JAN 27 1998

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 622995

2. To: (Receiving Organization) Distribution		3. From: (Originating Organization) Criticality and Shielding		4. Related EDT No.:	
5. Proj./Prog./Dept./Div.: BWHC/19120		6. Design Authority/ Design Agent/Cog. Engr.: H. J. Goldberg		7. Purchase Order No.:	
8. Originator Remarks: Approval/Release				9. Equip./Component No.:	
				10. System/Bldg./Facility:	
11. Receiver Remarks: 11A. Design Baseline Document? ☐ Yes ☒ No				12. Major Assm. Dwg. No.:	
				13. Permit/Permit Application No.:	
				14. Required Response Date:	

15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Design- nator	Reason for Trans- mittal	Origin- ator Dispo- sition	Receiv- er Dispo- sition
1	HNF-2105		0	Calculational Note for the Radiological Effects of a UO ₃ Release from the T- Hopper Storage Pad		1,2	1	

16. KEY					
Approval Designator (F)		Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)		1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)		1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged	

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)											
(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
		Design Authority				1	1	Tech. Rvw. P. D. Rittman		1/14/98	B4-43
		Design Agent									
1	1	Cog.Eng. H. J. Goldberg	<i>Harry Goldberg</i>		B4-44						
1	1	Cog. Mgr. J. P. Estrellado	<i>J. P. Estrellado</i>		B4-45						
		QA									
		Safety									
		Env.									

18. H. J. Goldberg <i>Harry Goldberg</i> Signature of EDT Originator		19. J. P. Estrellado, Jr. <i>J. P. Estrellado, Jr.</i> Authorized Representative Date for Receiving Organization		20. J. P. Estrellado, Jr. <i>J. P. Estrellado, Jr.</i> Design Authority/ Cognizant Manager		21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments	
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Calculational Note for the Radiological Effects of a UO_3 Release from the T-Hopper Storage Pad

H. J. Goldberg

Fluor Daniel Northwest, Inc., Richland, WA 99352

U.S. Department of Energy Contract DE-AC06-96RL13200

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Total Pages: 33

Key Words: UO_3 , U-Plant, T-Hopper, Radiological Release

Abstract: The radiological results of a release of UO_3 powder from the T-Hopper Storage Pad near 271-U were calculated.

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Jessie Aardal 1-27-98
Release Approval Date

Release Stamp

Approved for Public Release

Calculational Note for the Radiological Effects of a UO_3 Release
from the T-Hopper Storage Pad

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Calculational Note for the Radiological Effects of a UO_3 Release
from the T-Hopper Storage Pad

Purpose

UO_3 powder is stored at the T-hopper storage area associated with the 2714-U building in the 200 west area. The T-hopper containers and 13 drums containing this material are used to store the powder on pads immediately north of the building.

An interim safety basis document (WHC,1996) was issued in 1996. In this document the isotope ^{99}Tc was not included in the source term used to calculate the radiological consequences of a postulated release of the powder. This calculational note is intended to remedy that deficiency.

Input Data and Assumptions

There is a total of 669,045 kg of uranium at the facility that is at risk for release to the atmosphere. Since uranium comprises 83.217 wt% of UO_3 , this represents a little over 804 tonnes of powder. The postulated accident scenario is that 0.001 of the material at risk is released to the atmosphere. The isotopic composition supplied by the customer is as follows;

Table 1: Isotopic Composition of UO_3 Powder	
Isotope	Weight Percent
^{238}U	99.081
^{236}U	0.073
^{235}U	0.836
^{234}U	0.009
^{99}Tc	0.001

Methodology and Calculations

The use of specific activity data from RHO,1984 and folding in the release fractions the material released was calculated.

Table 2: Activity Released to the Atmosphere				
Isotope	Fractional Abundance	Specific Activity (Ci/g)	Total Activity (Ci)	Total Released (Ci)
²³⁸ U	0.99081	3.36×10^{-7}	2.23×10^{-2}	2.23×10^{-1}
²³⁶ U	0.00073	6.47×10^{-5}	3.16×10^{-1}	3.16×10^{-2}
²³⁵ U	0.00836	2.16×10^{-6}	1.21×10^{-1}	1.21×10^{-2}
²³⁴ U	0.00009	6.25×10^{-3}	3.67×10^{-2}	3.76×10^{-1}
⁹⁹ Tc	0.00001	1.70×10^{-2}	1.14×10^{-2}	1.14×10^{-1}

The onsite receptor was assumed to be 100m from the point of release. The distance to the site boundary was estimated for sixteen directions centered on the point of release. These data were entered into the computer code GXQ (WHC,1994) which calculated the normalized exposure, ψ/Q ¹ for each of these directions and distances.

