START

0037070 49

ENGINEERING CHANGE NOTICE

Page 1 of 49

1. ECN 121576

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.		4. Date
Supplemental [X] Direct Revision [ ] Change ECN [ ] Temporary [ ] Supersedure [X] Discovery [ ] Cancel/Void [ ]	W. W. Olson, G5-10, 6-2736		
	5. Project Title/No./Work Order No TRUSAF Hazards Identification & Eval.	6. Bldg./Sys./Fac. No. 224-T	7. Impact Level 2
	8. Document Number Affected (include rev. and sheet no.) SD-WM-SAR-025 Rev. 0	9. Related ECN No(s). N/A	10. Related PO No. N/A

11a. Modification Work	11b. Work Package Doc. No.	11c. Complete Installation Work	11d. Complete Restoration (Temp. ECN only)
[ ] Yes (fill out Blk. 11b) [X] No (NA Blks. 11b, 11c, 11d)	N/A	N/A Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Modify the text in document SD-WM-SAR-025, "TRUSAF Hazards Identification and Evaluation", per attached "was/is" depictions.

This ECN supersedes ECN 106581 (prepared but not issued)

9413274.1573

JUN 1994 RECEIVED EDMC

APPROVED FOR PUBLIC RELEASE

3/2/92

13a. Justification (mark one)	13b. Justification Details
Criteria Change [X] Design Improvement [ ] Environmental [ ] As-Found [ ] Facilitate Const. [ ] Const. Error/Omission [ ] Design Error/Omission [ ]	The modification will reflect the operational detail and receipt of retrieved TRU waste drums at the TRUSAF. Operations will be per standard approved TRUSAF operating and criticality procedures.

14. Distribution (include name, MSIN, and no. of copies) SPONSOR LIMITED

B. C. Anderson	R2-87	B. K. Olson	R2-82
J. A. Demiter	L5-31	W. W. Olson	G5-10
J. P. Estrellado, Jr.	G5-10	R. J. Roberts	R2-97
K. L. Hunter	S1-52	J. L. Scott	R2-87
W. G. Jasen	R2-82	R. G. Stickney	R2-82
E. E. Leitz	N1-37	J. J. Zimmer	N1-83
R. L. Martin	R3-20	R. R. Ames	N3-13
S. H. Norton	T3-28	E. P. Mertens	N3-13
EDC	S0-05	R. D. Pierce	N3-13

RELEASE STAMP

OFFICIAL RELEASE BY WHC (11)

DATE JUN 27 1991

Station # 11

A-7900-013 (11/88)

ENGINEERING CHANGE NOTICE

1 ECN (use no. from pg. 1) 121576

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)
	ENGINEERING		CONSTRUCTION		
☐ Yes	Additional ☐	$	Additional ☐	$	Improvement ☐
☒ No	Savings ☐	$	Savings ☐	$	Delay ☐

18. 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 12. Enter the affected document number in Block 19.

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	☐		☐
Environmental Report	☐	Inspection Plan	☐		☐
Environmental Permit	☐	Inventory Adjustment Request	☐		☐

19. 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

20. Approvals

	Signature	Date		Signature	Date
OPERATIONS AND ENGINEERING			**ARCHITECT-ENGINEER**		
Cog./Project Engineer	W. W. Olson	5/22/91	PE		
Cog./Project Engr. Mgr.	J. P. Estrellado	5/22/91	QA		
QA	T. L. Bennington	6/14/91	Safety		
Safety	MR. L. Martin	6-13-91	Design		
Security			Other		
Proj.Prog./Dept. Mgr.					
Def. React. Div					
Chem. Proc. Div					
Def Wst. Mgmt. Div.	W. G. Jasen/R.J. Roberts		**DEPARTMENT OF ENERGY**		
Adv. React. Dev Div.					
Proj. Dept.					
Environ. Div.			**ADDITIONAL**		
IRM Dept.			B.K. Olsen		6/14/91
Facility Rep. (Ops)	S. H. Norton	6/10/91			
Other	R. G. Stickney / D. L. Armstrong	6/17/91			
	E. P. Mertens	5/30/91			
	E. E. Leitz	5/31/91			

9413274.1574

WAS: (Page 5, Section 1.1, 2nd paragraph)

In 1984, the 224-T Building was targeted to house the transuranic waste storage and assay operation which is under the jurisdiction of the Burial Grounds Operations (Fig. 1). The transuranic waste storage and assay facility (TRUSAF) operation consists of a nondestructive analysis of transuranic (TRU) waste. The analysis is used as an overview for sealed, certified, contact handled, TRU solid-waste packages, to verify general compliance with Waste Isolation Pilot Plant (WIPP) Waste Acceptance Criteria (WAC). Those containers meeting WIPP WAC criteria are stored at 224-T and maintained in a manner to retain their certification pending shipment to the WIPP. The TRUSAF operation also performs a sorting function for the plutonium finishing plant. Some containers that are determined to be low-level-waste burial trenches. The containers that have deficiencies are returned to those who generated the waste for the correction of the deficiencies or stored in the 200 West Area for future certification processing.

IS: (Page 5, Section 1.1, 2nd paragraph)

In 1984, the 224-T Building was targeted to house the transuranic waste storage and assay operation which is under the jurisdiction of the Burial Grounds Operations (Fig. 1). The Transuranic Waste Storage and Assay Facility (TRUSAF) operation consists of a nondestructive analysis of transuranic (TRU) waste 55-gallon drums. The analysis is used as an overview for sealed, certified (from newly generated) and uncertified (from retrieved) contact handled, TRU solid-waste packages, to verify general compliance with the Waste Isolation Pilot Plant (WIPP) Waste Acceptance Criteria (WAC). Those containers meeting WIPP WAC criteria are stored at 224-T and maintained in a manner to retain their certification pending shipment to the WIPP. The TRUSAF operation also performs a sorting function for the plutonium finishing plant and the contact handled (CH) TRU waste characterization program as defined in the phase 2 portion of WHC-EP-0223, "Stored, Contact-Handled Transuranic Waste Characterization at the Hanford Site" (Westinghouse 1989a). Some containers that are determined to be low-level waste by assay (<100 nCi/g) are transferred to and disposed of in the low-level-waste burial trenches. The containers that have deficiencies are returned to those who generated the waste for the correction of the deficiencies or stored in the 200 West Area for future certification processing. Uncertified (from Trench Retrieval) contact-handled drums will be overpacked and stored in TRUSAF if deficiencies in the waste are discovered through RTR or assay.

WAS: (Page 23, Section 3.7.1, 4th paragraph)

The shipment is received at TRUSAF and is checked for acceptability before it is unloaded. This includes an examination of the documentation to assure it is proper and complete. The required documents include a "Radioactive Shipment Record," "Solid Waste Storage Record," "WIPP Certification Checklist," "Nuclear Material Item transfer" or equivalent, and a "Contents Inventory Sheet (CIS)." Hazardous waste manifest are also required if hazardous constituents are present in the containers.

IS: (Page 23, Section 3.7.1, 4th paragraph)

The shipment is received at TRUSAF and is checked for acceptability before it is unloaded. For newly generated waste, this includes an examination of the documentation to assure it is proper and complete. The required documents include a "Radioactive Shipment Record," "Solid Waste Storage Record," "WIPP Certification Checklist," "Nuclear Material Item Transfer" or equivalent, and a "Contents Inventory Sheet (CIS)." Hazardous waste manifest are also required if hazardous constituents are present in the containers. Retrieved waste drums shall be accompanied with Radioactive Shipment Record (RSR) including a copy of the original burial record and radiation pre-shipment checklist. (If existing records show hazardous wastes are contained in the drum, a hazardous waste manifest shall also accompany the drum). A print out of the data in Richland-Stored Waste Information Management System (R-SWIMS) will be available at TRUSAF for additional information. The documentation will be used to initially characterize the containers and as a comparison during the NDE/NDA examination. The examinations will be used to access the accuracy of the historical assay data and estimate waste material contents. Retrieved waste data forms from NDE and visual inspections performed to approved SWBG retrieval work plans or procedures shall be sent to TRUSAF as verification of meeting TRUSAF entry requirements.

9413274.1576

WAS: (Page 25, Section 3.7.1, 1st paragraph)

Container integrity is verified (DOT 1986); the approved container for TRUSAF is the DOT 17C, 55 gal galvanized drum. Signs of its compromise include bulges, dents and weather deterioration. Should any discrepancies be discovered, Tank Farm Surveillance and Operations (TFS&O) management is notified and the shipment is not accepted until further review or corrections are made.

