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ENGINEERING CHANGE NOTICE

1. ECN	644796
Proj. ECN	

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.		4. USQ Required?	5. Date
Supplemental []	H. J. Goldberg, Criticality and Shielding, B4-44, 376-3765		[X] Yes [] No	06/09/98
Direct Revision [X]				
Change ECN []	6. Project Title/No./Work Order No		7. Bldg./Sys./Fac. No.	8. Approval Designator
Temporary []	UO_3 Release T-Hopper Pad		N/A	SQ
Standby []				
Supersedure []	9. Document Numbers Changed by this ECN (includes sheet no. and rev.)		10. Related ECN No(s).	11. Related PO No.
Cancel/Void []	HNF-2105, Rev. 0		N/A	N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b)	N/A	N/A	N/A
[X] No (NA Blks. 12b, 12c, 12d)		Design Authority/Cog. Engineer Signature & Date	Design Authority/Cog. Engineer Signature & Date

13a. Description of Change   **13b. Design Baseline Document?** [X] Yes [] No

Lung Translocation class changed which changed the radiological effects and necessitated inclusion of toxicological effects analysis.

Independent design verification performed by FDNW technical peer review.

14a. Justification (mark one)

Criteria Change [X]	Design Improvement []	Environmental []	Facility Deactivation []
As-Found []	Facilitate Const []	Const. Error/Omission []	Design Error/Omission [X]

14b. Justification Details

Comply with HNF-PRO-704 criteria.

15. Distribution (include name, MSIN, and no. of copies)
See attached Distribution Sheet.

RELEASE STAMP

JUN 18 1998

DATE: HANFORD

STA: 37   RELEASE   ID:

A-7900-013-2 (05/96) GEF095

16. Design Verification Required	17. Cost Impact						18. Schedule Impact (days)	
		ENGINEERING			CONSTRUCTION			
[x] Yes	Additional	[] $		Additional	[] $		Improvement	[]
[] No	Savings	[] $		Savings	[] $		Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
None		

21. Approvals

Signature	Date	Signature	Date
Design Authority *M W Gameby* 13 Jun 98		Design Agent	
Cog. Eng. HJ Goldberg *Harvey Goldby*	*15 June 1998*	PE	
Cog. Mgr. JP Estrellado, Jr.	6/15/98	QA	
QA ME Riste *ME*	6/18/98	Safety	
Safety AM Horner *A M. A*	6/10/98	Design	
Environ.		Environ.	
		Other	
Tech Peer Review PD Rittmann *Paul Rittmann*	6/15/98		
		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

A-7900-013-3 (05/96) GEF096

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Calculational Note for the Radiological and Toxicological 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

Abstract: The radiological and toxicological consequences of a
hypothetical release of UO_3 powder from the T-hopper storage pad
adjacent the 2714-U building were calculated.

JUN 18 1998

DATE: HANFORD
STA: 37 RELEASE
ID:
20
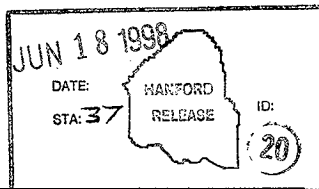
Release Approval   6-18-98
                        Date

Release Stamp

Approved for Public Release

	RECORD OF REVISION		(1) Document Number		
			HNF-2105, Rev. 1		Page 1

(2) Title

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

		CHANGE CONTROL RECORD		
			Authorized for Release	
(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages		(5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Original release per EDT 622995		HJ Goldberg	JP Estrellado, Jr
1 ℞	Lung Translocation class of UO_3 changed which changed the radiological effects and necessitated consideration of toxicological effects. ECN 644796		HJ Goldberg *Harvey Holdberg*	JP Estrellado, Jr. *[signature]* 6/15/98

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

Table of Contents

Calculational Note for the Radiological and Toxicological 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 for the UO_3 powder storage area. 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. A calculational note (HNF,1998) was issued to remedy that deficiency. The present document is a revision to that document to reflect updated data concerning the solubility of UO_3 in simulated lung fluid and to utilize more realistic powder release fractions.

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. Millward, 1993 describes the UO_3 powder thusly;

The shape of the UO3 powder produced at the UO_3 Plant is spherical, resembling a small fertilizer prill. The structure of the powder particle is a layered, onion-like construction.

The UO_3 Plant Safety Analysis Report (Yasutake, 1983) uses a respirable fraction (RF) of 1×10^{-2}. This is consistent with Millward, 1993, who reports the results of sieving the material. Using a 325 mesh (passing particles < $40\mu m$) 10% of the powder passed through this size screen. The SAR value for the RF was used in this analysis.

For the radiological release, Mishima, 1994 uses the value of 3×10^{-4} for the airborne release fraction for the free-fall spill of less than 3m of cohesionless powders under general low-wind outside conditions with the air velocity normal to the powder flow.

The toxicological analysis used a release rate since this determination is rate dependent. The rate of release generally is high at the beginning of a release and decreases with time as the most readily dispersable particles have been suspended. For comparison with guidelines, concentrations are calculated at the peak fifteen minute average concentrations for substances whose toxic effect is concentration-dependent. For a substance whose toxic effect is dose dependent, the peak one hour concentration is used. Uranium falls into the dose dependent category.

The customer has not supplied either a time over which the release happens nor a surface area for the powder spill. Mishima (DOE,1994) gives an upper bound for the release of a homogeneous bed of powder exposed to ambient conditions (u < 2 m/s with gusts up to 20 m/s) of 4×10^{-5} /hr. This figure is based on experiments at Hanford (PNL, 1975) which measured release rates ranging from 4×10^{-7}/hr to 4×10^{-5}/hr.

Garger, Gavrilov, and Zhukov (1992) modeled the Chernobyl releases and checked these with air sampling. The resuspension rates of 1×10^{-9}/s (3.6×10^{-6}/hr) for wind speeds of 5 m/s and 2×10^{-7}/s (7.2×10^{-4}/hr) for wind speeds of 15 m/s were calculated. Except for the high wind number all of these are below the number in Mishima that is used herein.

The isotopic composition supplied by the customer is as follows;

Table 1: Isotopic Composition of UO_2 Powder	
Isotope	Weight Percent
^{238}U	98.972
^{236}U	0.073
^{235}U	0.945
^{234}U	0.009
^{99}Tc	0.001

Methodology and Calculations

The use of specific activity data from RHO,1984 and folding in the respirable release fractions the yields the source term.

Table 2: Activity Released to the Atmosphere				
Isotope	Fractional Abundance	Specific Activity (Ci/g)	Total Activity (Ci)	Total Respirable Activity Released (Ci)
^{238}U	0.98972	3.36×10^{-7}	2.23×10^{2}	6.69×10^{-4}
^{236}U	0.00073	6.47×10^{-5}	3.16×10^{1}	9.48×10^{-5}
^{235}U	0.00945	2.16×10^{-6}	1.37×10^{1}	4.10×10^{-5}
^{234}U	0.00009	6.25×10^{-3}	3.76×10^{2}	1.13×10^{-3}
^{99}Tc	0.00001	1.70×10^{-2}	1.14×10^{2}	3.42×10^{-4}

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.

