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GENII DOSE CALCULATIONS FOR OFFSITE MXIMUM
INDIVIDUAL & POPULATIONS FROM PFP

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SUPPORTING DOCUMENT

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7. Abstract

Document describes the potential dose consequences to the offsite maximum individual and population for ground and stack level releases at the offsite receptors from the Plutonium Finishing Plant.

8. RELEASE STAMP

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**GENII DOSE CONSEQUENCE CALCULATIONS FOR OFFSITE
MAXIMUM INDIVIDUAL AND POPULATIONS FROM
PLUTONIUM FINISHING PLANT**

**L. V. Nguyen
September 29, 1995**

I PURPOSE

Potential dose consequences to the offsite maximum individual and population for ground and stack level releases at the offsite receptors have been calculated.

II SOURCE TERMS

The worst case releases for stack and ground level from the 1993 and 1991 datas, respectively, were used to calculated doses. The plutonium is assumed to be released in the form of non-oxide. The release location is to be at Plutonium Finishing Plant building.

III METHODOLOGIES AND ASSUMPTIONS

The objectives for these problems are to calculate the maximum individual and population doses for the ground and stack level releases at offsite receptors using computer code GENII Version 1.485 (Napier et al. 1988). In addition, the dispersion coefficient values for onsite and offsite for acute and chronic (annual average) at both ground and stack level releases were included. All material released is assumed respirable. Acute and chronic release 99.5 percentile dispersion factors (X/Q) were generated using the GXQ (B. Hey, 1995) for a variety onsite occupied facilities and site boundary locations. The higher X/Q will be use for the dose calculations (NRC, Regulation Guide 1.145).

The stack downwash model was applied (GXQ, 1993) to ground-level concentrations downwind of elevated releases. The stack height of 61 meters (200 ft), flow rates of 260,000 scfm (123 m³/s), and inside diameters of 13.5 ft (4.1 meters) were specified on WHC-1991. The stack height is assumed to be equivalent to a freestanding stack that is the stack height is sufficient that plumes emitted avoid entering the building wake. The stack downwash correction model (GXQ, 1993) depends upon the ratio of efflux velocity to cross-flow velocity at the top of the stack. The effluent is assumed to be at ambient temperature.

IV DEFINITIONS

Health Effect

As used here, *health effect* refers to the negative health impact on a population resulting from an action which hopefully, has some benefit. It may be that the action's net result will enhance population health (i.e. reduce risk of exposure from current system configuration); however, only the negative health impact is of current concern. The only *health effect* considered here is latent cancer fatality (LCF) resulting from accidental release of man-made radioactive materials.

99.5% Meteorology

As used here, *99.5% meteorology* represents a condition of atmospheric dispersion which is exceeded 0.5% of the time during the year in the given sector.

Offsite Population

The *offsite population* is assumed to extend from the Hanford site boundary to a circle having a 50 mile radius centered at the release point. It is assumed that the population distribution within a sector interval (i.e. area enclosed by radial and azimuthal increment) is uniform. Hanford site specific population data from the 1990 census are used.

The exposed *offsite population* is that portion of the *offsite population* immersed in the radioactive plume. The worst case exposed *offsite population* is the sector population which experiences the greatest combined *health effect*.

OFFSITE POPULATION HEALTH EFFECT WITH 99.5% METEOROLOGY

Given a stack release from PFP, the *offsite population health effect* is evaluated for *99.5% meteorology*. The *offsite population* is chosen to be the population in the compass sector which yields the highest population health effect. The results are reported as LCF for the worst case *offsite population ; or acute and chronic*.

The worst case *offsite population* lays in the SE sector, towards the city of Richland. This sector, out to 80,000 m (50 miles) has a population of 114,734. For example, the committed effective dose equivalent (CEDE) for offsite acute ground level release to this population is calculated to be 2.9 E-02 person-rem.

The International Commission on Radiological Protection has determined that the nominal cancer fatality coefficient for a population of all ages for low dose, low dose-rate whole body irradiation is approximately $5.0 \text{ E-04 LCF/person-rem EDE}$ (ICRP 1991).

Assuming the accident occurs during 99.5% meteorology, the health effect to the exposed offsite population chronic stack level release is given by

$$(9.0 \text{ E-04 person-rem}) (5.0 \text{ E-04 LCF/person-rem}) = 4.5 \text{ E-07 LCF.}$$

To place this in perspective, this exposed offsite population of 114,734 persons would normally be expected to have approximately two-hundred twenty-five LCFs per year (NSC 1990) from causes other than the accident.

The difference is approximately a factor of 5.0×10^8 . It says that the risk to the exposed offsite population chronic stack level release of a cancer fatality from all causes is 500 million times greater than the risk of a cancer fatality resulting from the postulated accident (completed populations risk of cancer fatality are included in Table 11).

CODE DOCUMENTATION

The released radionuclides are long lived and external doses (i.e. submersion and ground shine) are small in comparison to the inhalation dose. The dose due to ingestion is not included in this analysis since it is assumed that the contaminated soil would either be condemned or cleaned up following the postulated accident. This would prevent ingestion from becoming a potential exposure pathway.

The computer code GXQ Version 4.0 (Hey 1995) was used to perform the X/Q calculations necessary for the offsite and onsite population dose estimates. GXQ output files are included in Appendix B. GXQ calculates acute population-weighted atmospheric dispersion identically to GENII with one exception. GXQ sector averages the plume concentration to effectively simulate a uniform population distribution at the sector interval. Conversely, GENII calculates an acute population dose assuming centerline plume concentrations. This results in approximately one order of magnitude over-estimation by GENII.

GXQ was used to calculate 99.5% meteorology, population-weighted, sector averaged X/Qs for each sector. The sector having the largest scaled X/Q was chosen as the worst case for population exposure in person-rem CEDE.

Although plume depletion was neglected, calculated worst case offsite doses could be reduced approximately 30% by considering this mechanism. All results in this analysis assumed a standard man breathing rate of 330 cm³/s.

The offsite population file used by GXQ is the same as that used by GENII. Its header is given below:

"Population within 80 km of the Hanford 200 Area, 1990 Census (Beck, et al 1991)
Created 10/21/91 KR, Revised 2/4/92 KR"

Annual Average

The annual average X/Q for a particular sector is calculated by summing the frequency weighted X/Qs for all atmospheric stability classes and wind speed bins in the JOINTFRE.IN (GENII, 1988) file for a particular sector. The annual average X/Q for a sector K is calculated using the following equation:

$$\left(\frac{X}{Q}\right)_k = \sum_{j=1}^J \sum_{i=1}^I \left(\frac{X}{Q}\right)_{ijk} \frac{f_{ijk}}{C_k}$$

where f_{ijk} is the annual frequency in percent that atmospheric conditions fall within stability class I, wind speed j, and sector k. This X/Q is suitable for evaluating the consequences in sector k for a chronic, year long release. The cumulative frequency that the wind is in the direction of sector k is given by.

$$C_k = \sum_{j=1}^J \sum_{i=1}^I f_{ijk}$$

This value represents the annual average X/Q of all conditions having a wind speed in the direction of sector k.

Chronic

Chronic X/Q is calculated by using joint frequency to compute frequency to exceedance.

The frequency of exceedance X/Q', refers to atmospheric conditions which are less dispersing for a specific (usually small) fraction of time. This is accomplished by sorting the sector k X/Qs calculated for each stability class and wind speed bin such that the following equation is satisfied,

$$\left(\frac{X}{Q} \right)_{k,l} > \left(\frac{X}{Q} \right)_{k,l+1} \quad (3)$$

where the index l includes all combinations of stability class and wind speed and $L=I+J$. Additionally, there is a frequency, $f_{k,l}$, associated with each $(X/Q)_{k,l}$. If the percent of time the X/Q' is to be exceeded is specified as C_x , then an index ll is found such that

$$C_{k,ll} < C_x < C_{k,ll+1} \quad (4)$$

If $inorm=F$, the cumulative frequency for sector k, $C_{k,ll}$, is calculated as follows,

$$C_{k,ll} = \sum_{l=1}^{ll} \left(\frac{f_{k,l} + f_{k,l-1}}{2} \right)$$

e:

. 0

. joint frequency that conditions are characteri
by stability class and wind speed interval l
in sector k (%)

(5)

$C_{k,II}$ as defined in equation 4.4-8 represents the cumulative frequency that $(X/Q)_{k,II}$ is exceeded, including those times the wind is not blowing in the direction of sector k. The X/Q' associated with C_x is found by linear interpolation such that

$$\left(\frac{X}{Q'} \right)_{k, II} > \left(\frac{X}{Q'} \right)_{k, X} > \left(\frac{X}{Q'} \right)_{k, II+1} \quad (6)$$

If $inorm = T$ then equation 4.4-8 is modified as follows,

$$C_{k, II} = \sum_{l=1}^{II} \left(\frac{f_{k, l} + f_{k, l+1}}{2} \right) \frac{100}{C_k} \quad (7)$$

The above equation for calculating the cumulative frequency is that used in the GENII code (Napier 1988); and, for consistency, the GXQ code has that capability as well. $C_{k,II}$ as defined in equation 4.4-10 represents the cumulative frequency that the sector k $(X/Q)_{k,II}$ is exceeded, excluding those times the wind is not blowing in the direction of sector k. C_k is defined in equation 4.4-2.

If a bounding overall site X/Q' is desired (i.e., $isite = T$), then the procedure described above includes all 16 sectors such that the index l includes all combinations of stability class, wind speed and sector and $L = I + J + K$. Calculations similar to equations 4.4-6 through 4.4-9 are solved. X/Qs are sorted such that,

$$\left(\frac{X}{Q} \right)_l > \left(\frac{X}{Q} \right)_{l+1} \quad (8)$$

If the percent of time the X/Q' is to be exceeded for the overall site is specified as C_x , then an index ll is found such that

$$C_{ll} < C_x < C_{ll+1} \quad (9)$$

where the cumulative frequency for the overall site, C_{ll} , is defined as,

$$C_{ll} = \sum_{i=1}^{ll} \left(\frac{f_i + f_{i-1}}{2} \right) \quad (10)$$

C_{ll} as defined in equation 4.4-13 represents the cumulative frequency that the overall site $(X/Q)_{ll}$ is exceeded. The X/Q' associated with C_x is found by linear interpolation such that

$$\left(\frac{X}{Q'} \right)_{ll} > \left(\frac{X}{Q'} \right)_x > \left(\frac{X}{Q'} \right)_{ll+1} \quad (11)$$

Again, setting $inorm=T$ in addition to setting $isite=T$ has no effect.

Population Weighting

Population weighting X/Q for each sector, stability class, and wind speed bin, $(X/Q)_{ijk}$ is calculated as follows:

$$\left(\frac{X}{Q} \right)_{ijk} = \sum_{m=1}^M \left(\frac{X}{Q} \right)_{ijk} P_{km}$$

where:

M = number of radial intervals

P_{km} = population contained in sector k, radial interval m.

The radial intervals are defined by their midpoint distances specified in the population file POP.IN.

V ATMOSPHERIC DISPERSION COEFFICIENT - X/Q

After the radioactive material becomes airborne, it is transported downwind and could potentially be inhaled by the public. The concentration of this material is reduced, or diluted, as it is being transported due to atmospheric mixing and turbulence. An atmospheric relative concentration value (X/Q) is used to characterize the dilution of the airborne contaminants during atmospheric transport and dispersion of the airborne contaminants during atmospheric transport and dispersion. X/Q is a function of the atmospheric conditions (i.e., wind speed, stability class) and the distance to the receptor.

The Gaussian straight line model is employed by GXQ for calculating atmospheric dispersion. The time integrated atmospheric dispersion coefficient X/Q for a continuous point source strength is given by:

$$\frac{X}{Q} = \frac{f(y) g(z)}{2\pi\sigma_y\sigma_z\bar{U}}$$

where:

σ_y = Horizontal diffusion coefficient (m)
 σ_z = Vertical diffusion coefficient (m)
 $f(y)$ = Horizontal corrections term
 $g(z)$ = Vertical corrections term
 $\bar{U}$ = Mean wind speed (m/s)

The horizontal correction term is given by:

$$f(y) = \exp\left\{-\frac{1}{2}\left\{\frac{y}{\sigma_y}\right\}^2\right\}$$

where:

y = Horizontal offset from a plume centerline (m)

If the mixing height is large compared to the release height and the vertical diffusion coefficient, then the vertical correction term is given by:

$$g(z) = F_{ref} \exp \left\{ -\frac{1}{2} \left\{ \frac{h_e - z}{\sigma_z} \right\}^2 \right\}$$

where:

F_{ref} = Reflection factors
 h_e = Effective releases height (m)
 z = Receptor height (m).

Mathematical approximations are used to evaluate the atmospheric diffusion coefficients σ_y & σ_z which are based on the Pasquill-Gifford-Turner curves. These approximations are identical to those used in the GENII Code (Napier, 1988).

VI APPLICATIONS

This section describes how X/Q is used to estimate the dose from a release of radioactive materials.

The X/Q refers to the concentration of airborne contamination. It is the ratio of contaminant concentration at a specific receptor location to a contaminant release rate. The receptor of concern is normally defined as a human having a standard breathing rate and metabolism. The standard man breathing rates are typically taken from ICRP 23 (1975) as shown below:

<u>Release scenario</u>	<u>Breathing rates</u>
Acute release (i.e., less than 24 hours)	3.3 E-4 m ³ /s
Chronic release (i.e., greater than 24 hours)	2.7 E-4 m ³ /s

The product of X/Q and breathing rate is a unitless number representing the fraction of contaminant inhaled to contaminant released. Inhalation is by far the most significant, unavoidable, and likely pathway to human exposure. Although ingestion represents an additional theoretical pathway, the ingestion pathway can be avoided through interdiction of

food products if necessary in the event of an accident. The ground shine and plume submersion pathways can, for all practical purposes, be ignored for releases of plutonium.

The dose from the inhalation of radioactive materials, plutonium in particular, can be calculated using the following formula:

$$D \text{ (rem)} = Q \text{ (g)} \times \frac{X}{Q} \text{ (s/m}^3\text{)} \times R \text{ (m}^3\text{/s)} \times C \text{ (rem/g)}$$

Where:

Q	=	Quantity plutonium released
X/Q	=	Atmospheric dispersion coefficient
R	=	Breathing rate
C	=	Gram plutonium to dose conversion factor.

The quantity released, Q, is specific to the accident scenario. It is a function of several factors, including the inventory at risk, dispersing energy available, release fraction, respirable fraction, and mitigation. It is essentially a source term represented in grams. The grams plutonium to dose conversion factor, C, is specific to the isotopic mixture and chemical compound under consideration. The Technical Basis for Characterization of Plutonium for PFP Safety Analyses (Crowe and Szempruch 1994) contains such information for the inhalation pathway. Conversion factors for both oxides and nonoxides are provided for both the committed effective dose equivalent and the maximum organ committed dose.