IS: (Page 25, Section 3.7.1, 1st paragraph)

Container integrity is verified (DOT 1986); the approved container for newly generated waste in TRUSAF is the DOT 17C, 55-gal galvanized drum. For waste retrieved for characterization, the container may be carbon steel or galvanized 55-gal drum DOT type A containers. The container wall thickness will be measured in situ at the retrieval site to verify that the wall thickness is not less than 0.042 inches and has no evidence of a breach condition. The 0.042 inch dimension is the minimum wall thickness of a 17H type A 55-gal drum. Should the container be found to be less than the required wall thickness, the container will be left at the burial ground retrieval site in accordance with the RCRA permit. The retrieved containers may be placed in poly bags to minimize the spread of dirt that may cling to the container. The assessment at the trench retrieval site will include NDE of the drum wall thickness and evaluating signs of drum compromise such as bulges, dents, leakage and weather deterioration.

WAS: (Page 25, Section 3.7.1, 4th paragraph)

The container is moved by a hand-operated fork lift to the RTR operating room where it is X-rayed. The purpose of the RTR is to visually overview the waste and insure that what can be identified is in general agreement with the documentation.

IS: (Page 25, Section 3.7.1, 4th paragraph)

The container is moved by a hand-operated fork lift to the RTR operating room where it is x-rayed. The purpose of the RTR is to visually overview the waste and insure that what can be identified is in general agreement with the documentation. For retrieved waste, the RTR will be used to assist in the identification and characterization of the waste contents.

9413274.1578

WAS: (Page 29, Section 3.7.1, 4th and 5th paragraphs)

- Hold (drums that have one or more hold points checked on the Traveler form and are held for further analysis)

- Return to Generator (drums that have been designated to be returned by the TRUSAF manager)

All TRU waste packages that successfully meet the requirements are placed in interim storage pending shipment to WIPP. Interim storage areas are located on the second and third floor. TRUSAF also plans to receive drums that require no overview. The are received as certified waste containers that are sent to TRUSAF for storage only. These containers will be from offsite WIPP-WAC certified generators and will be sent directly to the interim storage area.

IS: (Page 29, Section 3.7.1 4th and 5th paragraphs)

- Hold (drums that have one or more hold points checked on the Traveler form and are being held for further analysis). The retrieved drums that exceed 100 nCi/g will be placed on Hold pending further examination and/or treatment in WRAP.

- Return to Generator (drums that have been designated to be returned by the TRUSAF manager).

All TRUSAF waste packages that successfully meet the requirements are placed in interim storage pending shipment to WIPP. Interim storage area are located on the second and third floor. TRUSAF also plans to receive drums that require no overview. They are received as certified waste containers that are sent to TRUSAF for storage only. These containers will be from offsite WIPP-WAC certified generators and will be sent directly to the interim storage area. The retrieved drums will be stored in separate zones from certified drums.

WAS: (Page 32, Section 3.7.1, 1st and 2nd paragraphs)

- Low level (these are drums which assay less than 100 nCi/g TRU activity and are to be relabeled and buried as low level waste. All existing TRU labels are destroyed to avoid confusion.)
- Hold (drums that have one or more hold points checked on the Traveler and are being held for further analysis).
- Return to Generator (drums that have been designated to be returned by the TRUSAF manager).

All TRU waste packages that successfully meet requirements are placed in interim storage pending shipment to WIPP. Interim storage areas are located on the second and third floor. TRUSAF also plans to receive drums that require no overview. They are received as certified waste containers that are sent to TRUSAF for storage only. These containers will be from offsite WIPP-WAC certified generators and will be sent directly to the interim storage area.

IS: (Page 32, Section 3.7.1, 1st and 2nd paragraphs)

(Deleted because of duplication)

WAS: (Page 32, Section 3.7.1, the last sentence)

These limits are not exceeded without a structural analysis. The drums are arranged with aisles around the modules to allow for easy access through the storage areas, Drums with thermal wattage in excess of 1.W/ft^3 are segregated and stored in single tiers at least 3 feet away from other stored drums.

The drums remain in storage until shipment to WIPP. The anticipated shipping years are 1988 through 2013.

IS: (Page 32, Section 3.7.1, the last sentence)

These limits are not exceeded without a structural analysis. The drums are arranged with aisles around the modules to allow for easy access through the storage areas. Drums with thermal wattage in excess of 1.W/ft^3 are segregated and stored in single tiers at least 3 feet away from other stored drums.

The drums remain in storage until shipment to WIPP. Retrieved TRU waste drums will be held for treatment in the WRAP facility. The anticipated shipping years to WRAP are 1996 through 2013. Retrieved drums may be shipped from TRUSAF to other interim storage facilities depending on future TRUSAF space requirements and interim storage construction.

WAS: (Page 39, Fig. 15, Title)

Figure 15. The HVAC System for 244-T.

IS: (Page 39, Fig. 15, Title)

Figure 15. The HVAC System for 224-T.

9413274.1582

WAS: (Page 53, Table 2)

Table 2. Radiological Hazard Class Determination Total Dose Equivalent (Internal Plus External) Received by a Maximum-Exposed Individual Following a Credible Accident.

Hazard Class	Offsite (rem)[a]			Onsite (rem)[a]		
	Whole body	Bone surface thyroid	Lung, other organs	Whole body	Bone surface thyroid	Lung, other organs
Low	≥0.5	≤6	≤1.5	≤5	≤60	≤15
Moderate	>0.5 to <25	>6 to <300	>1.5 to <75	>5 to <25	≥60 to <300	>15 to <75
High	≥25	≥300	≥75	≥25	≥300	≥75

[a]Committed dose (50-yr).

IS: (Page 53, Table 2)

Table 2. Facility Hazard Classification Criteria.

Criteria Onsite	Low	Moderate	High
Radiological Consequences	≤5 rem	5 rem to 25 rem	25 rem
Toxicological consequences	≤PAG	PAG to 2 PAG	2 PAG*
Environmental Impact		Site Groundwater Contamination	
Offsite			
Radiological Consequences	≤0.5 rem	0.5 rem to 5 rem	5 rem
Toxicological consequences	≤TVL-TWA	TVL-TWA to PAG	PAG*
Environmental Impact	<EPA PPAG	EPA PPAG to EPA EPAG	EPA EPAG

*Evaluated on a case-by-case basis.

Acronyms

EPA = Environmental Protection Agency.
EPAG = Environmental Protection Agency Guide.
PAG = Protective Action Guidelines.
PPAG = Preventative Protective Action Guidelines.
TLV-TWA = Threshold Limit Value-Time Weighted Average.

WAS: (Page 53, Table 3)

Table 3. Radiological Risk Acceptance Guidelines.

Probability of source term	Offsite (rem)[a]			Onsite (rem)[a]		
	Whole Body	Bone	Lung	Whole Body	Bone	Lung
$1 \geq P \geq 10^{-2}$	<0.01	<0.12	<0.03	0.1	<1.2	<0.3
$10^{-2} > P \geq 10^{-4}$	0.5	6	1.5	5	60	15
$10^{-4} > P > 10^{-7}$	25	300	75	25	300	75

[a]Committed dose (50-yr).

IS: (Page 53, Table 3)

Table 3. Radiological Risk Acceptance Guidelines*

Probability category	Nominal range of probability (per year)	Effective dose equivalent (rem)	Organ dose equivalent for lens of eye (rem)	Organ dose equivalent for all other organs (rem)
		Offsite guidelines		
Anticipate	1 to 10^{-2}	0.1 - 0.5	0.3 - 1.5	1 - 5
Unlikely	10^{-2} to 10^{-4}	0.5 - 4	1.5 - 12	5 - 40
Extremely Unlikely	10^{-4} to 10^{-6}	4 - 25	12 - 75	40 - 250
		Onsite guidelines		
Anticipated	1 to 10^{-2}	0.5 - 5	1.5 - 15	5 - 50
Unlikely	10^{-2} to 10^{-4}	5 - 10	15 - 30	50 - 100
Extremely Unlikely	10^{-4} to 10^{-6}	10 - 25	30 - 75	100 - 250

*From Table 4-1 of WHC-CM-46 (Westinghouse 1989b).

WAS: (Page 56, Section 5.1.1.7, 2nd paragraph)

The process is essentially material handling (55-gal drums), NDE/NDA, and storage of the drums on concrete floors. The potential for a fire, as a result of a reaction within a container, is minimized in accordance with the guidelines provided in RHO-MA-222, Rev. 4, (Rockwell 1987a).

These guidelines require that:

- Storage containers must meet 49 CFR (DOT 1986) requirements for type A containers
- Particulate waste must be immobilized
- Free liquids must be solidified, absorbed, or otherwise bound in the waste matrix by inert materials
- Reactive chemicals by neutralized or packaged in such a manner to protect the containment barriers
- Noncompatible materials must be placed in separate containers.

IS: (Page 56, Section 5.1.1.7, 2nd paragraph)

The process is essentially material handling (55-gal drums), NDE/NDA, and storage of the drums on concrete floors. The potential for a fire, as a result of a reaction within a container, is minimized in accordance with the guidelines provided in WHC-EP-0063 (Westinghouse 1990).