Table 3: Distances from the Release Point to the Site Boundaries (m)		
Transport Direction	Distance to Site Boundary	Distance to 240 & near bank of river
S	13710	4560
SSW	13930	4560
SW	15700	4920
WSW	13380	4970
W	13110	5060
WNW	13400	6710
NW	16420	9860
NNW	17490	10320
N	19210	10420
NNE	27610	13390
NE	26170	18600
ENE	22980	17870
E	22800	19660
ESE	28320	18820
SE	22790	10630
SSE	19310	5730

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[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 infintesimal time, dt, centered at the time of interest.

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/m^3 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/m^3 with the wind blowing at 2.65 m/s towards the west. For the onsite public individual, the maximum ψ/Q was calculated to be 5.21×10^{-5} s/m^3 with the wind blowing 2.65 m/s toward the west. This individual would be a traveler on route 240. On all of the cases the 99.5% calculation was used.

The bivariant 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[2], or inhalation class for each isotope. However, in ICRP 30 (ICRP,1978) it states that the class weeks (W) is appropriate for UO_3. (See also Hursh,1973 and Morrow,1972) This group was originally chosen for the translocation class. However, after the original document was issued, it was learned that EGG,1988 placed UO_3 in the class days (D).

Further investigation unearthed evidence that although UO_3 was grouped with insoluble oxides, a study with dogs indicated that it behaved more like the soluble uranyl nitrate (C.L.Yuile's article in H.C.Hodge,1973). Voigtlin and Hodge (Voigtlin, 1949) state that UO_3 is forty time as soluble in plasma.

Sula, et. al. (PNL, 1991) correct the original designation of UO_3 as class weeks in their original document. In the revision referenced herein, in the section specifically addressing the UO_3 Plant, they reference a solubility test using simulated lung fluid, performed on a smear sample from the UO_3 Plant in 1984. This test indicated that the material was approximately 80% class D and 20% class W. This was what is used in this calculational note.

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[2] The term translocation class has been used herein. This is often labeled as solubility class. However, the issue of occasional differences in the material's solubility in water and in blood plasma or lung fluid illustrates that the term transport class is a more accurate term, since it is an indication of the material's transport out of the lung.

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).
Very Soluble Yearly Dose Increments (23 Jul-93 PDR)

Note that two "solubility" classes were used.

The meteorological data used was 9-year averaged Hanford data, jf20010.9y. GENII (PNL,1988) calculates doses for each of the seasons. The worst case situation, Autumn, was used in this analysis. The doses for the onsite public were not run in separate runs of GENII, but scaled from the worker doses in proportion to their respective ψ/Qs. The customer originally specified a release factor of 1×10^{-3} and the GENII runs used this number. When the release fraction and respirable fraction used herein were substituted for this original number, the results were scaled to the new number rather than being recalculated.

Results

Table 4: Resulting Doses in mSv (rem)				
Receptor	Dose	Class Days	Class Weeks	80% Days + 20% Weeks
Worker	E.D.E.	0.58 (0.058)	1.6 (0.16)	0.78 (0.078)
	Bone Surface*	8.2 (0.82)	2.6 (0.26)	7.1 (0.71)
Public	E.D.E.	0.0029 (0.00029)	0.0033 (0.00033)	0.0030 (0.00030)
	Bone Surface*	0.041 (0.0041)	0.0038 (0.00038)	0.034 (0.0034)
Onsite Public	E.D.E.	0.00088 (0.000088)	0.0025 (0.00025)	0.0012 (0.00012)
	Bone Surface*	0.013 (0.0013)	0.0040 (0.00040)	0.011 (0.0011)

* For the class weeks form of the material, the limiting organ is the lung. However, overall the bone
surfaces predominate and thus the contribution to the dose to this organ is listed for the class weeks
material.

It was found that ^{99}Tc contributes negligibly to the doses. This would indicate that this isotope could have been left out of the calculations with no difference in results.

The toxicological results were obtained by multiplying the release rate with units of h^{-1}, times the material at risk by the ψ/Q with units of s/m^3, for each receptor, i.e.

$$\left(\frac{4 \times 10^{-5}/h}{3600 \ s/h} \right) \ (0.01) \ (6.69045 \times 10^{11}) \ mg \ \frac{\psi}{Q} \ s/m^3 \quad .$$

Note that the material at risk is the total amount times the fraction (1×10^{-2}) that is respirable. For the onsite receptor, this led to a concentration of 2.5 mg/m^3 and, for the offsite receptor, a concentration of 0.0011 mg/m^3, and for the member of the onsite public, a concentrations of 0.0039 mg/m^3.

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Independent Reviews

CHECKLIST FOR INDEPENDENT TECHNICAL REVIEW

DOCUMENT REVIEWED

NUMBER: HNF-2105 , REV. 1

TITLE: Calculational Note for Radiological and Toxicological Efects of A UO$_3$ Release From the T-Hopper Storage Pad

AUTHOR(s): H. J. Goldberg

I. Method(s) of Review
- ($\checkmark$) Input data checked for accuracy
- ($\checkmark$) Independent calculation performed
  - ($\checkmark$) Hand calculation
  - ( ) Alternate computer code:_____
- ( ) Comparison to experiment or previous results
- ( ) Alternate method (define)_____

II. Checklist (either check or enter NA if not applied)
- ($\checkmark$) Task completely defined
- ($\checkmark$) Activity consistent with task specification
- ($\checkmark$) Necessary assumptions explicitly stated and supported
- ($\checkmark$) Resources properly identified and referenced
- ($\checkmark$) Resource documentation appropriate for this application
- ($\checkmark$) Input data explicitly stated
- ($\checkmark$) Input data verified to be consistent with original source
- (na) Geometric model adequate representation of actual geometry
- (na) Material properties appropriate and reasonable
- (na) Mathematical derivations checked including dimensional consistency
- ($\checkmark$) Hand calculations checked for errors
- ($\checkmark$) Assumptions explicitly stated and justified
- ($\checkmark$) Computer software appropriate for task and used within range of validity
- (na) Use of resource outside range of established validity is justified
- ($\checkmark$) Software runstreams correct and consistent with results
- ($\checkmark$) Software output consistent with input
- ($\checkmark$) Results consistent with applicable previous experimental or analytical findings
- ($\checkmark$) Results and conclusions address all points and are consistent with task requirements and/or established limits or criteria
- ($\checkmark$) Conclusions consistent with analytical results and established limits
- (na) Uncertainty assesment appropriate and reasonable
- ( ) Other (define)_____

