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THE X/Q VALUES AND UNIT DOSES FOR THE SPENT NUCLEAR FUEL PROJECT

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Abstract: This document provides the X/Q and unit dose calculations for the spent nuclear fuel project.

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THE X/Q VALUES AND UNIT DOSES FOR SPENT NUCLEAR FUEL PROJECT

C. H. HUANG

FEBRUARY 26, 1997

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THE X/Q VALUES AND UNIT DOSES FOR SPENT NUCLEAR FUEL PROJECT

1.0 PURPOSE

The purpose of this document is to provide a single referenceable document that provides the X/Qs for all the facilities in the spent nuclear fuel projects, and includes the bases for the X/Q calculations.

The X/Q values for the nuclear fuel projects were calculated over the past several years. The values currently used in the nuclear fuel project were documented in letter reports and as attached to various PSEs and Safety Analysis documents. Therefore, there is a need to consolidate these documents or reports into a single referenceable document.

The final document includes the X/Qs for KE and KW Basins, the cold vacuum drying facility, and the canister storage building.

The specific documents which we seek to consolidate into a single document mainly for providing atmospheric dispersion coefficients are as follows:

- (1). Hey, B. E., 1995: Revision 1 to Supporting Calculations for K Basin ISB. 8D150-BEH-94-003 R1. Westinghouse Hanford Company, Richland Washington.
- (2). Brehm, J. R., 1995: Spent Nuclear Fuel Project Path Forward Preliminary Safety Evaluation. WHC-SD-SNF-PSE-001, Rev. 0. Westinghouse Hanford Company, Richland Washington.
- (3). Himes, D. A., 1995: Acute Stack Release X/Qs for the Hanford Waste Vitrification Plant Canister Storage Building. DAH-8M400-95-014. Westinghouse Hanford Company, Richland Washington.

In this document, Section 2.0 contains unit dose estimates for K Basin sludge, water and fuel. Section 3.0 provides atmospheric dispersion coefficients (X/Q) for transport of the released material to downwind receptors. Section 4.0 discusses the use of the unit doses and X/Q to calculate radiological doses for hypothetical accident scenarios developed elsewhere.

The receptor locations and the calculated X/Qs for various facilities are given in Sections 3.1 and 3.6, respectively.

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2.0 RADIOLOGICAL DOSES

This section provides unit dose estimates for K Basin sludge and water. Sludge and water activity concentrations used in the dose calculations are based on laboratory sample results which are in units of $\mu\text{Ci/g}$ dried material in the case of sludge and $\mu\text{Ci/L}$ in the case of contaminated water. Since the intended use of the calculated unit dose is for accident analysis consequence assessment, the unit dose for sludge material is converted to rem/ml of settled solids inhaled.

Transuranic and fission product inventories are based on theoretical (ORIGEN2 code) estimates which account for fuel type, power history and decay period (Willis and Praga 1995). Transuranic and fission product inventory estimates were calculated for the combined K Basins, K East Basin, K West Basin, and K Basin Mark IV fuel.

Both inhalation and submersion pathways are considered in the dose calculations. In all cases the external submersion pathway, based on a semi-infinite plume model, is insignificant compared to the internal inhalation pathway and is therefore not reported separately. The basic assumptions made in the dose estimates are that the released material is 100% respirable. Plutonium is assumed to be in oxide form. Effective dose equivalent (EDE) and the limiting organ dose is reported for a 50 year commitment period for an acute uptake.

To convert the dose per unit quantity inhaled, to a dose per unit quantity released, the atmospheric dispersion coefficient and breathing rate must be estimated (see Section 4 for methodology). Atmospheric dispersion coefficients for a number of hypothetical receptors are provided in Section 3.0.

The filenames and titles of programs and libraries used in the unit dose calculation are:

GENII Dose Calculation Program (Version 1.485 3-Dec-90; Napier, 1988)
GENII Default Parameter Values (23-Mar-90 RAP)
Radionuclide Library - Times < 100 years (23-July-93 PDR)
External Dose Factors for GENII in person Sv/yr per Bq/n (3-May-90 RAP)
PNL Solubilities, Yearly Dose Increments (23-Jul-93 PDR)

2.1 K EAST BASIN

This section provides radiological unit doses for laboratory characterizations of K East (KE) Basin sludge and water.

2.1.1 K East Basin Sludge

Laboratory characterization of KE Basin sludge are reported in Bechtold (1993 and 1994). Unit doses derived from this characterization data are provided in Tables 2-1 through 2-4.

Table 2-1. Radiological Analysis of K East Basin Sludge Samples - July 1993.

Nitric acid digestion results ($\mu\text{Ci/g}$ dried)	Sample ID			
	S3-032-01	S3-032-02	S3-032-03	S3-032-04 ¹
^{239,240} Pu ²	6.83	4.24	5.87	2.35
²⁴¹ Am ³	8.05	4.90	8.13	2.03
¹⁵⁴ Eu	0.928	0.930	1.66	0.370
¹³⁷ Cs	42.8	47.5	41.5	13.1
⁹⁰ Sr	88.1	30.0	74.8	7.01
⁶⁰ Co	1.41	0.950	1.63	0.594
Residue concentration as-settled (g/ml)	0.764	0.811	0.198	0.114
Sludge density as-settled (g/ml)	1.53	1.54	1.13	1.11
Committed EDE per unit intake as-settled ⁴ (rem/ml)	4.3 E+3	2.8 E+3	1.1 E+3	1.8 E+2
Limiting committed organ dose ⁵ as-settled ⁴ (rem/ml)	6.6 E+4	4.3 E+4	1.7 E+4	2.6 E+3

Note: It is recommended that 1.0 E+4 rem EDE/ml as-settled sludge be used as a safety basis to bound the variation found in these four sludge samples and to bound the additional dose contribution due to isotopes not analyzed by the laboratory (see footnote 2).

¹Based on mean value.

²Although the isotopes of ²³⁸Pu, ²⁴¹Pu, and ²⁴²Pu are not evaluated, these isotopes contribute 20% or less to the dose attributed to ²³⁹Pu, ²⁴⁰Pu, and ²⁴¹Am in typical fuels and weapons grade mixtures.

³Activity concentration based on Gamma Energy Analysis (GEA).

⁴Code calculated doses converted from g dried to as-settled ml basis.

⁵Maximum organ was bone surface in all cases.

Table 2-2. Radiological Analysis of K East Basin Sand Filter Backwash Pit (SFBWP) Samples - First Campaign - September 1993.

Nitric acid digestion results ($\mu\text{Ci/g}$ dried)	Sample ID		
	S3-059-03	S3-059-04	S3-059-11
$^{239,240}\text{Pu}$	7.55	3.51	2.25
^{238}Pu	NA ⁷	NA	0.39
^{241}Am	6.98	2.92	1.89 ²
^{137}Cs	NA	16.1	48.8
Total Beta	63.2	39.0	156
^{90}Sr ⁶	NA	11.5	54
Residue concentration as-settled (g/ml)	0.123	0.483	0.452
Sludge density as-settled (g/ml)	1.08	1.30	1.30
Committed EDE per unit intake as-settled ⁴ (rem/ml)	6.6 E+2	1.2 E+3	7.7 E+2
Limiting committed organ dose ⁵ as-settled ⁴ (rem/ml)	1.0 E+3	1.6 E+4	1.1 E+4

⁶The laboratory did not specifically analyze sludge samples for ^{90}Sr . However, since the dominant beta contributors are ^{137}Cs , ^{90}Sr , and ^{90}Y , the ^{90}Sr activity is estimated to be one-half of the total beta activity less the ^{137}Cs activity.

⁷Not analyzed.

Table 2-3. Radiological Analysis of K East SFBWP Transfer Channel Samples - First Campaign - September 1993.

Nitric acid digestion results ($\mu\text{Ci/g}$ dried)	Sample ID			
	S3-059-05	S3-059-06	S3-059-07	S3-059-08
$^{239,240}\text{Pu}$	45.7	5.02	3.00	4.41
^{241}Am	34.6	3.92	2.25	2.87
^{137}Cs	109	16.7	25.8	26.2
Total beta	525	75.1	53.6	59.4
$^{90}\text{Sr}^6$	208	29.2	13.9	16.6
Residue concentration as-settled (g/ml)	0.049	0.251	0.484	0.406
Sludge Density as-settled (g/ml)	1.08	1.21	1.41	1.31
Committed EDE per unit intake as-settled ⁴ (rem/ml)	1.5 E+3	8.3 E+2	9.2 E+2	1.1 E+3
Limiting committed organ dose ⁵ as-settled ⁴ (rem/ml)	2.1 E+4	1.2 E+4	1.4 E+4	1.5 E+4

Table 2-4a. Radiological Analysis of K East SFBWP Second Campaign - November 1994.

Nitric acid digestion results ($\mu\text{Ci/g}$ dried)	Sample ID			
	S3-062-02	S3-062-03	S3-062-04	S3-062-05
$^{239,240}\text{Pu}$	3.01	2.18	5.85	2.20
^{238}Pu	NA	0.38	0.99	0.31
$^{241}\text{Am}^2$	2.70	1.83	4.56	1.46
^{137}Cs	32.1	14.7	43.4	15.1
Total beta	98.0	57.2	125	34.9
$^{90}\text{Sr}^6$	33.0	21.3	40.8	9.9
Residue concentration as-settled (g/ml)	0.308	0.479	0.288	0.594
Sludge Density as-settled (g/ml)	1.18	1.24	1.25	1.48
Committed EDE per unit intake as-settled ⁴ (rem/ml)	6.5 E+2	7.7 E+2	1.2 E+3	8.3 E+2
Limiting committed organ dose ⁵ as-settled ⁴ (rem/ml)	9.5 E+3	1.1 E+4	1.7 E+4	1.2 E+4

Table 2-4b. Radiological Analysis of K East SFBWP Second Campaign - November 1994.

Nitric acid digestion results ($\mu\text{Ci/g}$ dried)	Sample ID		
	S3-062-06	S3-062-07	S3-062-08
$^{239,240}\text{Pu}$	0.94	33.7	3.95
^{238}Pu	NA	4.55	0.64
$^{241}\text{Am}^3$	0.81	30.2	3.17
^{137}Cs	12.2	119	13.0
Total beta	21.0	313	40.9
$^{90}\text{Sr}^6$	4.4	97	14.0
Residue concentration as-settled (g/ml)	0.818	0.056	0.386
Sludge Density as-settled (g/ml)	1.53	1.05	1.36
Committed EDE per unit intake as-settled ⁴ (rem/ml)	6.0 E+2	1.4 E+3	1.1 E+3
Limiting committed organ dose ⁵ as-settled ⁴ (rem/ml)	8.2 E+3	2.0 E+4	1.5 E+4

It is recommended that 3 E+3 rem EDE/ml as-settled sludge be used as a safety basis for releases involving SFBWP and transfer channel sludge.

2.1.2 K East Basin Water

The unit dose results listed in Table 2-5 are based on the laboratory characterization data reported in WHC (1994a).

Table 2-5. Radiological Analysis of KE Basin Water.

Radionuclide	Inventory ($\mu\text{Ci/L}$)
$^{239,240}\text{Pu}$	3.3 E-01
^{238}Pu	6.9 E-02
^{241}Am	7.0 E-03
^3H	3.4
^{90}Sr	2.5
^{137}Cs	6.1
Committed EDE per unit intake (rem/L)	1.2 E+02
Limiting committed organ dose (rem/L)	1.3 E+03

2.2 K WEST BASIN

This section is to provide radiological unit doses for laboratory characterizations of K West (KW) Basin sludge and water. However, laboratory characterizations of KW Basin sludge and water are not currently available.

2.2.1 K West Basin Sludge

Data not available.

2.2.2 K West Basin Water

Data not available.

2.3 K Basin Fuel

The inventories of K East and K West Basin fuels and K Basin Mark IV fuel are given in sections 2.3.1 and 2.3.2, respectively. These inventories were obtained from the RADNUC computer program (WHC 1995) based on ORIGEN II.

2.3.1 KE And KW Basin Fuels

K Basin fuel and fission product inventories are reported in the document (WHC-SD-SNF-TI-009, Willis and Praga, 1995). The RADNUC computer program (WHC 1995) is based on ORIGEN II. The RADNUC computer program was used for the K Basin inventory estimates. Tables 2-6, 2-7, and 2-8 contain the radionuclide inventory of the N Reactor Fuel in storage at the K Basins. Table 2-6 contains an inventory estimate for the combined total for both basins. Table 2-7 contains an inventory estimate specific to the K East Basin, and Table 2-8 contains inventory estimate specific to the K West Basin. The ⁸⁵Kr data provided in both tables assumes there has been no release of this gaseous nuclide from the fuel.