¹ The normalized exposure in units of s/m^3 is the time integrated normalized concentration, $\psi/Q = \int \chi/Q \, dt$. χ/Q is in units of m^{-3} . If the release rate is constant, this can also be expressed as $\psi/Q = \chi/Q'$, however, where the integral expression is correct over any time period, the second expression gives the normalized exposure only over an infinitesimal time, dt , centered at the time of interest.

Table 3: Distances from the Release Point to the Site Boundaries (m)	
Transport Direction	Distance
S	13710
SSW	13930
SW	15700
WSW	13380
W	13110
WNW	13400
NW	16420
NNW	17490
N	19210
NNE	27610
NE	26170
ENE	22980
E	22800
ESE	28320
SE	22790
SSE	19310

In the time interval between the original ISB and the present analysis, the procedure for these calculations has been standardized to conform to NRC,1982, which states that the values should be the maximum of

- those values exceeded in each sector no more than 0.5% of the time, and
- the values that are exceeded no more than 5% in all sectors.

In the present case, the maximum onsite ψ/Q value for 100 m was calculated to be 3.41×10^{-2} s/m³ with the wind blowing at 0.89 m/s towards the east, and the maximum site boundary ψ/Q was calculated to be 1.52×10^{-5} s/m³ with the wind blowing at 2.65 m/s towards the west. On both cases the 99.5% calculation was used.

The bivariate gaussian meteorological computer code GENII (PNL, 1988) was run to calculate the doses from the release. The onsite receptor dose was calculated using inhalation and direct external doses, while the site boundary receptor dose was calculated using inhalation, ingestion, and direct external doses.

When large numbers of radionuclides existing in a variety of chemical states or when the chemical state is unknown the standard practice is to use the worst case lung translocation, or inhalation class for each isotope. However, in ICRP 30 (ICRP, 1978) it states that the class weeks (W) is appropriate for UO₃. (See also Hursh, 1973 and Morrow, 1972) Thus, the group weeks was chosen for the translocation class.

The libraries used for this GENII run were

GENII Default Parameter Values (28-Mar-90 RAP)
 Radionuclide Library - Times < 100 years (23-July-93 PDR)
 PNL Food Transfer Factor Library (by Z, with Fr&Os 7/19/93 PDR)
 Bioaccumulation Factor Library - (30-Aug-88) RAP
 External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90) RAP
 Moderately Soluble Yearly Dose Increments (23-Jul-93 PDR).

The meteorological data used was 9-year averaged Hanford data, jf20010.9y. GENII calculates doses for each of the seasons. The worst case situation, Autumn, was used in this analysis.

Results

The maximally exposed onsite receptor is located 100 m to the east of the release and is expected to receive an effective dose equivalent (EDE) of 560 mSv (56 rem). The most highly exposed organ, the lung, is expected to receive an absorbed dose of 4.2 Sv (420 rem).

The maximally exposed site boundary receptor is located 13 km to the west of the release and is expected to receive an EDE of 1.1 mSv (0.11 rem). The most highly exposed organ, the bone surfaces, is expected to receive 13 mSv (1.3 rem).

Note in the onsite case ⁹⁹Tc contributes 0.020% of the total EDE, while in the site boundary case it contributes 0.118% of the total EDE. This would indicate that this isotope could have been left out of the calculations with no difference in results.

References

- ICRP,1978, *Limits for Intakes of Radionuclides by Workers*, ICRP publication 30, Pergamon Press, Oxford, U.K., 1978.
- Hursh, 1973, *Uranium, Plutonium, Transplutonium Elements pp. 197-239*, J.B. Hursh and N. L. Spoor, Eds. Hodge, Stannard, and Hursh, Springer-Verlag, Berlin, Germany, 1973.
- Morrow,1972, *Inhalation Studies of Uranium Trioxide*, P. E. Morrow, F. R. Gibb, and H. D. Beiter, Health Physics, 23, 273-280, 1972.
- NRC,1982, *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants*, NRC Regulatory Guide 1.145, U. S. Nuclear Regulatory Commission, Washington, D. C., 1984
- PNL,1988, GENII - The Hanford Environmental Radiation Dosimetry Software System, PNL-6584, B. A. Napier, R. A. Peloquin, D. L. Strenge, J. V. Ramsdell, Pacific Northwest National Laboratory, Richland, Washington, 1988.
- RHO,1984, *Specific Activity and Heat Generation for Selected Radionuclides*, SD-RE-TI-121, T. D. Kirkpatric and R. C. Brown, Rockwell Hanford Corporation, Richland, Washington, 1984.
- WHC,1995, *GXQ 4.0 Program User's Guide*, WHC-SD-GN-SWD-30002, Rev 1, B. E. Hey, Westinghouse Hanford Company, Richland, Washington, 1995.
- WHC,1996, *Interim Safety Basis for Uranium Trioxide (UO₃) Powder Storage*, WHC-SD-CP-ISB-003, Rev. 0, E. N. Dodd III, Westinghouse Hanford Company, Richland, Washington, 1996.