The guidelines for newly generated waste require that:

- Storage containers must meet 49 CFR 173 (DOT 1986) requirements for type A containers
- Particulate waste must be immobilized
- Free liquids must be solidified, absorbed, or otherwise bound in the waste matrix by inert materials.
- Reactive chemicals be neutralized or packaged in such a manner to protect the containment barriers.
- Noncompatible materials must be placed in separate containers.

Retrieved drums were packaged prior to the above criteria being promulgated. The storage period and repeated handling minimize the probability that the drums contain reactive or noncompatible materials. The NDE measurements and visual inspections will provide a measure of container integrity indicating that excessive corrosion has not been encountered due to previous storage environment or liquid waste. Hence, loss of containment will not be a likely event during storage.

WAS: (Page 57, Section 5.1.1.7.3, 6th bullet)

- Facility Design. Sufficient exhaust duct length exists between potential areas of fire and the HEPA filters to minimize the likelihood of thermal damage to the HEPA filters. At room temperatures, less than 1,000 °C, heat transfer along an exhaust duct of length greater than 10 times its diameter is sufficient to reduce the gas temperature at the HEPA filter stage to temperatures where filter endurance is sufficient to provide containment over the period of active firefighting and until alternate containment ventilation can be provided (LLNL 1980).

IS: (Page 57, Section 5.1.1.7.3, 6th bullet)

- Facility Design. Sufficient exhaust duct length exists between potential areas of fire and the HEPA filters to minimize the likelihood of thermal damage to the HEPA filters. Heat transfer calculations show that if the gases that enter the duct are somewhat less than 1,000 °C, heat transfer along an exhaust duct of length greater than 10 times its diameter is sufficient to reduce the gas temperature at the HEPA filter stage to temperatures where filter endurance is sufficient to provide containment over the period of active firefighting and until alternate containment ventilation can be provided (LLNL 1980).

WAS: (Page 61, 1st paragraph, 2nd bullet)

- The DOT-17C drums in use are designed to withstand incidents of transportation without losing their integrity, this includes a 4 ft drop on an unyielding object. The assayer platform is <2 ft above the floor.

IS: (Page 61, 1st paragraph, 2nd bullet)

- The DOT-17C DOT type A drums in use are designed to withstand incidents of transportation without losing integrity, this includes a 4 ft drop on an unyielding object. The assayer platform is <2 ft above the floor, and drums are restricted to two tiers storage, which exceeds 2 ft but not 4 ft at TRUSAF. The drums that are retrieved will be in a condition comparable with the minimum specifications of a 17H DOT type A 55-gal drum based on NDE and visual examinations at the retrieval site. Drums that are less than 0.042 in thickness will not be transported from the retrieval site to TRUSAF.

WAS: (Page 63, Section 5.1.4.1)

5.1.4.1 Drums. The DOT-17C drums meet the U.S. Department of Transportation requirements for "DOT-type A." The drums are sealed with a 12-gauge, galvanized-steel rings that hold the lids on the container. The ring is connected with a threaded bolt and retained in place with a lock nut. The bolt is torqued to 40 ft lbs. The drums are inspected by the generator, the carrier, and by 224-T personnel prior to off-loading, during receipt and before to removal from storage. Drums require an NDE and the signatures of the QA representative as well as the TRUSAF manager before storage, or removal from the facility.

IS: (Page 63, Section 5.1.4.1)

5.1.4.1 Drums. The DOT-17C drums meet the U.S. Department of Transportation requirements for "DOT-type A." The drums are sealed with 12-gauge, galvanized-steel rings that hold the lids on the container. The ring is connected with a threaded bolt and retained in place with a lock nut. The bolt is torqued to 40 ft lbs. The drums are inspected by the generator, the carrier, and by 224-T personnel prior to off-loading, during receipt and before removal from storage. Drums require an NDE and the signatures of the QA representative as well as the TRUSAF manager before storage, or removal from the facility.

Retrieved drums will be inspected at the retrieval site utilizing NDE and visual means to verify that the containers are safe to transport and store in TRUSAF. The NDE and visual criteria for retrieving stored CH-TRU waste drums are as follows:

- Only 55-gallon drums meeting the minimum thickness criteria for 17H drums shall be retrieved.
- Drums shall be vented.
- Drum contact dose rate shall be less than 200 mrem/hr.
- Drums must not be bulging, breached, or show significant deterioration.
- Drum lids must not be loose.
- Drum smearable contamination shall be less than 100 dpm/100 cm^2 - alpha and less than 1000 dpm/100 cm^2 - beta/gamma.
- Drums shall be accompanied with a Radioactive Shipment Record (RSR) including a copy of the original burial ground record and radiation preshipment check list. (If existing records show hazardous wastes are contained in the drum a hazardous waste manifest shall also accompany the drum.)
- Drums shall comply with TRUSAF floor loading limits: less than or equal to 600 lbs. if stored on the 2nd floor and less than or equal to 800 lbs if stored on the 3rd floor.
- Drums shall contain less than 200 g Pu based on existing records.
- Drums shall meet designated labeling and marking requirements.

9413274.1558

WAS: (Pages 63 and 64, Section 5.1.4.4)

5.1.4.4 Release Due to From Handling Mishap. The most credible mishap during the movement of drums, with a walking forklift, is the dropping of a pallet with 4 drums. The drums are designed to withstand incidents associated with transportation. Dropping of drums, worst case, would not result in a puncture of the drum; however, it could be postulated that a lid could be released. This would, at worst, spill the plastic-contained contents onto the floor.

It is assumed that a drum falls from the truck in such a manner that the lid is removed and the plastic wrappings containing 200 g of PuO_2 is spilled and ruptured.

It is further assumed that the PuO_2 is in dispersable form and that the impact results in lofting 0.05% of the PuO_2; then, 0.1 g of Pu is released as a small puff.

The assumptions for the exposures are that the maximum onsite individual is 100 m from the spill and that maximum exposed offsite individual is assumed for inhalation purposes, to be located on Highway 240, 5.5 mi southwest of the Hanford Meteorological station. For a reference, the potential dose exposure is compared to a similar release postulated in the burial ground SAR (Rockwell 1984a).

The postulated burial ground release assumed a dispersion 0.176 g of Pu. The calculated maximum onsite/offsite dose exposure was extrapolated using the 0.1 g Pu release postulated for the TRUSAF spill. (0.1/0.176 x doses resulting from the postulated burial ground release.)

Accordingly, the postulated TRUSAF spill result in dose consequences as shown in Table 5.

Table 5. Consequence as a Result of Postulated Spill at TRUSAF (rem).

Time (yr)	Whole body	Bone	Lung
Maximum onsite individual			
1	2.8×10^{-4}	6.3×10^{-3}	5.5×10^{-1}
50	7.9×10^{-2}	1.7×10^{0}	1.4×10^{0}
Maximum offsite individual			
1	2.6×10^{-5}	5.3×10^{-3}	5.3×10^{-3}
50	7.9×10^{-4}	1.6×10^{-2}	1.4×10^{-2}

9413274.1589

IS: (Pages 63 and 64, Section 5.1.4.4)

5.1.4.4 Release Due to Drum Handling Mishap. The most credible mishap during the movement of drums, with a walking forklift, is the dropping of the drum. The drums are designed to withstand incidents associated with transportation. Dropping of a drum, worst case, would not result in a puncture of the drum; however, it cold be postulated that a lid could be released. This would, at worst, spill the plastic-contained contents onto the floor.

The isotopic distribution of the dropped drum is postulated to be that shown in Table 5, which represents 12% (nominal) ^{240}Pu, 20-yr old drums, which has a higher plutonium equivalent (PE) curie (Ci) per gram TRU than either 6% (nominal) or 12% (nominal) ^{240}Pu, due to ^{241}Am build-up.

Table 5. Isotopic Distribution of 12% (nominal) ^{240}Pu (20-yr old drums).

Isotope	PE factor[a]	Quantity (wt%)	Composition			
			(Bq x g^{-1})	(PE Bq x g^{-1})[b]	(Ci x g^{-1})	(PE Ci x g^{-1})[b]
^{238}Pu	1.1	0.08	4.88 E+08	4.44 E+08	1.32 E-02	1.20 E-02
^{239}Pu	1.0	83.95	1.93 E+09	1.93 E+09	5.21 E-02	5.21 E-02
^{240}Pu	1.0	12.97	1.09 E+09	1.09 E+09	2.94 E-02	2.94 E-02
^{241}Pu	52.0	1.10	4.18 E+10	3.80 E+10	1.13 E+00	2.17 E-02
^{242}Pu	1.1	0.03	4.37 E+04	3.97 E+04	1.18 E-06	1.07 E-06
^{241}Am	1.0	1.75	2.22 E+09	2.22 E+09	6.00 E-02	6.00 E-02
Total				4.37 E+10		1.75 E-01

PE = plutonium equivalent.
[a]From WHC-EP-0063 (WHC 1990).
[b]One PE Becquerel (Bq) is equal to one disintegration per second. One PE Curie (Ci) is equal to 3.7 E+10 disintegrations per second. Calculated by dividing the number of Bq x g^{-1} by the PE Factor. A similar method is used for calculating the PE Ci x g^{-1}.

