-04	8.635E-05	2140.	2.160E-04	1.806E-04
SW	1372.	1372.	1.099E-04	9.272E-05	1372.	2.682E-04	2.254E-04	1372.	7.263E-04	6.065E-04
WSW	823.	823.	1.979E-04	1.670E-04	823.	6.335E-04	5.322E-04	823.	2.055E-03	1.713E-03
W	713.	713.	2.585E-04	2.181E-04	713.	8.524E-04	7.157E-04	713.	3.381E-03	2.814E-03
WNW	713.	713.	2.323E-04	1.960E-04	713.	8.874E-04	7.442E-04	713.	4.500E-03	3.743E-03
NW	823.	823.	2.227E-04	1.878E-04	823.	6.913E-04	5.805E-04	823.	2.772E-03	2.309E-03
NNW	1481.	1481.	1.264E-04	1.066E-04	1491.	3.575E-04	3.004E-04	1481.	9.461E-04	7.897E-04

Quad Cities Site Meteorological Data 1/78 - 12/87

Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Xe-135

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Mixed Mode(Vent) Release Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Ground Level Release Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	1.787E-04	1.521E-04	864.	6.779E-04	5.753E-04	864.	2.851E-03	2.409E-03
NNE	1029.	1029.	1.867E-04	1.588E-04	1029.	6.045E-04	5.134E-04	1029.	2.178E-03	1.842E-03
NE	1212.	1212.	1.196E-04	1.018E-04	1212.	3.894E-04	3.308E-04	1212.	1.917E-03	1.621E-03
ENE	1367.	1367.	8.192E-05	6.970E-05	1367.	2.860E-04	2.429E-04	1367.	1.285E-03	1.088E-03
E	1170.	1170.	1.145E-04	9.741E-05	1170.	4.571E-04	3.880E-04	1170.	1.913E-03	1.618E-03
ESE	1170.	1170.	1.504E-04	1.280E-04	1170.	5.067E-04	4.302E-04	1170.	1.833E-03	1.551E-03
SE	1189.	1189.	1.287E-04	1.096E-04	1189.	3.627E-04	3.081E-04	1189.	1.113E-03	9.414E-04
SSE	1422.	1422.	8.204E-05	6.980E-05	1422.	2.113E-04	1.795E-04	1422.	6.264E-04	5.301E-04
S	1198.	1198.	7.961E-05	6.776E-05	1198.	2.044E-04	1.737E-04	1198.	7.175E-04	6.070E-04
SSW	2140.	2140.	4.304E-05	3.661E-05	2140.	1.103E-04	9.366E-05	2140.	3.945E-04	3.340E-04
SW	1372.	1372.	7.655E-05	6.515E-05	1372.	2.359E-04	2.004E-04	1372.	1.046E-03	8.845E-04
WSW	823.	823.	1.242E-04	1.057E-04	823.	4.833E-04	4.103E-04	823.	2.225E-03	1.881E-03
W	713.	713.	1.573E-04	1.339E-04	713.	6.395E-04	5.427E-04	713.	3.478E-03	2.937E-03
WNW	713.	713.	1.415E-04	1.205E-04	713.	6.923E-04	5.870E-04	713.	4.660E-03	3.934E-03
NW	823.	823.	1.384E-04	1.178E-04	823.	5.510E-04	4.676E-04	823.	3.277E-03	2.768E-03
NNW	1481.	1481.	8.796E-05	7.484E-05	1481.	3.406E-04	2.891E-04	1481.	1.605E-03	1.357E-03

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Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Xe-137