VII RECEPTOR DESCRIPTIONS

- Maximum Individual Onsite: Doses calculated for the onsite receptor include inhalation and submersion. Ground level release dispersion factors (X/Q) were generated using the GXQ code for surrounding occupied facility around the PFP. These results are summarized in the Tables 1 and 2. The release location will be determined based on the largest X/Q value. The single asterisks in the tables identify the worst X/Q which will be used for dose calculations.

- Maximum Individual Site Boundary: Receptors at the site boundary in the worst direction. Where the site is bounded by the Columbia River, the site boundary is taken to be at the nearer bank of the river. This receptor is assumed to stay at this location for the duration of the accident. Doses calculated include inhalation and submersion. Atmosphere dispersion factors (X/Q) were generated for 16 sectors location around the

site boundary. These results are summarized in the Table 3. The single asterisks in the table identify the worst X/Q which will be used for dose calculations.

VIII CODE DOCUMENTATION

- GENII version 1.485 (12/3/90)
- GENII Default Parameter Values (28-Mar-90 RAP)
- Radionuclide Master Library (7/23/93 PDR)
- PNL Food Transfer Factor Library (7/19/93)
- External Dose Factor Library (8-May-90-RAP)
- Internal Dose Increments, Maximum Worst Case Solubilities, (7/23/93 PDR)
- Joint Frequency Data:
 - 200 Area, 10 m, Pasquill A-G (1983-1991 Average)
 - 200 Area, 61 m, Pasquill A-G (1983-1991 Average)
 - 200 Area, 89 m, Pasquill A-G (1983-1991 Average)
- GXQ Version 4 (1995)

Typical GENII and GXQ input files are attached in Appendix A and B.

NOTE 1: *Please, be aware of the fact that the new joint frequency data, and NRC Regulatory Guide 1.145 atmospheric dispersion coefficients (λ/Q methods) were applied for dose calculations. These changes may effect consistency with previous λ/Q s and dose consequences. This document was performed based on the best available information at this time.*

IX RESULTS

The resulting EDE and limiting organ doses for onsite and site boundary receptors calculated by GENII 1.485 for stack and ground level releases are shown in the Tables 7, 8, and 9. Inhalation doses were 50-year committed doses based on an acute uptake. Submersion doses were calculated using a semi-infinite cloud model.

In addition, population health effects in terms of latent cancer fatalities (LCF) were determined and are reported. The health effect results are summarized in Table 11.

Table 1: Maximum Individual with an Acute and Chronic at Onsite Nearest Occupied Facilities for Ground Level Release (99.5 Percentile X/Q).

Building	Direction	Distance (m)	Acute (s/m ³)	Chronic (s/m ³)
272-WA	WNW	550	8.72 E-04 *	6.00 E-06 *
T-PLANT	NE	1540	1.59 E-04	7.92 E-07
2713-WB	ENE	750	8.22 E-04	3.65 E-06
U-PLANT	ESE	1050	6.03 E-04	5.81 E-06
242-S	SSE	930	3.59 E-04	2.47 E-06

Table 2: Maximum Individual with an Acute and Chronic at Onsite Nearest Occupied Facilities for Stack Level Release (99.5 Percentile X/Q).

Building	Direction	Distance (m)	Acute (s/m ³)	Chronic (s/m ³)
272-WA	WNW	630	5.57 E-06 *	5.63 E-08 *
T-PLANT	NE	1580	1.03 E-06	8.90 E-09
2713-WB	ENE	830	2.16 E-06	2.42 E-08
U-PLANT	ESE	1060	2.52 E-06	2.77 E-08
242-S	SSE	930	3.35 E-06	3.28 E-08

Table 3: 99.5 Percentile X/Qs Values and 95 Percentile X/Qs at Site Boundary Locations for a Maximum Individual Ground and Stack Level for Acute and Chronic Releases.

Sector	Distance (km)	Ground Level Release		Stack Level Release	
		X/Q (s/m ³) Acute	X/Q (s/m ³) Chronic	X/Q (s/m ³) Acute	X/Q (s/m ³) Chronic
S	15.0	6.71 E-06	3.62 E-08	5.28 E-07	9.69 E-09
SSW	15.4	4.10 E-06	2.09 E-08	4.32 E-07	6.05 E-09
SW	16.1	4.97 E-06	1.94 E-08	4.10 E-07	4.99 E-09
WSW	13.2	6.40 E-06	2.57 E-08	5.10 E-07	5.86 E-09
W	12.5	1.62 E-05 *	5.02 E-08 *	6.24 E-07 *	1.03 E-08 *
WNW	13.2	8.49 E-06	3.85 E-08	5.85 E-07	7.83 E-09
NW	16.5	1.18 E-05	3.29 E-08	5.10 E-07	7.04 E-09
NNW	17.4	1.11 E-05	3.12 E-08	5.12 E-07	6.23 E-09
N	19.2	1.05 E-05	2.91 E-08	4.82 E-07	5.47 E-09
NNE	26.0	3.15 E-06	1.07 E-08	2.01 E-07	2.37 E-09
NE	28.9	2.98 E-06	1.09 E-08	1.95 E-07	2.65 E-09
ENE	25.6	6.02 E-06	1.72 E-08	2.36 E-07	3.92 E-09
E	25.2	8.21 E-06	4.82 E-08	4.35 E-07	9.21 E-09
ESE	30.0	6.34 E-06	3.95 E-08	3.42 E-07	9.47 E-09
SE	25.2	7.44 E-06	2.95 E-08	3.60 E-07	7.86 E-09
SSE	22.9	4.03 E-06	1.85 E-08	3.40 E-07	5.29 E-09

Table 4: 99.5 Percentile X/Qs Values at Site Boundary Locations for a Population Ground and Stack Level for Acute and Chronic Releases at 80 km Around 16 Sectors.

Sector	Ground Level Release		Stack Level Release	
	X/Q (s/m ³) Acute	X/Q (s/m ³) Chronic	X/Q (s/m ³) Acute	X/Q (s/m ³) Chronic
S	3.37 E-03	7.40 E-05	1.54 E-03	2.61 E-05
SSW	3.59 E-03	7.77 E-05	2.05 E-03	3.20 E-05
SW	6.59 E-03	1.27 E-04	3.42 E-03	4.61 E-05
WSW	6.66 E-03	1.27 E-04	3.47 E-03	4.87 E-05
W	2.21 E-02	5.01 E-04	1.37 E-02	2.02 E-04
WNW	1.80 E-03	3.52 E-05	8.06 E-04	1.22 E-05
NW	1.21 E-03	2.64 E-05	5.73 E-04	8.24 E-06
NNW	2.22 E-03	4.86 E-05	1.28 E-03	1.59 E-05
N	2.00 E-03	3.68 E-05	9.05 E-04	1.07 E-05
NNE	5.28 E-03	7.73 E-05	1.88 E-03	2.43 E-05
NE	3.85 E-03	6.40 E-05	1.35 E-03	1.81 E-05
ENE	1.48 E-03	3.20 E-05	5.58 E-04	8.95 E-06
E	2.66 E-03	9.06 E-05	9.79 E-04	2.18 E-05
ESE	1.83 E-03	7.38 E-05	6.60 E-04	1.98 E-05
SE	4.86 E-02 *	1.36 E-03 *	1.85 E-02 *	4.55 E-04 *
SSE	7.66 E-03	1.55 E-04	2.85 E-03	5.34 E-05

Table 5: Summazed The Maximum Individual Worst Cases 99.5 Percentile X/Qs for Onsite and Offsite.

Location of release	Acute Release (s/m ³)	Chronic Release (s/m ³)
Onsite Ground level	8.72 E-04 (550 m, WNW)	6.00 E-06 (550 m, WNW)
Onsite Stack level	5.57 E-06 (630 m, WNW)	5.63 E-08 (630 m, WNW)
Offsite Ground level	1.62 E-05 (12.5 km W)	5.02 E-08 (12.5 km, W)
Offsite Stack level	6.24 E-07 (12.5 km W)	1.03 E-08 (12.5 km, W)

Table 6: Summazed The Population Weighted Worst Cases 99.5 Percentile X/Qs for Onsite and Offsite at 80 km.

Location of release	Acute Release (s/m ³)	Chronic Release (s/m ³)
Offsite Ground level	4.86 E-02 (SE)	1.36 E-03 (SE)
Offsite Stack level	1.85 E-02 (SE)	4.55 E-04 (SE)

Table 7. Maximum Individual Doses Calculated for an Acute and Chronic Offsite Stack Level Release, Inventory from 1993, 291-Z-1 Elevated Release.

Release Type	Dose type	EDE (rem)	Limiting organ (rem)
Chronic X/Q = 1.03 E-08	Inhalation	1.0 E-06	1.9 E-05 (Bone Sur)
	Submersion	2.2 E-15	2.2 E-15
Total		1.0 E-06	1.9 E-05 (Bone Sur)
Acute X/Q = 6.24 E-07	Inhalation	6.1 E-05	1.1 E-03 (Bone Sur)
	Submersion	1.3 E-13	1.3 E-13
Total		6.1 E-05	1.1 E-03 (Bone Sur)

EDE effective dose equivalent.
Bone Sur bone surface.

Table 8. Population Doses Calculated for an Acute and Chronic Offsite Stack Level Release, Unit Are in person-rem, Inventory from 1993, 291-Z-1 Elevated Release.

Release Type	Dose type	EDE	Limiting organ
Chronic X/Q = 4.55 E-04	Inhalation	4.4 E-02	8.2 E-01 (Bone Sur)
	Submersion	9.6 E-11	9.6 E-11
Total		4.4 E-02	8.2 E-01 (Bone Sur)
Acute X/Q = 1.85 E-02	Inhalation	1.8 E+00	3.3 E+01 (Bone Sur)
	Submersion	3.9 E-09	3.9 E-09
Total		1.8 E+00	3.3 E+01 (Bone Sur)

EDE effective dose equivalent.
Bone Sur bone surface.

Table 9. Maximum Individual Doses Calculated for an Acute and Chronic Offsite Ground Level Release, Inventory from 1991, 296-Z-3 Ground Release.

Release Type	Dose type	EDE (rem)	Limiting organ (rem)
Chronic X/Q = 5.02 E-08	Inhalation	3.0 E-08	5.5 E-07 (Bone Sur)
	Submersion	5.0 E-17	5.0 E-17
Total		3.0 E-08	5.5 E-07 (Bone Sur)
Acute X/Q = 1.62 E-05	Inhalation	9.6 E-06	1.8 E-04 (Bone Sur)
	Submersion	1.6 E-14	1.6 E-14
Total		9.6 E-06	1.8 E-04 (Bone Sur)

EDE effective dose equivalent.

Bone Sur bone surface.

Table 10. Population Doses Calculated for an Acute and Chronic Offsite Ground Level Release, Unit Are in person-rem, Inventory from 1991, 296-Z-3 Ground Release.

Release Type	Dose type	EDE	Limiting organ
Chronic X/Q = 1.36 E-03	Inhalation	8.0 E-04	1.5 E-02 (Bone Sur)
	Submersion	1.4 E-12	1.4 E-12
Total		8.0 E-04	1.5 E-02 (Bone Sur)
Acute X/Q = 4.86 E-02	Inhalation	2.9 E-02	5.4 E-01 (Bone Sur)
	Submersion	4.9 E-11	4.9 E-11
Total		2.9 E-02	5.4 E-01 (Bone Sur)

EDE effective dose equivalent.

Bone Sur bone surface.

Table 11: Worst Case Offsite Population (114,734) Health Effects in SE.

Receptor	Health Effect	Risk to the exposed ^a
Acute Ground Level Release	1.5 E-05 LCF	3.00 E+09
Chronic Ground Level Release	4.0 E-07 LCF	1.13 E+10
Acute Stack Level Release	2.2 E-05 LCF	2.05 E+08
Chronic Stack Level Release	9.0 E-04 LCF	5.00 E+08

^a Risk of a cancer fatality.

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U.S. Nuclear Regulatory Commission, November 1982, *Atmospheric Dispersion Models For Potential Accident Consequence Assessments At Nuclear Power Plants*, Regulatory Guide 1.145, Revision 1, Office Of Nuclear Regulatory Research.

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APPENDIX A

Sample GENII Input & Output Decks for $X/Q = 1.0 \text{ s/m}^3$

WHC-SD-CP-TI-197 Revision 0

SAMPLE GENII INPUT DECK FOR UNIT RELEASE FROM 291-Z-1 STACK LEVEL RADIOACTIVE AIRBORNE RELEASE FROM 1993 DATA.

Program GENII Input File ##### 8 Jul 88

Title: FSAR Chapter 8 - Section 6 Annually Dose Calculations

\GENII\

Created on 06-15-1995 at 02:30

OPTIONS=====Default=====

F Near-field scenario? (Far-field) NEAR-FIELD: narrowly-focused
F Population dose? (Individual) release, single site
T Acute release? (Chronic) FAR-FIELD: wide-scale release,
Maximum Individual data set used multiple sites

TRANSPORT OPTIONS=====Section Complete

T Air Transport 1 F Finite plume, external 5
F Surface Water Transport 2 T Infinite plume, external 5
F Biotic Transport (near-field) 3,4 F Ground, external 5
F Waste Form Degradation (near) 3,4 F Recreation, external 5
T Inhalation uptake 5,6

REPORT OPTIONS=====

T Report AEDE only F Drinking water ingestion 7,8
T Report by radionuclide F Aquatic foods ingestion 7,8
T Report by exposure pathway F Terrestrial foods ingestion 7,9
F Debug report on screen F Animal product ingestion 7,10
F Inadvertent soil ingestion

INVENTORY #####

4 Inventory input activity units: (1-pCi 2-uCi 3-mCi 4-Ci 5-Bq)

0 Surface soil source units (1- m2 2- m3 3- kg)

Equilibrium question goes here

-----Release Terms-----			-----Basic Concentrations-----				
Use when	transport selected		near-field scenario, optionally				
Release	Surface	Buried	Surface	Deep	Ground	Surface	
Radio-	Air	Water	Waste	Air	Soil	Soil	Water
nuclide	/yr	/yr	/m3	/m3	/unit	/m3	/L
PU239	5.1E-04						
PU241	3.4E-03						
AM241	9.3E-05						
-----Derived Concentrations-----							
Use when	measured values are known						
Release	Terres.	Animal	Drink	Aquatic			
Radio-	Plant	Product	Water	Food			
nuclide	/kg	/kg	/L	/kg			