Appendix F provides the results of onsite (550 m south) and offsite (14.5 km WNW) radiological consequences for maximally exposed individuals from accidents occurring at TRUSAF. Table 5A provides the radiological consequences for these two locations based upon one Ci respirable (<10 micron) of Pu-239.

Table 5A. Radiological Consequences for One Ci of ^{239}Pu

Location	EDE (rem)	Limiting Organ[a] (rem)
Onsite	3.8E+01	4.0E+02
Offsite	1.3E+00	1.3E+01

[a]Bone Surface

9113274.1590

IS: (Pages 63 and 64, Section 5.1.4.4 Continued)

It is assumed that a drum falls from the truck in such a manner that the lid is removed and the plastic wrappings containing 200 g of PuO_2 is spilled and ruptured.

To calculate the release fraction, NUREG 0782 (NRC 1981) is utilized. NUREG 0782 indicates that unsolidified waste streams (assumed to be all powder) are assumed to have a fractional release equal to 1 E-03. This fractional release is multiplied by a factor which accounts for the relative dispersivity and leachability of improved waste forms to compute the fraction of respirable particles (<10 microns) released. The values for this factor are based on comparative mechanical strengths measured for modern waste forms. Comparison of these waste forms with the waste anticipated to be in the retrieved drums suggests that a leachability/dispersivity value of 1 E-01 is appropriate. Thus, the respirable release fraction for the dropped drum is 1 E-04. For a 200 g drum that is dropped and conservatively assuming all is released from the drum, the release that is respirable is 0.02 g. At 0.175 PE Ci per gram, the release is 2.9 E-03 PE Ci. Using Table 5 which shows the values for 1 PE Ci, the radiological consequences are shown in Table 5B.

Table 5B. Radiological Consequences for Dropped Drum Accident

Location	EDE (rem)	Limiting Organ[a] (rem)
Onsite	1.1E-01	1.2E+00
Offsite	3.8E-03	3.8E-02

[a]Bone Surface

WAS: (Page 64A, Section 5.1.4.5)

This Page did not exist in the previous document.

IS: (Add Page 64A, Section 5.1.4.5)

5.1.4.5 Release During Receipt of Waste Drums. Transportation of the retrieved waste drums from the burial ground to the TRUSAF will be in accordance with an approved Safety Analysis Report for Packaging (SARP). However, it is assumed that a truck carrying the drums containing PuO_2 could have an accident colliding with another vehicle at the TRUSAF unloading area. It is further assumed that one of the drums which fall out of the truck is exposed to heat from a fire caused by the accident and its contents burn.

The potential worst case fire scenario is a fire involving a drum containing the maximum 200 g of PuO_2. A release fraction of 0.053% from NUREG-1320 (NRC 1988) for open burning of contaminated combustible solid is utilized. Assuming all of the contents are subject to burning, the release respirable is 1.1 E-01 g or 1.9 E-02 PE Ci. Comparing this with Table 5, the radiological consequences are shown in Table 5C.

Table 5C. Radiological Consequences for Waste Drum Rupture and Fire

Location	EDE (rem)	Limiting Organ[a]
Onsite	7.2E-01	7.6E+00
Offsite	2.5E-02	2.5E-01

[a]Bone Surface

9413274.1592

WAS: (Page 65, Sections 5.1.4.4 and 5.2)

The dose consequence as shown in Table 2 meets the criteria for a low hazard class, and the risk-acceptability criteria for a high probability event. Therefore, it is concluded that the TRUSAF is a low hazard operation with acceptable risks.

5.2 CONCLUSIONS OF HAZARDS ANALYSIS

The TRUSAF operation is conducted in accordance with Westinghouse manuals and plant operating procedures. These documents provide a basis for a safe operation. The facility and the TRUSAF operation is capable of withstanding the natural force events as postulated for the Hanford Site.

The worst case effects of a natural forces event are the loss of damage to the HVAC system that is not seismically hardened or tornado resistant, and the potential injury to personnel that could result from falling or shifting equipment/materials.

The loss of the HVAC system will not result in a significant release of contaminated air as the sealed containers are protected and are expected to retain their integrity, and the contamination in the sealed process cells are "fixed." Additionally, the HEPA filters in the duct leading from the sealed process cells should remain intact.

The potential for personal injury from falling/shifting equipment or material is very limited because the small amount of equipment employed is bolted to the floor and drum stacking is limited to two-high tiers.

The NDE equipment is surveyed by a RPT prior to daily use. The RTR emissions outside the shielding, at full power is below detectable limits. The readings obtained from the assayer are less than those prescribed by RHO-GA-MA-2, Vol. 6, *Standard Requirements and Procedures - Safety and Environment* (Rockwell 1986h).

The NDE units meet or exceed all requirements for radiation protection and industrial safety.

The fire protection for the facility is such that it is capable of withstanding the limited fire potential from internal/external sources.

The industrial injuries associated with material handling operations are generally limited to first-aid type cases.

A drum handling mishap is postulated to release 0.1 g of PuO^2. An evaluation of the consequences revealed that the incident would be in the low hazard class and that the risks are acceptable in accordance with the risk acceptance guidelines as depicted in Table 5-3.

IS: (Page 65, Sections 5.1.4.4 and 5.2)

This bounding dose consequence as shown in Table 5B and 5C meets the criteria for a low hazard class, and the risk-acceptance guideline for a high probability event shown in Tables 2 and 3 respectively. Therefore, it is concluded that the TRUSAF is a low hazard operation with acceptable risks for receiving the retrieved TRU waste drums.

5.2 CONCLUSIONS OF HAZARDS ANALYSIS

The TRUSAF operation is conducted in accordance with Westinghouse manuals and plant operating procedures. These documents provide a basis for a safe operation. The facility and the TRUSAF operation is capable of withstanding the natural forces events as postulated for the Hanford Site.

The worst case effects of a natural forces event are the loss or damage to the HVAC system that is not seismically hardened or tornado resistant, and the potential injury to personnel that could result from falling or shifting equipment/materials.

The loss of the HVAC system will not result in a significant release of contaminated air as the sealed containers are protected and are expected to retain their integrity, and the contamination in the sealed process cells are "fixed". Additionally, the HEPA filters in the duct leading from the sealed process cells should remain intact.

The potential for personal injury from falling/shifting equipment or material is very limited because the small amount of equipment employed is bolted to the floor and drum stacking is limited to two-high tiers.

The NDE equipment is surveyed by a HPT prior to daily use. The RTR emissions outside the shielding, at full power is below detectable limits. The readings obtained from the assayer are less than those prescribed by WHC-CM-4-10, *Radiation Protection Manual* (WHC 1990a).

The NDE units meet or exceed all requirements for radiation protection and industrial safety.

The fire protection for the facility is such that it is capable of withstanding the limited fire potential from internal/external sources.

The industrial injuries associated with material handling operations are generally limited to first-aid type cases.

A bounding accident during the receipt of waste drums is postulated to release 0.11 g of PuO_2. An evaluation of the consequences revealed that the incident would be in the low hazard class and that the risks are acceptable in accordance with the risk acceptance guidelines as depicted in Table 3.

WAS: (Page 66)

Given the limited scope of the TRUSAF operation, it is concluded that the operation is of a low-hazard level, and that the credible worst-case events are those associated with industrial type injuries. It is further concluded that the risks are acceptable.

IS: (Page 66)

This page will be deleted.

Add the following to Section 7.0 References:

NRC, 1981, *Draft Environmental Impact Statement on 10CFR Part 61-Licensing Requirements for Land Disposal of Radioactive Waste*, Appendices G-Q, NUREG-0782, U.S. Nuclear Regulatory Commission, Washington, D.C.

NRC, 1988, *Nuclear Fuel Cycle Facility Accident Analysis Handbook*, NUREG-1320, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington D. C.

Rittmann, P. D., 1989. Internal Memo to H. H. Isakari, "Environmental Impacts Postulated Plutonium Releases from 224-T," Westinghouse Hanford Company, Richland, Washington, (August, 1989).

WHC, 1988, *Nonreactor Facility Safety Analysis Manual*, WHC-CM-4-46, Westinghouse Hanford Company, Richland, Washington.

WHC, 1989a, *Stored Contact-Handled Transuranic Waste Characterization at the Hanford Site*, WHC-EP-0223, Westinghouse Hanford Company, Richland, Washington.

WHC, 1989b, *Facility Review and Authorization Level Classification of the Hanford Central Waste Complex*, SD-WM-SAR-037 (Rev. 0), Westinghouse Hanford Company, Richland, Washington.