III. Comments:_____

IV. REVIEWER: _Paul Rittmann_ DATE: _6/15/98_

HEDOP REVIEW CHECKLIST
for
Radiological and Nonradiological Release Calculations

Document Reviewed: <u>Calculational Note for the Radiological and Toxicological</u>
<u>Effects of A UO₃ Release from the T-Hopper Storage Pad</u>

Submitted by: <u> H. J. Goldberg</u>   Date Submitted: <u>4 Feb 1998</u>

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: <u>Paul D. Rittman , Ph.D., CHP</u>
(print or type)

HEDOP-Approved Reviewer (Signature) *Paul Rittmann* Date <u>6/15/98</u>

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 UO3 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
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
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                   reference                     frequency
c     release       anemometer    mixing          to
c     height        height        height          exceed
c     hs(m)         ha(m)         hm(m)           Cx(%)
c
      0.00000E+00   1.00000E+01   1.00000E+03     5.00000E-01
c
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
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)
c
      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
    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

```
                    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 = 02/18/98
Run Time = 08:10:41.05

INPUT ECHO:
UO3 release from T-Hopper - U-Plant - 99.5% Road 240
c
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
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                     reference                   frequency
c    release          anemometer     mixing       to
c    height           height         height       exceed
c    hs(m)            ha(m)          hm(m)        Cx(%)
c
     0.00000E+00      1.00000E+01    1.00000E+03  5.00000E-01
c
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
```

```
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)
c
     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
     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

UO3 release from T-Hopper - U-Plant - 99.5% Road 240

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	4560	0	6.30	1	3.27E-05	3.27E-05	E	0.89
SSW	4560	0	4.53	1	2.37E-05	2.37E-05	F	2.65
SW	4920	0	2.93	1	2.31E-05	2.31E-05	F	2.65
WSW	4970	0	2.72	1	2.29E-05	2.29E-05	F	2.65
W	5060	0	4.80	1	5.21E-05	5.21E-05	G	2.65
WNW	6710	0	3.98	1	2.03E-05	2.03E-05	G	4.70
NW	9860	0	4.72	1	2.26E-05	2.26E-05	G	2.65
NNW	10320	0	4.58	1	2.14E-05	2.14E-05	G	2.65
N	10420	0	4.36	1	2.27E-05	2.27E-05	G	2.65
NNE	13390	0	2.49	1	7.46E-06	7.46E-06	E	0.89
NE	18600	0	3.90	1	5.20E-06	5.20E-06	E	0.89
ENE	17870	0	6.17	1	9.37E-06	9.37E-06	G	2.65
E	19660	0	14.05	1	1.11E-05	1.11E-05	F	0.89
ESE	18820	0	18.80	1	1.12E-05	1.12E-05	F	0.89
SE	10630	0	10.83	1	2.18E-05	2.18E-05	G	2.65
SSE	5730	0	4.78	1	2.43E-05	2.43E-05	G	4.70

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

Case title:   UO3 Release - Dose to Public - Class Days

Executed on:  06/12/98 at 13:26:14                             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
Very 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     3.4E-04 0.0E+00 0.0E+00
         U 234    1.1E-03 0.0E+00 0.0E+00
         U 235    4.1E-05 0.0E+00 0.0E+00
         TH231    4.1E-05 0.0E+00 0.0E+00
```

```
        U 236   9.5E-05 0.0E+00 0.0E+00
        U 238   6.7E-04 0.0E+00 0.0E+00
        TH234   6.7E-04 0.0E+00 0.0E+00
        PA234   1.1E-06 0.0E+00 0.0E+00
```

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

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

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

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

========== DRINKING WATER SOURCE/IRRIGATION ======================================
7.3E+02   Drinking water consumption rate (1/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 ===

```
                  TRAN-    PROD-    ----CONSUMPTION----
        FOOD      SIT      UCTION   HOLDUP    RATE
        TYPE      h        kg/yr    d         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--			YIELD kg/m2	PROD- UCTION kg/yr	--CONSUMPTION--	
		S	RATE * in/yr	TIME mo/yr			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---- CONSUMPTION RATE kg/yr	HOLDUP d	TOTAL PROD- UCTION kg/yr	DRINK WATER CONTAM FRACT.	DIET FRAC- TION	GROW TIME d	S *	-IRRIGATION-- RATE in/yr	TIME mo/yr	YIELD kg/m3	STOR- AGE d
						STORED FEED					
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: UO3 Release - Dose to Public - Class Days

Executed on: 06/12/98 at 13:26:36   Page C. 1
```
------------------------------------------------------------------------
```

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

                        Committed   Weighted
                          Dose   Weighting   Dose
           Organ   Equivalent   Factors   Equivalent
       --------------   ----------   ---------   ----------
           Gonads   5.8E-02   2.5E-01   1.4E-02
           Breast   5.8E-02   1.5E-01   8.6E-03
           R Marrow   1.6E+00   1.2E-01   1.9E-01
           Lung   7.4E-01   1.2E-01   8.9E-02
           Thyroid   1.1E-01   3.0E-02   3.3E-03
           Bone Sur   2.4E+01   3.0E-02   7.3E-01
           Kidneys   1.0E+01   6.0E-02   6.0E-01
           Stomach   2.9E-01   6.0E-02   1.7E-02
           LL Int.   1.3E-01   6.0E-02   7.6E-03
           UL Int.   8.1E-02   6.0E-02   4.9E-03
           S Int.   6.2E-02   6.0E-02   3.7E-03

       Internal Effective Dose Equivalent   1.7E+00
       External Dose   3.6E-06

       Annual Effective Dose Equivalent   1.7E+00

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

       Total Inhalation EDE: 1.7E+00
```

Total Ingestion EDE: 2.2E-02

.

.

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

Case title:  Winter: U03 Release - Dose to Public - Class Days

Executed on:  06/12/98 at 13:26:36                                  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   │ 5.6E-01 + 1.0E-01 + 7.8E-02 + ...  =  1.7E+00  Dose
                                                            Equivalent
                   ||          ||          ||
Internal                                                    Cumulative
Annual         5.6E-01 + 1.0E-01 + 7.8E-02 + ...  =  1.7E+00  Internal
Dose                                                        Dose
                   +           +           +                 +
External
Annual         3.6E-06     0.0E+00     0.0E+00  ...       3.6E-06
Dose
                   ||          ||          ||              ||
Annual                                                      Cumulative
Dose           5.6E-01 + 1.0E-01 + 7.8E-02 + ...  =  1.7E+00  Dose

                                                            Maximum
                                                 5.6E-01    Annual
                                                            Dose Occurred
                                                            In Year  1
```

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

Case title:   Winter: UO3 Release - Dose to Public - Class Days

Executed on:  06/12/98 at 13:26:36                                  Page C.  3
--------------------------------------------------------------------------------
```