TIME #####

1 Intake ends after (yr)

50 Dose calc. ends after (yr)

0 Release ends after (yr)

0 No. of years of air deposition prior to the intake period

0 No. of years of irrigation water deposition prior to the intake period

FAR-FIELD SCENARIOS (IF POPULATION DOSE) #####

0 Definition option: 1-Use population grid in file POP.IN

0 2-Use total entered on this line

WHC-SD-CP-TI-197 Revision 0

NEAR-FIELD SCENARIOS

```

    Prior to the beginning of the intake period: (yr)
0      When was the inventory disposed? (Package degradation starts)
0      When was LOIC? (Biotic transport starts)
0      Fraction of roots in upper soil (top 15 cm)
0      Fraction of roots in deep soil
0      Manual redistribution: deep soil/surface soil dilution factor
0      Source area for external dose modification factor (m2)
TRANSPORT #####
====AIR TRANSPORT=====SECTION 1=====
1      0-Calculat PM          |0      Release type (0-3)
      Option: 1-Use chi/Q or PM value |F      Stack release (T/F)
      2-Select MI dist & dir |0      Stack height (m)
      3-Specify MI dist & dir |0      Stack flow (m3/sec)
1.0    Chi/Q or PM value      |0      Stack radius (m)
0      MI sector index (1=5)   |0      Effluent temp. (C)
0      MI distance from release point (m)|0      Building x-section (m2)
T      Use jf data, (T/F) else chi/Q grid|0      Building height (m)

====SURFACE WATER TRANSPORT=====SECTION 2=====
0      Mixing ratio model: 0-use value, 1-river, 2-lake
0      Mixing ratio, dimensionless
0      Average river flow rate for: MIXFLG=0 (m3/s), MIXFLG=1,2 (m/s),
0      Transit time to irrigation withdrawal location (hr)
      If mixing ratio model > 0:
0      Rate of effluent discharge to receiving water body (m3/s)
0      Longshore distance from release point to usage location (m)
0      Offshore distance to the water intake (m)
0      Average water depth in surface water body (m)
0      Average river width (m), MIXFLG=1 only
0      Depth of effluent discharge point to surface water (m), lake only

====WASTE FORM AVAILABILITY=====SECTION 3=====
0      Waste form/package half life, (yr)
0      Waste thickness, (m)
0      Depth of soil overburden, m

====BIOTIC TRANSPORT OF BURIED SOURCE=====SECTION 4=====
T      Consider during inventory decay/buildup period (T/F)?
T      Consider during intake period (T/F)? | 1-Arid non agricultural
0      Pre-intake site condition.....| 2-Humid non agricultural
      | 3-Agricultural

```

EXPOSURE

```

====EXTERNALEXPOSURE=====SECTION 5=====
Exposure time: | Residential irrigation:
0      Plume (hr) | T      Consider: (T/F)
0      Soil contamination (hr) | 0      Source: 1-ground water
0      Swimming (hr) | | 2-surface water
0      Boating (hr) | 0      Application rate (in/yr)
0      Shoreline activities (hr) | 0      Duration (mo/yr)
0      Shoreline type: (1-river, 2-lake, 3-ocean, 4-tidal basin)
0      Transit time for release to reach aquatic recreation (hr)
1.0    Average fraction of time submersed in acute cloud (hr/person hr)

====INHALATION=====SECTION 6=====
8766.0 Hours of exposure to contamination per year
0      0-No resus- 1-Use Mass Loading 2-Use Anspaugh model

```

WHC-SD-CP-TI-197 Revision 0

0 pension Mass loading factor (g/m3) Top soil available (cm)

====INGESTION POPULATION=====SECTION 7=====

1 Atmospheric production definition (select option):

0 0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line

1 1-Use population-weighted chi/Q

2 2-Use uniform production

3 3-Use chi/Q and production grids (PRODUCTION will be overridden)

0 Population ingesting aquatic foods, 0 defaults to total (person)

0 Population ingesting drinking water, 0 defaults to total (person)

F Consider dose from food exported out of region (default=F)

Note below: S* or Source: 0-none, 1-ground water, 2-surface water
3-Derived concentration entered above

==== AQUATIC FOODS / DRINKING WATER INGESTION=====SECTION 8=====

F Salt water? (default is fresh)

USE ?	FOOD T/F TYPE	TRAN- SIT hr	PROD- UCTION kg/yr	-CONSUMPTION- HOLDUP da	RATE kg/yr	DRINKING WATER
F	FISH	0.00	0.0E+00	0.00	0.0	0 Source (see above)
F	MOLLUS	0.00	0.0E+00	0.00	0.0	1 Treatment? T/F
F	CRUSTA	0.00	0.0E+00	0.00	0.0	0 Holdup/transit(da)
F	PLANTS	0.00	0.0E+00	0.00	0.0	0 Consumption (L/yr)

====TERRESTRIAL FOOD INGESTION=====SECTION 9=====

USE ?	FOOD T/F TYPE	GROW TIME da	--IRRIGATION-- S RATE * in/yr	TIME mo/yr	YIELD kg/m2	PROD- UCTION kg/yr	--CONSUMPTION-- HOLDUP da	RATE kg/yr
F	LEAF V	90.00	0	0.0	0.0	1.5	0.0E+00	1.0 30.0
F	ROOT V	90.00	0	0.0	0.0	4.0	0.0E+00	5.0 220.0
F	FRUIT	90.00	0	0.0	0.0	2.0	0.0E+00	5.0 330.0
F	GRAIN	90.00	0	0.0	0.0	0.8	0.0E+00	180.0 80.0

====ANIMAL PRODUCTION CONSUMPTION=====SECTION 10=====

USE ?	FOOD T/F TYPE	---HUMAN--- CONSUMPTION RATE kg/yr	TOTAL HOLDUP da	PROD- UCTION kg/yr	DRINK WATER CONTAM FRACT.	DIET FRAC- TION	GROW TIME da	---STORED FEED--- S RATE * in/yr	TIME mo/yr	YIELD kg/m3	STOR- AGE da
F	BEEF	80.0	15.0	0.00	0.00	0.25	90.0	0	0.0	0.00	0.80 0.0
F	POULTR	18.0	1.0	0.00	0.00	1.00	90.0	0	0.0	0.00	0.80 0.0
F	MILK	270.0	1.0	0.00	0.00	0.25	45.0	0	0.0	0.00	2.00 0.0
F	EGG	30.0	1.0	0.00	0.00	1.00	90.0	0	0.0	0.00	0.80 0.0
	BEEF					0.75	45.0	0	0.0	0.00	2.00 100.0
	MILK					0.75	30.0	0	0.0	0.00	1.50 0.0

#####

WHC-SD-CP-TI-197 Revision 0

SAMPLE GENII INPUT DECK FOR UNIT RELEASE FROM 296-Z-3 GROUND LEVEL RADIOACTIVE AIRBORNE RELEASE FROM 1991 DATA.

Program GENII Input File ##### 8 Jul 88

Title: FSAR Chapter 8 - Section 6 Annually Dose Calculations

\GENII\

Created on 06-15-1995 at 02:30

OPTIONS=====Default=====

F Near-field scenario? (Far-field) NEAR-FIELD: narrowly-focused
F Population dose? (Individual) release, single site
T Acute release? (Chronic) FAR-FIELD: wide-scale release,
Maximum Individual data set used multiple sites
Complete Complete

TRANSPORT OPTIONS===== Section EXPOSURE PATHWAY OPTIONS===== Section

T Air Transport 1 F Finite plume, external 5
F Surface Water Transport 2 T Infinite plume, external 5
F Biotic Transport (near-field) 3,4 F Ground, external 5
F Waste Form Degradation (near) 3,4 F Recreation, external 5
T Inhalation uptake 5,6

REPORT OPTIONS=====

T Report AEDE only F Drinking water ingestion 7,8
T Report by radionuclide F Aquatic foods ingestion 7,8
T Report by exposure pathway F Terrestrial foods ingestion 7,9
F Debug report on screen F Animal product ingestion 7,10
F Inadvertent soil ingestion

INVENTORY #####

4 Inventory input activity units: (1-pCi 2-uCi 3-mCi 4-Ci 5-Bq)

0 Surface soil source units (1- m2 2- m3 3- kg)

Equilibrium question goes here

-----Release Terms-----				-----Basic Concentrations-----				
Use when	transport selected			near-field scenario, optionally				
Release	Surface Buried			Surface Deep Ground Surface				
Radio-	Air	Water	Waste	Air	Soil	Soil	Water	Water
nuclide	/yr	/yr	/m3	/m3	/unit	/m3	/L	/L

PU239 3.5E-06

AM241 4.4E-07

-----Derived Concentrations-----

Use when measured values are known

Release	Terres.	Animal	Drink	Aquatic
Radio-	Plant	Product	Water	Food
nuclide	/kg	/kg	/L	/kg

TIME #####

1 Intake ends after (yr)

50 Dose calc. ends after (yr)

0 Release ends after (yr)

0 No. of years of air deposition prior to the intake period

0 No. of years of irrigation water deposition prior to the intake period

FAR-FIELD SCENARIOS (IF POPULATION DOSE) #####

0 Definition option: 1-Use population grid in file POP.IN

0 2-Use total entered on this line

WHC-SD-CP-TI-197 Revision 0

NEAR-FIELD SCENARIOS

```

    Prior to the beginning of the intake period: (yr)
0      When was the inventory disposed? (Package degradation starts)
0      When was LOIC? (Biotic transport starts)
0      Fraction of roots in upper soil (top 15 cm)
0      Fraction of roots in deep soil
0      Manual redistribution: deep soil/surface soil dilution factor
0      Source area for external dose modification factor (m2)
TRANSPORT #####
=====AIR TRANSPORT=====SECTION 1=====
0      0-Calculate PM          |0      Release type (0-3)
1      Option: 1-Use chi/Q or PM value |F      Stack release (T/F)
          2-Select MI dist & dir      |0      Stack height (m)
          3-Specify MI dist & dir      |0      Stack flow (m3/sec)
1.0    Chi/Q or PM value          |0      Stack radius (m)
0      MI sector index (1=S)        |0      Effluent temp. (C)
0      MI distance from release point (m)|0      Building x-section (m2)
T      Use jf data, (T/F) else chi/Q grid|0      Building height (m)

=====SURFACE WATER TRANSPORT=====SECTION 2=====
0      Mixing ratio model: 0-use value, 1-river, 2-lake
0      Mixing ratio, dimensionless
0      Average river flow rate for: MIXFLG=0 (m3/s), MIXFLG=1,2 (m/s),
0      Transit time to irrigation withdrawal location (hr)
      If mixing ratio model > 0:
0      Rate of effluent discharge to receiving water body (m3/s)
0      Longshore distance from release point to usage location (m)
0      Offshore distance to the water intake (m)
0      Average water depth in surface water body (m)
0      Average river width (m), MIXFLG=1 only
0      Depth of effluent discharge point to surface water (m), lake only

=====WASTE FORM AVAILABILITY=====SECTION 3=====
0      Waste form/package half life, (yr)
0      Waste thickness, (m)
0      Depth of soil overburden, m

=====BIOTIC TRANSPORT OF BURIED SOURCE=====SECTION 4=====
T      Consider during inventory decay/buildup period (T/F)?
T      Consider during intake period (T/F)? | 1-Arid non agricultural
0      Pre-Intake site condition.....| 2-Humid non agricultural
          | 3-Agricultural

```

EXPOSURE

```

=====EXTERNAL EXPOSURE=====SECTION 5=====
0      Exposure time:          | Residential irrigation:
      Plume (hr)              | T      Consider: (T/F)
0      Soil contamination (hr) | 0      Source: 1-ground water
0      Swimming (hr)           |          2-surface water
0      Boating (hr)            | 0      Application rate (in/yr)
0      Shoreline activities (hr) | 0      Duration (mo/yr)
0      Shoreline type: (1-river, 2-lake, 3-ocean, 4-tidal basin)
0      Transit time for release to reach aquatic recreation (hr)
1.0    Average fraction of time submersed in acute cloud (hr/person hr)

=====INHALATION=====SECTION 6=====
8766.0 Hours of exposure to contamination per year
0      0-No resus- 1-Use Mass Loading      2-Use Anspaugh model

```

WHC-SD-CP-TI-197 Revision 0

0 pension Mass loading factor (g/m3) Top soil available (cm)

====INGESTION POPULATION=====SECTION 7=====

1 Atmospheric production definition (select option):

0 0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line

1-Use population-weighted chi/Q

2-Use uniform production

3-Use chi/Q and production grids (PRODUCTION will be overridden)

0 Population ingesting aquatic foods, 0 defaults to total (person)

0 Population ingesting drinking water, 0 defaults to total (person)

F Consider dose from food exported out of region (default=F)

Note below: S* or Source: 0-none, 1-ground water, 2-surface water

3-Derived concentration entered above

==== AQUATIC FOODS / DRINKING WATER INGESTION=====SECTION 8=====

F Salt water? (default is fresh)

USE ?	FOOD T/F TYPE	TRAN- SIT hr	PROD- UCTION kg/yr	-CONSUMPTION- HOLDUP da	RATE kg/yr	DRINKING WATER	
F	FISH	0.00	0.0E+00	0.00	0.0	0	Source (see above)
F	MOLLUS	0.00	0.0E+00	0.00	0.0	T	Treatment? T/F
F	CRUSTA	0.00	0.0E+00	0.00	0.0	0	Holdup/transit(da)
F	PLANTS	0.00	0.0E+00	0.00	0.0	0	Consumption (L/yr)

====TERRESTRIAL FOOD INGESTION=====SECTION 9=====

USE ?	FOOD T/F TYPE	GROW TIME da	--IRRIGATION-- S RATE * in/yr	TIME mo/yr	YIELD kg/m2	PROD- UCTION kg/yr	--CONSUMPTION-- HOLDUP da	RATE kg/yr
F	LEAF V	90.00	0	0.0	0.0	1.5	0.0E+00	1.0 30.0
F	ROOT V	90.00	0	0.0	0.0	4.0	0.0E+00	5.0 220.0
F	FRUIT	90.00	0	0.0	0.0	2.0	0.0E+00	5.0 330.0
F	GRAIN	90.00	0	0.0	0.0	0.8	0.0E+00	180.0 80.0

====ANIMAL PRODUCTION CONSUMPTION=====SECTION 10=====

USE ?	FOOD T/F TYPE	---HUMAN--- CONSUMPTION RATE kg/yr	TOTAL HOLDUP da	PROD- UCTION kg/yr	DRINK WATER CONTAM FRACT.	DIET FRAC- TION	GROW TIME da	---STOR- ED FEED--- --IRRIGATION-- S RATE * in/yr	TIME mo/yr	YIELD kg/m3	STOR- AGE da
F	BEEF	80.0	15.0	0.00	0.00	0.25	90.0	0	0.0	0.00	0.80 0.0
F	POULTR	18.0	1.0	0.00	0.00	1.00	90.0	0	0.0	0.00	0.80 0.0
F	MILK	270.0	1.0	0.00	0.00	0.25	45.0	0	0.0	0.00	2.00 0.0
F	EGG	30.0	1.0	0.00	0.00	1.00	90.0	0	0.0	0.00	0.80 0.0
	BEEF					0.75	45.0	0	0.0	0.00	2.00 100.0
	MILK					0.75	30.0	0	0.0	0.00	1.50 0.0

#####

WHC-SD-CP-TI-197 Revision 0

GENII OUTPUT DECK FOR ELEVATED UNIT RELEASE

 GENII Dose Calculation Program
 (Version 1.485 3-Dec-90)

Case title: FSAR Chapter 8 - Section 6 Annually Dose Calculations

Executed on: 06/21/95 at 14:53:32

Page A. 1

 This is a far-field (wide-scale release, multiple site) scenario.
 Release is acute
 Individual dose

THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
 Air

THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
 Infinite plume, external
 Inhalation uptake

THE FOLLOWING TIMES ARE USED:
 Intake ends after (yr): 1.0
 Dose calculations ends after (yr): 50.0

===== FILENAMES AND TITLES OF FILES/LIBRARIES USED =====

Input file name: \GENII\
 GENII Default Parameter Values (28-Mar-90 RAP)
 Radionuclide Library - Times<100 years (23-July-93 PDR)
 External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R
 Worst-Case Solubilities, Yearly Dose Increments (23-Jul-93 PDR)

=====

-----Release Terms-----			
Release	Surface Buried		
Radio-	Air	Water	Source
nuclide	Ci/yr	Ci/yr	Ci/m3
PU239	5.1E-04	0.0E+00	0.0E+00
PU241	3.4E-03	0.0E+00	0.0E+00
AM241	9.3E-05	0.0E+00	0.0E+00

===== AIR TRANSPORT =====
 1.0E+00 Input E/Q value (s/m3)

===== EXTERNAL EXPOSURE =====
 1.0E+00 Fraction of time spent in cloud

===== INHALATION =====
 Resuspension not considered

=====

Input prepared by: _____

Date: _____

WHC-SD-CP-TI-197 Revision 0

Input checked by: _____ Date: _____

GENII Dose Calculation Program (Version 1.485 3-Dec-90)

Case title: FSAR Chapter 8 - Section 6 Annually Dose Calculations

Executed on: 06/21/95 at 14:53:42

Page C. 1

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	2.5E+01	2.5E-01	6.2E+00
Breast	1.1E-03	1.5E-01	1.6E-04
R Marrow	1.4E+02	1.2E-01	1.7E+01
Lung	1.3E+01	1.2E-01	1.5E+00
Thyroid	8.4E-04	3.0E-02	2.5E-05
Bone Sur	1.8E+03	3.0E-02	5.4E+01
Liver	3.1E+02	6.0E-02	1.9E+01
LL Int.	2.2E-02	6.0E-02	1.3E-03
UL Int.	8.0E-03	6.0E-02	4.8E-04
S Int.	2.2E-03	6.0E-02	1.3E-04
Stomach	1.5E-03	6.0E-02	9.0E-05
Internal Effective Dose Equivalent			9.7E+01
External Dose			2.1E-07
Annual Effective Dose Equivalent			9.7E+01

Controlling Organ: Bone Sur
Controlling Pathway: Inh
Controlling Radionuclide: PU239
Total Inhalation EDE: 9.7E+01
Total Ingestion EDE: 0.0E+00

GENII Dose Calculation Program

WHC-SD-CP-TI-197 Revision 0

(Version 1.485 3-Dec-90)

Case title: FSAR Chapter 8 - Section 6 Annually Dose Calculations

Executed on: 06/21/95 at 14:53:42

Page C. 2

Acute release

Uptake/exposure period:

1.0

Dose commitment period:

50.0

Dose units:

Rem

	Dose Commitment Year				
	1	2	3	...	
Internal Intake					
Year: 3			0.0E+00	...	
			+		
2		0.0E+00	0.0E+00	...	Internal Effective Dose Equivalent
		+	+		
1	3.8E+00	+ 2.6E+00	+ 2.6E+00	+ ... = 9.7E+01	
Internal Annual Dose	3.8E+00 + 2.6E+00 + 2.6E+00 + ... = 9.7E+01				Cumulative Internal Dose
	+	+	+	+	
External Annual Dose	2.1E-07	0.0E+00	0.0E+00	...	2.1E-07
Annual Dose	3.8E+00 + 2.6E+00 + 2.6E+00 + ... = 9.7E+01				Cumulative Dose
			3.8E+00		Maximum Annual Dose Occurred In Year 1

GENII Dose Calculation Program (Version 1.485 3-Dec-90)

Case title: FSAR Chapter 8 - Section 6 Annually Dose Calculations

Executed on: 06/21/95 at 14:53:42

Page C. 3

Acute release

Uptake/exposure period:

1.0

Dose commitment period:

50.0

Dose units:

Rem

Committed Dose Equivalent by Exposure Pathway

WHC-SD-CP-TI-197 Revision 0

Pathway	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
Inhale	1.3E+01	1.5E-03	2.2E-03	8.0E-03	2.2E-02	1.8E+03	1.4E+02	2.5E+01
Total	1.3E+01	1.5E-03	2.2E-03	8.0E-03	2.2E-02	1.8E+03	1.4E+02	2.5E+01

Pathway	Ovaries	Muscle	Thyroid	Liver
Inhale	2.5E+01	1.1E-03	8.4E-04	3.1E+02
Total	2.5E+01	1.1E-03	8.4E-04	3.1E+02

External Dose by Exposure Pathway

Pathway	
Plume	2.1E-07
Total	2.1E-07

GENII Dose Calculation Program (Version 1.485 3-Dec-90)

Case title: FSAR Chapter 8 - Section 6 Annually Dose Calculations

Executed on: 06/21/95 at 14:53:42

Page C. 4

Acute release

Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Committed Dose Equivalent by Radionuclide

Radionuclide	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
PU 241	3.0E-02	1.5E-04	1.8E-04	3.9E-04	6.5E-04	1.7E+02	1.3E+01	2.6E+00
U 237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
AM 241	2.1E+00	4.0E-04	5.0E-04	1.5E-03	3.7E-03	2.5E+02	2.0E+01	3.5E+00
PU 239	1.1E+01	9.4E-04	1.5E-03	6.1E-03	1.8E-02	1.4E+03	1.1E+02	1.9E+01
Total	1.3E+01	1.5E-03	2.2E-03	8.0E-03	2.2E-02	1.8E+03	1.4E+02	2.5E+01

Radionuclide	Ovaries	Muscle	Thyroid	Liver
PU 241	2.5E+00	1.6E-04	6.9E-05	2.7E+01
U 237	0.0E+00	0.0E+00	0.0E+00	0.0E+00
AM 241	3.5E+00	3.4E-04	1.9E-04	4.5E+01
PU 239	1.9E+01	5.8E-04	5.7E-04	2.4E+02
Total	2.5E+01	1.1E-03	8.4E-04	3.1E+02

WHC-SD-CP-TI-197 Revision 0

GENII Dose Calculation Program (Version 1.485 3-Dec-90)

Case title: FSAR Chapter 8 - Section 6 Annually Dose Calculations

Executed on: 06/21/95 at 14:53:42

Page C. 5

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
PU 241	9.0E+00	0.0E+00	2.6E-13	9.0E+00	9.0E+00
U 237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
AM 241	1.4E+01	0.0E+00	2.0E-07	1.4E+01	1.4E+01
PU 239	7.4E+01	0.0E+00	1.1E-08	7.4E+01	7.4E+01

SAMPLE UNIT RELEASE FOR GROUND LEVEL RELEASE

 GENII Dose Calculation Program
 (Version 1.485 3-Dec-90)

Case title: MI Acute - Ground Level

Executed on: 06/23/95 at 08:50:31

Page A. 1

 This is a far-field (wide-scale release, multiple site) scenario.
 Release is acute
 Individual dose

THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
 Air

THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
 Infinite plume, external
 Inhalation uptake

THE FOLLOWING TIMES ARE USED:
 Intake ends after (yr): 1.0
 Dose calculations ends after (yr): 50.0

===== FILENAMES AND TITLES OF FILES/LIBRARIES USED =====

Input file name: \GENII\
 GENII Default Parameter Values (28-Mar-90 RAP)
 Radionuclide Library - Times<100 years (23-July-93 PDR)
 External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R)
 Worst-Case Solubilities, Yearly Dose Increments (23-Jul-93 PDR)

=====

-----Release Terms-----

Release	Surface Buried		
Radio- Air	Water	Source	
nuclide	Ci/yr	Ci/yr	Ci/m3
PU239	3.5E-06	0.0E+00	0.0E+00
AM241	4.4E-07	0.0E+00	0.0E+00

===== AIR TRANSPORT =====
 1.0E+00 Input E/Q value (s/m3)

===== EXTERNAL EXPOSURE =====
 1.0E+00 Fraction of time spent in cloud

===== INHALATION =====
 Resuspension not considered

=====

Input prepared by: _____ Date: _____

Input checked by: _____ Date: _____

WHC-SD-CP-TI-197 Revision 0

GENII Dose Calculation Program (Version 1.485 3-Dec-90)

Case title: MI Acute - Ground Level

Executed on: 06/23/95 at 08:50:38

Page C. 1

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	1.5E-01	2.5E-01	3.8E-02
Breast	5.8E-06	1.5E-01	8.7E-07
R Marrow	8.4E-01	1.2E-01	1.0E-01
Lung	8.6E-02	1.2E-01	1.0E-02
Thyroid	5.0E-06	3.0E-02	1.5E-07
Bone Sur	1.1E+01	3.0E-02	3.3E-01
Liver	1.9E+00	6.0E-02	1.1E-01
LL Int.	1.4E-04	6.0E-02	8.5E-06
UL Int.	5.0E-05	6.0E-02	3.0E-06
S Int.	1.3E-05	6.0E-02	7.9E-07
Stomach	8.6E-06	6.0E-02	5.2E-07
Internal Effective Dose Equivalent			5.9E-01
External Dose			1.0E-09
Annual Effective Dose Equivalent			5.9E-01

Controlling Organ: Bone Sur
Controlling Pathway: Inh
Controlling Radionuclide: PU239
Total Inhalation EDE: 5.9E-01
Total Ingestion EDE: 0.0E+00

GENII Dose Calculation Program (Version 1.485 3-Dec-90)

Case title: MI Acute - Ground Level

Executed on: 06/23/95 at 08:50:38

Page C. 2

WHC-SD-CP-TI-197 Revision 0

Acute release
 Uptake/exposure period: 1.0
 Dose commitment period: 50.0
 Dose units: Rem

		Dose Commitment Year				
		1	2	3	...	
Internal	:					
Intake	:					
Year:	3			0.0E+00	...	
				+		
	2		0.0E+00	0.0E+00	...	Internal
			+	+		Effective
	1	2.5E-02	1.8E-02	1.7E-02	...	Dose
					=	Equivalent
Internal						
Annual		2.5E-02	1.8E-02	1.7E-02	...	Cumulative
Dose					=	Internal
		+	+	+	+	Dose
External						
Annual		1.0E-09	0.0E+00	0.0E+00	...	
Dose						
Annual						Cumulative
Dose		2.5E-02	1.8E-02	1.7E-02	...	Dose
					=	
					2.5E-02	Maximum
						Annual
						Dose Occurred
						In Year 1

 GENII Dose Calculation Program
 (Version 1.485 3-Dec-90)

Case title: MI Acute - Ground Level

Executed on: 06/23/95 at 08:50:38

Page C. 3

 Acute release
 Uptake/exposure period: 1.0
 Dose commitment period: 50.0
 Dose units: Rem

Committed Dose Equivalent by Exposure Pathway

Pathway	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
Inhale	8.6E-02	8.6E-06	1.3E-05	5.0E-05	1.4E-04	1.1E+01	8.4E-01	1.5E-01
Total	8.6E-02	8.6E-06	1.3E-05	5.0E-05	1.4E-04	1.1E+01	8.4E-01	1.5E-01

WHC-SD-CP-TI-197 Revision 0

Pathway	Ovaries	Muscle	Thyroid	Liver
Inhale	1.5E-01	5.8E-06	5.0E-06	1.9E+00
Total	1.5E-01	5.8E-06	5.0E-06	1.9E+00

External Dose by Exposure Pathway

Pathway	
Plume	1.0E-09
Total	1.0E-09

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: MI Acute - Ground Level

Executed on: 06/23/95 at 08:50:38

Page C. 4

Acute release

Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Committed Dose Equivalent by Radionuclide

Radionuclide	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
AM 241	1.0E-02	1.9E-06	2.4E-06	7.2E-06	1.8E-05	1.2E+00	9.5E-02	1.7E-02
PU 239	7.5E-02	6.7E-06	1.1E-05	4.3E-05	1.2E-04	9.6E+00	7.5E-01	1.3E-01
Total	8.6E-02	8.6E-06	1.3E-05	5.0E-05	1.4E-04	1.1E+01	8.4E-01	1.5E-01

Radionuclide	Ovaries	Muscle	Thyroid	Liver
AM 241	1.7E-02	1.7E-06	9.4E-07	2.2E-01
PU 239	1.3E-01	4.1E-06	4.0E-06	1.7E+00
Total	1.5E-01	5.8E-06	5.0E-06	1.9E+00

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: MI Acute - Ground Level

Executed on: 06/23/95 at 08:50:38

Page C. 5

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0

WHC-SD-CP-TI-197 Revision 0

Dose units:			Rem		
Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
AM 241	6.6E-02	0.0E+00	9.7E-10	6.6E-02	6.6E-02
PU 239	5.2E-01	0.0E+00	7.4E-11	5.2E-01	5.2E-01

APPENDIX B

GXQ OUTPUT DECKS

WHC-SD-CP-TI-197 Revision 0

GXQ Version 4.0
December 19, 1994

General Purpose Atmospheric Dispersion Code
Produced by Westinghouse Hanford Company

Users Guide documented in WHC-SD-GN-SWD-30002 Rev. 1.
Validation documented in WHC-SD-GN-SWD-30003 Rev. 1.
Code Custodian is: Brit E. Hey

Westinghouse Hanford Company
P.O. Box 1970
Richland, WA 99352
(509) 376-2921

Run Date = 06/19/95
Run Time = 15:38:52.90

ONSITE AND OFFSITE 99.5 PERCENTILE X/Q ACUTE GROUND LEVEL RELEASE

c GXQ Version 4.0 Input File

c mode
1

c

c MODE CHOICE:

c mode = 1 then X/Q based on Hanford site specific meteorology

c mode = 2 then X/Q based on atmospheric stability class and wind speed

c mode = 3 then X/Q plot file is created

c

c LOGICAL CHOICES:

c ifox inorm icdf ichk isite ipop
T F F F F F

c ifox = t then joint frequency used to compute frequency to exceed X/Q

c = f then joint frequency used to compute annual average X/Q

c inorm = t then joint frequency data is normalized (as in GENII)

c = f then joint frequency data is un-normalized

c icdf = t then cumulative distribution file created (CDF.OUT)

c = f then no cumulative distribution file created

c ichk = t then X/Q parameter print option turned on

c = f then no parameter print

c isite = t then X/Q based on joint frequency data for all 16 sectors

c = f then X/Q based on joint frequency data of individual sectors

c ipop = t then X/Q is population weighted

c = f then no population weighting

c

c X/Q AND WIND SPEED ADJUSTMENT MODELS:

c ipuff idep isrc iwind
0 0 0 0

c DIFFUSION COEFFICIENT ADJUSTMENT MODELS:

c iwake ipm iflow ientr
0 0 0 0

c EFFECTIVE RELEASE HEIGHT ADJUSTMENT MODELS:

c (irise igrnd)iwash igrav
0 0 0 0

c ipuff = 1 then X/Q calculated using puff model

c = 0 then X/Q calculated using default continuous plume model

c idep = 1 then plume depletion model turned on (Chamberlain model)