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release			Mixed Mode(Vent) Release			Ground Level Release		
		Radius (meters)	S	SBAR	Radius (meters)	V	VBAR	Radius (meters)	G	GBAR
			(mrad/yr)/(uCi/sec)			(mrad/yr)/(uCi/sec)			(mrad/yr)/(uCi/sec)	
N	864.	864.	9.587E-05	8.138E-05	864.	2.169E-04	1.840E-04	864.	3.650E-04	3.093E-04
NNE	1029.	1029.	8.396E-05	7.127E-05	1029.	1.789E-04	1.517E-04	1029.	2.883E-04	2.443E-04
NE	1212.	1212.	4.406E-05	3.740E-05	1212.	8.327E-05	7.062E-05	1212.	1.506E-04	1.276E-04
ENE	1367.	1367.	2.876E-05	2.441E-05	1367.	6.062E-05	5.140E-05	1367.	9.706E-05	8.225E-05
E	1170.	1170.	5.014E-05	4.256E-05	1170.	1.280E-04	1.086E-04	1170.	2.375E-04	2.012E-04
ESE	1170.	1170.	6.821E-05	5.790E-05	1170.	1.517E-04	1.287E-04	1170.	2.747E-04	2.328E-04
SE	1189.	1189.	5.604E-05	4.757E-05	1189.	1.044E-04	8.854E-05	1189.	1.631E-04	1.382E-04
SSE	1422.	1422.	2.842E-05	2.412E-05	1422.	4.591E-05	3.893E-05	1422.	6.975E-05	5.911E-05
S	1198.	1198.	3.027E-05	2.569E-05	1198.	5.064E-05	4.295E-05	1198.	8.267E-05	7.006E-05
SSW	2140.	2140.	8.925E-06	7.575E-06	2140.	1.344E-05	1.140E-05	2140.	1.753E-05	1.486E-05
SW	1372.	1372.	2.697E-05	2.290E-05	1372.	5.261E-05	4.461E-05	1372.	8.334E-05	7.062E-05
WSW	823.	823.	6.236E-05	5.294E-05	823.	1.682E-04	1.426E-04	823.	3.760E-04	3.186E-04
W	713.	713.	8.655E-05	7.348E-05	713.	2.349E-04	1.992E-04	713.	5.968E-04	5.057E-04
WNW	713.	713.	7.777E-05	6.603E-05	713.	2.298E-04	1.949E-04	713.	7.354E-04	6.230E-04
NW	823.	823.	7.090E-05	6.019E-05	823.	1.705E-04	1.446E-04	823.	3.973E-04	3.367E-04
NNW	1481.	1481.	3.192E-05	2.709E-05	1481.	6.298E-05	5.341E-05	1481.	7.935E-05	6.724E-05

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Table F-7 (Cont'd)

Site Boundary Finite Plume Gamma Dose Factors for Xe-138

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Mixed Mode(Vent) Release Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Ground Level Release Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	7.602E-04	6.584E-04	864.	1.909E-03	1.650E-03	864.	5.007E-03	4.315E-03
NNE	1029.	1029.	7.527E-04	6.518E-04	1029.	1.728E-03	1.494E-03	1029.	3.991E-03	3.441E-03
NE	1212.	1212.	4.600E-04	3.984E-04	1212.	1.005E-03	8.684E-04	1212.	2.814E-03	2.426E-03
ENE	1367.	1367.	3.014E-04	2.610E-04	1367.	7.202E-04	6.223E-04	1367.	1.859E-03	1.603E-03
E	1170.	1170.	4.505E-04	3.901E-04	1170.	1.258E-03	1.087E-03	1170.	3.418E-03	2.947E-03
ESE	1170.	1170.	5.943E-04	5.146E-04	1170.	1.414E-03	1.222E-03	1170.	3.473E-03	2.994E-03
SE	1189.	1189.	5.059E-04	4.381E-04	1189.	1.022E-03	8.834E-04	1189.	2.076E-03	1.790E-03
SSE	1422.	1422.	2.995E-04	2.593E-04	1422.	5.384E-04	4.652E-04	1422.	1.049E-03	9.044E-04
S	1198.	1198.	3.027E-04	2.621E-04	1198.	5.469E-04	4.727E-04	1198.	1.174E-03	1.012E-03
SSW	2140.	2140.	1.297E-04	1.122E-04	2140.	2.269E-04	1.961E-04	2140.	4.390E-04	3.787E-04
SW	1372.	1372.	2.843E-04	2.462E-04	1372.	6.005E-04	5.189E-04	1372.	1.480E-03	1.276E-03
WSW	823.	823.	5.252E-04	4.549E-04	823.	1.428E-03	1.234E-03	823.	4.220E-03	3.637E-03
W	713.	713.	6.885E-04	5.964E-04	713.	1.914E-03	1.654E-03	713.	6.917E-03	5.959E-03
WNW	713.	713.	6.188E-04	5.360E-04	713.	1.974E-03	1.705E-03	713.	9.182E-03	7.909E-03
NW	823.	823.	5.894E-04	5.105E-04	823.	1.550E-03	1.339E-03	823.	5.640E-03	4.860E-03
NNW	1481.	1481.	3.244E-04	2.809E-04	1481.	7.909E-04	6.833E-04	1481.	1.903E-03	1.641E-03