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

              Inhalation Ingestion   Internal   Annual
              Effective   Effective   Effective   Effective
  Radio-   Dose   Dose   External   Dose   Dose
  nuclide   Equivalent Equivalent Dose   Equivalent Equivalent
  --------   ---------- ---------- ---------- ---------- ----------
  TC 99   1.8E-04   2.1E-02   2.7E-09   2.1E-02   2.1E-02
  U   236   8.1E-02   7.8E-05   3.1E-09   8.1E-02   8.1E-02
  U   234   9.8E-01   9.8E-04   4.6E-08   9.8E-01   9.8E-01
  U   238   5.5E-01   5.3E-04   1.9E-08   5.5E-01   5.5E-01
  TH 234   6.4E-03   2.8E-05   3.0E-06   6.5E-03   6.5E-03
  PA 234   2.8E-07   7.4E-09   4.5E-07   2.9E-07   7.3E-07
  U   235   3.6E-02   3.3E-05   0.0E+00   3.6E-02   3.6E-02
  TH 231   1.2E-05   1.6E-07   6.9E-08   1.2E-05   1.2E-05
  --------   ---------- ---------- ---------- ---------- ----------
</pre>

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

Case title:   Spring: UO3 Release - Dose to Public - Class Days

Executed on:  06/12/98 at 13:26:39                                   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	6.7E-02	2.5E-01	1.7E-02
Breast	6.7E-02	1.5E-01	1.0E-02
R Marrow	1.9E+00	1.2E-01	2.2E-01
Lung	7.5E-01	1.2E-01	9.0E-02
Thyroid	1.2E-01	3.0E-02	3.6E-03
Bone Sur	2.9E+01	3.0E-02	8.6E-01
Kidneys	1.2E+01	6.0E-02	7.0E-01
LL Int.	3.8E-01	6.0E-02	2.3E-02
Stomach	3.0E-01	6.0E-02	1.8E-02
UL Int.	1.7E-01	6.0E-02	1.0E-02
S Int.	8.5E-02	6.0E-02	5.1E-03

```
------------------------------------------------
Internal Effective Dose Equivalent      2.0E+00
External Dose                           3.6E-06
------------------------------------------------
Annual Effective Dose Equivalent        2.0E+00
```

```
--------------------------------------------------
Controlling Organ:                   Bone Sur
Controlling Pathway:                 Inh
Controlling Radionuclide:            U 234
--------------------------------------------------
Total Inhalation EDE:                1.7E+00
```

Total Ingestion EDE: 3.1E-01

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

Case title: Spring: UO3 Release - Dose to Public - Class Days

Executed on: 06/12/98 at 13:26:39   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
         1 │ 6.5E-01 + 1.2E-01 + 9.1E-02 + ... = 2.0E+00   Dose
            │   Equivalent
              || || ||
Internal   Cumulative
Annual   6.5E-01 + 1.2E-01 + 9.1E-02 + ... = 2.0E+00   Internal
Dose   Dose
               +   +   +   +
External
Annual   3.6E-06   0.0E+00   0.0E+00   ...   3.6E-06
Dose
              || || || ||
Annual   Cumulative
Dose   6.5E-01 + 1.2E-01 + 9.1E-02 + ... = 2.0E+00   Dose

                                                              Maximum
                                              6.5E-01   Annual
                                                              Dose Occurred
                                                              In Year 1

_____

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

Case title:   Spring: UO3 Release - Dose to Public - Class Days

Executed on:  06/12/98 at 13:26:39                                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	1.8E-04	2.0E-02	2.7E-09	2.0E-02	2.0E-02
U 236	8.1E-02	1.4E-02	3.1E-09	9.5E-02	9.5E-02
U 234	9.8E-01	1.7E-01	4.6E-08	1.2E+00	1.2E+00
U 238	5.5E-01	9.2E-02	1.9E-08	6.4E-01	6.4E-01
TH 234	6.4E-03	6.5E-03	3.0E-06	1.3E-02	1.3E-02
PA 234	2.8E-07	1.7E-06	4.5E-07	2.0E-06	2.4E-06
U 235	3.6E-02	5.9E-03	0.0E+00	4.1E-02	4.1E-02
TH 231	1.2E-05	2.6E-05	6.9E-08	3.8E-05	3.8E-05

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

Case title:   Summer: UO3 Release - Dose to Public - Class Days

Executed on:  06/12/98 at 13:26:41                                   Page C.  7
--------------------------------------------------------------------------------

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


                        Committed                 Weighted
                          Dose       Weighting      Dose
             Organ      Equivalent    Factors    Equivalent
             --------   ----------   ---------   ----------
             Gonads      1.6E-01     2.5E-01      3.9E-02
             Breast      1.6E-01     1.5E-01      2.3E-02
             R Marrow    4.4E+00     1.2E-01      5.3E-01
             Lung        8.4E-01     1.2E-01      1.0E-01
             Thyroid     2.2E-01     3.0E-02      6.5E-03
             Bone Sur    6.7E+01     3.0E-02      2.0E+00
             Kidneys     2.8E+01     6.0E-02      1.7E+00
             LL Int.     2.6E+00     6.0E-02      1.6E-01
             UL Int.     9.8E-01     6.0E-02      5.9E-02
             Stomach     4.8E-01     6.0E-02      2.9E-02
             S Int.      3.0E-01     6.0E-02      1.8E-02
             -----------------------------------------------
             Internal Effective Dose Equivalent    4.7E+00
             External Dose                         3.6E-06
             -----------------------------------------------
             Annual Effective Dose Equivalent      4.7E+00




             -----------------------------------------------
             Controlling Organ:               Bone Sur
             Controlling Pathway:             Ing
             Controlling Radionuclide:        U 234
             -----------------------------------------------
             Total Inhalation EDE:            1.7E+00
```

Total Ingestion EDE: 3.0E+00

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

Case title:   Summer: UO3 Release - Dose to Public - Class Days

Executed on:  06/12/98 at 13:26:41                          Page C.  8
```

```
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 │ 1.6E+00 + 2.9E-01 + 2.2E-01 + ... = 4.7E+00  Dose
                                                    Equivalent
             ‖        ‖         ‖
Internal                                            Cumulative
Annual       1.6E+00 + 2.9E-01 + 2.2E-01 + ... = 4.7E+00  Internal
Dose                                                Dose

             +         +         +                  +
External
Annual       3.6E-06   0.0E+00   0.0E+00  ...    3.6E-06
Dose
             ‖        ‖         ‖               ‖
Annual                                              Cumulative
Dose         1.6E+00 + 2.9E-01 + 2.2E-01 + ... = 4.7E+00  Dose

                                                    Maximum
                                          1.6E+00  Annual
                                                    Dose Occurred
                                                    In Year  1
```