WHC-SD-CP-TI-197 Revision 0

```

c isrc = 1 then X/Q multiplied by scalar
c       = 2 then X/Q adjusted by wind speed function
c iwind = 1 then wind speed corrected for plume height
c iwake = 1 then NRC RG 1.145 building wake model turned on
c       = 2 then MACCS virtual distance building wake model turned on
c ipm   = 1 then NRC RG 1.145 plume meander model turned on
c       = 2 then 5th Power Law plume meander model turned on
c       = 3 then sector average model turned on
c iflow = 1 then sigmas adjusted for volume flow rate
c ientr = 1 then method of Pasquill used to account for entrainment
c irise = 1 then MACCS buoyant plume rise model turned on
c       = 2 then ISC2 momentum/buoyancy plume rise model turned on
c igrnd = 1 then Mills buoyant plume rise modification for ground effects
c iwash = 1 then stack downwash model turned on
c igrav = 1 then gravitational settling model turned on
c       = 0 unless specified otherwise, 0 turns model off
c
c PARAMETER INPUT:
c
c      release      reference      mixing      frequency
c      height      anemometer     height     to
c      hs(m)       ha(m)          hm(m)      exceed
c
c      0.00000E+00  1.00000E+01    1.00000E+03  5.00000E-01
c
c      initial      initial      release      deposition      gravitational
c      plume        plume        duration     velocity        settling
c      width        height       trd(hr)      vd(m/s)         velocity
c      Wb(m)        Wb(m)
c
c      0.00000E+00  0.00000E+00    1.00000E+00  1.00000E-03    1.00000E-03
c
c      ambient      initial      initial      release      convective
c      temperature  plume        plume       diameter    heat release
c      Tamb(C)      temperature  flow rate   d(m)         rate(1)
c                  T0(C)        V0(m3/s)
c
c      2.00000E+01  2.20000E+01    1.23000E+02  4.10000E+00    0.00000E+00
c
c (1) If zero then buoyant flux based on plume/ambient temperature difference.
c
c      X/Q          Wind
c      scaling      Speed
c      factor       Exponent
c      c(?)         a(?)
c
c      1.00000E+00  7.80000E-01
c
c RECEPTOR DEPENDENT DATA (no line limit)
c FOR MODE make RECEPTOR DEPENDENT DATA
c 1 (site specific) sector distance receptor-height
c 2 (by class & wind speed) class windspeed distance offset receptor-height
c 3 (create plot file) class windspeed xmax ymax jmax xmin power
c
c RECEPTOR PARAMETER DESCRIPTION
c sector = 0, 1, 2... (all, S, SSW, etc.)
c distance = receptor distance (m)
c receptor height = height of receptor (m)
c class = 1, 2, 3, 4, 5, 6, 7 (P-G stability class A, B, C, D, E, F, G)
c windspeed = anemometer wind speed (m/s)

```

WHC-SD-CP-TI-197 Revision 0

c offset = offset from plume centerline (m)
c xmax = maximum distance to plot or calculate to (m)
c imax = distance intervals
c ymax = maximum offset to plot (m)
c jmax = offset intervals
c xqmin = minimum scaled X/Q to calculate
c power = exponent in power function step size

MODE:

Site specific X/Q calculated.

LOGICAL CHOICES:

Joint frequency used to calculate X/Q based on frequency of exceedance.

No normalization of joint frequency.

X/Q calculated for single sector.

MODELS SELECTED:

Default Gaussian plume model selected.

WARNING/ERROR MESSAGES:

JOINT FREQUENCY DATA:

200 AREA (HMS) - 10 M - Pasquill A - G (1983 - 1991 Average)

Created 8/26/92 KR

Input title line

SECTOR	DISTANCE (m)	RECEPT HEIGHT (m)	SECT. FREQ. (%)	POPULATION	TOTAL POPULATION	AVERAGE INDIVIDUAL	ATM. STAB. CLASS	WIND SPEED (m/s)
					SCALED X/Q (s/m ³)	SCALED X/Q (s/m ³)		
WNW	550	0	3.98	1	8.72E-04	8.72E-04	G	4.70
NE	1540	0	3.90	1	1.59E-04	1.59E-04	E	0.89
ENE	750	0	6.17	1	8.22E-04	8.22E-04	G	2.65
ESE	1050	0	18.80	1	6.03E-04	6.03E-04	F	0.89
SSE	930	0	4.78	1	3.59E-04	3.59E-04	G	4.70
S	15000	0	6.30	1	6.71E-06	6.71E-06	E	0.89
SSW	15400	0	4.53	1	4.10E-06	4.10E-06	F	2.65
SW	16100	0	2.93	1	4.97E-06	4.97E-06	F	2.65
WSW	13200	0	2.72	1	6.40E-06	6.40E-06	F	2.65
W	12500	0	4.80	1	1.62E-05	1.62E-05	G	2.65
WNW	13200	0	3.98	1	8.49E-06	8.49E-06	G	4.70
NW	16500	0	4.72	1	1.18E-05	1.18E-05	G	2.65
NNW	17400	0	4.58	1	1.11E-05	1.11E-05	G	2.65
N	19200	0	4.36	1	1.05E-05	1.05E-05	G	2.65
NNE	26000	0	2.49	1	3.15E-06	3.15E-06	E	0.89
NE	28900	0	3.90	1	2.98E-06	2.98E-06	E	0.89
ENE	25600	0	6.17	1	6.02E-06	6.02E-06	G	2.65
E	25200	0	14.05	1	8.21E-06	8.21E-06	F	0.89
ESE	30000	0	18.80	1	6.34E-06	6.34E-06	F	0.89
SE	25200	0	10.83	1	7.44E-06	7.44E-06	G	2.65
SSE	22900	0	4.78	1	4.03E-06	4.03E-06	G	4.70

WHC-SD-CP-TI-197 Revision 0

GXQ Version 4.0
December 19, 1994

General Purpose Atmospheric Dispersion Code
Produced by Westinghouse Hanford Company

Users Guide documented in WHC-SD-GN-SWD-30002 Rev. 1.
Validation documented in WHC-SD-GN-SWD-30003 Rev. 1.
Code Custodian is: Brit E. Hey

Westinghouse Hanford Company
P.O. Box 1970
Richland, WA 99352
(509) 376-2921

Run Date = 08/25/95
Run Time = 13:34:05.73

INPUT ECHO:

Onsite & Offsite 99.5 % Acute Stack Level Release

c GXQ Version 4.0 Input File

c mode
1

c

c MODE CHOICE:

c mode = 1 then X/Q based on Hanford site specific meteorology

c mode = 2 then X/Q based on atmospheric stability class and wind speed

c mode = 3 then X/Q plot file is created

c

c LOGICAL CHOICES:

c ifox inorm icdf ichk isite ipop
T F F F F F

c ifox = t then joint frequency used to compute frequency to exceed X/Q

c = f then joint frequency used to compute annual average X/Q

c inorm = t then joint frequency data is normalized (as in GENII)

c = f then joint frequency data is un-normalized

c icdf = t then cumulative distribution file created (CDF.OUT)

c = f then no cumulative distribution file created

c ichk = t then X/Q parameter print option turned on

c = f then no parameter print

c isite = t then X/Q based on joint frequency data for all 16 sectors

c = f then X/Q based on joint frequency data of individual sectors

c ipop = t then X/Q is population weighted

c = f then no population weighting

c

c X/Q AND WIND SPEED ADJUSTMENT MODELS:

c ipuff idep isrc iwind
0 0 0 1

c DIFFUSION COEFFICIENT ADJUSTMENT MODELS:

c iwake ipm iflow ientr
0 3 1 0

c EFFECTIVE RELEASE HEIGHT ADJUSTMENT MODELS:

c (irise igrnd)iwash igrav
2 0 1 0

c ipuff = 1 then X/Q calculated using puff model

c = 0 then X/Q calculated using default continuous plume model

WHC-SD-CP-TI-197 Revision 0

```

c idep = 1 then plume depletion model turned on (Chamberlain model)
c isrc = 1 then X/Q multiplied by scalar
c      = 2 then X/Q adjusted by wind speed function
c iwind = 1 then wind speed corrected for plume height
c iwake = 1 then NRC RG 1.145 building wake model turned on
c      = 2 then MACCS virtual distance building wake model turned on
c ipm   = 1 then NRC RG 1.145 plume meander model turned on
c      = 2 then 5th Power Law plume meander model turned on
c      = 3 then sector average model turned on
c iflow = 1 then sigmas adjusted for volume flow rate
c ientr = 1 then method of Pasquill used to account for entrainment
c irise = 1 then MACCS buoyant plume rise model turned on
c      = 2 then ISC2 momentum/buoyancy plume rise model turned on
c igrnd = 1 then Mills buoyant plume rise modification for ground effects
c iwash = 1 then stack downwash model turned on
c igrav = 1 then gravitational settling model turned on
c      = 0 unless specified otherwise, 0 turns model off
c
c PARAMETER INPUT:
c
c      release      reference      mixing      frequency
c      height      height      height      to
c      hs(m)       ha(m)       hm(m)       exceed
c
c      6.10000E+01  6.10000E+01  1.00000E+03  5.00000E-01
c
c      initial      initial      release      deposition      gravitational
c      plume        plume        duration     velocity        settling
c      width        height       trd(hr)       vd(m/s)         velocity
c      Wb(m)        Hb(m)              vg(m/s)
c
c      0.00000E+00  0.00000E+00  1.00000E+00  1.00000E-03  1.00000E-03
c
c      ambient      initial      initial      release      convective
c      temperature  plume        plume        diameter    heat release
c      Tamb(C)      T0(C)        flow rate   d(m)         rate(1)
c                  V0(m3/s)
c                  qh(w)
c
c      2.00000E+01  2.20000E+01  1.23000E+02  4.10000E+00  0.00000E+00
c
c (1) If zero then buoyant flux based on plume/ambient temperature difference.
c
c      X/Q          Wind
c      scaling      Speed
c      factor       Exponent
c      c(?)         a(?)
c
c      1.00000E+00  7.80000E-01
c
c RECEPTOR DEPENDENT DATA (no line limit)
c FOR MODE make RECEPTOR DEPENDENT DATA
c 1 (site specific) sector distance receptor-height
c 2 (by class & wind speed) class windspeed distance offset receptor-height
c 3 (create plot file) class windspeed xmax imax ymax jmax xmin power
c
c RECEPTOR PARAMETER DESCRIPTION
c sector = 0, 1, 2... (all, S, SSW, etc.)
c distance = receptor distance (m)
c receptor height = height of receptor (m)
c class = 1, 2, 3, 4, 5, 6, 7 (P-G stability class A, B, C, D, E, F, G)

```

WHC-SD-CP-TI-197 Revision 0

c windspeed = anemometer wind speed (m/s)
c offset = offset from plume centerline (m)
c xmax = maximum distance to plot or calculate to (m)
c imax = distance intervals
c ymax = maximum offset to plot (m)
c jmax = offset intervals
c xqmin = minimum scaled X/Q to calculate
c power = exponent in power function step size

MODE:

Site specific X/Q calculated.

LOGICAL CHOICES:

Joint frequency used to calculate X/Q based on frequency of exceedance.
No normalization of joint frequency.
X/Q calculated for single sector.

MODELS SELECTED:

Flow adjustment model.
Sector average model selected.
ISC2 momentum/buoyancy plume model based on temperature difference.
Stack downwash model selected.
Default Gaussian plume model selected.
Wind velocity corrected for average plume height.

WARNING/ERROR MESSAGES:

WARNING #10 - X/Q may be underestimated for plume rise scenario without accounting for entrainment.

JOINT FREQUENCY DATA:

200 AREA (HMS) - 61 M - Pasquill A - G (1983 - 1991 Average)
Created 8/26/92 KR

Onsite & Offsite 99.5 % Acute Ground Level Release

SECTOR	DISTANCE (m)	RECEPT HEIGHT (m)	SECT. FREQ. (%)	POPULATION	TOTAL POPULATION SCALED X/Q (s/m3)	AVERAGE INDIVIDUAL SCALED X/Q (s/m3)	ATM. STAB. CLASS	WIND SPEED (m/s)
WNW	630	0	3.80	1	5.57E-06	5.57E-06	B	0.89
NE	1580	0	3.95	1	1.03E-06	1.03E-06	D	4.70
ENE	830	0	6.33	1	2.16E-06	2.16E-06	C	7.15
ESE	1060	0	19.39	1	2.52E-06	2.52E-06	C	0.89
SSE	930	0	4.75	1	3.35E-06	3.35E-06	C	2.65
S	15000	0	6.11	1	5.28E-07	5.28E-07	D	0.89
SSW	15400	0	4.33	1	4.32E-07	4.32E-07	D	0.89
SW	16100	0	2.79	1	4.10E-07	4.10E-07	D	0.89
WSW	13200	0	2.54	1	5.10E-07	5.10E-07	D	0.89
W	12500	0	4.56	1	6.24E-07	6.24E-07	F	0.89
WNW	13200	0	3.80	1	5.85E-07	5.85E-07	F	0.89
NW	16500	0	4.58	1	5.10E-07	5.10E-07	F	0.89
NNW	17400	0	4.51	1	5.12E-07	5.12E-07	F	0.89
N	19200	0	4.31	1	4.82E-07	4.82E-07	F	0.89
NNE	26000	0	2.48	1	2.01E-07	2.01E-07	G	0.89
NE	28900	0	3.95	1	1.95E-07	1.95E-07	G	0.89
ENE	25600	0	6.33	1	2.36E-07	2.36E-07	D	0.89
E	25200	0	14.39	1	4.35E-07	4.35E-07	F	0.89

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ESE	30000	0	19.39	1	3.42E-07	3.42E-07 F	0.89
SE	25200	0	11.01	1	3.60E-07	3.60E-07 F	0.89
SSE	22900	0	4.75	1	3.40E-07	3.40E-07 D	0.89

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GXQ Version 4.0
December 19, 1994

General Purpose Atmospheric Dispersion Code
Produced by Westinghouse Hanford Company

Users Guide documented in WHC-SD-GN-SWD-30002 Rev. 1.
Validation documented in WHC-SD-GN-SWD-30003 Rev. 1.
Code Custodian is: Brit E. Hey

Westinghouse Hanford Company
P.O. Box 1970
Richland, WA 99352
(509) 376-2921

Run Date = 08/04/95
Run Time = 10:10:41.45

INPUT ECHO:

Onsite & Offsite 99.5 % Chronic Ground Level Release

c GXQ Version 4.0 Input File

c mode
1

c

c MODE CHOICE:

c mode = 1 then X/Q based on Hanford site specific meteorology

c mode = 2 then X/Q based on atmospheric stability class and wind speed

c mode = 3 then X/Q plot file is created

c

c LOGICAL CHOICES:

c ifox inorm icdf ichk isite ipop
F F F F F F

c ifox = t then joint frequency used to compute frequency to exceed X/Q

c = f then joint frequency used to compute annual average X/Q

c inorm = t then joint frequency data is normalized (as in GENII)

c = f then joint frequency data is un-normalized

c icdf = t then cumulative distribution file created (CDF.OUT)

c = f then no cumulative distribution file created

c ichk = t then X/Q parameter print option turned on

c = f then no parameter print

c isite = t then X/Q based on joint frequency data for all 16 sectors

c = f then X/Q based on joint frequency data of individual sectors

c ipop = t then X/Q is population weighted

c = f then no population weighting

c

c X/Q AND WIND SPEED ADJUSTMENT MODELS:

c ipuff idep isrc iwind
0 0 0 0

c DIFFUSION COEFFICIENT ADJUSTMENT MODELS:

c iwake ipm iflow ientr
0 3 0 0

c EFFECTIVE RELEASE HEIGHT ADJUSTMENT MODELS:

c (irise igrnd)iwash igrav
0 0 0 0

c ipuff = 1 then X/Q calculated using puff model

c = 0 then X/Q calculated using default continuous plume model

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```

c idep = 1 then plume depletion model turned on (Chamberlain model)
c isrc = 1 then X/Q multiplied by scalar
c      = 2 then X/Q adjusted by wind speed function
c iwind = 1 then wind speed corrected for plume height
c iwake = 1 then NRC RG 1.145 building wake model turned on
c      = 2 then MACCS virtual distance building wake model turned on
c ipm   = 1 then NRC RG 1.145 plume meander model turned on
c      = 2 then 5th Power Law plume meander model turned on
c      = 3 then sector average model turned on
c iflow = 1 then sigmas adjusted for volume flow rate
c ientr = 1 then method of Pasquill used to account for entrainment
c irise = 1 then MACCS buoyant plume rise model turned on
c      = 2 then ISC2 momentum/buoyancy plume rise model turned on
c igrnd = 1 then Mills buoyant plume rise modification for ground effects
c iwash = 1 then stack downwash model turned on
c igrav = 1 then gravitational settling model turned on
c      = 0 unless specified otherwise, 0 turns model off
c
c PARAMETER INPUT:
c
c      release      reference      mixing      frequency
c      height      height      height      to
c      hs(m)       ha(m)       hm(m)       exceed
c
c      0.00000E+00  1.00000E+01  1.00000E+03  5.00000E-01
c
c      initial      initial      release      deposition      gravitational
c      plume        plume        duration     velocity        settling
c      width        height      trd(hr)      vd(m/s)         velocity
c      Wb(m)        Hb(m)
c
c      0.00000E+00  0.00000E+00  1.00000E+00  1.00000E-03  1.00000E-03
c
c      ambient      initial      initial      release      convective
c      temperature  plume        plume        diameter    heat release
c      Tamb(C)      temperature  flow rate    d(m)         rate(1)
c                  T0(C)
c                  V0(m3/s)
c
c      2.00000E+01  2.20000E+01  1.23000E+02  4.10000E+00  0.00000E+00
c
c (1) If zero then buoyant flux based on plume/ambient temperature difference.
c
c      X/Q          Wind
c      scaling      Speed
c      factor       Exponent
c      c(?)         a(?)
c
c      1.00000E+00  7.80000E-01
c
c RECEPTOR DEPENDENT DATA (no line limit)
c FOR MODE      make      RECEPTOR DEPENDENT DATA
c 1 (site specific)      sector distance receptor-height
c 2 (by class & wind speed) class windspeed distance offset receptor-height
c 3 (create plot file)   class windspeed xmax imax ymax jmax xmin power
c
c RECEPTOR PARAMETER DESCRIPTION
c sector = 0, 1, 2... (all, S, SSW, etc.)
c distance = receptor distance (m)
c receptor height = height of receptor (m)
c class = 1, 2, 3, 4, 5, 6, 7 (P-G stability class A, B, C, D, E, F, G)

```

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c windspeed = anemometer wind speed (m/s)
c offset = offset from plume centerline (m)
c xmax = maximum distance to plot or calculate to (m)
c imax = distance intervals
c ymax = maximum offset to plot (m)
c jmax = offset intervals
c xqmin = minimum scaled X/Q to calculate
c power = exponent in power function step size

MODE:

Site specific X/Q calculated.

LOGICAL CHOICES:

Joint frequency used to calculate annual average X/Q.
No normalization of joint frequency.
X/Q calculated for single sector.

MODELS SELECTED:

Sector average model selected.
Default Gaussian plume model selected.

WARNING/ERROR MESSAGES:

JOINT FREQUENCY DATA:

200 AREA (HMS) - 10 M - Pasquill A - G (1983 - 1991 Average)
Created 8/26/92 KR

Onsite & Offsite 99.5 % Chronic Ground Level Release

SECTOR	DISTANCE (m)	RECEPT HEIGHT (m)	SECT. FREQ. (%)	POPULATION	TOTAL POPULATION	AVERAGE INDIVIDUAL	ATM. STAB. CLASS	WIND SPEED (m/s)
					SCALED X/Q (s/m ³)	SCALED X/Q (s/m ³)		
WNW	550	0	3.98	1	6.00E-06	6.00E-06		
NE	1540	0	3.90	1	7.92E-07	7.92E-07		
ENE	750	0	6.17	1	3.65E-06	3.65E-06		
ESE	1050	0	18.80	1	5.81E-06	5.81E-06		
SSE	930	0	4.78	1	2.47E-06	2.47E-06		
S	15000	0	6.30	1	3.62E-08	3.62E-08		
SSW	15400	0	4.53	1	2.09E-08	2.09E-08		
SW	16100	0	2.93	1	1.94E-08	1.94E-08		
WSW	13200	0	2.72	1	2.57E-08	2.57E-08		
W	12500	0	4.80	1	5.02E-08	5.02E-08		
WNW	13200	0	3.98	1	3.85E-08	3.85E-08		
NW	16500	0	4.72	1	3.29E-08	3.29E-08		
NNW	17400	0	4.58	1	3.12E-08	3.12E-08		
N	19200	0	4.36	1	2.91E-08	2.91E-08		
NNE	26000	0	2.49	1	1.07E-08	1.07E-08		
NE	28900	0	3.90	1	1.09E-08	1.09E-08		
ENE	25600	0	6.17	1	1.72E-08	1.72E-08		
E	25200	0	14.05	1	4.82E-08	4.82E-08		
ESE	30000	0	18.80	1	3.95E-08	3.95E-08		
SE	25200	0	10.83	1	2.95E-08	2.95E-08		
SSE	22900	0	4.78	1	1.85E-08	1.85E-08		

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GXQ Version 4.0
December 19, 1994

General Purpose Atmospheric Dispersion Code
Produced by Westinghouse Hanford Company

Users Guide documented in WHC-SD-GN-SWD-30002 Rev. 1.
Validation documented in WHC-SD-GN-SWD-30003 Rev. 1.

Code Custodian is: Brit E. Hey
Westinghouse Hanford Company
P.O. Box 1970
Richland, WA 99352
(509) 376-2921

Run Date = 08/04/95
Run Time = 08:43:22.77

INPUT ECHO:

Onsite & Offsite 99.5 % Chronic Stack Level Release
c GXQ Version 4.0 Input File
c mode
1
c
c MODE CHOICE:
c mode = 1 then X/Q based on Hanford site specific meteorology
c mode = 2 then X/Q based on atmospheric stability class and wind speed
c mode = 3 then X/Q plot file is created
c
c LOGICAL CHOICES:
c ifox inorm icdf ichk isite ipop
F F F F F F
c ifox = t then joint frequency used to compute frequency to exceed X/Q
c = f then joint frequency used to compute annual average X/Q
c inorm = t then joint frequency data is normalized (as in GENII)
c = f then joint frequency data is un-normalized
c icdf = t then cumulative distribution file created (CDF.OUT)
c = f then no cumulative distribution file created
c ichk = t then X/Q parameter print option turned on
c = f then no parameter print
c isite = t then X/Q based on joint frequency data for all 16 sectors
c = f then X/Q based on joint frequency data of individual sectors
c ipop = t then X/Q is population weighted
c = f then no population weighting
c
c X/Q AND WIND SPEED ADJUSTMENT MODELS:
c ipuff idep isrc iwind
0 0 0 1
c DIFFUSION COEFFICIENT ADJUSTMENT MODELS:
c iwake ipm iflow ientr
0 3 1 0
c EFFECTIVE RELEASE HEIGHT ADJUSTMENT MODELS:
c (irise igrnd)iwash igrav
2 0 1 0
c ipuff = 1 then X/Q calculated using puff model
c = 0 then X/Q calculated using default continuous plume model

WHC-SD-CP-TI-197 Revision 0

```

c idcp = 1 then plume depletion model turned on (Chamberlain model)
c isrc = 1 then X/Q multiplied by scalar
c      = 2 then X/Q adjusted by wind speed function
c iwind = 1 then wind speed corrected for plume height
c iwake = 1 then NRC RG 1.145 building wake model turned on
c      = 2 then MACCS virtual distance building wake model turned on
c ipm   = 1 then NRC RG 1.145 plume meander model turned on
c      = 2 then 5th Power Law plume meander model turned on
c      = 3 then sector average model turned on
c iflow = 1 then sigmas adjusted for volume flow rate
c ientr = 1 then method of Pasquill used to account for entrainment
c irise = 1 then MACCS buoyant plume rise model turned on
c      = 2 then ISC2 momentum/buoyancy plume rise model turned on
c igrnd = 1 then Mills buoyant plume rise modification for ground effects
c iwash = 1 then stack downwash model turned on
c igrav = 1 then gravitational settling model turned on
c      = 0 unless specified otherwise, 0 turns model off
c
c PARAMETER INPUT:
c
c      release      reference      mixing      frequency
c      height      anemometer     height     to
c      hs(m)       ha(m)          hm(m)      exceed
c
c      8.90000E+01  8.90000E+01  1.00000E+03  5.00000E-01
c
c      initial      initial      release      deposition      gravitational
c      plume        plume        duration     velocity        settling
c      width        height       trd(hr)      vd(m/s)         velocity
c      Wb(m)        Hb(m)         trd(hr)      vd(m/s)         vg(m/s)
c
c      0.00000E+00  0.00000E+00  1.00000E+00  1.00000E-03  1.00000E-03
c
c      ambient      initial      initial      release      convective
c      temperature  plume        plume        diameter    heat release
c      Tamb(C)      temperature  flow rate    d(m)         rate(1)
c
c      2.00000E+01  2.20000E+01  1.23000E+02  4.10000E+00  0.00000E+00
c
c (1) If zero then buoyant flux based on plume/ambient temperature difference.
c
c      X/Q          Wind
c      scaling      Speed
c      factor       Exponent
c      c(?)         a(?)
c
c      1.00000E+00  7.80000E-01
c
c RECEPTOR DEPENDENT DATA (no line limit)
c FOR MODE make RECEPTOR DEPENDENT DATA
c 1 (site specific) sector distance receptor-height
c 2 (by class & wind speed) class windspeed distance offset receptor-height
c 3 (create plot file) class windspeed xmax imax ymax jmax xqmin power
c
c RECEPTOR PARAMETER DESCRIPTION
c sector = 0, 1, 2... (all, S, SSW, etc.)
c distance = receptor distance (m)
c receptor height = height of receptor (m)
c class = 1, 2, 3, 4, 5, 6, 7 (P-G stability class A, B, C, D, E, F, G)

```

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c windspeed = anemometer wind speed (m/s)
 c offset = offset from plume centerline (m)
 c xmax = maximum distance to plot or calculate to (m)
 c imax = distance intervals
 c ymax = maximum offset to plot (m)
 c jmax = offset intervals
 c xqmin = minimum scaled X/Q to calculate
 c power = exponent in power function step size

MODE:

Site specific X/Q calculated.

LOGICAL CHOICES:

Joint frequency used to calculate annual average X/Q.
 No normalization of joint frequency.
 X/Q calculated for single sector.

MODELS SELECTED:

Flow adjustment model.
 Sector average model selected.
 ISC2 momentum/buoyancy plume model based on temperature difference.
 Stack downwash model selected.
 Default Gaussian plume model selected.
 Wind velocity corrected for average plume height.

WARNING/ERROR MESSAGES:

WARNING #10 - X/Q may be underestimated for plume rise scenario without accounting for entrainment.

JOINT FREQUENCY DATA:

200 AREA (HMS) - 89 M - Pasquill A - G (1983 - 1991 Average)
 Created 8/26/92 KR

Onsite & Offsite 99.5 % Chronic Stack Level Release

SECTOR	DISTANCE (m)	RECEPT HEIGHT (m)	SECT. FREQ. (%)	POPULATION	TOTAL POPULATION SCALED X/Q (s/m ³)	AVERAGE INDIVIDUAL SCALED X/Q (s/m ³)	ATM. STAB. CLASS	WIND SPEED (m/s)
WNW	630	0	3.81	1	5.63E-08	5.63E-08		
NE	1540	0	3.89	1	8.90E-09	8.90E-09		
ENE	830	0	6.27	1	2.42E-08	2.42E-08		
ESE	1060	0	19.41	1	2.77E-08	2.77E-08		
SSE	930	0	4.73	1	3.28E-08	3.28E-08		
S	15000	0	6.12	1	9.69E-09	9.69E-09		
SSW	15400	0	4.29	1	6.05E-09	6.05E-09		
SW	16100	0	2.82	1	4.99E-09	4.99E-09		
WSW	13200	0	2.57	1	5.86E-09	5.86E-09		
W	12500	0	4.58	1	1.03E-08	1.03E-08		
WNW	13200	0	3.81	1	7.83E-09	7.83E-09		
NW	16500	0	4.58	1	7.04E-09	7.04E-09		
NNW	17400	0	4.52	1	6.23E-09	6.23E-09		
N	19200	0	4.33	1	5.47E-09	5.47E-09		
NNE	26000	0	2.48	1	2.37E-09	2.37E-09		
NE	28900	0	3.89	1	2.65E-09	2.65E-09		
ENE	25600	0	6.27	1	3.92E-09	3.92E-09		

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E	25200	0	14.38	1	9.21E-09	9.21E-09
ESE	30000	0	19.41	1	9.47E-09	9.47E-09
SE	25200	0	11.04	1	7.86E-09	7.86E-09
SSE	22900	0	4.73	1	5.29E-09	5.29E-09

WHC-SD-CP-TI-197 Revision 0

GXQ Version 4.0
December 19, 1994

General Purpose Atmospheric Dispersion Code
Produced by Westinghouse Hanford Company

Users Guide documented in WHC-SD-GN-SWD-30002 Rev. 1.
Validation documented in WHC-SD-GN-SWD-30003 Rev. 1.
Code Custodian is: Brit E. Hey

Westinghouse Hanford Company
P.O. Box 1970
Richland, WA 99352
(509) 376-2921

Run Date = 08/02/95
Run Time = 10:37:53.18

INPUT ECHO:

Population Offsite 99.5 % Acute Ground Level Release
c GXQ Version 4.0 Input File

c mode
1

c

c MODE CHOICE:

c mode = 1 then X/Q based on Hanford site specific meteorology
c mode = 2 then X/Q based on atmospheric stability class and wind speed
c mode = 3 then X/Q plot file is created

c

c LOGICAL CHOICES:

c ifox inorm icdf ichk isite ipop
T F F F F T

c ifox = t then joint frequency used to compute frequency to exceed X/Q
c = f then joint frequency used to compute annual average X/Q
c inorm = t then joint frequency data is normalized (as in GENII)
c = f then joint frequency data is un-normalized
c icdf = t then cumulative distribution file created (CDF.OUT)
c = f then no cumulative distribution file created
c ichk = t then X/Q parameter print option turned on
c = f then no parameter print
c isite = t then X/Q based on joint frequency data for all 16 sectors
c = f then X/Q based on joint frequency data of individual sectors
c ipop = t then X/Q is population weighted
c = f then no population weighting

c

c X/Q AND WIND SPEED ADJUSTMENT MODELS:

c ipuff idep isrc iwind
0 0 0 0

c DIFFUSION COEFFICIENT ADJUSTMENT MODELS:

c iwake ipm iflow ientr
0 3 0 0

c EFFECTIVE RELEASE HEIGHT ADJUSTMENT MODELS:

c (irise igrnd)iwash igrav
0 0 0 0

c ipuff = 1 then X/Q calculated using puff model

c = 0 then X/Q calculated using default continuous plume model

WHC-SD-CP-TI-197 Revision 0