Independent Reviews

CHECKLIST FOR INDEPENDENT TECHNICAL REVIEW

DOCUMENT REVIEWED

NUMBER: HNF-2105

TITLE: Calculational Note for Radiological Effects of A UO₂ Release
From the T-Hopper Storage PadAUTHOR(s): H. J. Goldberg

I. Method(s) of Review

- ☒ Input data checked for accuracy
- ☒ Independent calculation performed
 - ☐ Hand calculation
 - ☐ Alternate computer code: _____
- ☐ Comparison to experiment or previous results
- ☐ Alternate method (define) _____

II. Checklist (either check or enter NA if not applied)

- ☒ Task completely defined
- ☒ Activity consistent with task specification
- ☒ Necessary assumptions explicitly stated and supported
- ☒ Resources properly identified and referenced
- ☒ Resource documentation appropriate for this application
- ☒ Input data explicitly stated
- ☒ Input data verified to be consistent with original source
- ☒ Geometric model adequate representation of actual geometry
- ☒ Material properties appropriate and reasonable
- ☒ Mathematical derivations checked including dimensional consistency
- ☒ Hand calculations checked for errors
- ☒ Assumptions explicitly stated and justified
- ☒ Computer software appropriate for task and used within range of validity
- ☒ Use of resource outside range of established validity is justified
- ☒ Software runstreams correct and consistent with results
- ☒ Software output consistent with input
- ☒ Results consistent with applicable previous experimental or analytical findings
- ☒ Results and conclusions address all points and are consistent with task requirements and/or established limits or criteria
- ☒ Conclusions consistent with analytical results and established limits
- ☒ Uncertainty assesment appropriate and reasonable
- ☐ Other (define) _____

III. Comments: _____

IV. REVIEWER: Paul Rittmann PhD CHP DATE: Jan 14, 1998

HEDOP REVIEW CHECKLIST
for
Radiological and Nonradiological Release Calculations

Document Reviewed: Calculational Note for the Radiological Effects of

A UO₃ Release from the T-Hopper Storage Pad

Submitted by: H. J. Goldberg Date Submitted: 12 Jan 1998

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.

Reviewer Name: Paul D. Rittman, Ph.D., CHP
(print or type)

HEDOP-Approved Reviewer (Signature) Paul Rittman Date 1/14/98

Computer Output Decks

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 = 01/08/98

Run Time = 14:14:46.18

INPUT ECHO:

Input title line

c U03 release from T-Hopper - U-Plant - 99.5%

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

X/Q AND WIND SPEED ADJUSTMENT MODELS:

c ipuff idep isrc iwind
 0 0 0 0

DIFFUSION COEFFICIENT ADJUSTMENT MODELS:

c iwake ipm iflow ientr
 0 0 0 0

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

PARAMETER INPUT:

	reference anemometer	mixing height	frequency to exceed Cx(%)	
release height hs(m)	height ha(m)	height hm(m)		
0.00000E+00	1.00000E+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(l) qh(w)
2.00000E+01	2.20000E+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.

MODELS SELECTED:

Default Gaussian plume model selected.

WARNING/ERROR MESSAGES:

JOINT FREQUENCY DATA:

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

Created 8/26/92 KR

Input title line

SECTOR	DISTANCE (m)	RECEPT HEIGHT (m)	SECT. FREQ. (%)	POPULATION	TOTAL POPULATION 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	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	13710	0	6.30	1	7.54E-06	7.54E-06	E	0.89
SSW	13930	0	4.53	1	4.65E-06	4.65E-06	F	2.65
SW	15700	0	2.93	1	5.13E-06	5.13E-06	F	2.65
WSW	13380	0	2.72	1	6.29E-06	6.29E-06	F	2.65
W	13110	0	4.80	1	1.52E-05	1.52E-05	G	2.65
WNW	13400	0	3.98	1	8.33E-06	8.33E-06	G	4.70
NW	16420	0	4.72	1	1.19E-05	1.19E-05	G	2.65
NNW	17490	0	4.58	1	1.11E-05	1.11E-05	G	2.65
N	19210	0	4.36	1	1.05E-05	1.05E-05	G	2.65
NNE	27610	0	2.49	1	2.92E-06	2.92E-06	E	0.89
NE	26170	0	3.90	1	3.38E-06	3.38E-06	E	0.89
ENE	22980	0	6.17	1	6.87E-06	6.87E-06	G	2.65
E	22800	0	14.05	1	9.28E-06	9.28E-06	F	0.89
ESE	28320	0	18.80	1	6.80E-06	6.80E-06	F	0.89
SE	22790	0	10.83	1	8.42E-06	8.42E-06	G	2.65
SSE	19310	0	4.78	1	5.00E-06	5.00E-06	G	4.70

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

Case title: UO3 Release - Dose to Worker

Executed on: 01/08/98 at 15:12:08

Page A. 1

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

THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
Air

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

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

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

Input file name: \GENII\uo3-w.in
GENII Default Parameter Values (28-Mar-90 RAP)
Radionuclide Library - Times<100 years (23-July-93 PDR)
External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R)
Moderately Soluble Yearly Dose Increments (23-Jul-93 PDR)

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

Release	Surface Buried		
Radio-	Air	Water	Source
nuclide	Ci/yr	Ci/yr	Ci/m3
TC99	1.1E-01	0.0E+00	0.0E+00
U 234	3.8E-01	0.0E+00	0.0E+00
U 235	1.2E-02	0.0E+00	0.0E+00
TH231	1.2E-02	0.0E+00	0.0E+00
U 236	3.2E-02	0.0E+00	0.0E+00
U 238	2.2E-01	0.0E+00	0.0E+00
TH234	2.2E-01	0.0E+00	0.0E+00
PA234	3.6E-04	0.0E+00	0.0E+00

===== AIR TRANSPORT =====

3.4E-02 Input E/Q value (s/m3)

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

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

=====

Input prepared by: _____ Date: _____

Input checked by: _____ Date: _____

=====

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

Case title: U03 Release - Dose to Worker

Executed on: 01/08/98 at 15:12:24

Page C. 1

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

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	2.0E-01	2.5E-01	5.0E-02
Breast	2.0E-01	1.5E-01	2.9E-02
R Marrow	5.9E+00	1.2E-01	7.0E-01
Lung	4.2E+02	1.2E-01	5.0E+01
Thyroid	2.0E-01	3.0E-02	6.1E-03
Bone Sur	9.0E+01	3.0E-02	2.7E+00
Kidneys	3.6E+01	6.0E-02	2.1E+00
LL Int.	1.0E+00	6.0E-02	6.2E-02
UL Int.	4.8E-01	6.0E-02	2.9E-02
S Int.	2.4E-01	6.0E-02	1.5E-02
Stomach	2.4E-01	6.0E-02	1.4E-02
Internal Effective Dose Equivalent			5.6E+01
External Dose			4.1E-05
Annual Effective Dose Equivalent			5.6E+01

Controlling Organ: Lung
 Controlling Pathway: Inh
 Controlling Radionuclide: U 234

Total Inhalation EDE: 5.6E+01
 Total Ingestion EDE: 0.0E+00

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

Case title: UO3 Release - Dose to Worker

Executed on: 01/08/98 at 15:12:24

Page C. 2

Acute release

Uptake/exposure period:

1.0

Dose commitment period:

50.0

Dose units:

Rem

		Dose Commitment Year				
		1	2	3	...	
Internal Intake Year:	3	0.0E+00 ...				
				+		
	2	0.0E+00 0.0E+00 ...				Internal Effective Dose Equivalent
				+		
	1	5.1E+01 + 1.4E+00 + 2.4E-01 + ... = 5.6E+01				
Internal Annual Dose		5.1E+01 + 1.4E+00 + 2.4E-01 + ... = 5.6E+01				Cumulative Internal Dose
		+	+	+	+	
External Annual Dose		4.1E-05 0.0E+00 0.0E+00 ... 4.1E-05				
Annual Dose		5.1E+01 + 1.4E+00 + 2.4E-01 + ... = 5.6E+01				Cumulative Dose
					5.1E+01	Maximum Annual Dose Occurred In Year 1