Table 2-6: Radionuclide Inventory of the Combined K Basins¹

Isotope	Activity (Ci)	Mass (Kg)	Heat Generation (W)	Isotope	Activity (Ci)	Mass (Kg)	Heat Generation (W)
Fission and Activation Products							
H-3	4.15e+04	4.30e-03	1.39e+00	Sn-123	1.25e-02	1.52e-09	3.90e-05
C-14	6.63e+02	1.49e-01	1.94e-01	Sn-126	1.42e+02	5.00e+00	4.37e-02
Fe-55	4.36e+03	1.74e-03	1.45e-01	Sb-124	4.58e-12	2.62e-19	6.04e-14
Co-60	1.48e+05	1.31e-01	2.28e+03	Sb-125	7.17e+04	6.94e-02	2.25e-02
Ni-59	3.92e+01	5.17e-01	1.56e-03	Sb-126	1.99e+01	2.38e-07	3.60e-01
Ni-63	4.41e+03	7.15e-02	4.45e-01	Sb-126m	1.42e+02	1.81e-09	1.82e+00
Se-79	8.13e+01	1.17e+00	2.51e-02	Te-123m	3.25e-08	3.66e-15	4.72e-11
Kr-85	7.03e+05	1.79e+00	1.05e+03	Te-125m	1.74e+04	9.69e-04	1.47e+01
Sr-89	1.94e-10	6.68e-18	6.71e-13	Te-127	2.41e-03	9.13e-13	3.25e-06
Sr-90	1.05e+07	7.70e+01	1.22e+04	Te-127m	2.46e-03	2.61e-10	1.22e-06
Y-90	1.05e+07	1.93e-02	5.80e+04	Te-129	0.00	0.00	0.00
Y-91	5.44e-08	2.22e-15	1.95e-10	Te-129m	0.00	0.00	0.00
Zr-93	3.81e+02	1.51e+02	4.39e-02	I-129	5.93e+00	3.36e+01	2.78e-03
Zr-95	1.16e-06	5.40e-14	5.86e-09	Cs-134	4.63e+04	3.58e-02	4.72e-02
Nb-93m	2.11e+02	7.46e-04	3.79e-02	Cs-135	7.25e+01	6.30e+01	2.42e-02
Nb-95	2.57e-06	6.58e-14	1.24e-08	Cs-137	1.35e+07	1.55e+02	1.36e+04
Nb-95m	8.61e-09	2.26e-17	1.14e-11	Ba-137m	1.28e+07	2.38e-05	5.01e+04
Tc-99	2.72e+03	1.60e+02	1.37e+00	Ce-141	0.00	0.00	0.00
Ru-103	2.22e-15	6.88e-23	7.27e-18	Ce-144	1.80e+04	5.64e-03	1.19e+01
Ru-106	1.74e+04	5.20e-03	1.04e+00	Pr-143	0.00	0.00	0.00
Rh-103m	2.00e-15	6.15e-26	4.60e-19	Pr-144	1.78e+04	2.36e-07	1.31e+02
Rh-106	1.74e+04	4.89e-09	1.67e+02	Pr-144m	2.16e+02	1.19e-09	7.27e-02
Pd-107	1.47e+01	2.86e+01	8.09e-04	Pm-147	1.08e+06	1.16e+00	3.98e+02
Ag-110	8.07e-03	1.94e-15	6.07e-08	Pm-148	1.23e-17	7.49e-26	9.46e-20
Ag-110m	6.07e-01	1.28e-07	1.01e-02	Pm-148m	2.18e-16	1.02e-23	2.73e-18
Cd-113m	3.76e+03	1.73e-02	4.13e+00	Sm-151	1.72e+05	6.54e+00	2.01e+01
Cd-115m	1.22e-15	4.79e-23	4.54e-18	Eu-152	1.02e+03	5.90e-03	4.60e+00
In-113m	3.63e-04	2.17e-14	8.38e-07	Eu-154	1.28e+05	4.74e-01	1.15e+03
Sn-113	3.63e-04	3.62e-11	6.04e-08	Eu-155	3.31e+04	7.12e-02	2.40e+01
Sn-119m	9.34e+00	2.09e-06	4.82e-03	Gd-153	4.16e-03	1.18e-09	3.75e-06
Sn-121m	7.88e+01	1.33e-03	8.27e-02	Tb-160	3.85e-10	3.41e-17	3.08e-12
Fission and Activation Product Totals					4.98e+07	6.86e+02	1.40e+05
Actinides							
U-234	8.78e+02	1.41e+02	2.48e+01	Pu-241	7.38e+06	7.16e+01	2.29e+02
U-235	3.40e+01	1.57e+04	9.23e-01	Pu-242	5.90e+01	1.55e+01	1.72e+00
U-236	1.27e+02	1.96e+03	3.40e+00	Am-241	3.15e+05	9.18e+01	1.03e+04
U-238	6.96e+02	2.07e+06	1.73e+01	Am-242	3.50e+02	4.33e-07	2.91e+00
Np-237	6.54e+01	9.28e+01	1.88e+00	Am-242m	3.52e+02	3.62e-02	5.39e-01
Pu-238	1.25e+05	7.30e+00	4.07e+03	Am-243	5.51e+01	2.76e-01	1.74e+00
Pu-239	2.25e+05	3.62e+03	6.86e+03	Cm-242	2.90e+02	8.77e-05	1.05e+01
Pu-240	1.30e+05	5.70e+02	3.98e+03	Cm-244	1.51e+04	1.87e-01	5.19e+02
Actinide Totals					8.19e+06	2.09e+06	2.60e+04

¹ 3/29/95 RADNUC run for the combined K Basins. Results decayed to 01/01/1995. Total fuel Mass in the combined basins 2.10e+03 MTU. Total fuel activity in the combined basins 5.80e+07 Ci. Total fuel heat generation in the combined basins 1.66e+05 W.

Table 2-7: K-East Radionuclide Inventory²

Isotope	Activity (Ci)	Mass (Kg)	Heat Generation (W)	Isotope	Activity (Ci)	Mass (Kg)	Heat Generation (W)
Fission and Activation Products							
H-3	2.04e+04	2.12e-03	6.85e-01	Sn-123	1.05e-02	1.28e-09	3.28e-05
C-14	3.48e+02	7.81e-02	1.02e-01	Sn-126	7.39e+01	2.60e+00	2.27e-02
Fe-55	2.27e+03	9.08e-04	7.56e-02	Sb-124	3.73e-12	2.13e-19	4.92e-14
Co-60	6.96e+04	6.16e-02	1.07e+03	Sb-125	3.60e+04	3.49e-02	1.13e+02
Ni-59	2.03e+01	2.68e-01	8.06e-04	Sb-126	1.03e+01	1.23e-07	1.87e-01
Ni-63	2.27e+03	3.68e-02	2.29e-01	Sb-126m	7.39e+01	9.41e-10	9.46e-01
Se-79	4.10e+01	5.88e-01	1.26e-02	Te-123m	2.73e-08	3.08e-15	3.96e-11
Kr-85	3.38e+05	8.61e-01	5.07e+02	Te-125m	8.78e+03	4.88e-04	7.39e+00
Sr-89	1.54e-10	5.30e-18	5.30e-13	Te-127	2.00e-03	7.58e-13	2.70e-06
Sr-90	5.14e+06	3.77e+01	5.98e+03	Te-127m	2.04e-03	2.16e-10	1.01e-06
Y-90	5.14e+06	9.45e-03	2.85e+04	Te-129	0.00	0.00	0.00
Y-91	4.34e-08	1.77e-15	1.55e-10	Te-129m	0.00	0.00	0.00
Zr-93	1.90e+02	7.57e-01	2.19e-02	I-129	3.03e+00	1.72e+01	1.42e-03
Zr-95	9.31e-07	4.33e-14	4.70e-09	Cs-134	2.03e+04	1.57e-02	2.08e+02
Nb-93m	1.08e+02	3.81e-04	1.93e-02	Cs-135	3.70e+01	3.21e+01	1.24e-02
Nb-95	2.07e-06	5.29e-14	9.91e-09	Cs-137	6.69e+06	7.69e+01	6.77e+03
Nb-95m	6.91e-09	1.81e-17	9.11e-12	Ba-137m	6.33e+06	1.18e-05	2.48e+04
Tc-99	1.37e+03	8.08e+01	6.89e-01	Ce-141	0.00	0.00	0.00
Ru-103	1.77e-15	5.48e-23	5.77e-18	Ce-144	1.49e+04	4.67e-03	9.82e+00
Ru-106	1.33e+04	3.97e-03	7.91e-01	Pr-143	0.00	0.00	0.00
Rh-103m	1.59e-15	4.89e-26	3.66e-19	Pr-144	1.47e+04	1.95e-07	1.08e+02
Rh-106	1.33e+04	3.74e-09	1.27e+02	Pr-144m	1.78e+02	9.81e-10	5.98e-02
Pd-107	7.82e+00	1.52e+01	4.31e-04	Pm-147	5.71e+05	6.16e-01	2.09e+02
Ag-110	6.46e-03	1.55e-15	4.83e-08	Pm-148	9.75e-18	5.93e-26	7.50e-20
Ag-110m	4.86e-01	1.02e-07	8.06e-03	Pm-148m	1.73e-16	8.10e-24	2.16e-18
Cd-113m	1.91e+03	8.81e-03	2.11e+00	Sm-151	8.68e+04	3.30e+00	1.02e+01
Cd-115m	9.90e-16	3.89e-23	3.66e-18	Eu-152	5.02e+02	2.90e-03	2.27e+00
In-113m	2.99e-04	1.79e-14	6.91e-07	Eu-154	6.36e+04	2.36e-01	5.71e+02
Sn-113	2.99e-04	2.98e-11	4.95e-08	Eu-155	1.69e+04	3.63e-02	1.22e+01
Sn-119m	7.82e+00	1.75e-06	4.03e-03	Gd-153	3.11e-03	8.82e-10	2.80e-06
Sn-121m	3.98e+01	6.73e-04	4.18e-02	Tb-160	3.18e-10	2.82e-17	2.54e-12
Fission and Activation Product Totals					2.46e+07	3.44e+02	6.90e+04
Actinides							
U-234	4.68e+02	7.49e+01	1.32e+01	Pu-241	3.84e+06	3.73e+01	1.19e+02
U-235	1.79e+01	8.28e+03	4.86e-01	Pu-242	3.36e+01	8.80e+00	9.79e-01
U-236	6.61e+01	1.02e+03	1.76e+00	Am-241	1.77e+05	5.16e+01	5.80e+03
U-238	3.80e+02	1.13e+06	9.46e+00	Am-242	2.09e+02	2.59e-07	1.74e+00
Np-237	3.46e+01	4.91e+01	9.96e-01	Am-242m	2.10e+02	2.16e-02	3.22e-01
Pu-238	6.86e+04	4.01e+00	2.24e+03	Am-243	3.24e+01	1.63e-01	1.02e+00
Pu-239	1.19e+05	1.91e+03	3.63e+03	Cm-242	1.73e+02	5.23e-05	6.27e+00
Pu-240	6.91e+04	3.03e+02	2.12e+03	Cm-244	9.12e+03	1.13e-01	3.14e+02
Actinide Totals					4.28e+06	1.14e+06	1.43e+04

² 3/29/1995 RADNUC 2.0 run for K East Basin fuel. Results decayed to 01/01/1995. Total fuel mass in K East 1.14e+03 MTU. Total fuel Activity in K East as of 1/1/1995 2.89e+07 Ci. Total fuel Heat Generation in K East 8.32e+04 W.

Table 2-8: K-West Basin Radionuclide Inventory³

Isotope	Activity (Ci)	Mass (Kg)	Heat Generation (W)	Isotope	Activity (Ci)	Mass (Kg)	Heat Generation (W)
Fission and Activation Products							
H-3	2.11e+04	2.18e-03	7.07e-01	Sn-123	2.02e-03	2.46e-10	6.30e-06
C-14	3.15e+02	7.07e-02	9.20e-02	Sn-126	6.85e+01	2.41e+00	2.10e-02
Fe-55	2.09e+03	8.36e-04	6.94e-02	Sb-124	8.42e-13	4.81e-20	1.11e-14
Co-60	7.86e+04	6.95e-02	1.21e+03	Sb-125	3.57e+04	3.46e-02	1.12e+02
Ni-59	1.89e+01	2.50e-01	7.53e-04	Sb-126	9.59e+00	1.15e-07	1.74e-01
Ni-63	2.14e+03	3.47e-02	2.16e-01	Sb-126m	6.85e+01	8.72e-10	8.76e-01
Se-79	4.03e+01	5.78e-01	1.24e-02	Te-123m	5.19e-09	5.85e-16	7.53e-12
Kr-85	3.65e+05	9.30e-01	5.48e+02	Te-125m	8.70e+03	4.83e-04	7.33e+00
Sr-89	4.01e-11	1.38e-18	1.38e-13	Te-127	4.08e-04	1.55e-13	5.51e-07
Sr-90	5.37e+06	3.94e+01	6.24e+03	Te-127m	4.16e-04	4.41e-11	2.06e-07
Y-90	5.37e+06	9.87e-03	2.96e+04	Te-129	0.00	0.00	0.00
Y-91	1.10e-08	4.48e-16	3.96e-11	Te-129m	0.00	0.00	0.00
Zr-93	1.90e+02	7.57e+01	2.19e-02	I-129	2.90e+00	1.64e+01	1.36e-03
Zr-95	2.30e-07	1.07e-14	1.16e-09	Cs-134	2.60e+04	2.01e-02	2.65e+02
Nb-93m	1.03e+02	3.66e-04	1.85e-02	Cs-135	3.55e+01	3.08e+01	1.19e-02
Nb-95	5.12e-07	1.31e-14	2.45e-09	Cs-137	6.79e+06	7.81e+01	6.88e+03
Nb-95m	1.71e-09	4.48e-18	2.26e-12	Ba-137m	6.43e+06	1.20e-05	2.52e+04
Tc-99	1.35e+03	7.96e+01	6.77e-01	Ce-141	0.00	0.00	0.00
Ru-103	4.49e-16	1.39e-23	1.47e-18	Ce-144	3.17e+03	9.94e-04	2.09e+00
Ru-106	4.17e+03	1.25e-03	2.48e-01	Pr-143	0.00	0.00	0.00
Rh-103m	4.05e-16	1.24e-26	9.32e-20	Pr-144	3.13e+03	4.14e-08	2.29e+01
Rh-106	4.17e+03	1.17e-09	3.98e+01	Pr-144m	3.80e+01	2.10e-10	1.28e-02
Pd-107	6.91e+00	1.34e+01	3.81e-04	Pm-147	5.14e+05	5.54e-01	1.89e+02
Ag-110	1.61e-03	3.86e-16	1.21e-08	Pm-148	2.56e-18	1.56e-26	1.97e-20
Ag-110m	1.21e-01	2.55e-08	2.01e-03	Pm-148m	4.54e-17	2.12e-24	5.68e-19
Cd-113m	1.84e+03	8.48e-03	2.03e+00	Sm-151	8.50e+04	3.23e+00	9.93e+00
Cd-115m	2.30e-16	9.03e-24	8.56e-19	Eu-152	5.16e+02	2.98e-03	2.34e+00
In-113m	6.41e-05	3.83e-15	1.48e-07	Eu-154	6.44e+04	2.39e-01	5.80e+02
Sn-113	6.40e+05	6.37e-12	1.06e-08	Eu-155	1.63e+04	3.50e-02	1.18e+01
Sn-119m	1.52e+00	3.39e-07	7.83e-04	Gd-153	1.05e-03	2.98e-10	9.46e-07
Sn-121m	3.90e+01	6.60e-04	4.10e-02	Tb-160	6.72e-11	5.95e-18	5.36e-13
Fission and Activation Product Totals					2.52e+07	3.42e+02	7.09e+04
Actinides							
U-234	4.09e+02	6.54e+01	1.16e+01	Pu-241	3.54e+06	3.44e+01	1.10e+02
U-235	1.61e+01	7.45e+03	4.37e-01	Pu-242	2.54e+01	6.65e+00	7.41e-01
U-236	6.11e+01	9.44e+02	1.63e+00	Am-241	1.38e+05	4.02e+01	4.54e+03
U-238	3.16e+02	9.40e+05	7.88e+00	Am-242	1.41e+02	1.74e-07	1.17e+00
Np-237	3.08e+01	4.37e+01	8.88e-01	Am-242m	1.42e+02	1.46e-02	2.17e-01
Pu-238	5.67e+04	3.31e+00	1.85e+03	Am-243	2.27e+01	1.14e-01	7.18e-01
Pu-239	1.06e+05	1.71e+03	3.25e+03	Cm-242	1.17e+02	3.54e-05	4.25e+00
Pu-240	6.06e+04	2.66e+02	1.85e+03	Cm-244	5.95e+03	7.35e-02	2.05e+02
Actinide Totals					3.91e+06	9.50e+05	1.18e+04

³ 2/22/1995 RADNUC 2.0 run for K West Basin. Results decayed to 01/01/1995. Total fuel mass in K West 9.53e+02 MTU. Total fuel activity in K West as of 1/1/1995 2.91e+07. Total Heat Generation of fuel in K West 8.29e+04 W.