```

c idep = 1 then plume depletion model turned on (Chamberlain model)
c isrc = 1 then X/Q multiplied by scalar
c      = 2 then X/Q adjusted by wind speed function
c iwind = 1 then wind speed corrected for plume height
c iwake = 1 then NRC RG 1.145 building wake model turned on
c      = 2 then MACCS virtual distance building wake model turned on
c ipm = 1 then NRC RG 1.145 plume meander model turned on
c      = 2 then 5th Power Law plume meander model turned on
c      = 3 then sector average model turned on
c iflow = 1 then sigmas adjusted for volume flow rate
c ientr = 1 then method of Pasquill used to account for entrainment
c irise = 1 then MACCS buoyant plume rise model turned on
c      = 2 then ISC2 momentum/buoyancy plume rise model turned on
c igrnd = 1 then Mills buoyant plume rise modification for ground effects
c iwash = 1 then stack downwash model turned on
c igrav = 1 then gravitational settling model turned on
c      = 0 unless specified otherwise, 0 turns model off
c
c PARAMETER INPUT:
c
c      release      reference      mixing      frequency
c      height      anemometer     height     to
c      hs(m)       ha(m)          hm(m)      exceed
c
c      0.00000E+00  1.00000E+01      1.00000E+03  5.00000E-01
c
c      initial      initial      release      deposition      gravitational
c      plume        plume        duration     velocity        settling
c      width        height       trd(hr)      vd(m/s)         velocity
c      Wb(m)        Hb(m)                                     vg(m/s)
c
c      0.00000E+00  0.00000E+00      1.00000E+00  1.00000E-03     1.00000E-03
c
c      ambient      initial      initial      release      convective
c      temperature  plume        plume        diameter    heat release
c      Tamb(C)      T0(C)         V0(m3/s)     d(m)         rate(1)
c
c      2.00000E+01  2.20000E+01      1.23000E+02  4.10000E+00     0.00000E+00
c
c (1) If zero then buoyant flux based on plume/ambient temperature difference.
c
c      X/Q          Wind
c      scaling      Speed
c      factor       Exponent
c      c(?)         a(?)
c
c      1.00000E+00  7.80000E-01
c
c RECEPTOR DEPENDENT DATA (no line limit)
c FOR MODE make RECEPTOR DEPENDENT DATA
c 1 (site specific) sector distance receptor-height
c 2 (by class & wind speed) class windspeed distance offset receptor-height
c 3 (create plot file) class windspeed xmax imax ymax jmax xqmin power
c
c RECEPTOR PARAMETER DESCRIPTION
c sector = 0, 1, 2... (all, S, SSW, etc.)
c distance = receptor distance (m)
c receptor height = height of receptor (m)
c class = 1, 2, 3, 4, 5, 6, 7 (P-G stability class A, B, C, D, E, F, G)

```

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c windspeed = anemometer wind speed (m/s)
c offset = offset from plume centerline (m)
c xmax = maximum distance to plot or calculate to (m)
c imax = distance intervals
c ymax = maximum offset to plot (m)
c jmax = offset intervals
c xqmin = minimum scaled X/Q to calculate
c power = exponent in power function step size

MODE:

Site specific X/Q calculated.

LOGICAL CHOICES:

Joint frequency used to calculate X/Q based on frequency of exceedance.
No normalization of joint frequency.
X/Q calculated for single sector.
X/Q is population weighted.

MODELS SELECTED:

Sector average model selected.
Default Gaussian plume model selected.

WARNING/ERROR MESSAGES:

JOINT FREQUENCY DATA:

200 AREA (HMS) - 10 M - Pasquill A - G (1983 - 1991 Average)
Created 8/26/92 KR

POPULATION DATA:

Population within 80 km of the Hanford 200 Area, 1990 Census (Beck, et al 1991)
Created 10/21/91 KR, Revised 2/4/92 KR

Population Offsite 99.5 % Acute Ground Level Release

SECTOR	DISTANCE (m)	RECEPT HEIGHT (m)	SECT. FREQ. (%)	POPULATION	TOTAL POPULATION SCALED X/Q (s/m ³)	AVERAGE INDIVIDUAL SCALED X/Q (s/m ³)	ATM. STAB. CLASS	WIND SPEED (m/s)
S	80000	0	6.30	5845	3.37E-03	5.76E-07	E	0.89
SSW	80000	0	4.53	13937	3.59E-03	2.58E-07	F	2.65
SW	80000	0	2.93	22666	6.59E-03	2.91E-07	F	2.65
WSW	80000	0	2.72	31223	6.66E-03	2.13E-07	F	2.65
W	80000	0	4.80	102538	2.21E-02	2.15E-07	G	2.65
WNW	80000	0	3.98	5292	1.80E-03	3.40E-07	G	2.65
NW	80000	0	4.72	2879	1.21E-03	4.20E-07	G	2.65
NNW	80000	0	4.58	7308	2.22E-03	3.04E-07	G	2.65
N	80000	0	4.36	4643	2.00E-03	4.31E-07	G	2.65
NNE	80000	0	2.49	24085	5.28E-03	2.19E-07	E	0.89
NE	80000	0	3.90	10372	3.85E-03	3.71E-07	E	0.89
ENE	80000	0	6.17	3956	1.48E-03	3.73E-07	G	2.65
E	80000	0	14.05	3992	2.66E-03	6.67E-07	F	0.89
ESE	80000	0	18.80	3000	1.83E-03	6.09E-07	F	0.89
SE	80000	0	10.83	114734	4.86E-02	4.23E-07	G	2.65
SSE	80000	0	4.78	19390	7.66E-03	3.95E-07	E	0.89

WHC-SD-CP-TI-197 Revision 0

GXQ Version 4.0
December 19, 1994

General Purpose Atmospheric Dispersion Code
Produced by Westinghouse Hanford Company

Users Guide documented in WHC-SD-GN-SWD-30002 Rev. 1.
Validation documented in WHC-SD-GN-SWD-30003 Rev. 1.
Code Custodian is: Brit E. Hey

Westinghouse Hanford Company
P.O. Box 1970
Richland, WA 99352
(509) 376-2921

Run Date = 08/04/95
Run Time = 08:29:53.60

INPUT ECHO:
Population Offsite 99.5 % Acute Stack Level Release
c GXQ Version 4.0 Input File
c mode
1
c
c MODE CHOICE:
c mode = 1 then X/Q based on Hanford site specific meteorology
c mode = 2 then X/Q based on atmospheric stability class and wind speed
c mode = 3 then X/Q plot file is created
c
c LOGICAL CHOICES:
c ifox inorm icdf ichk isite ipop
T F F F F T
c ifox = t then joint frequency used to compute frequency to exceed X/Q
c = f then joint frequency used to compute annual average X/Q
c inorm = t then joint frequency data is normalized (as in GENII)
c = f then joint frequency data is un-normalized
c icdf = t then cumulative distribution file created (CDF.OUT)
c = f then no cumulative distribution file created
c ichk = t then X/Q parameter print option turned on
c = f then no parameter print
c isite = t then X/Q based on joint frequency data for all 16 sectors
c = f then X/Q based on joint frequency data of individual sectors
c ipop = t then X/Q is population weighted
c = f then no population weighting
c
c X/Q AND WIND SPEED ADJUSTMENT MODELS:
c ipuff idep isrc iwind
0 0 0 1
c DIFFUSION COEFFICIENT ADJUSTMENT MODELS:
c iwake ipm iflow ientr
0 3 1 0
c EFFECTIVE RELEASE HEIGHT ADJUSTMENT MODELS:
c (irise igrnd)iwash igrav
2 0 1 0
c ipuff = 1 then X/Q calculated using puff model
c = 0 then X/Q calculated using default continuous plume model

WHC-SD-CP-TI-197 Revision 0

```

c idcp = 1 then plume depletion model turned on (Chamberlain model)
c isrc = 1 then X/Q multiplied by scalar
c      = 2 then X/Q adjusted by wind speed function
c iwind = 1 then wind speed corrected for plume height
c iwake = 1 then NRC RG 1.145 building wake model turned on
c      = 2 then MACCS virtual distance building wake model turned on
c ipm   = 1 then NRC RG 1.145 plume meander model turned on
c      = 2 then 5th Power Law plume meander model turned on
c      = 3 then sector average model turned on
c iflow = 1 then sigmas adjusted for volume flow rate
c ientr = 1 then method of Pasquill used to account for entrainment
c irise = 1 then MACCS buoyant plume rise model turned on
c      = 2 then ISC2 momentum/buoyancy plume rise model turned on
c igrnd = 1 then Mills buoyant plume rise modification for ground effects
c iwash = 1 then stack downwash model turned on
c igrav = 1 then gravitational settling model turned on
c      = 0 unless specified otherwise, 0 turns model off
c
c PARAMETER INPUT:
c
c   release      reference      mixing      frequency
c   height      height        height        to
c   hs(m)       ha(m)         hm(m)       exceed
c                                     Cx(%)
c
c   6.10000E+01  6.10000E+01    1.00000E+03  5.00000E-01
c
c   initial      initial      release      deposition      gravitational
c   plume        plume        duration     velocity        settling
c   width        height      trd(hr)       vd(m/s)         velocity
c   Wb(m)        Hb(m)                                     vg(m/s)
c
c   0.00000E+00  0.00000E+00    1.00000E+00  1.00000E-03    1.00000E-03
c
c   ambient      initial      initial      release      convective
c   temperature  plume        plume        diameter    heat release
c   Tamb(C)      T0(C)        flow rate   d(m)         rate(1)
c                                     qh(w)
c
c   2.00000E+01  2.20000E+01    1.23000E+02  4.10000E+00    0.00000E+00
c
c (1) If zero then buoyant flux based on plume/ambient temperature difference.
c
c   X/Q          Wind
c   scaling      Speed
c   factor        Exponent
c   c(?)         a(?)
c
c   1.00000E+00  7.80000E-01
c
c RECEPTOR DEPENDENT DATA (no line limit)
c FOR MODE      make      RECEPTOR DEPENDENT DATA
c 1 (site specific)      sector distance receptor-height
c 2 (by class & wind speed) class windspeed distance offset receptor-height
c 3 (create plot file)   class windspeed xmax ymax jmax xmin power
c
c RECEPTOR PARAMETER DESCRIPTION
c sector = 0, 1, 2... (all, S, SSW, etc.)
c distance = receptor distance (m)
c receptor height = height of receptor (m)
c class = 1, 2, 3, 4, 5, 6, 7 (P-G stability class A, B, C, D, E, F, G)

```


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c windspeed = anemometer wind speed (m/s)
c offset = offset from plume centerline (m)
c xmax = maximum distance to plot or calculate to (m)
c imax = distance intervals
c ymax = maximum offset to plot (m)
c jmax = offset intervals
c xqmin = minimum scaled X/Q to calculate
c power = exponent in power function step size

MODE:

Site specific X/Q calculated.

LOGICAL CHOICES:

Joint frequency used to calculate X/Q based on frequency of exceedance.
No normalization of joint frequency.
X/Q calculated for single sector.
X/Q is population weighted.

MODELS SELECTED:

Flow adjustment model.
Sector average model selected.
ISC2 momentum/buoyancy plume model based on temperature difference.
Stack downwash model selected.
Default Gaussian plume model selected.
Wind velocity corrected for average plume height.

WARNING/ERROR MESSAGES:

WARNING #10 - X/Q may be underestimated for plume rise scenario without accounting for entrainment.

JOINT FREQUENCY DATA:

200 AREA (HMS) - 61 M - Pasquill A - G (1983 - 1991 Average)
Created 8/26/92 KR

POPULATION DATA:

Population within 80 km of the Hanford 200 Area, 1990 Census (Beck, et al 1991)
Created 10/21/91 KR, Revised 2/4/92 KR

Population Offsite 99.5 % Acute Stack Level Release

SECTOR	DISTANCE (m)	RECEPT HEIGHT (m)	SECT. FREQ. (%)	POPULATION	TOTAL POPULATION SCALED X/Q (s/m3)	AVERAGE INDIVIDUAL SCALED X/Q (s/m3)	ATM. STAB. CLASS	WIND SPEED (m/s)
S	80000	0	6.11	5845	1.54E-03	2.64E-07	D	0.89
SSW	80000	0	4.33	13937	2.05E-03	1.47E-07	D	0.89
SW	80000	0	2.79	22666	3.42E-03	1.51E-07	D	0.89
WSW	80000	0	2.54	31223	3.47E-03	1.11E-07	D	0.89
W	80000	0	4.56	102538	1.37E-02	1.33E-07	G	0.89
WNW	80000	0	3.80	5292	8.06E-04	1.52E-07	G	0.89
NW	80000	0	4.58	2879	5.73E-04	1.99E-07	G	0.89
NNW	80000	0	4.51	7308	1.28E-03	1.75E-07	E	0.89
N	80000	0	4.31	4643	9.05E-04	1.95E-07	E	0.89
NNE	80000	0	2.48	24085	1.88E-03	7.82E-08	D	0.89
NE	80000	0	3.95	10372	1.35E-03	1.30E-07	D	0.89
ENE	80000	0	6.33	3956	5.58E-04	1.41E-07	G	0.89

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E	80000	0	14.39	3992	9.79E-04	2.45E-07 E	0.89
ESE	80000	0	19.39	3000	6.60E-04	2.20E-07 E	0.89
SE	80000	0	11.01	114734	1.85E-02	1.61E-07 G	0.89
SSE	80000	0	4.75	19390	2.85E-03	1.47E-07 G	0.89

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GXQ Version 4.0
December 19, 1994

General Purpose Atmospheric Dispersion Code
Produced by Westinghouse Hanford Company

Users Guide documented in WHC-SD-GN-SWD-30002 Rev. 1.
Validation documented in WHC-SD-GN-SWD-30003 Rev. 1.
Code Custodian is: Brit E. Hey

Westinghouse Hanford Company
P.O. Box 1970
Richland, WA 99352
(509) 376-2921

Run Date = 08/02/95
Run Time = 10:56:38.99

INPUT ECHO:
Population Offsite 99.5 % Chronic Ground Level Release
c GXQ Version 4.0 Input File
c mode
1
c
c MODE CHOICE:
c mode = 1 then X/Q based on Hanford site specific meteorology
c mode = 2 then X/Q based on atmospheric stability class and wind speed
c mode = 3 then X/Q plot file is created
c
c LOGICAL CHOICES:
c ifox inorm icdf ichk isite ipop
F F F F F T
c ifox = t then joint frequency used to compute frequency to exceed X/Q
c = f then joint frequency used to compute annual average X/Q
c inorm = t then joint frequency data is normalized (as in GENII)
c = f then joint frequency data is un-normalized
c icdf = t then cumulative distribution file created (CDF.OUT)
c = f then no cumulative distribution file created
c ichk = t then X/Q parameter print option turned on
c = f then no parameter print
c isite = t then X/Q based on joint frequency data for all 16 sectors
c = f then X/Q based on joint frequency data of individual sectors
c ipop = t then X/Q is population weighted
c = f then no population weighting
c
c X/Q AND WIND SPEED ADJUSTMENT MODELS:
c ipuff idep isrc iwind
0 0 0 0
c DIFFUSION COEFFICIENT ADJUSTMENT MODELS:
c iwake ipm iflow ientr
0 3 0 0
c EFFECTIVE RELEASE HEIGHT ADJUSTMENT MODELS:
c (irise igrnd)iwash igrav
0 0 0 0
c ipuff = 1 then X/Q calculated using puff model
c = 0 then X/Q calculated using default continuous plume model

WHC-SD-CP-TI-197 Revision 0