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

Case title: Summer: UO3 Release - Dose to Public - Class Days

Executed on: 06/12/98 at 13:26:41   Page C. 9

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


              Inhalation  Ingestion                  Internal   Annual
              Effective   Effective                  Effective  Effective
   Radio-     Dose        Dose        External       Dose       Dose
   nuclide    Equivalent  Equivalent  Dose           Equivalent Equivalent
   --------   ----------  ----------  ----------     ---------- ----------
   TC 99       1.8E-04     2.4E-02     2.7E-09        2.4E-02    2.4E-02
   U   236     8.1E-02     1.4E-01     3.1E-09        2.3E-01    2.3E-01
   U   234     9.8E-01     1.8E+00     4.6E-08        2.7E+00    2.7E+00
   U   238     5.5E-01     9.7E-01     1.9E-08        1.5E+00    1.5E+00
   TH 234      6.4E-03     5.2E-02     3.0E-06        5.8E-02    5.8E-02
   PA 234      2.8E-07     1.4E-05     4.5E-07        1.4E-05    1.4E-05
   U   235     3.6E-02     6.2E-02     0.0E+00        9.7E-02    9.7E-02
   TH 231      1.2E-05     3.0E-04     6.9E-08        3.2E-04    3.2E-04
   --------   ----------  ----------  ----------     ---------- ----------
```

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

Case title: Autumn: UO3 Release - Dose to Public - Class Days

Executed on: 06/12/98 at 13:26:44   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	6.2E-01	2.5E-01	1.6E-01
Breast	6.2E-01	1.5E-01	9.3E-02
R Marrow	1.8E+01	1.2E-01	2.1E+00
Lung	1.3E+00	1.2E-01	1.6E-01
Thyroid	6.8E-01	3.0E-02	2.0E-02
Bone Sur	2.7E+02	3.0E-02	8.1E+00
Kidneys	1.1E+02	6.0E-02	6.7E+00
LL Int.	1.5E+01	6.0E-02	8.8E-01
UL Int.	5.3E+00	6.0E-02	3.2E-01
S Int.	1.4E+00	6.0E-02	8.5E-02
Stomach	1.2E+00	6.0E-02	7.3E-02

Internal Effective Dose Equivalent   1.9E+01
External Dose   3.6E-06

Annual Effective Dose Equivalent   1.9E+01

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

Total Inhalation EDE: 1.7E+00

Total Ingestion EDE: 1.7E+01

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

Case title:   Autumn: UO3 Release - Dose to Public - Class Days

Executed on:  06/12/98 at 13:26:44                              Page C. 11
----------------------------------------------------------------------------

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  │ 6.3E+00 + 1.1E+00 + 8.6E-01 + ...  =  1.9E+01    Dose
            │                                                  Equivalent
              ││          ││        ││
Internal      ││          ││        ││                         Cumulative
Annual        6.3E+00 + 1.1E+00 + 8.6E-01 + ...  =  1.9E+01    Internal
Dose                                                           Dose

              +          +          +                     +
External
Annual        3.6E-06    0.0E+00    0.0E+00    ...    3.6E-06
Dose

              ││          ││        ││                    ││
Annual        ││          ││        ││                    ││    Cumulative
Dose          6.3E+00 + 1.1E+00 + 8.6E-01 + ...  =  1.9E+01    Dose

                                                              Maximum
                                                   6.3E+00    Annual
                                                              Dose Occurred
                                                              In Year  1
```

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

Case title: Autumn: UO3 Release - Dose to Public - Class Days

Executed on: 06/12/98 at 13:26:44   Page C. 12

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

                Inhalation Ingestion   Internal   Annual
                Effective   Effective   Effective   Effective
    Radio-   Dose   Dose   External   Dose   Dose
    nuclide   Equivalent Equivalent Dose   Equivalent Equivalent
    --------   ---------- ---------- ----------   ---------- ----------
    TC 99   1.8E-04   2.5E-02   2.7E-09   2.5E-02   2.5E-02
    U   236   8.1E-02   8.2E-01   3.1E-09   9.0E-01   9.0E-01
    U   234   9.8E-01   9.9E+00   4.6E-08   1.1E+01   1.1E+01
    U   238   5.5E-01   5.6E+00   1.9E-08   6.1E+00   6.1E+00
    TH 234   6.4E-03   3.2E-01   3.0E-06   3.3E-01   3.3E-01
    PA 234   2.8E-07   8.4E-05   4.5E-07   8.4E-05   8.4E-05
    U   235   3.6E-02   3.5E-01   0.0E+00   3.9E-01   3.9E-01
    TH 231   1.2E-05   1.7E-03   6.9E-08   1.7E-03   1.7E-03
    --------   ---------- ---------- ----------   ---------- ----------

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

Case title:   UO3 Release - Dose to Worker - Class Days

Executed on:  06/12/98 at 13:25:38                              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
Very 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     3.4E-04 0.0E+00 0.0E+00
           U 234    1.1E-03 0.0E+00 0.0E+00
           U 235    4.1E-05 0.0E+00 0.0E+00
           TH231    4.1E-05 0.0E+00 0.0E+00
           U 236    9.5E-05 0.0E+00 0.0E+00
           U 238    6.7E-04 0.0E+00 0.0E+00
           TH234    6.7E-04 0.0E+00 0.0E+00
           PA234    1.1E-06 0.0E+00 0.0E+00

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

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

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

===============================================================================
```

Input prepared by: _____   Date: _____

Input checked by: _____   Date: _____


```
===============================================================================
```

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

Case title:   UO3 Release - Dose to Worker - Class Days

Executed on:  06/12/98 at 13:25:56                              Page C.  1
-----------------------------------------------------------------------------
```

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

	Committed		Weighted
	Dose	Weighting	Dose
Organ	Equivalent	Factors	Equivalent
Gonads	5.5E-02	2.5E-01	1.4E-02
Breast	5.5E-02	1.5E-01	8.3E-03
R Marrow	1.6E+00	1.2E-01	1.9E-01
Lung	7.4E-01	1.2E-01	8.9E-02
Thyroid	5.6E-02	3.0E-02	1.7E-03
Bone Sur	2.4E+01	3.0E-02	7.3E-01
Kidneys	1.0E+01	6.0E-02	6.0E-01
LL Int.	8.7E-02	6.0E-02	5.2E-03
UL Int.	6.7E-02	6.0E-02	4.0E-03
Stomach	5.9E-02	6.0E-02	3.5E-03
S Int.	5.8E-02	6.0E-02	3.5E-03

```
-------------------------------------------------
Internal Effective Dose Equivalent     1.7E+00
External Dose                          3.6E-06
-------------------------------------------------
Annual Effective Dose Equivalent       1.7E+00
```

```
-------------------------------------------------
Controlling Organ:                     Bone Sur
Controlling Pathway:                   Inh
Controlling Radionuclide:              U 234
-------------------------------------------------
Total Inhalation EDE:                  1.7E+00
```