WHC, 1990, *Hanford Site Radioactive Solid Waste Acceptance Criteria*, WHC-EP-0063-2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990a, *Radiation Protection Manual*, WHC-CM-4-10, Westinghouse Hanford Company, Richland, Washington.

WAS: (Appendix F)

This appendix did not exist in the previous document.

IS: (Add Appendix F)

APPENDIX F

Westinghouse Hanford Company

Internal Memo

From: Radiological Safety Analysis 29250-DAH-91.005
Phone: 6-8190 N1-19
Date: April 16, 1991
Subject: REVISED ANALYSIS OF A POSTULATED PLUTONIUM RELEASE FROM 224-T FACILITY

To: M. R. Harker N1-37

cc: J. S. Davis N1-19
J. C. Van Keuren N1-19
R. J. Van Vleet N1-31
DAH File/LB

Reference: Memo, P. D. Rittmann to H. H. Isakari, "Environmental Impacts of Postulated Plutonium Release From 224-T," August 11, 1989.

The updated analysis you requested is attached. This report supersedes the referenced document.

D. A. Himes
Principal Engineer

raw

Concurrence J. C. Van Keuren
J. C. Van Keuren, Manager
Radiological Safety Analysis

REVISED ANALYSIS OF A POSTULATED PLUTONIUM RELEASE FROM 224-T FACILITY

D.A. Himes
3/29/91

The radiological consequences of a postulated fire in the 224-T Facility have been evaluated in terms of a limiting amount of plutonium involved. The plutonium is composed of a range of isotopic mixes which is handled by specifying the at-risk material and the postulated release in terms of a Pu239 Plutonium Equivalent (PE) as detailed in WHC-EP-0063. The plutonium Equivalent (PE) factors are shown in Table 1 below. The PE factor is the number of Curies of the particular isotope which is equivalent in radiological inhalation dose effect to 1 Curie of Pu239. The PE (PU239) of a particular isotope is therefore the Curies of the particular isotope divided by the PE factor.

Table 1: Data for converting plutonium mixes to their PE

Isotope	Half-life (y)	Sp. Activity (Ci/g)	PE Factor
Pu 238	8.78E+1	1.71E+1	1.1
239	2.41E+4	6.20E-2	1
240	6.57E+3	2.27E-1	1
241	1.44E+1	1.03E+2	52
242	3.76E+5	3.93E-3	1.1
Am 241	4.32E+2	3.43E+0	1

Source Term Development:

The reference accident is a fire in a drum of TRU contaminated waste involving 200 g of plutonium with any of four sample compositions shown in Table 2. The assumed release factor for burning contaminated solids is 5.3E-4 [1]. The release associated with the burning of contaminated material containing 200 g of TRU would therefore be 0.106 g. The TRU handled by the 224-T Facility is assumed to be in an insoluble chemical form (i.e. oxides) so Y class lung clearance factors were used.

Table 2: Isotopic compositions of four sample mixes (% by weight)

Isotope	6% Pu240 Case A	6% Pu240 Case B	12% Pu240	High Exposure
Pu 238	0.02%	0.03%	0.093%	0.58%
239	93.5	93.2	84.0	72.1
240	5.90	6.03	13.0	19.2
241	0.50	0.57	2.88	6.29
242	0.02	0.02	0.03	1.88
Am 241	0.06	0.16	0.00	0.00

Table 3: Curies per gram of mixture

Isotope	6% Pu240 Case A	6% Pu240 Case B	12% Pu240	High Exposure
Pu 238	3.43E-3	5.14E-3	1.59E-2	9.93E-2
239	5.80E-2	5.78E-2	5.21E-2	4.47E-2
240	1.34E-2	1.37E-2	2.95E-2	4.35E-2
241	5.15E-1	5.88E-1	2.97E+0	6.48E+0
242	7.87E-7	9.05E-7	1.06E-6	7.40E-5
Am 241	2.06E-3	5.50E-3	0.00E+0	0.00E+0

Table 4: PE Curies per gram of mixture

Isotope	6% Pu240 Case A	6% Pu240 Case B	12% Pu240	High Exposure	
Pu 238	3.11E-3	4.67E-3	1.45E-2	9.03E-2	
239	5.80E-2	5.78E-2	5.21E-2	4.47E-2	
240	1.34E-2	1.37E-2	2.95E-2	4.35E-2	
241	9.91E-3	1.13E-2	5.71E-2	1.25E-1	
242	7.15E-7	8.22E-7	9.66E-7	6.72E-5	
Am 241	2.06E-3	5.50E-3	0.00E+0	0.00E+0	
Totals:	8.65E-2	9.30E-2	1.53E-1	3.03E-1	PE Ci/g
	↓	↓	↓	↓	
	11.6	10.8	6.5	3.3	g/PE Ci

The radiological dose consequences were calculated for reference release of 1 Ci of Pu239. The resulting consequences for any of the sample mixes can be calculated using the parameters in Table 4, or for any other TRU mix in a like manner.

Transport Assumptions:

Acute ground level release dispersion factors (X/Q) were generated using the GENII dosimetry code [2] for four onsite locations in accordance with Reference 3, and at the 16 sector locations around the site boundary. For this accident the agricultural location corresponding to the maximum ingestion pathway receptor (IPR) coincides with the worst case site boundary location. These results are summarized in the tables below. The asterisks in the tables identify the worst case locations.

Table 5: Acute 95 percentile X/Q values at nearby onsite locations for a ground level release at 224-T

Facility	Location	X/Q (s/m^3)
2722-W	**550 m SSE**	**1.5E-3 ***
283-W	600 m S	1.4E-3
2713-W	810 m SSW	7.4E-4
231-Z	1330 m SW	3.6E-4

Table 6: Acute 95 percentile X/Q values at site boundary locations for a ground level release at 224-T

Sector	Distance (km)	X/Q (s/m^3)
S	14.6	1.3E-5
SSW	14.8	1.2E-5
SW	17.2	1.1E-5
WSW	14.5	1.5E-5
W	14.1	1.5E-5
WNW	**14.5**	**1.6E-5 ***
NW	17.4	1.1E-5
NNW	18.7	1.1E-5
N	20.5	1.0E-5
NNE	25.6	7.5E-6
NE	28.0	6.0E-6
ENE	24.5	5.5E-6
E	24.2	5.6E-6
ESE	30.0	2.6E-6
SE	25.6	3.1E-6
SSE	21.8	7.7E-6

Note that the above dispersion coefficients do not include plume meander effects. Plume meander effects were calculated for the accident in accordance with USNRC Regulatory Guide 1.145 assuming zero source area (ie. no building wake). The resulting dose reduction factors are 4.00 and 1.22 at 550 m and 14.5 km, respectively.

Receptor Descriptions:

Onsite:

Receptor at the nearest occupied facility, or at a distance of 100 m in the worst direction, whichever is further [3]. Doses calculated for this receptor include inhalation and submersion. The release is assumed to have a relatively short duration (< 2 hours) so no credit was taken for evacuation of the onsite receptor.

Site Boundary:

Receptor at the site boundary in the worst direction. Where the site is bounded by the Columbia River, the site boundary is taken to be at the nearer bank of the river. This receptor is assumed to reside at this location for the duration of the accident. Doses calculated include inhalation and submersion.

Agricultural Area:

Residence of the ingestion pathway receptor (IPR). This receptor is assumed to grow his own food, including a variety of crops, meat and dairy products and to continue to do so at this location for 50 years following the accident. No credit is taken for uncontaminated foodstuffs brought in from outside the area. Note that IPR ingestion doses are reported only as a measure of economic damage since, in the case of an accident, any contaminated land or products would not be used. Ingestion and ground shine would not, therefore, be actual exposure pathways. The release is assumed to occur just prior to the autumn harvest in order to maximize consequences with regard to the time of the accident.

Code Documentation:

GENII version 1.485 (12/3/90) [2]
GENII Default Parameter Values (3/28/90 RAP)
RMDLIB - Radionuclide Master Library (11/15/90)
External Dose Factor Library (5/8/90)
Internal Dose Increment Library, PNL Solubilities, (12/3/90 PDR)
Joint Frequency Data: 200 Area, 10 m, Pasquill A-F (1983-1987 Average)
Food Transfer Factor Library (8/29/88)
EXTGAM - Gamma Energies by Group for Finite Plume (5/13/90 RAP)

==> The GENII input files are attached for reference.

Results:

The doses resulting from a standard 1 Ci Pu239 release to the three receptor types are shown in the Table 7 below. Submersion doses were calculated using a finite plume integration model. The site boundary receptor and the ingestion pathway receptor (IPR) are at the same location for this release point. The inhalation and submersion doses are therefore the same for the two receptors types.