```

c idep = 1 then plume depletion model turned on (Chamberlain model)
c isrc = 1 then X/Q multiplied by scalar
c      = 2 then X/Q adjusted by wind speed function
c iwind = 1 then wind speed corrected for plume height
c iwake = 1 then MRC RG 1.145 building wake model turned on
c      = 2 then MACCS virtual distance building wake model turned on
c ipm   = 1 then MRC RG 1.145 plume meander model turned on
c      = 2 then 5th Power Law plume meander model turned on
c      = 3 then sector average model turned on
c iflow = 1 then sigmas adjusted for volume flow rate
c ientr = 1 then method of Pasquill used to account for entrainment
c irise = 1 then MACCS buoyant plume rise model turned on
c      = 2 then ISC2 momentum/buoyancy plume rise model turned on
c igrnd = 1 then Mills buoyant plume rise modification for ground effects
c iwash = 1 then stack downwash model turned on
c igrav = 1 then gravitational settling model turned on
c      = 0 unless specified otherwise, 0 turns model off
c
c PARAMETER INPUT:
c
c   release      reference      mixing      frequency
c   height      height        height        to
c   hs(m)       ha(m)         hm(m)       exceed
c              Cx(%)
c
c   0.00000E+00  1.00000E+01    1.00000E+03    5.00000E-01
c
c   initial      initial      release      deposition      gravitational
c   plume        plume        duration      velocity        settling
c   width        height      trd(hr)       velocity        velocity
c   Wb(m)        Hb(m)         vd(m/s)      vg(m/s)
c
c   0.00000E+00  0.00000E+00    1.00000E+00    1.00000E-03    1.00000E-03
c
c   ambient      initial      initial      release      convective
c   temperature  plume        plume        diameter    heat release
c   Tamb(C)      T0(C)        flow rate    d(m)         rate(1)
c              V0(m3/s)
c              qh(w)
c
c   2.00000E+01  2.20000E+01    1.23000E+02    4.10000E+00    0.00000E+00
c
c (1) If zero then buoyant flux based on plume/ambient temperature difference.
c
c   X/Q          Wind
c   scaling      Speed
c   factor        Exponent
c   c(?)         a(?)
c
c   1.00000E+00  7.80000E-01
c
c RECEPTOR DEPENDENT DATA (no line limit)
c FOR MODE      make      RECEPTOR DEPENDENT DATA
c 1 (site specific)      sector distance receptor-height
c 2 (by class & wind speed) class windspeed distance offset receptor-height
c 3 (create plot file)   class windspeed xmax imax ymax jmax xmin power
c
c RECEPTOR PARAMETER DESCRIPTION
c sector = 0, 1, 2... (all, S, SSW, etc.)
c distance = receptor distance (m)
c receptor height = height of receptor (m)
c class = 1, 2, 3, 4, 5, 6, 7 (P-G stability class A, B, C, D, E, F, G)

```

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c windspeed = anemometer wind speed (m/s)
c offset = offset from plume centerline (m)
c xmax = maximum distance to plot or calculate to (m)
c imax = distance intervals
c ymax = maximum offset to plot (m)
c jmax = offset intervals
c xqmin = minimum scaled X/Q to calculate
c power = exponent in power function step size

MODE:

Site specific X/Q calculated.

LOGICAL CHOICES:

Joint frequency used to calculate annual average X/Q.
No normalization of joint frequency.
X/Q calculated for single sector.
X/Q is population weighted.

MODELS SELECTED:

Sector average model selected.
Default Gaussian plume model selected.

WARNING/ERROR MESSAGES:

JOINT FREQUENCY DATA:

200 AREA (HMS) - 10 M - Pasquill A - G (1983 - 1991 Average)
Created 8/26/92 KR

POPULATION DATA:

Population within 80 km of the Hanford 200 Area, 1990 Census (Beck, et al 1991)
Created 10/21/91 KR, Revised 2/4/92 KR

Population Offsite 99.5 % Chronic Ground Level Release

SECTOR	DISTANCE (m)	RECEPT HEIGHT (m)	SECT. FREQ. (%)	POPULATION	TOTAL POPULATION	AVERAGE INDIVIDUAL	ATM. STAB. CLASS	WIND SPEED (m/s)
					SCALED X/Q (s/m3)	SCALED X/Q (s/m3)		
S	80000	0	6.30	5845	7.40E-05	1.27E-08		
SSW	80000	0	4.53	13937	7.77E-05	5.57E-09		
SW	80000	0	2.93	22666	1.27E-04	5.60E-09		
WSW	80000	0	2.72	31223	1.27E-04	4.08E-09		
W	80000	0	4.80	102538	5.01E-04	4.88E-09		
WNW	80000	0	3.98	5292	3.52E-05	6.65E-09		
NW	80000	0	4.72	2879	2.64E-05	9.18E-09		
NNW	80000	0	4.58	7308	4.86E-05	6.65E-09		
N	80000	0	4.36	4643	3.68E-05	7.93E-09		
NNE	80000	0	2.49	24085	7.73E-05	3.21E-09		
NE	80000	0	3.90	10372	6.40E-05	6.17E-09		
ENE	80000	0	6.17	3956	3.20E-05	8.08E-09		
E	80000	0	14.05	3992	9.06E-05	2.27E-08		
ESE	80000	0	18.80	3000	7.38E-05	2.46E-08		
SE	80000	0	10.83	114734	1.36E-03	1.18E-08		
SSE	80000	0	4.78	19390	1.55E-04	8.00E-09		

WHC-SD-CP-TI-197 Revision 0

GXQ Version 4.0
December 19, 1994

General Purpose Atmospheric Dispersion Code
Produced by Westinghouse Hanford Company

Users Guide documented in WHC-SD-GN-SWD-30002 Rev. 1.
Validation documented in WHC-SD-GN-SWD-30003 Rev. 1.

Code Custodian is: Brit E. Hey
Westinghouse Hanford Company
P.O. Box 1970
Richland, WA 99352
(509) 376-2921

Run Date = 08/04/95
Run Time = 08:31:06.55

INPUT ECHO:

Population Offsite 99.5 % Chronic Stack Level Release

c GXQ Version 4.0 Input File

c mode

1

c

c MODE CHOICE:

c mode = 1 then X/Q based on Hanford site specific meteorology

c mode = 2 then X/Q based on atmospheric stability class and wind speed

c mode = 3 then X/Q plot file is created

c

c LOGICAL CHOICES:

c ifox inorm icdf ichk isite ipop

F F F F F T

c ifox = t then joint frequency used to compute frequency to exceed X/Q

c = f then joint frequency used to compute annual average X/Q

c inorm = t then joint frequency data is normalized (as in GENII)

c = f then joint frequency data is un-normalized

c icdf = t then cumulative distribution file created (CDF.OUT)

c = f then no cumulative distribution file created

c ichk = t then X/Q parameter print option turned on

c = f then no parameter print

c isite = t then X/Q based on joint frequency data for all 16 sectors

c = f then X/Q based on joint frequency data of individual sectors

c ipop = t then X/Q is population weighted

c = f then no population weighting

c

c X/Q AND WIND SPEED ADJUSTMENT MODELS:

c ipuff idep isrc iwind

0 0 0 1

c DIFFUSION COEFFICIENT ADJUSTMENT MODELS:

c iwake ipm iflow ientr

0 3 1 0

c EFFECTIVE RELEASE HEIGHT ADJUSTMENT MODELS:

c (irise igrnd)iwash igrav

2 0 1 0

c ipuff = 1 then X/Q calculated using puff model

c = 0 then X/Q calculated using default continuous plume model

WHC-SD-CP-TI-197 Revision 0

```

c idep = 1 then plume depletion model turned on (Chamberlain model)
c isrc = 1 then X/Q multiplied by scalar
c      = 2 then X/Q adjusted by wind speed function
c iwind = 1 then wind speed corrected for plume height
c iwake = 1 then NRC RG 1.145 building wake model turned on
c      = 2 then MACCS virtual distance building wake model turned on
c ipm   = 1 then NRC RG 1.145 plume meander model turned on
c      = 2 then 5th Power Law plume meander model turned on
c      = 3 then sector average model turned on
c iflow = 1 then sigmas adjusted for volume flow rate
c ientr = 1 then method of Pasquill used to account for entrainment
c irise = 1 then MACCS buoyant plume rise model turned on
c      = 2 then ISC2 momentum/buoyancy plume rise model turned on
c igrnd = 1 then Mills buoyant plume rise modification for ground effects
c iwash = 1 then stack downwash model turned on
c igrav = 1 then gravitational settling model turned on
c      = 0 unless specified otherwise, 0 turns model off
c
c PARAMETER INPUT:
c
c      release      reference      mixing      frequency
c      height      anemometer     height     to
c      hs(m)       ha(m)          hm(m)      exceed
c
c      8.90000E+01  8.90000E+01      1.00000E+03  5.00000E-01
c
c      initial      initial      release      deposition      gravitational
c      plume        plume        duration     velocity        settling
c      width        height      trd(hr)       vd(m/s)         velocity
c      Wb(m)        Hb(m)
c
c      0.00000E+00  0.00000E+00      1.00000E+00  1.00000E-03     1.00000E-03
c
c      ambient      initial      initial      release      convective
c      temperature  plume        plume        diameter    heat release
c      Tamb(C)      T0(C)        flow rate   d(m)         rate(1)
c                  V0(m3/s)
c
c      2.00000E+01  2.20000E+01      1.23000E+02  4.10000E+00     0.00000E+00
c
c (1) If zero then buoyant flux based on plume/ambient temperature difference.
c
c      X/Q          Wind
c      scaling      Speed
c      factor       Exponent
c      c(?)         a(?)
c
c      1.00000E+00  7.80000E-01
c
c RECEPTOR DEPENDENT DATA (no line limit)
c FOR MODE make RECEPTOR DEPENDENT DATA
c 1 (site specific) sector distance receptor-height
c 2 (by class & wind speed) class windspeed distance offset receptor-height
c 3 (create plot file) class windspeed xmax imax ymax jmax xqmin power
c
c RECEPTOR PARAMETER DESCRIPTION
c sector = 0, 1, 2... (all, S, SSW, etc.)
c distance = receptor distance (m)
c receptor height = height of receptor (m)
c class = 1, 2, 3, 4, 5, 6, 7 (P-G stability class A, B, C, D, E, F, G)

```

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c windspeed = anemometer wind speed (m/s)
c offset = offset from plume centerline (m)
c xmax = maximum distance to plot or calculate to (m)
c imax = distance intervals
c ymax = maximum offset to plot (m)
c jmax = offset intervals
c xqmin = minimum scaled X/Q to calculate
c power = exponent in power function step size

MODE:

Site specific X/Q calculated.

LOGICAL CHOICES:

Joint frequency used to calculate annual average X/Q.
No normalization of joint frequency.
X/Q calculated for single sector.
X/Q is population weighted.

MODELS SELECTED:

Flow adjustment model.
Sector average model selected.
ISC2 momentum/buoyancy plume model based on temperature difference.
Stack downwash model selected.
Default Gaussian plume model selected.
Wind velocity corrected for average plume height.

WARNING/ERROR MESSAGES:

WARNING #10 - X/Q may be underestimated for plume rise scenario without accounting for entrainment.

JOINT FREQUENCY DATA:

200 AREA (HMS) - 89 M - Pasquill A - G (1983 - 1991 Average)
Created 8/26/92 KR

POPULATION DATA:

Population within 80 km of the Hanford 200 Area, 1990 Census (Beck, et al 1991)
Created 10/21/91 KR, Revised 2/4/92 KR

Population Offsite 99.5 % Chronic Stack Level Release

SECTOR	DISTANCE (m)	RECEPT HEIGHT (m)	SECT. FREQ. (%)	POPULATION	TOTAL POPULATION	AVERAGE INDIVIDUAL	ATM. STAB. CLASS	WIND SPEED (m/s)
					SCALED X/Q (s/m3)	SCALED X/Q (s/m3)		
S	80000	0	6.12	5845	2.61E-05	4.46E-09		
SSW	80000	0	4.29	13937	3.20E-05	2.30E-09		
SW	80000	0	2.82	22666	4.61E-05	2.03E-09		
WSW	80000	0	2.57	31223	4.87E-05	1.56E-09		
W	80000	0	4.58	102538	2.02E-04	1.97E-09		
WNW	80000	0	3.81	5292	1.22E-05	2.31E-09		
NW	80000	0	4.58	2879	8.24E-06	2.86E-09		
NNW	80000	0	4.52	7308	1.59E-05	2.18E-09		
N	80000	0	4.33	4643	1.07E-05	2.30E-09		
NNE	80000	0	2.48	24085	2.43E-05	1.01E-09		
NE	80000	0	3.89	10372	1.81E-05	1.75E-09		
ENE	80000	0	6.27	3956	8.95E-06	2.26E-09		

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E	80000	0	14.38	3992	2.18E-05	5.47E-09
ESE	80000	0	19.41	3000	1.98E-05	6.60E-09
SE	80000	0	11.04	114734	4.55E-04	3.97E-09
SSE	80000	0	4.73	19390	5.34E-05	2.75E-09