Total Ingestion EDE: 0.0E+00

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

Case title:   UO3 Release - Dose to Worker - Class Days

Executed on:  06/12/98 at 13:25:56                           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  │  5.3E-01 + 1.0E-01 + 7.8E-02 + ...  =  1.7E+00  Dose
              │                                             Equivalent
                   ¦¦        ¦¦        ¦¦
Internal                                                    Cumulative
Annual          5.3E-01 + 1.0E-01 + 7.8E-02 + ...  =  1.7E+00  Internal
Dose                                                        Dose

                   +         +         +                 +
External
Annual          3.6E-06   0.0E+00   0.0E+00    ...      3.6E-06
Dose

                   ¦¦        ¦¦        ¦¦                 ¦¦
Annual                                                      Cumulative
Dose            5.3E-01 + 1.0E-01 + 7.8E-02 + ...  =  1.7E+00  Dose

                                                            Maximum
                                                5.3E-01     Annual
                                                            Dose Occurred
                                                            In Year  1
```

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

Case title:   UO3 Release - Dose to Worker - Class Days

Executed on:  06/12/98 at 13:25:56                              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	1.8E-04	0.0E+00	2.7E-09	1.8E-04	1.8E-04
U 236	8.1E-02	0.0E+00	3.1E-09	8.1E-02	8.1E-02
U 234	9.8E-01	0.0E+00	4.6E-08	9.8E-01	9.8E-01
U 238	5.5E-01	0.0E+00	1.9E-08	5.5E-01	5.5E-01
TH 234	6.4E-03	0.0E+00	3.0E-06	6.4E-03	6.4E-03
PA 234	2.8E-07	0.0E+00	4.5E-07	2.8E-07	7.2E-07
U 235	3.6E-02	0.0E+00	0.0E+00	3.6E-02	3.6E-02
TH 231	1.2E-05	0.0E+00	6.9E-08	1.2E-05	1.2E-05

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

Case title: UO3 Release - Dose to Public - Class Weeks

Executed on: 06/12/98 at 13:14:38   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   Surface Buried
            Radio-   Air   Water   Source
            nuclide Ci/yr   Ci/yr   Ci/m3
            -------- ------- ------- -------
            TC99   3.4E-04 0.0E+00 0.0E+00
            U 234   1.1E-03 0.0E+00 0.0E+00
            U 235   4.1E-05 0.0E+00 0.0E+00
            TH231   4.1E-05 0.0E+00 0.0E+00

```
          U 236    9.5E-05 0.0E+00 0.0E+00
          U 238    6.7E-04 0.0E+00 0.0E+00
          TH234    6.7E-04 0.0E+00 0.0E+00
          PA234    1.1E-06 0.0E+00 0.0E+00
```

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

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

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

========== 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 ===

```
                  TRAN-      PROD-      ----CONSUMPTION----
          FOOD    SIT        UCTION     HOLDUP     RATE
          TYPE    h          kg/yr      d          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 ===

```
                  GROW   --IRRIGATION--              PROD-    --CONSUMPTION--
          FOOD    TIME   S RATE   TIME    YIELD      UCTION   HOLDUP   RATE
          TYPE    d      * in/yr  mo/yr   kg/m2      kg/yr    d        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---- CONSUMPTION RATE kg/yr	HOLDUP d	TOTAL PROD-UCTION kg/yr	DRINK WATER CONTAM FRACT.	DIET FRAC-TION	GROW TIME d	S *	-IRRIGATION-- RATE in/yr	TIME mo/yr	YIELD kg/m3	STOR-AGE d
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: UO3 Release - Dose to Public - Class Weeks

Executed on: 06/12/98 at 13:15:00   Page C. 1

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

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	1.9E-02	2.5E-01	4.8E-03
Breast	1.9E-02	1.5E-01	2.9E-03
R Marrow	5.1E-01	1.2E-01	6.1E-02
Lung	3.6E+01	1.2E-01	4.3E+00
Thyroid	7.2E-02	3.0E-02	2.2E-03
Bone Sur	7.8E+00	3.0E-02	2.3E-01
Kidneys	3.1E+00	6.0E-02	1.8E-01
Stomach	2.5E-01	6.0E-02	1.5E-02
LL Int.	1.3E-01	6.0E-02	7.7E-03
UL Int.	5.6E-02	6.0E-02	3.4E-03
S Int.	2.5E-02	6.0E-02	1.5E-03

Internal Effective Dose Equivalent   4.8E+00
External Dose   3.6E-06

Annual Effective Dose Equivalent   4.8E+00

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

Total Inhalation EDE: 4.8E+00

Total Ingestion EDE: 2.2E-02

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

Case title:  Winter: UO3 Release - Dose to Public - Class Weeks

Executed on:  06/12/98 at 13:15:00                                    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  │ 4.4E+00 + 1.2E-01 + 2.1E-02 + ...  =  4.8E+00  Dose
             │                                          Equivalent
                 ││         ││         ││
Internal                                              Cumulative
Annual       4.4E+00 + 1.2E-01 + 2.1E-02 + ...  =  4.8E+00  Internal
Dose                                                  Dose
                 +          +          +                  +
External
Annual       3.6E-06    0.0E+00   0.0E+00   ...     3.6E-06
Dose
                 ││         ││         ││               ││
Annual                                                Cumulative
Dose         4.4E+00 + 1.2E-01 + 2.1E-02 + ...  =  4.8E+00  Dose

                                                              Maximum
                                                   4.4E+00    Annual
                                                              Dose Occurred
                                                              In Year  1
```

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

Case title:   Winter: UO3 Release - Dose to Public - Class Weeks

Executed on:  06/12/98 at 13:15:00                                 Page C.  3
-------------------------------------------------------------------------------
```

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


                  Inhalation  Ingestion                 Internal    Annual
                  Effective   Effective                 Effective   Effective
     Radio-       Dose        Dose        External      Dose        Dose
     nuclide      Equivalent  Equivalent  Dose          Equivalent  Equivalent
     --------     ----------  ----------  ----------     ----------  ----------
     TC 99        9.9E-04     2.1E-02     2.7E-09        2.2E-02     2.2E-02
     U   236      2.3E-01     7.8E-05     3.1E-09        2.3E-01     2.3E-01
     U   234      2.9E+00     9.8E-04     4.6E-08        2.9E+00     2.9E+00
     U   238      1.5E+00     5.3E-04     1.9E-08        1.5E+00     1.5E+00
     TH 234       6.4E-03     2.8E-05     3.0E-06        6.5E-03     6.5E-03
     PA 234       2.8E-07     7.4E-09     4.5E-07        2.9E-07     7.3E-07
     U   235      1.0E-01     3.3E-05     0.0E+00        1.0E-01     1.0E-01
     TH 231       1.2E-05     1.6E-07     6.9E-08        1.2E-05     1.2E-05
     --------     ----------  ----------  ----------     ----------  ----------
```