2.3.2 K Basin Mark IV Fuel

Single Pass Reactor and N Reactor fuels were both considered in the evaluation. In the case of the single pass reactor fuel, the americium, cesium, plutonium, and strontium were taken from the fuel inventory baseline document (WHC 1994b). The results of the evaluation indicate that N Reactor Mark IV fuel with a ^{240}Pu content of 16.72% discharged from the reactor 2/20/1979, represents the mix of isotopes with the largest potential dose impact on people. There is 6.9 MTU total of this 16.72% fuel stored in the K Basins. The K Basin Mark IV fuel inventory for the mixture of isotopes is shown in Table 2-9. The inventory in Table 2-9 was used for unit dose calculations for the spent nuclear fuel to be stored in the Canister Storage Building in the 200 East Area (Huang, 1996) and for the safety/regulatory assessment design basis.

Table 2-9: K Basin Mark IV Fuel⁴
(Based on Mk IV Fuel at 16.72% Pu-240)

Isotope	Activity Ci/MTU	Heat Generation (W/MTU)	Isotope	Activity Ci/MTU	Heat Generation (W/MTU)
Fission and Activation Products					
H-3	3.57e+01	1.20e-03	Sn-123	3.25e-11	1.01e-13
C-14	5.52e-01	1.61e-04	Sn-126	1.23e-01	3.77e-05
Fe-55	2.86e+00	9.51e-05	Sb-124	0.00	0.00
Co-60	1.19e+02	1.83e+00	Sb-125	5.31e+01	1.67e-01
Ni-59	3.17e-02	1.26e-06	Sb-126	1.71e-02	3.11e-04
Ni-63	3.64e+00	3.67e-04	Sb-126m	1.23e-01	1.57e-03
Se-79	6.32e-02	1.95e-05	Te-123m	7.51e-16	1.09e-18
Kr-85	5.39e+02	8.07e-01	Te-125m	1.30e+01	1.09e-02
Sr-89	0.00	0.00	Te-127	3.86e-13	5.22e-16
Sr-90	7.84e+03	9.09e+00	Te-127m	3.94e-13	1.95e-16
Y-90	7.84e+03	4.33e+01	Te-129	0.00	0.00
Y-91	0.00	0.00	Te-129m	0.00	0.00
Zr-93	2.88e-01	3.31e-05	I-129	4.94e-03	2.31e-06
Zr-95	0.00	0.00	Cs-134	5.16e+01	5.27e-01
Nb-93m	1.56e-01	2.79e-05	Cs-135	5.74e-02	1.92e-05
Nb-95	0.00	0.00	Cs-137	1.08e+04	1.10e+01
Nb-95m	0.00	0.00	Ba-137m	1.02e+04	4.02e+01
Tc-99	2.12e+00	1.06e-03	Ce-141	0.00	0.00
Ru-103	0.00	0.00	Ce-144	1.97e-01	1.30e-04
Ru-106	1.77e+00	1.05e-04	Pr-143	0.00	0.00
Rh-103m	0.00	0.00	Pr-144	1.96e-01	1.43e-03
Rh-106	1.77e+00	1.69e-02	Pr-144m	2.36e-03	7.94e-07
Pd-107	1.48e-02	8.15e-07	Pm-147	5.45e+02	2.00e-01
Ag-110	3.80e-07	2.85e-12	Pm-148	0.00	0.00
Ag-110m	2.86e-05	4.76e-07	Pm-148m	0.00	0.00
Cd-113m	3.51e+00	3.86e-03	Sm-151	1.01e+02	1.18e-02
Cd-115m	0.00	0.00	Eu-152	1.07e+00	4.84e-03
In-113m	1.22e-13	2.82e-16	Eu-154	1.81e+02	1.63e+00
Sn-113	1.22e-13	2.02e-17	Eu-155	2.42e+01	1.75e-02
Sn-119m	3.82e-05	1.97e-08	Gd-153	3.33e-07	3.00e-10
Sn-121m	6.72e-02	7.05e-05	Tb-160	0.00	0.00
Fission and Activation Product Totals				3.84e+04	1.09e+02
Actinides					
U-234	3.83e-01	1.08e-02	Pu-241	9.25e+03	2.87e-01
U-235	1.25e-02	3.40e-04	Pu-242	1.05e-01	3.05e-03
U-236	7.20e-02	1.92e-03	Am-241	3.58e+02	1.18e+01
U-238	3.29e-01	8.20e-03	Am-242	8.30e-01	6.92e-03
Np-237	5.67e-02	1.63e-03	Am-242m	8.35e-01	1.28e-03
Pu-238	1.71e+02	5.61e+00	Am-243	1.20e-01	3.81e-03
Pu-239	1.58e+02	4.84e+00	Cm-242	6.90e-01	2.50e-02
Pu-240	1.28e+02	3.92e+00	Cm-244	5.36e+01	1.85e+00
Actinide Totals				1.01e+04	2.83e+01

⁴ RADNUP 2.0 Run 3/7/1995 for The Maximum Pu-240 content K Basin Fuel discharged from N Reactor 2/20/1979. Results decayed to 01/01/1995. Total mass of fuel 6.90e+00 MTU. Total Activity as of 01/01/1995 3.35e+05 Ci. Total Heat Generation 9.46e+02 W.

3.0 ATMOSPHERIC TRANSPORT

Atmospheric transport calculations provide estimates of air concentration resulting from atmospheric discharges of radionuclides. These air concentrations are then used to calculate doses to man. The following sections discuss the models and data used to perform these calculations.

3.1 RELEASE POINT TO RECEPTOR DISTANCES

The receptor locations for K-Basin, Cold Vacuum Drying Facility, and Canister Storage Building are given in the following sections.

3.1.1 K-Basin

Site and river boundary distances used in this report are based on the 105-KW storage facility location. Atmospheric transport analysis based on the location of 105-KW conservatively bounds those that might use the 105-KE location. The difference is not great. Both onsite and site boundary receptors are considered. Additionally, receptors located on the near bank of the Columbia River are also considered. The sector yielding the maximum dispersion coefficient is chosen as the bounding value to be used in safety analysis. The receptor is assumed to remain at the given location for the duration of plume passage. The maximum onsite receptor is assumed to be at a distance of 100 m. Hanford site boundary distances are given in Tables 3-1 and 3-2.

Table 3-1. Distance from 105-KW to 1994 Hanford Site Boundary.

Transport direction	Distance (km)	Transport direction	distance (km)
S	25.15	N	10.91
SSW	25.54	NNE	15.19
SW	17.31	NE	19.88
WSW	15.66	ENE	20.38
W	12.04	E	20.57
WNW	10.07	ESE	21.70
NW	8.65	SE	30.94
NNW	8.81	SSE	30.99

Table 3-2. Distance from 105-KW to Near Bank of Columbia River.

Transport direction	Distance (km)	Transport direction	distance (km)
S	N/A	N	0.53
SSW	N/A	NNE	0.73
SW	N/A	NE	2.25
WSW	1.06	ENE	11.33
W	0.71	E	11.78
WNW	0.52	ESE	15.05
NW	0.48	SE	N/A
NNW	0.48	SSE	N/A

3.1.2 Cold Vacuum Drying Facility

The onsite receptor is at 100 m. The facility is near the KW Basin. Therefore, the same X/Q values calculated for the KW Basin can be used for the Cold Vacuum Drying Facility. The receptor locations from the Cold Vacuum Drying Facility in 100 K Area to the locations at the near river bank for the worse conditions are shown in Table 3-3.

Table 3-3. Distance from Cold Vacuum Facility to Near Bank of Columbia River (the Proposed Site Boundary).

Transport direction	Distance (m)	Transport direction	Distance (m)
NNW	590	WNW	610
NW	540		

3.1.3 Canister Storage Building

For ground level releases, the onsite receptor is at 100 m and the locations in Table 3-4 are for stack releases only. For stack release from the Canister Storage Building, a parametric calculation is needed to find the location of maximum onsite X/Q. The onsite receptor locations which were used for the parametric calculation are shown in Table 3-4. The receptor locations at the site boundary and the proposed site boundary are shown in Tables 3-5 and 3-6, respectively.

Table 3-4. Onsite Receptor Locations for Various Downwind Distances for Canister Storage Building.

Onsite Receptor Locations	220 m	230 m	240 m	250 m	260 m	270 m

Table 3-5. Distance from Canister Storage Building to Hanford Site Boundary.

Transport direction	Distance (km)	Transport direction	distance (km)
S	20.0	N	23.9
SSW	17.0	NNE	27.4
SW	18.3	NE	21.6
WSW	20.0	ENE	18.4
W	19.4	E	18.3
WNW	20.0	ESE	22.8
NW	21.1	SE	27.2
NNW	20.9	SSE	22.0

Table 3-6. Distance from Canister Storage Building to Near Bank of Columbia River.

Transport direction	Distance (km)	Transport direction	distance (km)
S	8.7	N	13.3
SSW	8.9	NNE	15.2
SW	8.9	NE	13.7
WSW	9.3	ENE	13.3
W	11.1	E	15.0
WNW	14.6	ESE	22.8
NW	12.4	SE	27.2
NNW	12.0	SSE	11.7

3.2 FREQUENCY-BASED X/Q METHODOLOGY

The meteorological data are used as input parameters to calculate the atmospheric dispersion coefficient, X/Q . The methodology used to calculate X/Q s for K-Basin, Cold Vacuum Storage Facility, and Canister Storage Building are described in the following sections.

3.2.1 K-BASIN

The atmospheric dispersion coefficient X/Q represents the dilution of an airborne contaminant due to atmospheric mixing and turbulence. It is the ratio of the average contaminant air concentration X at the receptor to the contaminant release rate Q at the release point. Since atmospheric conditions fluctuate, a bounding atmospheric condition is determined to be that condition which causes a downwind concentration of airborne contaminants that is exceeded only a small fraction of time due to weather fluctuations. The Nuclear Regulatory Commission (NRC) defines this fraction as 0.5% for each sector or 5% for the overall Site, whichever is greater (NRC 1982). Bounding X/Q values are provided in this report.

3.2.2 COLD VACUUM DRYING FACILITY

The methodology used to calculate the X/Q is the same as given in section 3.2.1.

3.2.3 CANISTER STORAGE BUILDING

The values of X/Q were calculated for ground level, point source releases using the GXQ version 4.0. The required stack release X/Q s were also calculated using the GXQ Version 3.1 c (Hey, 1993) using the ISC2 momentum/buoyancy plume rise model (EPA, 1992). Variation of wind speed with height, wind entrainment, initial volume rate effects, and plume downwash were accounted for. A 2D parametric calculation was used to determine the worst-case onsite receptor with respect to both distance and direction. The worst-case site boundary receptors were found by evaluating each of the 16 direction sectors around both the present and proposed site boundaries.

Using the atmospheric stabilities and wind speeds determined in the above calculations, effective plume heights were determined for onsite and site boundary conditions. If the effective release height (stack height plus plume rise) is greater than 2.5 times the building height, the plume can be assumed to be unaffected by the building wake (EPA, 1992).

3.3 GAUSSIAN STRAIGHT LINE PLUME

Not only is the straight-line Gaussian plume model the most widely used method of estimating downwind air concentrations of radionuclides released to the atmosphere, but also it is the most often verified atmospheric dispersion model (Miller 1984). For a continuous point source and invariant meteorology, this model is given by

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

where

σ_y = Horizontal diffusion coefficient (m)
 σ_z = Vertical diffusion coefficient (m)
 $f(y)$ = Horizontal correction term
 $g(z)$ = Vertical correction 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 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 factor
 h_e = Effective release height (m)
 z = Receptor height (m).

Mathematical approximations are used to evaluate the atmospheric diffusion coefficients σ_y and σ_z , which are based on the Pasquill-Gifford-Turner curves. These approximations are identical to those used in the GENII Code (Napier 1988). The reflection factor F_{ref} is based on the virtual image source and assumes 100% ground and mixing layer reflection. The mathematical expression is given in Hey (1993a and 1994).

3.4 PLUME MEANDER

To account for the increased dispersion due to a fluctuating wind direction over an extended release period, a plume meander model based on the empirical correlation recommended by the NRC (1982) is used. When selected, it effectively increases the value of the horizontal diffusion coefficient. The amount of increase is dependent upon both atmospheric stability class and wind speed. The procedure is given below.

For $1 \text{ m/s} \leq u \leq 2 \text{ m/s}$

M =	6	Stability Class	G
	4		F
	3		E
	2		D

For $2 \text{ m/s} < u \leq 6 \text{ m/s}$

M =	$(u/6)^{(-\ln(6)/\ln(3))}$	Stability Class	G
=	$(u/6)^{(-\ln(4)/\ln(3))}$		F
=	$(u/6)^{(-\ln(3)/\ln(3))}$		E
=	$(u/6)^{(-\ln(2)/\ln(3))}$		D

For $x < 800 \text{ m}$

$$\Sigma_y = M \sigma_y(x)$$

For $x \geq 800 \text{ m}$

$$\Sigma_y = (M - 1)\sigma_y(800) + \sigma_y(x)$$

3.5 BUILDING WAKE

The dispersion of a plume can also be enhanced by the added turbulence of a building wake. To account for this effect, a building wake model taken from NRC (1990) is employed. The model does not alter the Gaussian shape of the plume; but initializes the width and height of the plume on the basis of the building dimensions. It assumes the release point to be at the ground level and in the middle of the downwind face of the building. The plume horizontal and vertical dimensions are initialized such that the plume concentrations at the sides and roof line of the building from which the release occurs are 10% of plume centerline concentrations (i.e., building edges are 2.15σ from the plume centerline). The formulae below were taken from Equation 2.2 of NRC (1990).

$$\sigma_y(x=0) = \frac{W_b}{4.3}$$

where

W_b = Building width (m)

$$\sigma_z(x=0) = \frac{H_b}{2.15}$$

where

H_b = Building height (m)

The above adjustment is made using the virtual distance method. The virtual distance method involves calculating the distances corresponding to $\sigma_y(x=0)$ and $\sigma_z(x=0)$ and adding these distances to the distance from the release point to receptor (x). These adjusted "virtual distances" are then used to calculate subsequent diffusion coefficients.