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

Case title: UO3 Release - Dose to Worker

Executed on: 01/08/98 at 15:12:24

Page C. 3

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

Radio- nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
TC 99	1.1E-02	0.0E+00	2.9E-08	1.1E-02	1.1E-02
U 236	2.7E+00	0.0E+00	3.6E-08	2.7E+00	2.7E+00
U 234	3.4E+01	0.0E+00	5.4E-07	3.4E+01	3.4E+01
U 238	1.7E+01	0.0E+00	2.2E-07	1.7E+01	1.7E+01
TH 234	7.3E-02	0.0E+00	3.4E-05	7.3E-02	7.3E-02
PA 234	3.2E-06	0.0E+00	5.0E-06	3.2E-06	8.1E-06
U 235	1.0E+00	0.0E+00	0.0E+00	1.0E+00	1.0E+00
TH 231	1.2E-04	0.0E+00	6.9E-07	1.2E-04	1.2E-04

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

Case title: UO3 Release - Dose to Public

Executed on: 01/08/98 at 15:12:30

Page A. 1

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

THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
Air

THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
Infinite plume, external
Inhalation uptake
Drinking water ingestion
Aquatic foods ingestion
Terrestrial foods ingestion
Animal product ingestion
Inadvertent soil ingestion

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

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

Input file name: \GENII\uo3-p.in
GENII Default Parameter Values (28-Mar-90 RAP)
Radionuclide Library - Times<100 years (23-July-93 PDR)
PNL Food Transfer Factor Library (by Z, with Fr&Os 7/19/93 PDR)
Bioaccumulation Factor Library - (30-Aug-88) RAP
External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R
Moderately Soluble Yearly Dose Increments (23-Jul-93 PDR)

-----Release Terms-----			
Release	Air	Surface	Buried
Radio-		Water	Source
nuclide	Ci/yr	Ci/yr	Ci/m3
TC99	1.1E-01	0.0E+00	0.0E+00
U 234	3.8E-01	0.0E+00	0.0E+00
U 235	1.2E-02	0.0E+00	0.0E+00
TH231	1.2E-02	0.0E+00	0.0E+00
U 236	3.2E-02	0.0E+00	0.0E+00
U 238	2.2E-01	0.0E+00	0.0E+00
TH234	2.2E-01	0.0E+00	0.0E+00
PA234	3.6E-04	0.0E+00	0.0E+00

===== AIR TRANSPORT =====
1.5E-05 Input E/Q value (s/m3)

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

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

===== INGESTION POPULATION =====
1 Atmospheric production definition: 1 - Use population-weighted chi/Q

===== DRINKING WATER SOURCE/IRRIGATION =====
7.3E+02 Drinking water consumption rate (l/yr)
0 Drinking water source: 1-ground, 2-surface, 3-system
T Drinking water treatment: T/F
1.0 Drinking water transit/holdup time (d)

===== AQUATIC FOODS INGESTION =====

FOOD TYPE	TRAN- SIT h	PROD- UCTION kg/yr	----CONSUMPTION----	
			HOLDUP d	RATE kg/yr
Fish	0.00E+00		1.00E+00	4.00E+01
Mollusc	0.00E+00		0.00E+00	6.90E+00
Crustace	0.00E+00		0.00E+00	6.90E+00
Aqu Plnt	0.00E+00		0.00E+00	6.90E+00

===== TERRESTRIAL FOOD INGESTION =====

FOOD TYPE	GROW TIME d	--IRRIGATION-- S RATE * in/yr		TIME mo/yr	YIELD kg/m2	PROD- UCTION kg/yr	--CONSUMPTION-- HOLDUP d		RATE kg/yr
Leaf Veg	90.0	0	0.0	0.0	1.5		1.0	3.0E+01	
Oth. Veg	90.0	0	0.0	0.0	4.0		5.0	2.2E+02	
Fruit	90.0	0	0.0	0.0	2.0		5.0	3.3E+02	
Cereals	90.0	0	0.0	0.0	0.8		180.0	8.0E+01	

===== ANIMAL FOOD INGESTION =====

FOOD TYPE	---HUMAN---		TOTAL PROD- UCTION kg/yr	DRINK WATER CONTAM FRACT.	DIET FRAC- TION	GROW TIME d	--STORED FEED-- --IRRIGATION--		STOR- YIELD kg/m3	AGE d
	CONSUMPTION RATE kg/yr	HOLDUP d					S *	RATE in/yr		
Meat	8.0E+01	15.0		0.00		90.00	0	0.0	0.0	0.80
Poultry	1.8E+01	1.0		0.00		90.00	0	0.0	0.0	0.80
Cow Milk	2.7E+02	1.0		0.00		45.00	0	0.0	0.0	2.00
Eggs	3.0E+01	1.0		0.00		90.00	0	0.0	0.0	0.80