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Table F-7 (Cont'd)
Site Boundary Finite Plume Gamma Dose Factors for Ar-41

Downwind Direction	Unrestricted Area Bound (meters)	Elevated(Stack) Release			Mixed Mode(Vent) Release			Ground Level Release		
		Radius (meters)	S (mrad/yr)/(uCi/sec)	SBAR	Radius (meters)	V (mrad/yr)/(uCi/sec)	VBAR	Radius (meters)	G (mrad/yr)/(uCi/sec)	GBAR
N	864.	864.	9.169E-04	7.812E-04	864.	2.639E-03	2.249E-03	864.	9.453E-03	8.054E-03
NNE	1029.	1029.	9.534E-04	8.123E-04	1029.	2.410E-03	2.053E-03	1029.	7.295E-03	6.215E-03
NE	1212.	1212.	6.143E-04	5.234E-04	1212.	1.545E-03	1.316E-03	1212.	6.170E-03	5.257E-03
ENE	1367.	1367.	4.130E-04	3.519E-04	1367.	1.116E-03	9.509E-04	1367.	4.131E-03	3.520E-03
E	1170.	1170.	5.748E-04	4.897E-04	1170.	1.782E-03	1.518E-03	1170.	6.371E-03	5.428E-03
ESE	1170.	1170.	7.494E-04	6.384E-04	1170.	1.976E-03	1.684E-03	1170.	6.148E-03	5.238E-03
SE	1189.	1189.	6.447E-04	5.493E-04	1189.	1.435E-03	1.223E-03	1189.	3.710E-03	3.161E-03
SSE	1422.	1422.	4.090E-04	3.485E-04	1422.	8.282E-04	7.056E-04	1422.	2.052E-03	1.748E-03
S	1198.	1198.	4.040E-04	3.442E-04	1198.	8.103E-04	6.903E-04	1198.	2.334E-03	1.988E-03
SSW	2140.	2140.	2.070E-04	1.764E-04	2140.	4.157E-04	3.542E-04	2140.	1.195E-03	1.018E-03
SW	1372.	1372.	3.864E-04	3.292E-04	1372.	9.192E-04	7.832E-04	1372.	3.318E-03	2.827E-03
WSW	823.	823.	6.504E-04	5.541E-04	823.	1.917E-03	1.634E-03	823.	7.433E-03	6.333E-03
W	713.	713.	8.303E-04	7.074E-04	713.	2.525E-03	2.152E-03	713.	1.179E-02	1.005E-02
WNW	713.	713.	7.474E-04	6.368E-04	713.	2.689E-03	2.291E-03	713.	1.583E-02	1.348E-02
NW	823.	823.	7.219E-04	6.150E-04	823.	2.157E-03	1.838E-03	823.	1.085E-02	9.246E-03
NNW	1481.	1481.	4.362E-04	3.716E-04	1481.	1.291E-03	1.100E-03	1481.	4.963E-03	4.229E-03