3.6 ATMOSPHERIC DISPERSION COEFFICIENTS

The methods used to calculate X/Q s have been described in sections 3.2 to 3.5. The calculated results of X/Q s for K-Basin, Cold Vacuum Drying Facility, and Canister Storage Building are given in the following sections.

3.6.1 K-BASIN

A 99.5% sector and 95% overall site X/Q (NRC 1982), suitable for safety analyses, are calculated for various site locations as well as for the near river bank and site boundary receptors assuming ground level releases. The greater of the two is the 99.5% sector X/Q in all cases. The effects of plume meander and building wake, as discussed in previous sections are also evaluated. Building wake is based on a conservatively small building dimension of 67 ft (20 m) wide and 16 ft (5 m) tall (Meichle 1993). Results are provided in Table 3-7.

Table 3-7. Maximum 99.5% Sector Atmospheric Dispersion Coefficients.

Receptor description	X/Q (s/m^3)			
	Point source	W/ plume meander	W/ building wake	W/ PM and BW
100m radius (100m E)	7.32 E-2	1.24 E-2	1.40 E-2	5.67 E-3
Near river bank (480m NW)	2.15E-3	5.55E-4	1.53E-3 ^a	4.54E-4
N Reactor (3200m NE)	1.13E-4	6.13E-5	1.07E-4	6.01E-5
Fire station (4000m ESE)	1.47E-4	7.37E-5	1.40E-4	7.24E-5
B & C Reactor (4000m WSW)	8.51E-5	5.02E-5	8.20E-5	4.96E-5
1994 Hanford Site boundary (12040m W)	3.58E-5	2.60E-5	same as point source	same as W/PM

^aMaximum receptor located 710m W.

In addition to the maximum 99.5% sector X/Q given in Table 3-7, maximum sector X/Q based on annual average meteorology are provided in Table 3-8. These X/Q were calculated using sector averaging and are suitable for use in chronic release scenario consequence assessments or "best estimate" acute release scenario consequence assessments.

Table 3-8. Maximum Sector Annual Average Atmospheric Dispersion Coefficients.

Receptor description	X/Q (s/m^3)	
	Point source	W/ building wake
100m Radius (100m E)	5.12 E-4	2.58 E-4
Near river bank (520m WNW)	1.14 E-5	--
N Reactor (3200m NE)	4.58 E-7	--
Fire Station (4000m ESE)	5.17 E-7	--
B & C Reactor 4000m WSW)	3.16 E-7	--
1994 Hanford Site Boundary (12040m W)	1.23 E-7	--

Code Documentation:

The title of the joint frequency file used in the computation of the X/Q is:

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

A typical GXQ (Hey 1993a and b) output file for these calculations and GENII input file are provided in Appendix A.

GXQ code is GXQ Version 3.1 c (June 8, 1993). The difference between the X/Q values calculated from GXQ Version 3.1 c and from GXQ Version 4.0 or 4.0A (Hey, 1994) is insignificant.

3.6.2 Cold Vacuum Drying Facility

The objective of this section is to calculate dose exposure for the Cold Vacuum Drying Facility in the 100 K Area. The release location is at the facility. The ground level release is considered to determine whether the use of the K Basin X/Q s is justifiable and appropriate.

The calculated X/Q s for ground level release are given in Table 3-10.

Table 3-9. Site Boundary 99.5% X/Qs for Cold Vacuum Drying Facility (Near River Bank; Ground Level Release for Point Source).

Receptor Location at Site Boundary	X/Q (s/m^3)
590 m NNW	7.67E-04
540 m NW	1.76E-03*
610 m WNW	1.53E-03

The worst case as shown in Table 3-9 is in the northwest direction. The calculated X/Q value for the worst case is $1.76\text{E-}03$ (s/m^3) in the northwest sector. The maximum X/Q is indicated with an asterisk. The calculated X/Qs for this facility are less than the X/Q values calculated for the K Basin. Based on the atmospheric transport analysis, the X/Q values calculated for the K Basin bounds the X/Q value for point source that could be used for the Cold Vacuum Drying Facility.

Code Documentation:

The title of the joint frequency file used in the computation of the X/Q is:

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

The GXQ (Hey 1994) input and output files for these calculations are provided in Appendix B.

GXQ code is GXQ Version 4.0 (December 19, 1994).

3.6.3 CANISTER STORAGE BUILDING

The ground level and stack releases are considered in this section. A set of X/Qs for acute ground level and stack releases at the Hanford Waste Vitrification Plant Canister Storage Building are required. This facility is located west of B Plant in the 200 East Area.

The Canister Storage Building is 97.8 m x 55.3 m x 16.9 m high with a 120 ft (36.6 m) stack. The inside diameter of the stack is given as 40 in (1.02 m). The normal exhaust flow from the stack is specified to be 12,000 cfm (5.66 m^3/s) with one fan running. In an accident situation a second fan is to start giving a specified accident flow rate of 24,000 cfm (11.3 m^3/s). In both cases the exhaust temperature is given as 100°F - 105°F (38°C - 41°C).

X/Qs are required at the worst-case onsite location and at the worst-case location on the site boundary. Both the present site boundary and the proposed site boundary are to be evaluated.

THE RESULTS OF X/Q CALCULATIONS

For ground level releases, the X/Q values for the cases with and without plume meander at the onsite and offsite receptors are shown in Table 3-10.

Table 3-10. Maximum 99.5 Percent Atmospheric Dispersion Coefficients for Canister Storage Building.

Receptor description	X/Q (s/m^3)	
	Point source	With Plume Meander
100 m Radius (100 m E)	3.41 E-02	1.13 E-02 (ESE)
1995 Hanford Site Boundary (17,120 m E)	1.32 E-05	1.11 E-05
Proposed Hanford Site Boundary (Highway 240, Near River) (10,750 m W)	1.96 E-05	1.55 E-05

The resulting parametric arrays of 99.5 percentile onsite X/Qs for stack releases with one fan and two fans in operation are shown in Tables 3-11 and 3-12. The maximum X/Qs are indicated in bold face with asterisks.

Table 3-11: Onsite 99.5% X/Qs for 1 fan (12,000 cfm)
for various downwind distances

Sector	220 m	230 m	X/Q (s/m ³)			
			240 m	250 m	260 m	270 m
S	4.01E-5	4.06E-5	3.15E-5	3.35E-5	3.53E-5	3.69E-5
SSW	2.88E-5	3.02E-5	3.10E-5	3.04E-5	2.97E-5	2.88E-5
SW	2.66E-5	2.91E-5	2.93E-5	2.93E-5	2.91E-5	2.87E-5
WSW	2.90E-5	3.04E-5	3.14E-5	3.08E-5	3.00E-5	2.91E-5
W	4.12E-5	*4.18E-5*	3.15E-5	3.39E-5	3.60E-5	3.79E-5
WNW	3.18E-5	3.17E-5	3.14E-5	3.16E-5	3.15E-5	3.13E-5
NW	2.87E-5	3.02E-5	3.01E-5	2.99E-5	2.94E-5	2.88E-5
NNW	2.05E-5	2.03E-5	1.99E-5	1.94E-5	1.87E-5	1.86E-5
N	1.99E-5	1.97E-5	1.94E-5	1.90E-5	1.85E-5	1.80E-5
NNE	2.67E-6	3.15E-6	3.63E-6	4.10E-6	4.42E-6	4.29E-6
NE	1.31E-5	1.32E-5	1.32E-5	1.31E-5	1.26E-5	1.25E-5
ENE	1.82E-5	1.85E-5	1.87E-5	1.87E-5	1.74E-5	1.69E-5
E	2.11E-5	2.13E-5	2.13E-5	2.12E-5	1.87E-5	1.87E-5
ESE	2.19E-5	2.28E-5	2.34E-5	2.38E-5	1.99E-5	2.02E-5
SE	2.53E-5	2.85E-5	2.81E-5	2.85E-5	2.87E-5	2.87E-5
SSE	2.92E-5	3.05E-5	3.09E-5	3.04E-5	2.97E-5	2.88E-5
all(95%)	3.34E-5	3.33E-5	3.15E-5	3.22E-5	3.28E-5	3.31E-5

Table 3-12: Onsite 99.5% X/Qs for 2 fans (24,000 cfm)
for various downwind distances

Sector	220 m	230 m	X/Q (s/m ³)			
			240 m	250 m	260 m	270 m
S	2.81E-5	2.90E-5	2.95E-5	2.97E-5	2.97E-5	2.94E-5
SSW	2.24E-5	2.26E-5	2.25E-5	2.20E-5	2.22E-5	2.23E-5
SW	1.93E-5	1.93E-5	1.92E-5	1.89E-5	1.97E-5	2.04E-5
WSW	2.13E-5	2.15E-5	2.14E-5	2.20E-5	2.22E-5	2.23E-5
W	2.86E-5	2.95E-5	3.01E-5	*3.04E-5*	*3.04E-5*	3.01E-5
WNW	2.48E-5	2.51E-5	2.52E-5	2.50E-5	2.47E-5	2.42E-5
NW	2.18E-5	2.20E-5	2.20E-5	2.20E-5	2.22E-5	2.23E-5
NNW	1.47E-5	1.59E-5	1.70E-5	1.64E-5	1.62E-5	1.60E-5
N	1.37E-5	1.44E-5	1.54E-5	1.53E-5	1.55E-5	1.59E-5
NNE	6.90E-7	8.47E-7	1.02E-6	1.22E-6	1.46E-6	1.74E-6
NE	1.14E-5	1.13E-5	1.21E-5	1.17E-5	1.17E-5	1.13E-5
ENE	1.45E-5	1.58E-5	1.69E-5	1.54E-5	1.56E-5	1.57E-5
E	1.67E-5	1.70E-5	1.72E-5	1.70E-5	1.67E-5	1.61E-5
ESE	1.75E-5	1.75E-5	1.73E-5	1.73E-5	1.74E-5	1.63E-5
SE	2.06E-5	2.07E-5	2.06E-5	1.92E-5	2.00E-5	2.06E-5
SSE	2.26E-5	2.29E-5	2.28E-5	2.25E-5	2.27E-5	2.26E-5
all(95%)	2.56E-5	2.60E-5	2.62E-5	2.60E-5	2.57E-5	2.52E-5

Of these two cases, the lower plume rise would be associated with the lesser exhaust flow rate, i.e. the single fan case shown in Table 3-11. The conditions which produce the worst case shown in Table 3-11 for the West sector at 230 m are Pasquill A with a 2.65 m/s wind speed. The effective release height for these conditions was found to be 45.1 m. In order to eliminate building wake effects the effective release height must be greater than 2.5 times the building height of 16.9 m, or 42.3 m.

The resulting X/Qs for the present and proposed site boundary are shown in Tables 3-13 and 3-14. The values shown in parentheses for the worst-case locations on the proposed site boundary correspond to potential agricultural sites on the far river bank. The X/Qs in parentheses should therefore be used to calculate ingestion or ground shine doses if these are required.

Table 3-13: Site boundary 99.5% X/Qs for 1 fan (12,000 cfm)
for the present and proposed site boundaries

Sector	Present Site Boundary		Proposed Site Boundary	
	Distance (km)	X/Q (s/m ³)	Distance (km)	X/Q (s/m ³)
S	20.0	2.98E-6	8.7	5.69E-6
SSW	17.0	2.22E-6	8.9	4.95E-6
SW	18.3	1.82E-6	8.9	4.98E-6
WSW	20.0	1.64E-6	9.3	4.66E-6
W	19.4	3.73E-6	11.1	6.32E-6
WNW	20.0	3.58E-6	14.6	4.82E-6
NW	21.1	3.73E-6	12.4	6.94E-6
NNW	20.9	4.83E-6	12.0	8.27E-6
N	23.9	4.45E-6	13.3	8.24E-6
NNE	27.4	2.20E-6	15.2	3.96E-6
NE	21.6	2.89E-6	13.7	4.29E-6
ENE	18.4	3.93E-6	13.3	4.96E-6
E	18.3	*7.14E-6*	15.0	*8.31E-6*
			(15.7)	(8.01E-6)
ESE	22.8	4.21E-6	22.8	4.21E-6
SE	27.2	2.92E-6	27.2	2.92E-6
SSE	22.0	2.84E-6	11.7	4.67E-6

Table 3-14: Site boundary 99.5% X/Qs for 2 fans (24,000 cfm) for the present and proposed site boundaries

Sector	Present Site Boundary		Proposed Site Boundary	
	Distance (km)	X/Q (s/m^3)	Distance (km)	X/Q (s/m^3)
S	20.0	2.87E-6	8.7	4.89E-6
SSW	17.0	2.00E-6	8.9	4.33E-6
SW	18.3	1.68E-6	8.9	4.35E-6
WSW	20.0	1.52E-6	9.3	4.17E-6
W	19.4	3.36E-6	11.1	5.63E-6
WNW	20.0	3.26E-6	14.6	4.20E-6
NW	21.1	3.16E-6	12.4	5.85E-6
NNW	20.9	4.12E-6	12.0	6.59E-6
N	23.9	3.83E-6	13.3	6.52E-6
NNE	27.4	2.02E-6	15.2	3.37E-6
NE	21.6	2.64E-6	13.7	3.59E-6
ENE	18.4	3.44E-6	13.3	4.18E-6
E	18.3	*6.05E-6*	15.0 (15.7)	*7.13E-6* (7.07E-6)
ESE	22.8	3.60E-6	22.8	3.60E-6
SE	27.2	2.58E-6	27.2	2.58E-6
SSE	22.0	2.59E-6	11.7	4.15E-6

As before, the lower plume rise would be associated with the lesser exhaust flow rate, i.e. the single fan case shown in Table 3-13. The conditions which produce the worst case shown in Table 3-13 for the East sector at 18.3 km, 15.0 km, or 15.7 km are Pasquill F with a 0.89 m/s wind speed. The effective release height for these conditions was found to be 58.0 m.

The calculated X/Qs for the onsite receptors and the site boundary for stack releases are summarized as shown in Tables 3-15 and 3-16.

Table 3-15. Onsite X/Qs for Various Downwind Distances.

Onsite Receptor Location	Fan	X/Q (s/m^3)
230 m W	1 fan	4.18E-5
250 m W	2 fan	3.04E-5

Table 3-16. Existing Site and Proposed Site X/Qs for Various Downwind Distances.

Receptor Location at Site Boundary	Fan	X/Q (s/m^3)
18.3 Km E	1 fan	7.14E-6
18.3 Km E	2 fan	6.05E-6
Receptor location at Proposed Site Boundary	Fan	
15.0 Km E	1 fan	8.31E-6
15.0 Km E	2 fan	7.13E-6

Code Documentation:

The title of the joint frequency file used in the computation of the X/Q is:

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

The representative GXQ (Hey 1994) input and output files for these calculations are provided in Appendix C.