----- FRESH FORAGE -----										
Meat						45.00	0	0.0	0.0	2.00
Cow Milk						30.00	0	0.0	0.0	1.50

Input prepared by: _____

Date: _____

Input checked by: _____

Date: _____

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

Case title: Winter: U03 Release - Dose to Public

Executed on: 01/08/98 at 15:12:48

Page C. 1

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

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	9.8E-05	2.5E-01	2.5E-05
Breast	9.8E-05	1.5E-01	1.5E-05
R Marrow	2.6E-03	1.2E-01	3.1E-04
Lung	1.8E-01	1.2E-01	2.2E-02
Thyroid	3.6E-04	3.0E-02	1.1E-05
Bone Sur	4.0E-02	3.0E-02	1.2E-03
Kidneys	1.6E-02	6.0E-02	9.5E-04
Stomach	1.2E-03	6.0E-02	7.5E-05
LL Int.	6.5E-04	6.0E-02	3.9E-05
UL Int.	2.8E-04	6.0E-02	1.7E-05
S Int.	1.3E-04	6.0E-02	7.7E-06
Internal Effective Dose Equivalent			2.5E-02
External Dose			1.9E-08
Annual Effective Dose Equivalent			2.5E-02

Controlling Organ: Lung
 Controlling Pathway: Inh
 Controlling Radionuclide: U 234

Total Inhalation EDE: 2.5E-02
 Total Ingestion EDE: 1.1E-04

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

Case title: Winter: U03 Release - Dose to Public

Executed on: 01/08/98 at 15:12:48

Page C. 2

Acute release

Uptake/exposure period:

1.0

Dose commitment period:

50.0

Dose units:

Rem

		Dose Commitment Year				
		1	2	3	...	
Internal	:					
Intake	:					
Year:	3			0.0E+00	...	
				+		
	2		0.0E+00	0.0E+00	...	Internal
			+	+		Effective
	1	2.3E-02	+ 6.1E-04	+ 1.1E-04	+ ... = 2.5E-02	Dose
						Equivalent
Internal						Cumulative
Annual		2.3E-02	+ 6.1E-04	+ 1.1E-04	+ ... = 2.5E-02	Internal
Dose						Dose
		+	+	+	+	
External						
Annual		1.9E-08	0.0E+00	0.0E+00	...	1.9E-08
Dose						
Annual						Cumulative
Dose		2.3E-02	+ 6.1E-04	+ 1.1E-04	+ ... = 2.5E-02	Dose
					2.3E-02	Maximum
						Annual
						Dose Occurred
						In Year 1

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

Case title: Winter: U03 Release - Dose to Public

Executed on: 01/08/98 at 15:12:48

Page C. 3

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

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
TC 99	4.9E-06	1.0E-04	1.3E-11	1.1E-04	1.1E-04
U 236	1.2E-03	4.1E-07	1.5E-11	1.2E-03	1.2E-03
U 234	1.5E-02	5.1E-06	2.4E-10	1.5E-02	1.5E-02
U 238	7.7E-03	2.6E-06	9.9E-11	7.7E-03	7.7E-03
TH 234	3.2E-05	1.4E-07	1.6E-08	3.2E-05	3.2E-05
PA 234	1.4E-09	3.7E-11	2.2E-09	1.4E-09	3.6E-09
U 235	4.5E-04	1.5E-07	0.0E+00	4.5E-04	4.5E-04
TH 231	5.2E-08	7.1E-10	3.1E-10	5.3E-08	5.3E-08

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

Case title: Spring: U03 Release - Dose to Public

Executed on: 01/08/98 at 15:12:51

Page C. 4

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

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	1.5E-04	2.5E-01	3.7E-05
Breast	1.5E-04	1.5E-01	2.2E-05
R Marrow	4.0E-03	1.2E-01	4.8E-04
Lung	1.8E-01	1.2E-01	2.2E-02
Thyroid	4.0E-04	3.0E-02	1.2E-05
Bone Sur	6.1E-02	3.0E-02	1.8E-03
Kidneys	2.5E-02	6.0E-02	1.5E-03
LL Int.	2.0E-03	6.0E-02	1.2E-04
Stomach	1.3E-03	6.0E-02	7.8E-05
UL Int.	7.5E-04	6.0E-02	4.5E-05
S Int.	2.5E-04	6.0E-02	1.5E-05
Internal Effective Dose Equivalent			2.6E-02
External Dose			1.9E-08
Annual Effective Dose Equivalent			2.6E-02

Controlling Organ: Lung
 Controlling Pathway: Inh
 Controlling Radionuclide: U 234