Table 7: Resulting doses for a standard release of 1 Ci of Pu239 from the 224-T Facility

Receptor	Dose Type	Dose (rem) EDE	Limiting Organ
Onsite	Inhalation	3.8E+1	4.0E+2 (bone surface)
	Submersion	1.6E-8	1.6E-8
	Totals:	3.8E+1	4.0E+2 (bone surface)
Site Boundary	Inhalation	1.3E+0	1.3E+1 (bone surface)
	Submersion	1.2E-9	1.2E-9
	Totals:	1.3E+0	1.3E+1 (bone surface)
IPR	Inhalation	1.3E+0	1.3E+1 (bone surface)
	Submersion	1.2E-9	1.2E-9
	Ingestion	1.9E-2	2.5E-1 (bone surface)
	Ground Shine	3.2E-7	3.2E-7
	Totals:	1.3E+0	1.3E+1 (bone surface)

Radiological dose consequences from the four sample plutonium mixes shown in Table 2 were calculated using the PE Ci/g developed in Table 4 for each of the mixes. In all cases 200 g of plutonium was assumed to be involved leading to a release of 0.106 g. Resulting doses are shown in Tables 8 through 11.

Table 8: Resulting doses for a 0.106 g release of Case A 6% Pu239 mix (9.17E-3 PE Ci)

Receptor	Dose Type	Dose (rem) EDE	Limiting Organ
Onsite	Inhalation	3.4E-1	3.7E+0 (bone surface)
	Submersion	1.5E-10	1.5E-10
	Totals:	3.4E-1	3.7E+0 (bone surface)
Site Boundary	Inhalation	1.2E-2	1.2E-1 (bone surface)
	Submersion	1.1E-11	1.1E-11
	Totals:	1.2E-2	1.2E-1 (bone surface)
IPR	Inhalation	1.2E-2	1.2E-1 (bone surface)
	Submersion	1.1E-11	1.1E-11
	Ingestion	1.7E-4	2.3E-3 (bone surface)
	Ground Shine	2.9E-9	2.9E-9
	Totals:	1.2E-2	1.2E-1 (bone surface)

Table 9: Resulting doses for a 0.106 g release of Case B 6% Pu239 mix (9.86E-3 PE Ci)

Receptor	Dose Type	Dose (rem) EDE	Dose (rem) Limiting Organ
Onsite	Inhalation	3.7E-1	3.9E+0 (bone surface)
	Submersion	1.6E-10	1.6E-10
	Totals:	3.7E-1	3.9E+0 (bone surface)
Site Boundary	Inhalation	1.3E-2	1.3E-1 (bone surface)
	Submersion	1.2E-11	1.2E-11
	Totals:	1.3E-2	1.3E-1 (bone surface)
IPR	Inhalation	1.3E-2	1.3E-1 (bone surface)
	Submersion	1.2E-11	1.2E-11
	Ingestion	1.9E-4	2.4E-3 (bone surface)
	Ground Shine	3.2E-9	3.2E-9
	Totals:	1.3E-2	1.3E-1 (bone surface)

Table 10: Resulting doses for a 0.106 g release of 12% Pu239 mix (1.62E-2 PE Ci)

Receptor	Dose Type	Dose (rem) EDE	Dose (rem) Limiting Organ
Onsite	Inhalation	6.1E-1	6.5E+0 (bone surface)
	Submersion	2.6E-10	2.6E-10
	Totals:	6.1E-1	6.5E+0 (bone surface)
Site Boundary	Inhalation	2.1E-2	2.1E-1 (bone surface)
	Submersion	2.0E-11	2.0E-11
	Totals:	2.1E-2	2.1E-1 (bone surface)
IPR	Inhalation	2.1E-2	2.1E-1 (bone surface)
	Submersion	2.0E-11	2.0E-11
	Ingestion	3.1E-4	4.0E-3 (bone surface)
	Ground Shine	5.2E-9	5.2E-9
	Totals:	2.1E-2	2.1E-1 (bone surface)

Table 11: Resulting doses for a 0.106 g release of high exposure Pu mix (3.21E-2 PE Ci)

Receptor	Dose Type	Dose (rem) EDE	Limiting Organ
Onsite	Inhalation	1.2E+0	1.3E+1 (bone surface)
	Submersion	5.1E-10	5.1E-10
	Totals:	1.2E+0	1.3E+1 (bone surface)
Site Boundary	Inhalation	4.2E-2	4.2E-1 (bone surface)
	Submersion	3.9E-11	3.9E-11
	Totals:	4.2E-2	4.2E-1 (bone surface)
IPR	Inhalation	4.2E-2	4.2E-1 (bone surface)
	Submersion	3.9E-11	3.9E-11
	Ingestion	6.1E-4	7.9E-3 (bone surface)
	Ground Shine	1.0E-8	1.0E-8
	Totals:	4.3E-2	4.3E-1 (bone surface)

Conclusions:

For purposes of comparing the doses to applicable risk acceptance criteria, internal and external doses from inhalation and submersion pathways only are combined as follows.

Table 12: Inhalation and submersion dose summary for a 0.106 g release of Case A 6% Pu239 mix

Receptor	Combined Doses (rem) EDE	Limiting Organ
Onsite	3.4E-1	3.7E+0 (bone surface)
Site Boundary	1.2E-2	1.2E-1 (bone surface)

Table 13: Inhalation and submersion dose summary for a 0.106 g release of Case B 6% Pu239 mix

Receptor	Combined Doses (rem) EDE	Limiting Organ
Onsite	3.7E-1	3.9E+0 (bone surface)
Site Boundary	1.3E-2	1.3E-1 (bone surface)

Table 14: Inhalation and submersion dose summary for a 0.106 g release of 12% Pu239 mix

Receptor	Combined Doses (rem) EDE	Limiting Organ
Onsite	6.1E-1	6.5E+0 (bone surface)
Site Boundary	2.1E-2	2.1E-1 (bone surface)

Table 15: Inhalation and submersion dose summary for a 0.106 g release of high exposure Pu mix

Receptor	Combined Doses (rem) EDE	Limiting Organ
Onsite	1.2E+0	1.3E+1 (bone surface)
Site Boundary	4.2E-2	4.2E-1 (bone surface)

The limiting dose for all these releases is the onsite bone surface dose. If the probability of the postulated fire in a waste drum is assumed to be less than 0.01/y, the radiological risk acceptance guidelines are 5 rem EDE (50 rem bone surface) for the onsite receptor and 0.5 rem EDE (5 rem bone surface) for the offsite receptor [3]. The worst case considered here (the high exposure mix) is therefore well within the acceptance guidelines for the postulated fire involving 200 g of metal assuming a probability of 0.01/y.

The information developed here can also be used very simply to give maximum allowable inventories at risk for involvement in the postulated fire. Table 7 gives the limiting onsite bone surface dose for a reference release of 1 PE Ci as 400 rem. Since the risk acceptance guideline is 50 rem assuming a probability of 0.01/y, the maximum allowable release for this probability is 0.125 PE Ci, or given the release fraction of 5.3E-4, the maximum allowable at-risk inventory is 236 PE Ci. The corresponding maximum involved inventory of the various mixes can obtained using the g/PE Ci values developed in Table 4 as follows.

Table 16: Maximum involved inventories for 0.01/y fire

TRU Mix	Maximum Release (PE Ci)	Involved Inventory PE Ci	grams
Case A 6% Pu239	0.125	236	2700
Case B 6% Pu239	0.125	236	2500
12% Pu239	0.125	236	1500
High Exposure	0.125	236	780

References:

1. J.E. Ayer, et al., Nuclear Fuel Cycle Facility Accident Analysis Handbook, NUREG-1320, May 1988.

2. B.A. Napier, et al., GENII - The Hanford Environmental Radiation Dosimetry Software System, PNL-6484, Dec. 1988.

3. Nonreactor Facility Safety Analysis Manual, Westinghouse Hanford Co., WHC-CM-4-46, September, 1988.

GENII Input File
Onsite receptor 550 m SSE

```
######################### Program GENII Input File ############  8 Jul 88 ####
Title: Pu release from 224-T Facility - Ref. 1 Ci Pu 239 - OS 550 m SSE
       \GENII\224tlos.in                          Created on 03-28-1991 at 13:33
OPTIONS========================= Default ====================================
F    Near-field scenario?      (Far-field)    NEAR-FIELD: narrowly-focused
F    Population dose?         (Individual)                release, single site
T    Acute release?             (Chronic)     FAR-FIELD:  wide-scale release,
     Maximum Individual data set used                     multiple sites
                                Complete                                  Complete
TRANSPORT OPTIONS============ Section   EXPOSURE PATHWAY OPTIONS===== Section
T  Air Transport                  1     T  Finite plume, external        5
F  Surface Water Transport        2     F  Infinite plume, external      5
F  Biotic Transport (near-field)  3,4   F  Ground, external              5
F  Waste Form Degradation (near)  3,4   F  Recreation, external          5
                                        T  Inhalation uptake             5,6
REPORT OPTIONS======================    F  Drinking water ingestion      7,8
T  Report AEDE only                     F  Aquatic foods ingestion       7,8
F  Report by radionuclide               F  Terrestrial foods ingestion   7,9
T  Report by exposure pathway           F  Animal product ingestion      7,10
F  Debug report on screen               F  Inadvertent soil ingestion

INVENTORY ##################################################################

 4   Inventory input activity units: (1-pCi  2-uCi  3-mCi  4-Ci  5-Bq)
 0   Surface soil source units (1- m2  2- m3  3- kg)
     Equilibrium question goes here

     --------|----Release Terms------|----------Basic Concentrations---------|
     Use when|  transport selected   |  near-field scenario, optionally      |
     --------|-----------------------|---------------------------------------|
     Release |        Surface Buried |        Surface Deep    Ground  Surface|
     Radio-  |Air     Water   Waste  |Air     Soil    Soil    Water   Water  |
     nuclide |/yr     /yr     /m3    |/m3     /unit   /m3     /L      /L     |
     --------|------- ------- -------|------- ------- ------- ------- -------|
     PU239   1.0E+00

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