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

Case title: Spring: UO3 Release - Dose to Public - Class Weeks

Executed on: 06/12/98 at 13:15:03   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	2.9E-02	2.5E-01	7.1E-03
Breast	2.8E-02	1.5E-01	4.3E-03
R Marrow	7.7E-01	1.2E-01	9.3E-02
Lung	3.6E+01	1.2E-01	4.3E+00
Thyroid	8.0E-02	3.0E-02	2.4E-03
Bone Sur	1.2E+01	3.0E-02	3.6E-01
Kidneys	4.8E+00	6.0E-02	2.9E-01
LL Int.	3.9E-01	6.0E-02	2.3E-02
Stomach	2.6E-01	6.0E-02	1.6E-02
UL Int.	1.5E-01	6.0E-02	8.9E-03
S Int.	4.9E-02	6.0E-02	2.9E-03

```
Internal Effective Dose Equivalent      5.1E+00
External Dose                           3.6E-06
```

```
Annual Effective Dose Equivalent        5.1E+00
```

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

```
Total Inhalation EDE:           4.8E+00
```

Total Ingestion EDE: 3.1E-01

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

Case title:   Spring: UO3 Release - Dose to Public - Class Weeks

Executed on:  06/12/98 at 13:15:03                               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
          1  │  4.5E+00 + 1.4E-01 + 3.4E-02 + ...  =  5.1E+00   Dose
                                                             Equivalent
                 ╎╎         ╎╎          ╎╎
Internal                                                     Cumulative
Annual           4.5E+00 + 1.4E-01 + 3.4E-02 + ...  =  5.1E+00   Internal
Dose                                                         Dose
                  +          +          +                +
External
Annual           3.6E-06    0.0E+00    0.0E+00  ...     3.6E-06
Dose
                 ╎╎         ╎╎          ╎╎                ╎╎
Annual                                                       Cumulative
Dose             4.5E+00 + 1.4E-01 + 3.4E-02 + ...  =  5.1E+00   Dose

                                                             Maximum
                                                    4.5E+00   Annual
                                                             Dose Occurred
                                                             In Year  1
```

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

Case title:   Spring: UO3 Release - Dose to Public - Class Weeks

Executed on:  06/12/98 at 13:15:03                              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	9.9E-04	2.0E-02	2.7E-09	2.1E-02	2.1E-02
U 236	2.3E-01	1.4E-02	3.1E-09	2.5E-01	2.5E-01
U 234	2.9E+00	1.7E-01	4.6E-08	3.0E+00	3.0E+00
U 238	1.5E+00	9.2E-02	1.9E-08	1.6E+00	1.6E+00
TH 234	6.4E-03	6.5E-03	3.0E-06	1.3E-02	1.3E-02
PA 234	2.8E-07	1.7E-06	4.5E-07	2.0E-06	2.4E-06
U 235	1.0E-01	5.9E-03	0.0E+00	1.1E-01	1.1E-01
TH 231	1.2E-05	2.6E-05	6.9E-08	3.8E-05	3.8E-05

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

Case title: Summer: UO3 Release - Dose to Public - Class Weeks

Executed on: 06/12/98 at 13:15:06   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	1.2E-01	2.5E-01	3.0E-02
Breast	1.2E-01	1.5E-01	1.8E-02
R Marrow	3.3E+00	1.2E-01	4.0E-01
Lung	3.6E+01	1.2E-01	4.3E+00
Thyroid	1.8E-01	3.0E-02	5.4E-03
Bone Sur	5.1E+01	3.0E-02	1.5E+00
Kidneys	2.1E+01	6.0E-02	1.3E+00
LL Int.	2.6E+00	6.0E-02	1.6E-01
UL Int.	9.5E-01	6.0E-02	5.7E-02
Stomach	4.4E-01	6.0E-02	2.6E-02
S Int.	2.6E-01	6.0E-02	1.6E-02

Internal Effective Dose Equivalent   7.8E+00
External Dose   3.6E-06

Annual Effective Dose Equivalent   7.8E+00

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

Total Inhalation EDE: 4.8E+00

Total Ingestion EDE: 3.0E+00

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

Case title: Summer: UO3 Release - Dose to Public - Class Weeks

Executed on: 06/12/98 at 13:15:06   Page C. 8

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 |  5.4E+00 + 3.0E-01 + 1.6E-01 + ...  =  7.8E+00   Dose
           |                                                  Equivalent
              | |        | |        | |
Internal      | |        | |        | |                       Cumulative
Annual        5.4E+00 + 3.0E-01 + 1.6E-01 + ...  =  7.8E+00   Internal
Dose                                                          Dose

                 +         +         +                 +
External
Annual        3.6E-06   0.0E+00   0.0E+00   ...      3.6E-06
Dose
              | |        | |        | |                | |
Annual        | |        | |        | |                | |   Cumulative
Dose          5.4E+00 + 3.0E-01 + 1.6E-01 + ...  =  7.8E+00   Dose

                                                              Maximum
                                                    5.4E+00   Annual
                                                              Dose Occurred
                                                              In Year  1
```

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

Case title: Summer: UO3 Release - Dose to Public - Class Weeks

Executed on: 06/12/98 at 13:15:06   Page C. 9

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	9.9E-04	2.4E-02	2.7E-09	2.5E-02	2.5E-02
U 236	2.3E-01	1.4E-01	3.1E-09	3.8E-01	3.8E-01
U 234	2.9E+00	1.8E+00	4.6E-08	4.6E+00	4.6E+00
U 238	1.5E+00	9.7E-01	1.9E-08	2.5E+00	2.5E+00
TH 234	6.4E-03	5.2E-02	3.0E-06	5.8E-02	5.8E-02
PA 234	2.8E-07	1.4E-05	4.5E-07	1.4E-05	1.4E-05
U 235	1.0E-01	6.2E-02	0.0E+00	1.7E-01	1.7E-01
TH 231	1.2E-05	3.0E-04	6.9E-08	3.2E-04	3.2E-04

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

Case title: Autumn: UO3 Release - Dose to Public - Class Weeks

Executed on: 06/12/98 at 13:15:08   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	5.8E-01	2.5E-01	1.5E-01
Breast	5.8E-01	1.5E-01	8.7E-02
R Marrow	1.6E+01	1.2E-01	2.0E+00
Lung	3.6E+01	1.2E-01	4.3E+00
Thyroid	6.4E-01	3.0E-02	1.9E-02
Bone Sur	2.5E+02	3.0E-02	7.6E+00
Kidneys	1.0E+02	6.0E-02	6.3E+00
LL Int.	1.5E+01	6.0E-02	8.8E-01
UL Int.	5.3E+00	6.0E-02	3.2E-01
S Int.	1.4E+00	6.0E-02	8.3E-02
Stomach	1.2E+00	6.0E-02	7.1E-02