GXQ code is GXQ Version 4.0 (Version 4.0A for stack release) (December 19, 1994).

4.0 DOSE CONSEQUENCE ESTIMATION

The atmospheric dispersion coefficients and unit doses provided in this report can be used to determine the effective dose equivalent and the committed dose to the limiting organ. This is typically done using the following equation.

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

where

- Q = Quantity of respirable radioactive material released (g, L or ml)
- X/Q' = Atmospheric dispersion coefficient (s/m^3)
- R = $3.3 \text{ E-4 m}^3\text{/s}$ standard man acute breathing rate (ICRP 1975)
- C = Dose per unit respirable radioactive material inhaled (rem/(g, L or ml))

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5.0 REFERENCES

- Bechtold, D. B., July 27, 1993, *Analysis of 105 KE Basin Sludge Samples*, Internal Memorandum from D. B. Bechtold to M. A. Meier, Westinghouse Hanford Company, Richland, Washington.
- Bechtold, D. B., 1994, *Report of Laboratory Test Plan for Analysis of KE Basin Backwash Pit Samples*, WHC-SD-NR-TRP-021, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Brehm, J. R., 1995: Spent Nuclear Fuel Project Path Forward Preliminary Safety Evaluation. WHC-SD-SNF-PSE-001, Rev. 0. Westinghouse Hanford Company, Richland Washington.
- EPA, 1992, *User's Guide for the Industrial Source Complex (ISC2) Dispersion Models*, EPA-450/4-92-008a, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Technical Support Division, Research Triangle Park, North Carolina, Mar. 1992.
- Hey, B. E., 1993a, *GXQ Program Users' Guide*, WHC-SD-GN-SWD-30002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Hey, B. E., 1993b, *GXQ Program Verification and Validation*, WHC-SD-GN-SWD-30003, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Hey, B. E., 1994, *GXQ Program User's Guide*, WHC-SD-GN-SWD-30002, Rev. 1, Westinghouse Hanford Company, Richland, Washington, Dec. 19, 1994.
- Hey, B. E., 1995: Revision 1 to Supporting Calculations for K Basin ISB. 8D150-BEH-94-003 R1. Westinghouse Hanford Company, Richland Washington.
- Himes, D. A., 1995: Acute Stack Release X/Qs for the Hanford Waste Vitrification Plant Canister Storage Building. DAH-8M400-95-014. Westinghouse Hanford Company, Richland Washington.
- Huang, C. H., 1996, *Unit Dose Calculations for the Spent Nuclear Fuel*, WHC-SD-WM-CN-081, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- IRCP, 1975, *Reference Man: Anatomical, Physiological, and Metabolic Characteristics*, Publication 23, International Commission on Radiological Protection, Elmsford, New York.
- Meichle, R. H., December 1993, *Safety Analysis Report - Handling and Storage of Irradiated N Reactor Fuel in 105-KE and KW Fuel Storage Facilities*,
- Miller, C. W., 1984, *Models and Parameters for Environmental Radiological Assessments*, DOE/TIC-11468, Technical Information Center, Office of Scientific and Technical Information, U.S. Department of Energy.

- Napier, B. A., et al., 1988, *GENII - The Hanford Environmental Radiation Dosimetry Software System*, PNL-6584, Pacific Northwest Laboratory, Richland, Washington.
- NRC, 1990, *MELCOR Accident Consequence Code System (MACCS), Model Description*, NUREG/CR-4691, SAND86-1562, Vol. 2, U.S. Nuclear Regulatory Commission, Washington, D.C.
- NRC, 1982, *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants*, United States Nuclear Regulatory Commission Regulatory Guide 1.145, Rev. 1, Washington, D.C.
- WHC, 1994a, *K-East Basin Water Disposition Engineering Study*, WHC-SD-SNF-ES-001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1994b, *Hanford Irradiated Fuel Inventory Baseline*, WHC-SD-SNF-TI-001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1995, *Certification of RADNUC*, WHC-SD-HWV-SWD-001, Rev. 1, Westinghouse Hanford Company, Richland, Washington.
- Willis, W. L., and A. N. Praga, 1995, *105-K Basin Material Design Basis Feed Description for Spent Nuclear Fuel Project Facilities*, WHC-SD-SNF-TI-009, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

HNF-SD-WM-CN-095, REV. 0

APPENDIX A

K-BASIN

GXQ OUTPUT AND GENII INPUT FILES

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Current Input File Name: c:\p\kbasin\bupm.IN

 GXQ Version 3.1 C
 June 8, 1993

General Purpose Atmospheric Dispersion Code
 Produced by Radiological & Toxicological Analysis
 Westinghouse Hanford Company

Users Guide documented in WHC-SD-GN-SWD-3002 Rev. 0.
 Validation documented in WHC-SD-GN-SWD-3003 Rev. 0.
 Code Custodian is Brit E. Hey, WHC, ext. 6-2921.

Run Date = 10/12/1994
 Run Time = 10:12 46.79

```

INPUT ECHO:
105-KW X/Q Calculation w/ Building Wake and Plume Meander
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 mode
1
c
c LOGICAL CHOICES:
c ifox inorm icdf ichk isite ipop icon
c   T   F   F   F   F   F   F
c ifox = t then joint frequency used to compute frequency to exceed X/Q
c inorm = f then joint frequency used to compute annual average X/Q
c       = t then joint frequency data is normalized (as in GENII)
c icdf  = t then joint frequency data is un-normalized
c       = 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 icon  = t then X/Q is air concentration
c       = f then X/Q is integrated exposure
c
c MODEL CHOICES:
c idep iwake ipm irise igrav iwash iflow iwind
c   0   2   1   0   0   0   0   0
c idep = 1 then plume depletion model turned on (Chamberlain model)
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 irise = 1 then momentum/buoyancy plume rise model turned on, buoyancy
c       =   rise based on sensible heat emission
c       = 2 then momentum/buoyancy plume rise model turned on, buoyancy
c       =   rise based on initial plume density
c igrav = 1 then gravitational settling model turned on
c iwash = 1 then stack downwash model turned on
c iflow = 1 then sigmas adjusted for volume flow rate
c iwind = 1 then wind speed corrected for plume height
c       = 0 to turn any of the above models off
c
c PARAMETER INPUT:
c stack      wind      frequency
c release    speed     to
c height     height    mixing      scaling
c (m)        (m)       height      factor
c            (m)       (m)         (%)
c 0.00000E+00 1.00000E+01 1.00000E+03 5.00000E-01 1.00000E+00
c
c building    building    release    deposition    gravitational
c width       height     duration   velocity     settling
               velocity
  
```

```

c      (m)      (m)      (hr)      (m/s)      (m/s)
c      2.00000E+01  5.00000E+00  1.00000E+00  1.00000E-03  1.00000E-02
c
c      initial      initial      sensible
c      plume      plume      heat
c      plume      flow      emission
c      density      rate      diameter      rate
c      (g/cc)      (m3/s)      (m)      (cal/s)
c      3.10000E-04  7.07000E+00  3.00000E+00  2.80000E-06
c RECEPTOR DEPENDENT DATA

```

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.

Output is atmospheric dispersion coefficient.

MODELS SELECTED:

HACCS Virtual source building wake

NRC RG 1.145 plume meander

WARNING/ERROR MESSAGES:

JOINT FREQUENCY DATA:

100 M AREA 110 M - Pasquill A - G (1983 - 1991 Average)

Created 8/26/92 KR

105-KW X/Q Calculation w/ Building Wake and Plume Meander

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	100	0	6.18	1	4.87E-03	4.87E-03	F	.89
SSW	100	0	5.01	1	4.06E-03	4.06E-03	F	.89
SW	100	0	3.91	1	4.37E-03	4.37E-03	F	.89
WSW	100	0	3.38	1	4.62E-03	4.62E-03	F	.89
W	100	0	7.54	1	5.34E-03	5.34E-03	F	.89
WNW	100	0	5.46	1	4.61E-03	4.61E-03	F	.89
NW	100	0	4.92	1	4.35E-03	4.35E-03	F	.89
NNW	100	0	3.41	1	3.65E-03	3.65E-03	E	.89
N	100	0	3.89	1	4.21E-03	4.21E-03	F	.89
NNE	100	0	3.54	1	3.85E-03	3.85E-03	E	.89
NE	100	0	5.96	1	4.52E-03	4.52E-03	F	.89
ENE	100	0	9.19	1	5.17E-03	5.17E-03	F	.89
E	100	0	16.14	1	5.67E-03	5.67E-03	G	.89
ESE	100	0	10.16	1	5.31E-03	5.31E-03	F	.89
SE	100	0	6.17	1	5.06E-03	5.06E-03	F	.89
SSE	100	0	4.44	1	4.89E-03	4.89E-03	F	.89
WSW	3200	0	5.96	1	6.01E-05	6.01E-05	F	.89
ESE	4000	0	10.16	1	7.24E-05	7.24E-05	F	.89
WSW	4000	0	3.38	1	4.96E-05	4.96E-05	F	.89
S	25150	0	6.18	1	8.15E-06	8.15E-06	F	.89
SSW	25540	0	5.01	1	6.19E-06	6.19E-06	G	2.65
SW	17310	0	3.91	1	1.03E-05	1.03E-05	F	.89
WSW	15660	0	3.38	1	1.21E-05	1.21E-05	F	.89
W	12040	0	7.54	1	2.59E-05	2.59E-05	F	.89
WNW	10070	0	5.46	1	1.92E-05	1.92E-05	F	.89
NW	8650	0	4.92	1	2.14E-05	2.14E-05	G	2.65
NNW	8810	0	3.41	1	1.24E-05	1.24E-05	G	4.70
N	10910	0	3.89	1	1.59E-05	1.59E-05	G	2.65
NNE	15190	0	3.54	1	6.95E-06	6.95E-06	G	4.70
NE	19880	0	5.96	1	9.07E-06	9.07E-06	F	.89
ENE	20380	0	9.19	1	1.33E-05	1.33E-05	F	.89
E	20570	0	16.14	1	1.32E-05	1.32E-05	G	.89
ESE	21700	0	10.16	1	1.37E-05	1.37E-05	F	.89
SE	30940	0	6.17	1	7.73E-06	7.73E-06	F	.89
SSE	30990	0	4.44	1	6.58E-06	6.58E-06	F	.89
S	25150	0	6.18	1	8.15E-06	8.15E-06	F	.89

SSW	25540	0	5.01	1	6.19E-06	6.19E-06	G	2.65
SW	17310	0	3.91	1	1.03E-05	1.03E-05	F	.89
WSW	1060	0	3.88	1	1.72E-04	1.72E-04	F	.89
W	710	0	7.54	1	3.11E-04	3.11E-04	G	4.70
WNW	520	0	5.46	1	4.36E-04	4.36E-04	F	.39
NW	480	0	4.92	1	4.54E-04	4.54E-04	G	2.65
NNW	480	0	3.41	1	3.64E-04	3.64E-04	G	2.65
N	530	0	3.89	1	3.63E-04	3.63E-04	G	2.65
NNE	730	0	3.54	1	2.07E-04	2.07E-04	G	2.65
NE	2250	0	5.96	1	8.37E-05	8.37E-05	F	.89
ENE	11330	0	9.19	1	2.45E-05	2.45E-05	F	.89
E	11780	0	16.14	1	3.20E-05	3.20E-05	G	.89
ESE	15050	0	10.16	1	2.01E-05	2.01E-05	F	.89
SE	30940	0	6.17	1	7.73E-06	7.73E-06	F	.89
SSE	30990	0	4.44	1	6.58E-06	6.58E-06	F	.89

Execution Time = 0 hr 0 min 2.53 sec

Stop - Program terminated.

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Program GENII Input File ##### 8 Jul 88 ###
 Title: Onsite, Inhalation & Submersion, Acute, Ground Level Release

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
 TRANSPORT OPTIONS----- Section EXPOSURE PATHWAY OPTIONS----- 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----- F Drinking water ingestion 7,8
 T Report AEDE only F Aquatic foods ingestion 7,8
 T Report by radionuclide F Terrestrial foods ingestion 7,9
 F Report by exposure pathway F Animal product ingestion 7,10
 F Debug report on screen 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

Use when	---Release Terms--- transport selected			---Basic Concentrations--- near-field scenario, optionally				
	Air	Surface	Buried	Air	Surface	Deep	Ground	Surface
Radio-nuclide	/yr	Water	Waste	/m3	Soil	Soil	Water	Water
		/yr	/m3		/unit	/m3	/L	/L
PU238	3.1E+04							
PU239	1.0E+05							
PU240	5.4E+04							
PU241	2.6E+05							
AM241	2.0E+05							
CM244	5.7E+02							
H 3	1.0E+03							
KR85	1.2E+04							
SR90	1.5E+06							
Y 90	1.5E+06							
CS137	1.9E+06							

Use when	---Derived Concentrations--- measured values are known			
	Terres.	Animal	Drink	Aquatic
Radio-nuclide	Plant	Product	Water	Food
	/kg	/kg	/L	/kg

TIME #####

1 Intake ends after (yr)
 50 Dose calc. ends after (yr)
 1 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

NEAR-FIELD SCENARIOS

0 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 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)
 3.18E-6 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)
 F Use if 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)
 0 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-----
 Exposure time: Residential irrigation:
 0 Plume (hr) T Consider: (T/F)
 0 Soil contamination (hr) 0 Source: 1-ground water
 0 Swimming (hr) 0 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
 0 pension Mass loading factor (g/m3) Top soil available (cm)

-----INGESTION POPULATION-----SECTION 7-----
 0 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	0.00	0 0.0	0.0	0.0	0.0E+00	0.0	0.0
F ROOT V	0.00	0 0.0	0.0	0.0	0.0E+00	0.0	0.0

F	FRUIT	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	GRAIN	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0

----ANIMAL PRODUCTION CONSUMPTION-----SECTION 10----

USE ?	FOOD T/F	HUMAN		TOTAL PROD- UCTION	DRINK WATER CONTAH FRACT.	DIET FRAC- TION	GROW TIME da	STOR- FEED		STOR- YIELD AGE	
		CONSUMPTION RATE kg/yr	HOLDUP da					IRRIGATION S RATE in/yr	TIME mo/yr		
F	BEEF	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.0
F	POULTR	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.0
F	MILK	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.0
F	EGG	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.0
						-----FRESH FORAGE-----					
	BEEF					0.00	0.0	0	0.0	0.00	0.0
	MILK					0.00	0.0	0	0.0	0.00	0.0

#####

HNF-SD-WM-CN-095, REV. 0

APPENDIX B

COLD VACUUM DRYING FACILITY

GXQ INPUT AND OUTPUT FILES

HNH-SD-WM-CN-095, REV. 0

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HNF-SD-WM-CN-095 REV.0

GXQ Version 4.0
 December 19, 1994

General Purpose Atmospheric Dispersion Code
 Produced by Westinghouse Hanford Company

Users Guide documented in WMC-SD-GN-SWD-30002 Rev. 1.
 Validation documented in WMC-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 = 01/24/97
 Run Time = 14:07:17.22

INPUT ECHO:
 Cold Vacuum Drying Facility XQs, case 1. Acute Ground Level Releases, no effect
 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)
 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

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```

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                                     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      6.09000E+01      9.80000E+00      1.00000E+00      1.00000E-03      1.00000E-03
c
c      ambient      initial      initial      release      convective
c      temperature  plume        plume        flow rate    heat release
c      Tamb(C)      T0(C)         V0(m3/s)     diameter     rate(1)
c                                     d(m)         qh(w)
c
c      2.00000E+01      2.00000E+01      1.00000E+00      1.00000E+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)
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.