```
TIME ##################################################################

1     Intake ends after (yr)
50    Dose calc. ends after (yr)
0     Release ends after (yr)
0     No. of years of air deposition prior to the intake period
0     No. of years of irrigation water deposition prior to the intake period

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

0           Definition option: 1-Use population grid in file POP.IN
0                              2-Use total entered on this line

NEAR-FIELD SCENARIOS ########################################################

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

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

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

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

EXPOSURE ##################################################################

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

            ====INHALATION=======================================SECTION 6=====
8766.0      Hours of exposure to contamination per year
0           0-No resus-  1-Use Mass Loading          2-Use Anspaugh model
0             pension      Mass loading factor (g/m3)   Top soil available (cm)

            ====INGESTION POPULATION=============================SECTION 7=====
0           Atmospheric production definition (select option):
0             0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line
              1-Use population-weighted chi/Q
              2-Use uniform production
              3-Use chi/Q and production grids (PRODUCTION will be overridden)
0           Population ingesting aquatic foods, 0 defaults to total (person)
0           Population ingesting drinking water, 0 defaults to total (person)
F           Consider dose from food exported out of region (default=F)

            Note below: S* or Source: 0-none, 1-ground water, 2-surface water
                                      3-Derived concentration entered above
            ==== AQUATIC FOODS / DRINKING WATER INGESTION========SECTION 8====

F           Salt water? (default is fresh)

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

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

USE ? T/F	FOOD TYPE	GROW TIME da	S *	--IRRIGATION-- RATE in/yr	TIME mo/yr	YIELD kg/m2	PROD-UCTION kg/yr	--CONSUMPTION-- HOLDUP da	RATE kg/yr
F	LEAF V	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	ROOT V	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	FRUIT	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	GRAIN	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0

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

USE ? T/F	FOOD TYPE	---HUMAN---- CONSUMPTION RATE kg/yr	HOLDUP da	TOTAL PROD-UCTION kg/yr	DRINK WATER CONTAM FRACT.	----------STORED FEED---------- DIET FRAC-TION	GROW TIME da	S *	-IRRIGATION-- RATE in/yr	TIME mo/yr	YIELD kg/m3	STOR-AGE da
F	BEEF	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
F	POULTR	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
F	MILK	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
F	EGG	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
						----------FRESH FORAGE----------						
	BEEF					0.00	0.0	0	0.0	0.00	0.00	0.0
	MILK					0.00	0.0	0	0.0	0.00	0.00	0.0

##

GENII Input File
Site boundary receptor 14.5 km WNW

```
######################### Program GENII Input File ############  8 Jul 88 ####
Title: Pu release from 224-T Facility - Ref. 1 Ci Pu 239 - SB 14.5 km WNW
       \GENII\224tlsb.in                          Created on 03-28-1991 at 13:36
OPTIONS========================= Default ====================================
F    Near-field scenario?      (Far-field)    NEAR-FIELD: narrowly-focused
F    Population dose?         (Individual)                release, single site
T    Acute release?             (Chronic)     FAR-FIELD:  wide-scale release,
     Maximum Individual data set used                     multiple sites
                                Complete                                  Complete
TRANSPORT OPTIONS============ Section   EXPOSURE PATHWAY OPTIONS===== Section
T  Air Transport                  1     T  Finite plume, external       5
F  Surface Water Transport        2     F  Infinite plume, external     5
F  Biotic Transport (near-field)  3,4   F  Ground, external             5
F  Waste Form Degradation (near)  3,4   F  Recreation, external         5
                                        T  Inhalation uptake            5,6
REPORT OPTIONS======================    F  Drinking water ingestion     7,8
T  Report AEDE only                     F  Aquatic foods ingestion      7,8
F  Report by radionuclide               F  Terrestrial foods ingestion  7,9
T  Report by exposure pathway           F  Animal product ingestion     7,10
F  Debug report on screen               F  Inadvertent soil ingestion

INVENTORY ##################################################################

 4   Inventory input activity units: (1-pCi  2-uCi  3-mCi  4-Ci  5-Bq)
 0   Surface soil source units (1- m2  2- m3  3- kg)
     Equilibrium question goes here

     --------|----Release Terms------|----------Basic Concentrations---------|
     Use when|  transport selected   |  near-field scenario, optionally      |
     --------|-----------------------|---------------------------------------|
     Release |        Surface Buried |        Surface Deep    Ground  Surface|
     Radio-  |Air     Water   Waste  |Air     Soil    Soil    Water   Water  |
     nuclide |/yr     /yr     /m3    |/m3     /unit   /m3     /L      /L     |
     --------|------- ------- -------|------- ------- ------- ------- -------|
     PU239   1.0E+00

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

```
TIME ##################################################################

1     Intake ends after (yr)
50    Dose calc. ends after (yr)
0     Release ends after (yr)
0     No. of years of air deposition prior to the intake period
0     No. of years of irrigation water deposition prior to the intake period

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

0          Definition option: 1-Use population grid in file POP.IN
0                             2-Use total entered on this line

NEAR-FIELD SCENARIOS ########################################################

           Prior to the beginning of the intake period: (yr)
0            When was the inventory disposed?  (Package degradation starts)
0            When was LOIC?  (Biotic transport starts)
0          Fraction of roots in upper soil (top 15 cm)
0          Fraction of roots in deep soil
0          Manual redistribution: deep soil/surface soil dilution factor
0          Source area for external dose modification factor (m2)
TRANSPORT ###################################################################
           ====AIR TRANSPORT=================================SECTION 1=====
                    0-Calculate PM            |0        Release type (0-3)
3          Option: 1-Use chi/Q or PM value    |F        Stack release (T/F)
                   2-Select MI dist & dir     |0        Stack height (m)
                   3-Specify MI dist & dir    |0        Stack flow (m3/sec)
0          Chi/Q or PM value                  |0        Stack radius (m)
6          MI sector index (1=S)              |0        Effluent temp. (C)
14500.0    MI distance from release point (m) |0        Building x-section (m2)
T          Use jf data, (T/F) else chi/Q grid |0        Building height (m)

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

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

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

EXPOSURE ##################################################################

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

            ====INHALATION=======================================SECTION 6=====
8766.0      Hours of exposure to contamination per year
0           0-No resus-  1-Use Mass Loading          2-Use Anspaugh model
0             pension      Mass loading factor (g/m3)   Top soil available (cm)

            ====INGESTION POPULATION=============================SECTION 7=====
0           Atmospheric production definition (select option):
0             0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line
              1-Use population-weighted chi/Q
              2-Use uniform production
              3-Use chi/Q and production grids (PRODUCTION will be overridden)
0           Population ingesting aquatic foods, 0 defaults to total (person)
0           Population ingesting drinking water, 0 defaults to total (person)
F           Consider dose from food exported out of region (default=F)

            Note below: S* or Source: 0-none, 1-ground water, 2-surface water
                                      3-Derived concentration entered above
            ==== AQUATIC FOODS / DRINKING WATER INGESTION=========SECTION 8====

F           Salt water? (default is fresh)

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

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

USE ? T/F	FOOD TYPE	GROW TIME da	S *	--IRRIGATION-- RATE in/yr	TIME mo/yr	YIELD kg/m2	PROD-UCTION kg/yr	--CONSUMPTION-- HOLDUP da	RATE kg/yr
F	LEAF V	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	ROOT V	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	FRUIT	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	GRAIN	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0

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

USE ? T/F	FOOD TYPE	---HUMAN---- CONSUMPTION RATE kg/yr	HOLDUP da	TOTAL PROD-UCTION kg/yr	DRINK WATER CONTAM FRACT.	----------STORED FEED---------- DIET FRAC-TION	GROW TIME da	-IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m3	STOR-AGE da
F	BEEF	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
F	POULTR	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
F	MILK	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
F	EGG	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
						----------FRESH FORAGE----------						
	BEEF					0.00	0.0	0	0.0	0.00	0.00	0.0
	MILK					0.00	0.0	0	0.0	0.00	0.00	0.0