Total Inhalation EDE: 2.5E-02
 Total Ingestion EDE: 1.6E-03

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

Case title: Spring: U03 Release - Dose to Public

Executed on: 01/08/98 at 15:12:51

Page C. 5

Acute release

Uptake/exposure period:

1.0

Dose commitment period:

50.0

Dose units:

Rem

		Dose Commitment Year					
		1	2	3	...		
Internal Intake Year:	3	0.0E+00 ...					
	2	0.0E+00 0.0E+00 ...				Internal Effective Dose Equivalent	
	1	2.3E-02 + 7.0E-04 + 1.7E-04 + ... = 2.6E-02					
Internal Annual Dose		2.3E-02	7.0E-04	1.7E-04	...	2.6E-02	Cumulative Internal Dose
External Annual Dose		1.9E-08	0.0E+00	0.0E+00	...	1.9E-08	
Annual Dose		2.3E-02 + 7.0E-04 + 1.7E-04 + ...				= 2.6E-02	Cumulative Dose
						2.3E-02	Maximum Annual Dose Occurred In Year 1

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

Case title: Spring: U03 Release - Dose to Public

Executed on: 01/08/98 at 15:12:51

Page C. 6

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

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
TC 99	4.9E-06	9.9E-05	1.3E-11	1.0E-04	1.0E-04
U 236	1.2E-03	7.2E-05	1.5E-11	1.3E-03	1.3E-03
U 234	1.5E-02	8.9E-04	2.4E-10	1.6E-02	1.6E-02
U 238	7.7E-03	4.6E-04	9.9E-11	8.2E-03	8.2E-03
TH 234	3.2E-05	3.3E-05	1.6E-08	6.5E-05	6.5E-05
PA 234	1.4E-09	8.7E-09	2.2E-09	1.0E-08	1.2E-08
U 235	4.5E-04	2.7E-05	0.0E+00	4.8E-04	4.8E-04
TH 231	5.2E-08	1.1E-07	3.1E-10	1.7E-07	1.7E-07

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

Case title: Summer: U03 Release - Dose to Public

Executed on: 01/08/98 at 15:12:54

Page C. 7

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

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	6.1E-04	2.5E-01	1.5E-04
Breast	6.0E-04	1.5E-01	9.1E-05
R Marrow	1.7E-02	1.2E-01	2.0E-03
Lung	1.8E-01	1.2E-01	2.2E-02
Thyroid	9.0E-04	3.0E-02	2.7E-05
Bone Sur	2.6E-01	3.0E-02	7.8E-03
Kidneys	1.1E-01	6.0E-02	6.4E-03
LL Int.	1.4E-02	6.0E-02	8.1E-04
UL Int.	4.9E-03	6.0E-02	2.9E-04
Stomach	2.2E-03	6.0E-02	1.3E-04
S Int.	1.3E-03	6.0E-02	8.0E-05
Internal Effective Dose Equivalent			4.0E-02
External Dose			1.9E-08
Annual Effective Dose Equivalent			4.0E-02

Controlling Organ:	Bone Sur
Controlling Pathway:	Inh
Controlling Radionuclide:	U 234

Total Inhalation EDE:	2.5E-02
Total Ingestion EDE:	1.5E-02

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

Case title: Summer: U03 Release - Dose to Public

Executed on: 01/08/98 at 15:12:54

Page C. 8

Acute release

Uptake/exposure period:

Dose commitment period:

Dose units:

1.0

50.0

Rem

		Dose Commitment Year				
		1	2	3	...	
Internal Intake Year:	3			0.0E+00	...	
				+		
	2		0.0E+00	0.0E+00	...	Internal Effective Dose Equivalent
			+	+		
	1	2.8E-02	+ 1.6E-03	+ 8.1E-04	+ ... = 4.0E-02	
Internal Annual Dose		2.8E-02	+ 1.6E-03	+ 8.1E-04	+ ... = 4.0E-02	Cumulative Internal Dose
		+	+	+	+	
External Annual Dose		1.9E-08	0.0E+00	0.0E+00	... 1.9E-08	
Annual Dose		2.8E-02	+ 1.6E-03	+ 8.1E-04	+ ... = 4.0E-02	Cumulative Dose
					2.8E-02	Maximum Annual Dose Occurred In Year 1