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MODELS SELECTED:

Default Gaussian plume model selected.

WARNING/ERROR MESSAGES:

JOINT FREQUENCY DATA:

100 N AREA - 10 M - Pasquill A - G (1983 - 1991 Average)

Created 8/26/92 KR

Cold Vacuum Drying Facility XQs, case 1. Acute Ground Level Releases, no effect

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)		
NNW	590	0	3.41	1	7.67E-04	7.67E-04	G	4.70
NW	540	0	4.92	1	1.76E-03	1.76E-03	G	2.65
WNW	610	0	5.46	1	1.53E-03	1.53E-03	F	0.89

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APPENDIX C

CANISTER STORAGE BUILDING

X/Q INPUT AND OUTPUT FILES

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**Representative GXQ Input/Output Files
Onsite Receptor**

HNF-SD-WM-CN-095 REV.0

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```

99.5% Canister Storage 200 E, csbl.in, 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
c   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
c   0     0     0     0
c DIFFUSION COEFFICIENT ADJUSTMENT MODELS:
c   iwake ipm  iflow ientr
c   0     0     0     0
c EFFECTIVE RELEASE HEIGHT ADJUSTMENT MODELS:
c   (irise igrnd)iwash igrav
c   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)
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

release height hs(m)	reference anemometer height ha(m)	mixing height hm(m)	frequency to exceed Cx(%)
0	10	1000	0.5

initial plume width Wb(m)	initial plume height Hb(m)	release duration trd(hr)	deposition velocity vd(m/s)	gravitational settling velocity vg(m/s)
0	0	1.0	0.001	0.001

ambient temperature Tamb(C)	initial plume temperature TO(C)	initial plume flow rate VO(m3/s)	release diameter d(m)	convective heat release rate(1) qh(w)
20	20	1	1	0

c (1) If zero then buoyant flux based on plume/ambient temperature difference.

X/Q scaling factor c(?)	Wind Speed Exponent a(?)
1	.78

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 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)
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 xmin = minimum scaled X/Q to calculate
 c power = exponent in power function step size

0	100	0
1	8580	0
2	7910	0
3	7910	0
4	9230	0
5	10750	0
6	14160	0
7	11710	0
8	11470	0
9	13110	0
10	14360	0
11	12560	0
12	12450	0
13	14140	0
14	21290	0
15	14210	0
16	11180	0
1	19000	0
2	16300	0
3	17780	0
4	19090	0
5	18680	0
6	19160	0
7	19910	0
8	19680	0
9	23020	0
10	25790	0
11	20220	0
12	17250	0
13	17120	0
14	21290	0
15	25400	0
16	20910	0

HNF-SD-WM-CN-095 REV.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 = 04/09/97
Run Time = 11:09:20.20

INPUT ECHO:
99.5% Canister Storage 200 E, csbl.in, Acute Ground Level Release
c GXQ Version 4.0 Input File
c mode
c 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
c 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
c 0 0 0 0
c DIFFUSION COEFFICIENT ADJUSTMENT MODELS:
c iwake ipm iflow ientr
c 0 0 0 0
c EFFECTIVE RELEASE HEIGHT ADJUSTMENT MODELS:
c (irise igrnd)iwash igrav
c 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)
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

HNF-SD-WM-CN-095 REV.0

```

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 lwash = 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      release      reference      mixing      to
c      height      anemometer      height      exceed
c      hs(m)        ha(m)          hm(m)       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)       vd(m/s)         velocity
c      Wb(m)         Hb(m)         v0(m3/s)      rate(1)          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)      qh(w)
c
c      2.00000E+01    2.00000E+01    1.00000E+00    1.00000E+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 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)
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:
Default Gaussian plume model selected.

WARNING/ERROR MESSAGES:

HNF-SD-WM-CN-095 REV.0

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

99.5% Canister Storage 200 E, csb1.in, 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	100	0	6.30	1	1.56E-02	1.56E-02	E	0.89
SSW	100	0	4.53	1	1.13E-02	1.13E-02	F	2.65
SW	100	0	2.93	1	1.21E-02	1.21E-02	F	2.65
WSW	100	0	2.72	1	1.22E-02	1.22E-02	F	2.65
W	100	0	4.80	1	2.80E-02	2.80E-02	G	2.65
WNW	100	0	3.98	1	1.60E-02	1.60E-02	G	4.70
NW	100	0	4.72	1	2.89E-02	2.89E-02	G	2.65
NNW	100	0	4.58	1	2.90E-02	2.90E-02	G	2.65
N	100	0	4.36	1	3.12E-02	3.12E-02	G	2.65
NNE	100	0	2.49	1	1.54E-02	1.54E-02	E	0.89
NE	100	0	3.90	1	1.57E-02	1.57E-02	E	0.89
ENE	100	0	6.17	1	2.52E-02	2.52E-02	G	2.65
E	100	0	14.05	1	3.41E-02	3.41E-02	F	0.89
ESE	100	0	18.80	1	3.25E-02	3.25E-02	F	0.89
SE	100	0	10.83	1	3.07E-02	3.07E-02	G	2.65
SSE	100	0	4.78	1	1.58E-02	1.58E-02	G	4.70
S	8580	0	6.30	1	1.39E-05	1.39E-05	E	0.89
SSW	7910	0	4.53	1	9.53E-06	9.53E-06	F	2.65
SW	9230	0	2.93	1	1.23E-05	1.23E-05	F	2.65
WSW	9230	0	2.72	1	1.01E-05	1.01E-05	F	2.65
W	10750	0	4.80	1	1.96E-05	1.96E-05	G	2.65
WNW	14160	0	3.98	1	7.77E-06	7.77E-06	G	4.70
NW	11710	0	4.72	1	1.82E-05	1.82E-05	G	2.65
NNW	11470	0	4.58	1	1.87E-05	1.87E-05	G	2.65
N	13110	0	4.36	1	1.70E-05	1.70E-05	G	2.65
NNE	14360	0	2.49	1	6.81E-06	6.81E-06	E	0.89
NE	12560	0	3.90	1	8.60E-06	8.60E-06	E	0.89
ENE	12450	0	6.17	1	1.47E-05	1.47E-05	G	2.65
E	14140	0	14.05	1	1.68E-05	1.68E-05	F	0.89
ESE	21290	0	18.80	1	9.64E-06	9.64E-06	F	0.89
SE	14210	0	10.83	1	1.51E-05	1.51E-05	G	2.65
SSE	11180	0	4.78	1	1.01E-05	1.01E-05	G	4.70
S	19000	0	6.30	1	4.96E-06	4.96E-06	E	0.89
SSW	16300	0	4.53	1	3.82E-06	3.82E-06	F	2.65
SW	17780	0	2.93	1	4.39E-06	4.39E-06	F	2.65
WSW	19090	0	2.72	1	4.02E-06	4.02E-06	F	2.65
W	18680	0	4.80	1	9.78E-06	9.78E-06	G	2.65
WNW	19160	0	3.98	1	5.31E-06	5.31E-06	G	4.70
NW	19910	0	4.72	1	9.39E-06	9.39E-06	G	2.65
NNW	19680	0	4.58	1	9.56E-06	9.56E-06	G	2.65
N	23020	0	4.36	1	8.44E-06	8.44E-06	G	2.65
NNE	25790	0	2.49	1	3.18E-06	3.18E-06	E	0.89
NE	20220	0	3.90	1	4.68E-06	4.68E-06	E	0.89
ENE	17250	0	6.17	1	9.78E-06	9.78E-06	G	2.65
E	17120	0	14.05	1	1.32E-05	1.32E-05	F	0.89
ESE	21290	0	18.80	1	9.64E-06	9.64E-06	F	0.89
SE	25400	0	10.83	1	7.37E-06	7.37E-06	G	2.65
SSE	20910	0	4.78	1	4.52E-06	4.52E-06	G	4.70

HNF-SD-WM-CN-095 REV.0

99.5% Canister Storage 200 E, csb2.in, Acute G. Level Release, plume meander

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 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 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 1 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)
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

	reference	frequency
c release	anemometer	to
c height	height	exceed
c hs(m)	ha(m)	Cx(%)
0	10	1000 0.5

	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)
0	0	1.0	0.001	0.001

	initial	initial		convective
c ambient	plume	plume	release	heat release

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```

c temperature      temperature      flow rate      diameter      rate(1)
c Tamb(C)          T0(C)            V0(m3/s)       d(m)           qh(w)
c _____
c 20                20                1                1                0
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                .78
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)
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
0 100 0
1 8580 0
2 7910 0
3 7910 0
4 9230 0
5 10750 0
6 14160 0
7 11710 0
8 11470 0
9 13110 0
10 14360 0
11 12560 0
12 12450 0
13 14140 0
14 21290 0
15 14210 0
16 11180 0
1 19000 0
2 16300 0
3 17780 0
4 19090 0
5 18680 0
6 19160 0
7 19910 0
8 19680 0
9 23020 0
10 25790 0
11 20220 0
12 17250 0
13 17120 0
14 21290 0
15 25400 0
16 20910 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 = 04/09/97
Run Time = 11:19:31.68

INPUT ECHO:

99.5% Canister Storage 200 E, csb2.in, Acute G. Level Release, plume meander

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 1 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)

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

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```

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 twash = 1 then stack downwash model turned on
c lgrav = 1 then gravitational settling model turned on
c      = 0 unless specified otherwise, 0 turns model off
c      reference frequency
c release      anemometer      mixing      to
c height      height      height      exceed
c hs(m)      ha(m)      hm(m)      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)      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      initial      initial      release      convective
c ambient      plume      plume      heat release
c temperature      temperature      flow rate      rate(1)
c Tamb(C)      T0(C)      V0(m3/s)      diameter      qh(w)
c
c      2.00000E+01      2.00000E+01      1.00000E+00      1.00000E+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 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)
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 xmin = minimum scaled X/Q to calculate
c power = exponent in power function step size
c
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:
NRC RG 1.145 plume meander model selected.
Default Gaussian plume model selected.

```


HNF-SD-WM-CN-095 REV.0

WARNING/ERROR MESSAGES:

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

99.5% Canister Storage 200 E, csb2.in, Acute G. Level Release, plume meander

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	100	0	6.30	1	5.96E-03	5.96E-03	E	0.89
SSW	100	0	4.53	1	4.54E-03	4.54E-03	F	7.15
SW	100	0	2.93	1	4.80E-03	4.80E-03	F	4.70
WSW	100	0	2.72	1	4.80E-03	4.80E-03	F	4.70
W	100	0	4.80	1	7.43E-03	7.43E-03	G	2.65
WNW	100	0	3.98	1	6.67E-03	6.67E-03	G	2.65
NW	100	0	4.72	1	7.65E-03	7.65E-03	G	2.65
NNW	100	0	4.58	1	8.06E-03	8.06E-03	G	2.65
N	100	0	4.36	1	8.29E-03	8.29E-03	F	0.89
NNE	100	0	2.49	1	5.36E-03	5.36E-03	E	0.89
NE	100	0	3.90	1	6.02E-03	6.02E-03	E	0.89
ENE	100	0	6.17	1	7.79E-03	7.79E-03	G	2.65
E	100	0	14.05	1	1.09E-02	1.09E-02	G	4.70
ESE	100	0	18.80	1	1.13E-02	1.13E-02	G	4.70
SE	100	0	10.83	1	8.37E-03	8.37E-03	F	0.89
SSE	100	0	4.78	1	6.20E-03	6.20E-03	E	0.89
S	8580	0	6.30	1	1.20E-05	1.20E-05	E	0.89
SSW	7910	0	4.53	1	8.20E-06	8.20E-06	F	2.65
SW	7910	0	2.93	1	1.00E-05	1.00E-05	F	2.65
WSW	9230	0	2.72	1	8.42E-06	8.42E-06	F	2.65
W	10750	0	4.80	1	1.55E-05	1.55E-05	G	2.65
WNW	14160	0	3.98	1	7.37E-06	7.37E-06	G	4.70
NW	11710	0	4.72	1	1.46E-05	1.46E-05	G	2.65
NNW	11470	0	4.58	1	1.50E-05	1.50E-05	G	2.65
N	13110	0	4.36	1	1.38E-05	1.38E-05	G	2.65
NNE	14360	0	2.49	1	6.03E-06	6.03E-06	E	0.89
NE	12560	0	3.90	1	7.84E-06	7.84E-06	E	0.89
ENE	12450	0	6.17	1	1.23E-05	1.23E-05	G	2.65
E	14140	0	14.05	1	1.37E-05	1.37E-05	F	0.89
ESE	21290	0	18.80	1	8.37E-06	8.37E-06	F	0.89
SE	14210	0	10.83	1	1.24E-05	1.24E-05	G	2.65
SSE	11180	0	4.78	1	9.15E-06	9.15E-06	G	4.70
S	19000	0	6.30	1	4.60E-06	4.60E-06	E	0.89
SSW	16300	0	4.53	1	3.52E-06	3.52E-06	F	2.65
SW	17780	0	2.93	1	3.95E-06	3.95E-06	F	2.65
WSW	19090	0	2.72	1	3.64E-06	3.64E-06	F	2.65
W	18680	0	4.80	1	8.43E-06	8.43E-06	G	2.65
WNW	19160	0	3.98	1	5.10E-06	5.10E-06	G	4.70
NW	19910	0	4.72	1	8.14E-06	8.14E-06	G	2.65
NNW	19680	0	4.58	1	8.27E-06	8.27E-06	G	2.65
N	23020	0	4.36	1	7.41E-06	7.41E-06	G	2.65
NNE	25790	0	2.49	1	2.96E-06	2.96E-06	E	0.89
NE	20220	0	3.90	1	4.40E-06	4.40E-06	E	0.89
ENE	17250	0	6.17	1	8.54E-06	8.54E-06	G	2.65
E	17120	0	14.05	1	1.11E-05	1.11E-05	F	0.89
ESE	21290	0	18.80	1	8.37E-06	8.37E-06	F	0.89
SE	25400	0	10.83	1	6.54E-06	6.54E-06	G	2.65
SSE	20910	0	4.78	1	4.27E-06	4.27E-06	G	4.70