##

GENII Input File
Ingestion pathway receptor 14.5 km WNW .

```
######################### Program GENII Input File ############  8 Jul 88 ####
Title: Pu release from 224-T Facility - Ref. 1 Ci Pu 239 - IP 14.5 km WNW
       \GENII\224tlip.in                          Created on 03-28-1991 at 13:37
OPTIONS========================= Default ====================================
F    Near-field scenario?      (Far-field)    NEAR-FIELD: narrowly-focused
F    Population dose?         (Individual)                release, single site
T    Acute release?             (Chronic)     FAR-FIELD:  wide-scale release,
     Maximum Individual data set used                     multiple sites
                                Complete                                   Complete
TRANSPORT OPTIONS============ Section   EXPOSURE PATHWAY OPTIONS===== Section
T  Air Transport                  1     F  Finite plume, external       5
F  Surface Water Transport        2     F  Infinite plume, external     5
F  Biotic Transport (near-field)  3,4   T  Ground, external             5
F  Waste Form Degradation (near)  3,4   F  Recreation, external         5
                                        F  Inhalation uptake            5,6
REPORT OPTIONS=======================   F  Drinking water ingestion     7,8
F  Report AEDE only                     F  Aquatic foods ingestion      7,8
F  Report by radionuclide               T  Terrestrial foods ingestion  7,9
T  Report by exposure pathway           T  Animal product ingestion     7,10
F  Debug report on screen               T  Inadvertent soil ingestion

INVENTORY ##################################################################

 4   Inventory input activity units: (1-pCi  2-uCi  3-mCi  4-Ci  5-Bq)
 0   Surface soil source units (1- m2  2- m3  3- kg)
     Equilibrium question goes here

     --------|----Release Terms------|----------Basic Concentrations---------|
     Use when|  transport selected   |  near-field scenario, optionally      |
     --------|-----------------------|---------------------------------------|
     Release |        Surface Buried |        Surface Deep    Ground  Surface|
     Radio-  |Air     Water   Waste  |Air     Soil    Soil    Water   Water  |
     nuclide |/yr     /yr     /m3    |/m3     /unit   /m3     /L      /L     |
     --------|------- ------- -------|------- ------- ------- ------- -------|
     PU239   -1.0E+00

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

```
TIME ##################################################################

50    Intake ends after (yr)
50    Dose calc. ends after (yr)
0     Release ends after (yr)
0     No. of years of air deposition prior to the intake period
0     No. of years of irrigation water deposition prior to the intake period

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

0          Definition option: 1-Use population grid in file POP.IN
0                             2-Use total entered on this line

NEAR-FIELD SCENARIOS ########################################################

           Prior to the beginning of the intake period: (yr)
0            When was the inventory disposed?  (Package degradation starts)
0            When was LOIC?  (Biotic transport starts)
0          Fraction of roots in upper soil (top 15 cm)
0          Fraction of roots in deep soil
0          Manual redistribution: deep soil/surface soil dilution factor
0          Source area for external dose modification factor (m2)
TRANSPORT ###################################################################
           ====AIR TRANSPORT=====================================SECTION 1=====
                  0-Calculate PM              |0        Release type (0-3)
3          Option: 1-Use chi/Q or PM value    |F        Stack release (T/F)
                  2-Select MI dist & dir      |0        Stack height (m)
                  3-Specify MI dist & dir     |0        Stack flow (m3/sec)
0          Chi/Q or PM value                  |0        Stack radius (m)
6          MI sector index (1=S)              |0        Effluent temp. (C)
14500.0    MI distance from release point (m) |0        Building x-section (m2)
T          Use jf data, (T/F) else chi/Q grid |0        Building height (m)

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

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

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

EXPOSURE ##################################################################

            ====EXTERNAL EXPOSURE================================SECTION 5=====
            Exposure time:                  |   Residential irrigation:
0             Plume (hr)                    | T        Consider: (T/F)
4380.0        Soil contamination (hr)       | 0        Source: 1-ground water
0             Swimming (hr)                 |                  2-surface water
0             Boating (hr)                  | 0        Application rate (in/yr)
0             Shoreline activities (hr)     | 0        Duration (mo/yr)
0           Shoreline type: (1-river, 2-lake, 3-ocean, 4-tidal basin)
0           Transit time for release to reach aquatic recreation (hr)
1.0         Average fraction of time submersed in acute cloud (hr/person hr)

            ====INHALATION=======================================SECTION 6=====
8766.0      Hours of exposure to contamination per year
0           0-No resus-  1-Use Mass Loading          2-Use Anspaugh model
0             pension      Mass loading factor (g/m3)   Top soil available (cm)

            ====INGESTION POPULATION=============================SECTION 7=====
 1          Atmospheric production definition (select option):
0             0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line
              1-Use population-weighted chi/Q
              2-Use uniform production
              3-Use chi/Q and production grids (PRODUCTION will be overridden)
0           Population ingesting aquatic foods, 0 defaults to total (person)
0           Population ingesting drinking water, 0 defaults to total (person)
F           Consider dose from food exported out of region (default=F)

            Note below: S* or Source: 0-none, 1-ground water, 2-surface water
                                      3-Derived concentration entered above
            ==== AQUATIC FOODS / DRINKING WATER INGESTION=========SECTION 8====

F           Salt water? (default is fresh)

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

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

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

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

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

##

CHECKLIST FOR PEER REVIEWS

Document Reviewed: **REVISED ANALYSIS OF A POSTULATED PLUTONIUM RELEASE FROM 224-T FACILITY**, D.A. Himes, 3/29/91

Scope of Review: entire document

Yes	No	N/A	
[ ]	[ ]	[X] *	Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
[X]	[ ]	[ ]	Problem completely defined.
[X]	[ ]	[ ]	Accident scenarios developed in a clear and logical manner.
[X]	[ ]	[ ]	Necessary assumptions explicitly stated and supported.
[X]	[ ]	[ ]	Computer codes and data files documented.
[X]	[ ]	[ ]	Data used in calculations explicitly stated in document.
[X]	[ ]	[ ]	Data checked for consistency with original source information as applicable.
[X]	[ ]	[ ]	Mathematical derivations checked including dimensional consistency of results.
[X]	[ ]	[ ]	Models appropriate and used within range of validity or use outside range of established validity justified.
[X]	[ ]	[ ]	Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
[X]	[ ]	[ ]	Code runstreams correct and consistent with analysis documentation.
[X]	[ ]	[ ]	Code output consistent with input and with results reported in analysis documentation.
[ ]	[ ]	[X]	Acceptability limits on analytical results applicable and supported. Limits checked against sources.
[ ]	[ ]	[X]	Safety margins consistent with good engineering practices.
[X]	[ ]	[ ]	Conclusions consistent with analytical results and applicable limits.
[X]	[ ]	[ ]	Results and conclusions address all points required in the problem statement.
[X]	[ ]		Document presentation quality meet SA&R standards
[ ]	[ ]	[X]	Format consistent with appropriate NRC Regulatory Guide or other standards
[ ]		[X] *	Review calculations, comments, and/or notes are attached.

Rick J Van Vleet 04/16/1991

Reviewer Approval (Printed Name and Signature) Date

* Any calculations, comments, or notes generated as part of this review should be signed, dated and attached to this checklist. Such material should be labeled and recorded in such a manner as to be intelligible to a technically qualified third party.

[X] [ ] [ ] Analysis entered into analysis database

D.A. Himes 4/16/91

Analyst (Printed Name and Signature) Date

CHECKLIST FOR HEDOP REVIEW

Document Reviewed: **REVISED ANALYSIS OF A POSTULATED PLUTONIUM RELEASE FROM 224-T FACILITY**, D.A. Himes, 3/29/91

Scope of Review: entire document

Yes	No	N/A	
[X]	[ ]	[ ]	HEDOP-accepted code(s)/version(s) or other appropriate calculation methodology used.
[X]	[ ]	[ ]	Appropriate receptor locations evaluated.
[X]	[ ]	[ ]	Appropriate models (finite plume vs. semi-infinite cloud, building wake, etc.) used.
[X]	[ ]	[ ]	Appropriate pathways evaluated for each receptor.
[X]	[ ]	[ ]	Analysis consistent with HEDOP recommendations.
[ ]		[X] *	Review calculations, comments, and/or notes are attached.

Rick J. VanVleet 04/16/1991

HEDOP Reviewer Approval (Printed Name and Signature) Date

* Any calculations, comments, or notes generated as part of this review should be signed, dated and attached to this checklist. Such material should be labeled and recorded in such a manner as to be intelligible to a technically qualified third party.

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