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Table F-8

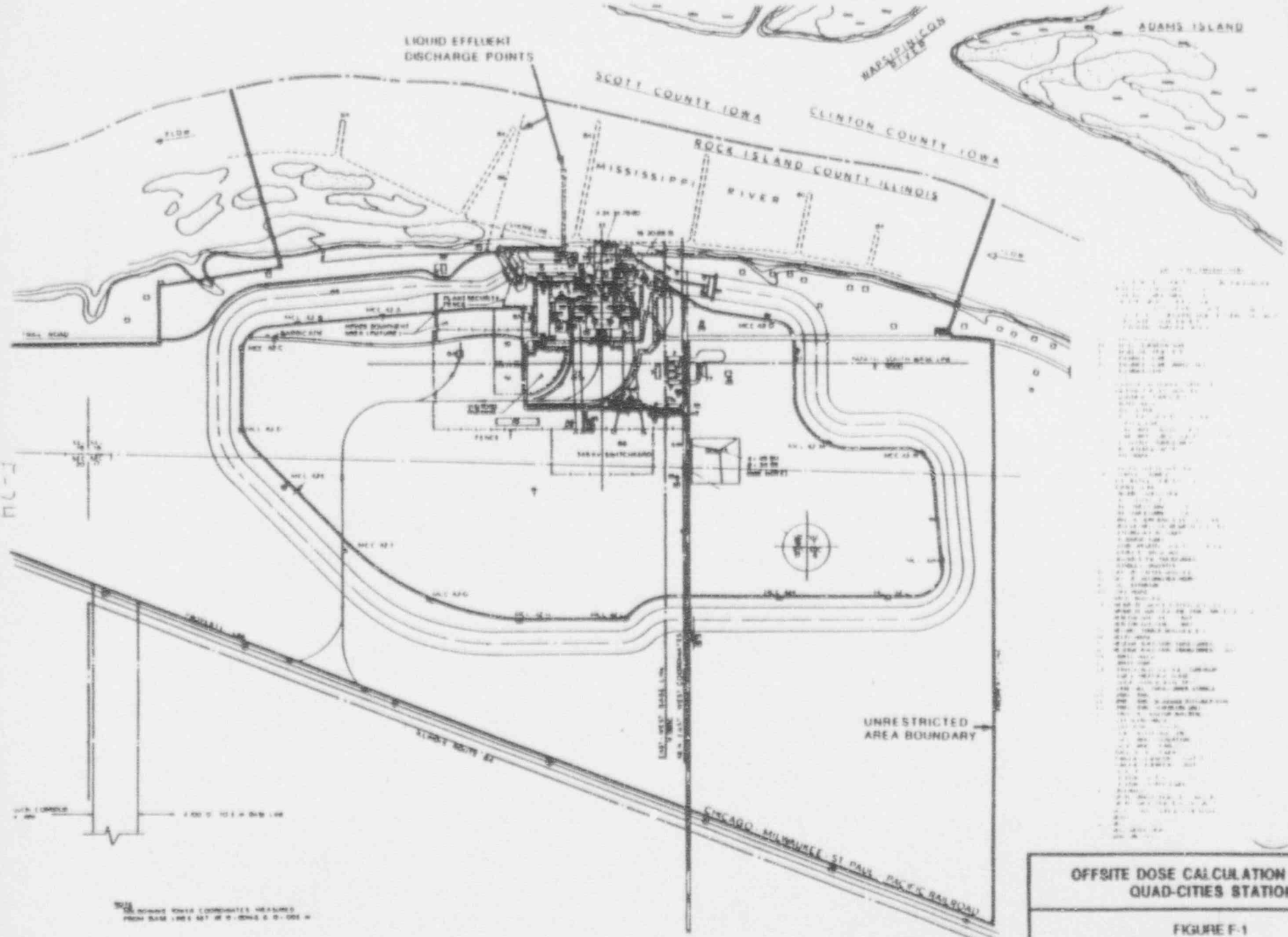
Parameters for Calculation of N-16 Skyshine Radiation From Quad-Cities

Location Number k	Activity	Occupancy Hours[a] OH_k	Shielding Factor SF_k	Distance R_k (m)
1	Living at home (nearest resident)	8160	0.7	966[b]
2	Fishing	50	1.0	140
3	Fishing	50	1.0	170
4	Fishing	100	1.0	200
5	Fishing	400	1.0	400

Note: These parameters are used to obtain an initial estimate of skyshine dose to the maximally exposed member of the public using Equation A-35 of Appendix A. If desired, more realistic parameters could be used in place of these to refine the estimate. For example, one could determine whether the nearest resident really fishes at the specified locations.

[a]Based on Reference 2 in Section F.2. The amount of time in a year that a maximally exposed fisherman would spend at various locations near the station was estimated on the basis of discussion with a member of the station staff.

[b]Distance to nearest residence (see Table F-3).



F-14

OFFSITE DOSE CALCULATION MANUAL
QUAD-CITIES STATION

FIGURE F-1

UNRESTRICTED AREA BOUNDARY