GXQ Version 4.0A
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 = 07/26/95
Run Time = 13:14:40.38

INPUT ECHO:

HWVP stack releases - onsite - accident vent rate

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
c     0     0     0     1
c DIFFUSION COEFFICIENT ADJUSTMENT MODELS:
c   iwake ipm   iflow ientr
c     0     0     1     1
c EFFECTIVE RELEASE HEIGHT ADJUSTMENT MODELS:
c   (irise igrnd)iwash igrav
c     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
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	release	reference	mixing	frequency	
c	height	anemometer	height	to	
c	hs(m)	height	height	exceed	
c		ha(m)	hm(m)	Cx(%)	
c	3.66000E+01	6.10000E+01	1.00000E+03	5.00000E-01	
c	initial	initial			gravitational
c	plume	plume	release	deposition	settling
c	width	height	duration	velocity	velocity
c	Wb(m)	Hb(m)	trd(hr)	vd(m/s)	vg(m/s)
c	0.00000E+00	0.00000E+00	0.00000E+00	1.00000E-03	1.00000E-03
c		initial	initial		convective
c	ambient	plume	plume	release	heat release
c	temperature	temperature	flow rate	diameter	rate(1)
c	Tamb(C)	TO(C)	VO(m3/s)	d(m)	qh(w)

```

2.00000E+01  3.80000E+01  1.13000E+01  1.02000E+00  0.00000E+00
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)
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.
Plume rise air entrainment 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:

JOINT FREQUENCY DATA:

HNF-SD-WM-CN-095 REV.0

200 AREA (HMS) - 61 M - Pasquill A - G (1983 - 1991 Average)

Created 8/26/92 KR

HWVP stack releases - onsite

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	200	0	6.11	1	2.52E-05	2.52E-05	A	2.65
SSW	200	0	4.33	1	2.10E-05	2.10E-05	A	2.65
SW	200	0	2.79	1	1.84E-05	1.84E-05	A	4.70
WSW	200	0	2.54	1	2.01E-05	2.01E-05	A	2.65
W	200	0	4.56	1	2.55E-05	2.55E-05	A	2.65
WNW	200	0	3.80	1	2.30E-05	2.30E-05	A	2.65
NW	200	0	4.58	1	2.06E-05	2.06E-05	A	2.65
NNW	200	0	4.51	1	1.31E-05	1.31E-05	A	7.15
N	200	0	4.31	1	1.20E-05	1.20E-05	A	7.15
NNE	200	0	2.48	1	4.40E-07	4.40E-07	G	0.89
NE	200	0	3.95	1	1.02E-05	1.02E-05	B	4.70
ENE	200	0	6.33	1	1.45E-05	1.45E-05	A	7.15
E	200	0	14.39	1	1.62E-05	1.62E-05	A	4.70
ESE	200	0	19.39	1	1.69E-05	1.69E-05	A	4.70
SE	200	0	11.01	1	1.95E-05	1.95E-05	A	4.70
SSE	200	0	4.75	1	2.12E-05	2.12E-05	A	2.65
S	210	0	6.11	1	2.69E-05	2.69E-05	A	2.65
SSW	210	0	4.33	1	2.19E-05	2.19E-05	A	2.65
SW	210	0	2.79	1	1.90E-05	1.90E-05	A	4.70
WSW	210	0	2.54	1	2.09E-05	2.09E-05	A	2.65
W	210	0	4.56	1	2.72E-05	2.72E-05	A	2.65
WNW	210	0	3.80	1	2.41E-05	2.41E-05	A	2.65
NW	210	0	4.58	1	2.14E-05	2.14E-05	A	2.65
NNW	210	0	4.51	1	1.32E-05	1.32E-05	A	7.15
N	210	0	4.31	1	1.28E-05	1.28E-05	A	7.15
NNE	210	0	2.48	1	5.55E-07	5.55E-07	G	0.89
NE	210	0	3.95	1	1.10E-05	1.10E-05	B	4.70
ENE	210	0	6.33	1	1.48E-05	1.48E-05	A	7.15
E	210	0	14.39	1	1.66E-05	1.66E-05	A	4.70
ESE	210	0	19.39	1	1.73E-05	1.73E-05	A	4.70
SE	210	0	11.01	1	2.02E-05	2.02E-05	A	4.70
SSE	210	0	4.75	1	2.21E-05	2.21E-05	A	2.65
S	220	0	6.11	1	2.81E-05	2.81E-05	A	2.65
SSW	220	0	4.33	1	2.24E-05	2.24E-05	A	2.65
SW	220	0	2.79	1	1.93E-05	1.93E-05	A	4.70
WSW	220	0	2.54	1	2.13E-05	2.13E-05	A	2.65
W	220	0	4.56	1	2.86E-05	2.86E-05	A	2.65

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WNW	220	0	3.80	1	2.48E-05	2.48E-05 A	2.65
NW	220	0	4.58	1	2.18E-05	2.18E-05 A	2.65
NNW	220	0	4.51	1	1.47E-05	1.47E-05 B	2.65
N	220	0	4.31	1	1.37E-05	1.37E-05 B	2.65
NNE	220	0	2.48	1	6.90E-07	6.90E-07 G	0.89
NE	220	0	3.95	1	1.14E-05	1.14E-05 B	4.70
ENE	220	0	6.33	1	1.45E-05	1.45E-05 B	2.65
E	220	0	14.39	1	1.67E-05	1.67E-05 A	4.70
ESE	220	0	19.39	1	1.75E-05	1.75E-05 A	4.70
SE	220	0	11.01	1	2.06E-05	2.06E-05 A	4.70
SSE	220	0	4.75	1	2.26E-05	2.26E-05 A	2.65
S	230	0	6.11	1	2.90E-05	2.90E-05 A	2.65
SSW	230	0	4.33	1	2.26E-05	2.26E-05 A	2.65
SW	230	0	2.79	1	1.93E-05	1.93E-05 A	4.70
WSW	230	0	2.54	1	2.15E-05	2.15E-05 A	2.65
W	230	0	4.56	1	2.95E-05	2.95E-05 A	2.65
WNW	230	0	3.80	1	2.51E-05	2.51E-05 A	2.65
NW	230	0	4.58	1	2.20E-05	2.20E-05 A	2.65
NNW	230	0	4.51	1	1.59E-05	1.59E-05 B	2.65
N	230	0	4.31	1	1.44E-05	1.44E-05 B	4.70
NNE	230	0	2.48	1	8.47E-07	8.47E-07 G	0.89
NE	230	0	3.95	1	1.13E-05	1.13E-05 B	7.15
ENE	230	0	6.33	1	1.58E-05	1.58E-05 B	2.65
E	230	0	14.39	1	1.70E-05	1.70E-05 A	4.70
ESE	230	0	19.39	1	1.75E-05	1.75E-05 A	4.70
SE	230	0	11.01	1	2.07E-05	2.07E-05 A	4.70
SSE	230	0	4.75	1	2.29E-05	2.29E-05 A	2.65
S	240	0	6.11	1	2.95E-05	2.95E-05 A	2.65
SSW	240	0	4.33	1	2.25E-05	2.25E-05 A	2.65
SW	240	0	2.79	1	1.92E-05	1.92E-05 A	4.70
WSW	240	0	2.54	1	2.14E-05	2.14E-05 A	4.70
W	240	0	4.56	1	3.01E-05	3.01E-05 A	2.65
WNW	240	0	3.80	1	2.52E-05	2.52E-05 A	2.65
NW	240	0	4.58	1	2.20E-05	2.20E-05 A	2.65
NNW	240	0	4.51	1	1.70E-05	1.70E-05 B	2.65
N	240	0	4.31	1	1.54E-05	1.54E-05 B	4.70
NNE	240	0	2.48	1	1.02E-06	1.02E-06 G	0.89
NE	240	0	3.95	1	1.21E-05	1.21E-05 B	0.89
ENE	240	0	6.33	1	1.69E-05	1.69E-05 B	2.65
E	240	0	14.39	1	1.72E-05	1.72E-05 A	4.70
ESE	240	0	19.39	1	1.73E-05	1.73E-05 A	4.70
SE	240	0	11.01	1	2.06E-05	2.06E-05 A	4.70
SSE	240	0	4.75	1	2.28E-05	2.28E-05 A	2.65
S	250	0	6.11	1	2.97E-05	2.97E-05 A	2.65
SSW	250	0	4.33	1	2.20E-05	2.20E-05 A	2.65
SW	250	0	2.79	1	1.89E-05	1.89E-05 B	2.65
WSW	250	0	2.54	1	2.20E-05	2.20E-05 A	2.65
W	250	0	4.56	1	3.04E-05	3.04E-05 A	2.65
WNW	250	0	3.80	1	2.50E-05	2.50E-05 A	2.65
NW	250	0	4.58	1	2.20E-05	2.20E-05 A	2.65

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NNW	250	0	4.51	1	1.64E-05	1.64E-05 A	4.70
N	250	0	4.31	1	1.53E-05	1.53E-05 B	4.70
NNE	250	0	2.48	1	1.22E-06	1.22E-06 G	0.89
NE	250	0	3.95	1	1.17E-05	1.17E-05 A	7.15
ENE	250	0	6.33	1	1.54E-05	1.54E-05 B	4.70
E	250	0	14.39	1	1.70E-05	1.70E-05 A	4.70
ESE	250	0	19.39	1	1.73E-05	1.73E-05 A	4.70
SE	250	0	11.01	1	1.92E-05	1.92E-05 B	2.65
SSE	250	0	4.75	1	2.25E-05	2.25E-05 A	2.65
S	260	0	6.11	1	2.97E-05	2.97E-05 A	2.65
SSW	260	0	4.33	1	2.22E-05	2.22E-05 A	2.65
SW	260	0	2.79	1	1.97E-05	1.97E-05 B	2.65
WSW	260	0	2.54	1	2.22E-05	2.22E-05 A	2.65
W	260	0	4.56	1	3.04E-05	3.04E-05 A	2.65
WNW	260	0	3.80	1	2.47E-05	2.47E-05 A	2.65
NW	260	0	4.58	1	2.22E-05	2.22E-05 A	2.65
NNW	260	0	4.51	1	1.62E-05	1.62E-05 A	4.70
N	260	0	4.31	1	1.55E-05	1.55E-05 B	4.70
NNE	260	0	2.48	1	1.46E-06	1.46E-06 D	7.15
NE	260	0	3.95	1	1.17E-05	1.17E-05 A	7.15
ENE	260	0	6.33	1	1.56E-05	1.56E-05 B	4.70
E	260	0	14.39	1	1.67E-05	1.67E-05 A	4.70
ESE	260	0	19.39	1	1.74E-05	1.74E-05 A	4.70
SE	260	0	11.01	1	2.00E-05	2.00E-05 B	2.65
SSE	260	0	4.75	1	2.27E-05	2.27E-05 A	2.65
S	270	0	6.11	1	2.94E-05	2.94E-05 A	2.65
SSW	270	0	4.33	1	2.23E-05	2.23E-05 A	2.65
SW	270	0	2.79	1	2.04E-05	2.04E-05 B	2.65
WSW	270	0	2.54	1	2.23E-05	2.23E-05 A	2.65
W	270	0	4.56	1	3.01E-05	3.01E-05 A	2.65
WNW	270	0	3.80	1	2.42E-05	2.42E-05 A	2.65
NW	270	0	4.58	1	2.23E-05	2.23E-05 A	2.65
NNW	270	0	4.51	1	1.60E-05	1.60E-05 A	4.70
N	270	0	4.31	1	1.59E-05	1.59E-05 A	4.70
NNE	270	0	2.48	1	1.74E-06	1.74E-06 D	7.15
NE	270	0	3.95	1	1.13E-05	1.13E-05 A	7.15
ENE	270	0	6.33	1	1.57E-05	1.57E-05 B	4.70
E	270	0	14.39	1	1.61E-05	1.61E-05 A	4.70
ESE	270	0	19.39	1	1.63E-05	1.63E-05 B	0.89
SE	270	0	11.01	1	2.06E-05	2.06E-05 B	2.65
SSE	270	0	4.75	1	2.26E-05	2.26E-05 A	2.65
S	280	0	6.11	1	2.90E-05	2.90E-05 A	2.65
SSW	280	0	4.33	1	2.23E-05	2.23E-05 A	2.65
SW	280	0	2.79	1	2.09E-05	2.09E-05 B	2.65
WSW	280	0	2.54	1	2.23E-05	2.23E-05 A	2.65
W	280	0	4.56	1	2.97E-05	2.97E-05 A	2.65
WNW	280	0	3.80	1	2.35E-05	2.35E-05 A	2.65
NW	280	0	4.58	1	2.23E-05	2.23E-05 A	2.65
NNW	280	0	4.51	1	1.57E-05	1.57E-05 B	4.70
N	280	0	4.31	1	1.55E-05	1.55E-05 A	4.70

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NNE	280	0	2.48	1	2.04E-06	2.04E-06 D	7.15
NE	280	0	3.95	1	1.08E-05	1.08E-05 A	7.15
ENE	280	0	6.33	1	1.47E-05	1.47E-05 A	4.70
E	280	0	14.39	1	1.57E-05	1.57E-05 B	4.70
ESE	280	0	19.39	1	1.61E-05	1.61E-05 B	4.70
SE	280	0	11.01	1	2.11E-05	2.11E-05 B	2.65
SSE	280	0	4.75	1	2.25E-05	2.25E-05 A	2.65
S	290	0	6.11	1	2.84E-05	2.84E-05 A	2.65
SSW	290	0	4.33	1	2.21E-05	2.21E-05 A	2.65
SW	290	0	2.79	1	2.14E-05	2.14E-05 B	2.65
WSW	290	0	2.54	1	2.21E-05	2.21E-05 A	2.65
W	290	0	4.56	1	2.91E-05	2.91E-05 A	2.65
WNW	290	0	3.80	1	2.28E-05	2.28E-05 A	2.65
NW	290	0	4.58	1	2.21E-05	2.21E-05 A	2.65
NNW	290	0	4.51	1	1.56E-05	1.56E-05 B	4.70
N	290	0	4.31	1	1.51E-05	1.51E-05 A	4.70
NNE	290	0	2.48	1	2.37E-06	2.37E-06 D	7.15
NE	290	0	3.95	1	1.03E-05	1.03E-05 A	7.15
ENE	290	0	6.33	1	1.42E-05	1.42E-05 A	4.70
E	290	0	14.39	1	1.56E-05	1.56E-05 B	4.70
ESE	290	0	19.39	1	1.65E-05	1.65E-05 B	4.70
SE	290	0	11.01	1	2.14E-05	2.14E-05 B	2.65
SSE	290	0	4.75	1	2.22E-05	2.22E-05 A	2.65
S	300	0	6.11	1	2.76E-05	2.76E-05 A	2.65
SSW	300	0	4.33	1	2.19E-05	2.19E-05 A	2.65
SW	300	0	2.79	1	2.17E-05	2.17E-05 B	2.65
WSW	300	0	2.54	1	2.19E-05	2.19E-05 A	2.65
W	300	0	4.56	1	2.84E-05	2.84E-05 A	2.65
WNW	300	0	3.80	1	2.20E-05	2.20E-05 A	2.65
NW	300	0	4.58	1	2.19E-05	2.19E-05 A	2.65
NNW	300	0	4.51	1	1.54E-05	1.54E-05 B	4.70
N	300	0	4.31	1	1.46E-05	1.46E-05 A	4.70
NNE	300	0	2.48	1	2.72E-06	2.72E-06 D	7.15
NE	300	0	3.95	1	1.00E-05	1.00E-05 A	7.15
ENE	300	0	6.33	1	1.37E-05	1.37E-05 A	4.70
E	300	0	14.39	1	1.55E-05	1.55E-05 B	4.70
ESE	300	0	19.39	1	1.68E-05	1.68E-05 B	4.70
SE	300	0	11.01	1	2.17E-05	2.17E-05 B	2.65
SSE	300	0	4.75	1	2.19E-05	2.19E-05 A	2.65

GXQ Version 4.0A
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 = 07/21/95
Run Time = 08:40:35.41

INPUT ECHO:

HWVP stack releases - onsite - normal vent rate

c GXQ Version 4.0 Input File

c mode
2

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 T 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      0      1      1
```