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

Case title: Summer: U03 Release - Dose to Public

Executed on: 01/08/98 at 15:12:54

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

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
TC 99	4.9E-06	1.2E-04	1.3E-11	1.2E-04	1.2E-04
U 236	1.2E-03	7.3E-04	1.5E-11	1.9E-03	1.9E-03
U 234	1.5E-02	9.2E-03	2.4E-10	2.4E-02	2.4E-02
U 238	7.7E-03	4.9E-03	9.9E-11	1.3E-02	1.3E-02
TH 234	3.2E-05	2.6E-04	1.6E-08	2.9E-04	2.9E-04
PA 234	1.4E-09	6.8E-08	2.2E-09	6.9E-08	7.1E-08
U 235	4.5E-04	2.7E-04	0.0E+00	7.2E-04	7.2E-04
TH 231	5.2E-08	1.3E-06	3.1E-10	1.4E-06	1.4E-06

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

Case title: Autumn: U03 Release - Dose to Public

Executed on: 01/08/98 at 15:12:56

Page C. 10

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

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	3.0E-03	2.5E-01	7.5E-04
Breast	3.0E-03	1.5E-01	4.5E-04
R Marrow	8.5E-02	1.2E-01	1.0E-02
Lung	1.9E-01	1.2E-01	2.2E-02
Thyroid	3.3E-03	3.0E-02	9.9E-05
Bone Sur	1.3E+00	3.0E-02	3.9E-02
Kidneys	5.4E-01	6.0E-02	3.3E-02
LL Int.	7.6E-02	6.0E-02	4.5E-03
UL Int.	2.7E-02	6.0E-02	1.6E-03
S Int.	7.1E-03	6.0E-02	4.3E-04
Stomach	6.0E-03	6.0E-02	3.6E-04
Internal Effective Dose Equivalent			1.1E-01
External Dose			1.9E-08
Annual Effective Dose Equivalent			1.1E-01

Controlling Organ: Bone Sur
 Controlling Pathway: Ing
 Controlling Radionuclide: U 234

Total Inhalation EDE: 2.5E-02
 Total Ingestion EDE: 8.8E-02

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

Case title: Autumn: U03 Release - Dose to Public

Executed on: 01/08/98 at 15:12:56

Page C. 11

Acute release

Uptake/exposure period:

Dose commitment period:

Dose units:

1.0

50.0

Rem

		Dose Commitment Year				
		1	2	3	...	
Internal Intake	:					
Year:	3			0.0E+00	...	
				+		
	2		0.0E+00	0.0E+00	...	Internal Effective Dose Equivalent.
			+	+		
	1	5.2E-02	+ 6.0E-03	+ 4.2E-03	+ ... = 1.1E-01	
Internal Annual Dose		5.2E-02	+ 6.0E-03	+ 4.2E-03	+ ... = 1.1E-01	Cumulative Internal Dose
		+	+	+	+	
External Annual Dose		1.9E-08	0.0E+00	0.0E+00	... 1.9E-08	
Annual Dose		5.2E-02	+ 6.0E-03	+ 4.2E-03	+ ... = 1.1E-01	Cumulative Dose
					5.2E-02	Maximum Annual Dose Occurred In Year 1

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

Case title: Autumn: UO3 Release - Dose to Public

Executed on: 01/08/98 at 15:12:56

Page C. 12

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

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
TC 99	4.9E-06	1.2E-04	1.3E-11	1.3E-04	1.3E-04
U 236	1.2E-03	4.2E-03	1.5E-11	5.4E-03	5.4E-03
U 234	1.5E-02	5.3E-02	2.4E-10	6.8E-02	6.8E-02
U 238	7.7E-03	2.8E-02	9.9E-11	3.6E-02	3.6E-02
TH 234	3.2E-05	1.6E-03	1.6E-08	1.6E-03	1.6E-03
PA 234	1.4E-09	4.1E-07	2.2E-09	4.2E-07	4.2E-07
U 235	4.5E-04	1.6E-03	0.0E+00	2.0E-03	2.0E-03
TH 231	5.2E-08	7.5E-06	3.1E-10	7.5E-06	7.5E-06

DISTRIBUTION SHEET

To Distribution	From Criticality and Shielding	Page 1 of 1			
		Date January 13, 1998			
Project Title/Work Order Calculational Note for the Radiological Effects of a UO ₃ Release from the T-Hopper Storage Pad		EDT No. 622995			
		ECN No.			
Name	MSIN	Text With All Attach.	Text Only	Attach./Appendix Only	EDT/ECN Only

M. M. Benecke	L6-26	X
J. P. Estrellado, Jr.	B4-44	X
H. J. Goldberg	B4-44	X
B. E. Hey	B4-47	X
P. K. Sato	E6-70	X
Central Files (Original + 1)	B1-07	X