Internal Effective Dose Equivalent	2.2E+01
External Dose	3.6E-06

Annual Effective Dose Equivalent	2.2E+01

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

Total Inhalation EDE:	4.8E+00

Total Ingestion EDE: 1.7E+01

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

Case title:   Autumn: U03 Release - Dose to Public - Class Weeks

Executed on:  06/12/98 at 13:15:08                        Page C. 11
------------------------------------------------------------------------

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 │ 1.0E+01 + 1.2E+00 + 8.0E-01 + ... = 2.2E+01  Dose
           │                                            Equivalent
              ¦¦        ¦¦         ¦¦
Internal                                             Cumulative
Annual       1.0E+01 + 1.2E+00 + 8.0E-01 + ... = 2.2E+01  Internal
Dose                                                 Dose
              +         +         +                 +
External
Annual       3.6E-06   0.0E+00   0.0E+00   ...    3.6E-06
Dose
              ¦¦        ¦¦         ¦¦               ¦¦
Annual                                             Cumulative
Dose         1.0E+01 + 1.2E+00 + 8.0E-01 + ... = 2.2E+01  Dose

                                                   Maximum
                                         1.0E+01   Annual
                                                   Dose Occurred
                                                   In Year  1
```

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

Case title: Autumn: UO3 Release - Dose to Public - Class Weeks

Executed on: 06/12/98 at 13:15:08   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	9.9E-04	2.5E-02	2.7E-09	2.6E-02	2.6E-02
U 236	2.3E-01	8.2E-01	3.1E-09	1.1E+00	1.1E+00
U 234	2.9E+00	9.9E+00	4.6E-08	1.3E+01	1.3E+01
U 238	1.5E+00	5.6E+00	1.9E-08	7.1E+00	7.1E+00
TH 234	6.4E-03	3.2E-01	3.0E-06	3.3E-01	3.3E-01
PA 234	2.8E-07	8.4E-05	4.5E-07	8.4E-05	8.4E-05
U 235	1.0E-01	3.5E-01	0.0E+00	4.6E-01	4.6E-01
TH 231	1.2E-05	1.7E-03	6.9E-08	1.7E-03	1.7E-03

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

Case title:   UO3 Release - Dose to Worker - Class Weeks

Executed on:  06/12/98 at 13:14:00                              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   3.4E-04 0.0E+00 0.0E+00
         U 234   1.1E-03 0.0E+00 0.0E+00
         U 235   4.1E-05 0.0E+00 0.0E+00
         TH231   4.1E-05 0.0E+00 0.0E+00
         U 236   9.5E-05 0.0E+00 0.0E+00
         U 238   6.7E-04 0.0E+00 0.0E+00
         TH234   6.7E-04 0.0E+00 0.0E+00
         PA234   1.1E-06 0.0E+00 0.0E+00

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

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

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

=============================================================================


Input prepared by:  _____        Date:  _____

Input checked by:  _____        Date:  _____


=============================================================================

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

Case title:   UO3 Release - Dose to Worker - Class Weeks

Executed on:  06/12/98 at 13:14:21                                  Page C.  1
------------------------------------------------------------------------------
```

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

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	1.7E-02	2.5E-01	4.2E-03
Breast	1.7E-02	1.5E-01	2.5E-03
R Marrow	5.0E-01	1.2E-01	6.0E-02
Lung	3.6E+01	1.2E-01	4.3E+00
Thyroid	1.7E-02	3.0E-02	5.2E-04
Bone Sur	7.7E+00	3.0E-02	2.3E-01
Kidneys	3.1E+00	6.0E-02	1.8E-01
LL Int.	8.9E-02	6.0E-02	5.3E-03
UL Int.	4.1E-02	6.0E-02	2.5E-03
S Int.	2.1E-02	6.0E-02	1.3E-03
Stomach	2.0E-02	6.0E-02	1.2E-03

```
----------------------------------------------------
Internal Effective Dose Equivalent       4.8E+00
External Dose                            3.6E-06
----------------------------------------------------
Annual Effective Dose Equivalent         4.8E+00
```

```
--------------------------------------------------
Controlling Organ:                    Lung
Controlling Pathway:                  Inh
Controlling Radionuclide:             U 234
--------------------------------------------------
Total Inhalation EDE:                 4.8E+00
```

Total Ingestion EDE: 0.0E+00

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

Case title:   UO3 Release - Dose to Worker - Class Weeks

Executed on:  06/12/98 at 13:14:21                                 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  │ 4.4E+00 + 1.2E-01 + 2.1E-02 + ...  =  4.8E+00   Dose
             │                                             Equivalent
                 ││         ││         ││
Internal                                                  Cumulative
Annual        4.4E+00 + 1.2E-01 + 2.1E-02 + ...  =  4.8E+00   Internal
Dose                                                      Dose
                 +          +          +                   +
External
Annual        3.6E-06    0.0E+00    0.0E+00   ...    3.6E-06
Dose
                 ││         ││         ││               ││
Annual                                                    Cumulative
Dose          4.4E+00 + 1.2E-01 + 2.1E-02 + ...  =  4.8E+00   Dose

                                                          Maximum
                                                 4.4E+00   Annual
                                                          Dose Occurred
                                                          In Year  1
_____
```

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

Case title:   UO3 Release - Dose to Worker - Class Weeks

Executed on:  06/12/98 at 13:14:21                               Page C.  3
-------------------------------------------------------------------------------

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


                 Inhalation  Ingestion                Internal   Annual
                 Effective   Effective                Effective  Effective
      Radio-       Dose        Dose       External      Dose       Dose
      nuclide    Equivalent  Equivalent     Dose      Equivalent Equivalent
      --------   ----------  ----------   ----------   ---------- ----------
      TC 99       9.9E-04     0.0E+00      2.7E-09      9.9E-04    9.9E-04
      U   236     2.3E-01     0.0E+00      3.1E-09      2.3E-01    2.3E-01
      U   234     2.9E+00     0.0E+00      4.6E-08      2.9E+00    2.9E+00
      U   238     1.5E+00     0.0E+00      1.9E-08      1.5E+00    1.5E+00
      TH 234      6.4E-03     0.0E+00      3.0E-06      6.4E-03    6.4E-03
      PA 234      2.8E-07     0.0E+00      4.5E-07      2.8E-07    7.2E-07
      U   235     1.0E-01     0.0E+00      0.0E+00      1.0E-01    1.0E-01
      TH 231      1.2E-05     0.0E+00      6.9E-08      1.2E-05    1.2E-05
      --------   ----------  ----------   ----------   ---------- ----------
```

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	Criticality and Shielding	Date June 18, 1998
Project Title/Work Order		EDT No. 644796
Calculational Note for the Radiological Effects of a UO_3 Release from the T-Hopper Storage Pad		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
M. W. Benecke	L6-26	x			
J. P. Estrellado, Jr.	B4-44	x			
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B. E. Hey	B4-47	x			
A. M. Horner	L6-57	x			
I. L. Metcalf	L6-26	x			
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