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
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 PARAMETER INPUT:

release height hs(m)	reference anemometer height ha(m)	mixing height hm(m)	frequency to exceed Cx(%)	
3.66000E+01	6.10000E+01	1.00000E+03	5.00000E-01	
initial plume width Wb(m)	initial plume height Hb(m)	release duration trd(hr)	deposition velocity vd(m/s)	gravitational settling velocity vg(m/s)
0.00000E+00	0.00000E+00	0.00000E+00	1.00000E-03	1.00000E-03
ambient temperature Tamb(C)	initial plume temperature T0(C)	initial plume flow rate V0(m3/s)	release diameter d(m)	convective heat release rate(1) qh(w)
2.00000E+01	3.80000E+01	5.66000E+00	1.02000E+00	0.00000E+00

```

c
c (1) If zero then buoyant flux based on plume/ambient temperature difference.

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)
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:
X/Q calculated by stability class and wind speed.

LOGICAL CHOICES:
X/Q parameter print option selected.

MODELS SELECTED:
Flow adjustment model.
Plume rise air entrainment 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:

HWVP stack releases - onsite

ATM. STAB. CLASS	WIND SPEED (m/s)	DISTANCE (m)	OFFSET (m)	RECEPTOR HEIGHT (m)	SCALED X/Q (s/m ³)

atmospheric stability class	=	A			
receptor distance	=	230.000			m
trans. dist. from plume to puff	=	0.000000			m
receptor horizontal offset	=	0.000000			m
receptor height	=	0.000000			m
momentum flux	=	11.7571			m ⁴ /s ²
buoyancy flux	=	1.02262			m ⁴ /s ³
distance dependent momentum rise	=	0.000000			m
distance dependent buoyancy rise	=	8.46056			m
plume rise limit	=	8.46056			m
stack downwash	=	0.000000			m
gravitational settling	=	0.000000			m
effective release height (he)	=	45.0606			m
anemometer wind speed	=	2.65000			m/s
wind speed at release height	=	2.55692			m/s
wind speed at he	=	2.59441			m/s
effective wind speed	=	2.57566			m/s
crit. wind spd. prevent. liftoff	=	9999.00			m/s
initial vertical plume speed	=	6.92670			m/s
Pasquill sigma y (unadjusted)	=	49.6730			m
Pasquill sigma z (unadjusted)	=	34.6013			m
Pasquill sigma x (flow adj.)	=	49.6730			m
Pasquill sigma y (flow adj.)	=	49.8924			m
Pasquill sigma z (flow adj.)	=	36.8901			m
Pasquill sigma y (wake adj.)	=	0.000000			m
Pasquill sigma z (wake adj.)	=	0.000000			m
Pasquill sigma y (meander adj.)	=	0.000000			m
Pasquill sigma y (rise adj.)	=	49.7318			m
Pasquill sigma z (rise adj.)	=	34.6856			m
off-axis horizontal factor	=	1.00000			
plume trapping reflection factor	=	2.00000			
off-axis vertical factor	=	0.948514			
plume depletion factor	=	1.00000			
source term factor	=	1.00000			
atmospheric disper. coeff. (X/Q)	=	0.318441E-04			
A	2.65	230	0	0	3.18E-05

GXQ Version 4.0A
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 = 07/26/95
Run Time = 13:57:58.90

INPUT ECHO:

HWVP stack releases - onsite normal vent rate - 95% all sectors

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 T 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 0 1 1

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
 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 PARAMETER INPUT:

release height hs(m)	reference anemometer height ha(m)	mixing height hm(m)	frequency to exceed Cx(%)	
3.66000E+01	6.10000E+01	1.00000E+03	5.00000E+00	
initial plume width Wb(m)	initial plume height Hb(m)	release duration trd(hr)	deposition velocity vd(m/s)	gravitational settling velocity vg(m/s)
0.00000E+00	0.00000E+00	0.00000E+00	1.00000E-03	1.00000E-03
ambient temperature Tamb(C)	initial plume temperature TO(C)	initial plume flow rate VO(m3/s)	release diameter d(m)	convective heat release rate(l) qh(w)
2.00000E+01	3.80000E+01	5.66000E+00	1.02000E+00	0.00000E+00

```

c
c (1) If zero then buoyant flux based on plume/ambient temperature difference.

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 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)
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 overall site.

MODELS SELECTED:
Flow adjustment model.
Plume rise air entrainment 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:

JOINT FREQUENCY DATA:
200 AREA (HMS) - 61 M - Pasquill A - G (1983 - 1991 Average)

Created 8/26/92 KR

HWVP stack releases - onsite

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)
ALL	220	0	99.83	1	3.34E-05	3.34E-05	A	2.65
ALL	230	0	99.83	1	3.33E-05	3.33E-05	A	2.65
ALL	240	0	99.83	1	3.15E-05	3.15E-05	A	2.65
ALL	250	0	99.83	1	3.22E-05	3.22E-05	A	2.65
ALL	260	0	99.83	1	3.28E-05	3.28E-05	A	2.65
ALL	270	0	99.83	1	3.31E-05	3.31E-05	A	2.65

**Representative GXQ Input/Output File
Site Boundary Receptor**

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GXQ Version 4.0A
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 = 07/27/95
Run Time = 08:12:16.56

INPUT ECHO:

HWVP stack releases - site boundary - accident vent rate

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 0 1 1

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
 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 PARAMETER INPUT:

	reference anemometer height ha(m)	mixing height hm(m)	frequency to exceed Cx(%)	
release height hs(m)	3.66000E+01	6.10000E+01	1.00000E+03	5.00000E-01
initial plume width Wb(m)	initial plume height Hb(m)	release duration trd(hr)	deposition velocity vd(m/s)	gravitational settling velocity vg(m/s)
0.00000E+00	0.00000E+00	0.00000E+00	1.00000E-03	1.00000E-03
ambient temperature Tamb(C)	initial plume temperature T0(C)	initial plume flow rate V0(m3/s)	release diameter d(m)	convective heat release rate(1) qh(w)
2.00000E+01	3.80000E+01	1.13000E+01	1.02000E+00	0.00000E+00

```

c
c (1) If zero then buoyant flux based on plume/ambient temperature difference.

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)
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.

Plume rise air entrainment 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:

JOINT FREQUENCY DATA:

200 AREA (HMS) - 61 M - Pasquill A - G (1983 - 1991 Average)

Created 8/26/92 KR

HWVP stack releases - site boundary

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	20000	0	6.11	1	2.87E-06	2.87E-06	F	2.65
SSW	17000	0	4.33	1	2.00E-06	2.00E-06	D	0.89
SW	18300	0	2.79	1	1.68E-06	1.68E-06	F	4.70
WSW	20000	0	2.54	1	1.52E-06	1.52E-06	F	4.70
W	19400	0	4.56	1	3.36E-06	3.36E-06	E	0.89
WNW	20000	0	3.80	1	3.26E-06	3.26E-06	E	0.89
NW	21100	0	4.58	1	3.16E-06	3.16E-06	G	2.65
NNW	20900	0	4.51	1	4.12E-06	4.12E-06	G	2.65
N	23900	0	4.31	1	3.83E-06	3.83E-06	G	2.65
NNE	27400	0	2.48	1	2.02E-06	2.02E-06	F	2.65
NE	21600	0	3.95	1	2.64E-06	2.64E-06	F	2.65
ENE	18400	0	6.33	1	3.44E-06	3.44E-06	G	2.65
E	18300	0	14.39	1	6.05E-06	6.05E-06	F	0.89
ESE	22800	0	19.39	1	3.60E-06	3.60E-06	G	2.65
SE	27200	0	11.01	1	2.58E-06	2.58E-06	G	2.65
SSE	22000	0	4.75	1	2.59E-06	2.59E-06	F	2.65
S	8700	0	6.11	1	4.89E-06	4.89E-06	F	2.65
SSW	8880	0	4.33	1	4.33E-06	4.33E-06	D	0.89
SW	8880	0	2.79	1	4.35E-06	4.35E-06	D	0.89
WSW	9250	0	2.54	1	4.17E-06	4.17E-06	D	0.89
W	11100	0	4.56	1	5.63E-06	5.63E-06	E	0.89
WNW	14600	0	3.80	1	4.20E-06	4.20E-06	E	0.89
NW	12400	0	4.58	1	5.85E-06	5.85E-06	E	0.89
NNW	12000	0	4.51	1	6.59E-06	6.59E-06	G	0.89
N	13300	0	4.31	1	6.52E-06	6.52E-06	G	0.89
NNE	15200	0	2.48	1	3.37E-06	3.37E-06	F	2.65
NE	13700	0	3.95	1	3.59E-06	3.59E-06	G	2.65
ENE	13300	0	6.33	1	4.18E-06	4.18E-06	G	2.65
E	15000	0	14.39	1	7.13E-06	7.13E-06	G	0.89
E	15700	0	14.39	1	7.07E-06	7.07E-06	G	0.89
ESE	22800	0	19.39	1	3.60E-06	3.60E-06	G	2.65
SE	27200	0	11.01	1	2.58E-06	2.58E-06	G	2.65
SSE	11700	0	4.75	1	4.15E-06	4.15E-06	F	2.65

CHECKLIST FOR PEER REVIEW

Document Reviewed: C. H. Huang, " THE X/Q VALUES AND UNIT DOSES FOR THE SPENT NUCLEAR FUEL PROJECT," February 26, 1997.

Scope of Review: Entire Document

Yes No NA

- ☐ ☐ ☒ * Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
- ☒ ☐ ☐ Problem completely defined.
- ☒ ☐ ☒ Accident scenarios developed in a clear and logical manner.
- ☒ ☐ ☐ Necessary assumptions explicitly stated and supported.
- ☒ ☐ ☐ Computer codes and data files documented.
- ☒ ☐ ☐ Data used in calculations explicitly stated in document.
- ☒ ☐ ☐ Data checked for consistency with original source information as applicable.
- ☒ ☐ ☐ Mathematical derivations checked including dimensional consistency of results.
- ☒ ☐ ☐ Models appropriate and used within range of validity or use outside range of established validity justified.
- ☒ ☐ ☐ Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
- ☒ ☐ ☐ Software input correct and consistent with document reviewed.
- ☒ ☐ ☐ Software output consistent with input and with results reported in document reviewed.
- ☐ ☐ ☒ Limits/criteria/guidelines applied to analysis results are appropriate and referenced. Limits/criteria/guidelines checked against references.
- ☐ ☐ ☒ Safety margins consistent with good engineering practices.
- ☒ ☐ ☐ Conclusions consistent with analytical results and applicable limits.
- ☒ ☐ ☐ Results and conclusions address all points required in the problem statement.
- ☐ ☐ ☒ Format consistent with appropriate NRC Regulatory Guide or other standards
- ☐ ☐ ☒ * Review calculations, comments, and/or notes are attached.
- ☒ ☐ ☐ Document approved.

DA. Himes
Reviewer (Printed Name and Signature)

3/3/97
Date

HEDOP REVIEW CHECKLIST
for
Radiological and Nonradiological Release Calculations

Document Reviewed: C. H. Huang, " THE X/Q VALUES AND UNIT DOSES FOR THE SPENT NUCLEAR FUEL PROJECT," February 26, 1997.

Submitted by: C. H. HUANG
Date Submitted: February 26, 1997

Scope of Review: Entire Document

YES NO* N/A

☒	☐	☐	1. A detailed technical review and approval of the environmental transport and dose calculation portion of the analysis has been performed and documented.
☐	☐	☒	2. Detailed technical review(s) and approval(s) of scenario and release determinations have been performed and documented.
☒	☐	☐	3. HEDOP-approved code(s) were used.
☐	☐	☒	4. Receptor locations were selected according to HEDOP recommendations.
☒	☐	☐	5. All applicable environmental pathways and code options were included and are appropriate for the calculations.
☒	☐	☐	6. Hanford site data were used.
☐	☐	☒	7. Model adjustments external to the computer program were justified and performed correctly.
☒	☐	☐	8. The analysis is consistent with HEDOP recommendations.
☒	☐	☒	9. Supporting notes, calculations, comments, comment resolutions, or other information is attached. (Use the "Page 1 of X" page numbering format and sign and date each added page.)
☒	☐		10. Approval is granted on behalf of the Hanford Environmental Dose Overview Panel.

* All "NO" responses must be explained and use of nonstandard methods justified.

D.A. Himes [Signature] 3/3/97
HEDOP-Approved Reviewer (Printed Name and Signature) Date

COMMENTS (add additional signed and dated pages if necessary):

Three different versions of GXX used correspond to the various documents the ~~incorporation~~ X/Qs were taken from along with the current calculation for ~~vacuum~~ vacuum drying facility.

C-388 CW

DISTRIBUTION SHEET

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M. Kummerer	C.H. Huang	Date 2/26/97			
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THE X/Q VALUES AND UNIT DOSES FOR THE SPENT NUCLEAR FUEL PROJECT		ECN No. N/A			
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