DOE/EH-0415—
Vol. 2-App. B-Pt. 9

PLUTONIUM WORKING GROUP REPORT

on

ENVIRONMENTAL, SAFETY AND HEALTH VULNERABILITIES ASSOCIATED WITH THE DEPARTMENT'S PLUTONIUM STORAGE

MASTER

VOLUME II, APPENDIX B, PART 9:
OAK RIDGE SITE
SITE ASSESSMENT TEAM REPORT

U.S. DEPARTMENT OF ENERGY
SEPTEMBER 1994

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Department of Energy
Plutonium ES&H Vulnerability Assessment

Oak Ridge Site Assessment Team Report

July 29, 1994

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MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 1, 1994

Mr. Garland Proco
Department of Energy
Oak Ridge Operations Office
Post Office Box 2001
Oak Ridge, Tennessee 37831

Dear Mr. Proco:

Classification Review of Plutonium ES&H Vulnerability Assessment

As per your request, I have investigated the classification review provided by Martin Marietta Energy Systems, Inc., for the document *Department of Energy, Plutonium ES&H Vulnerability Assessment, Oak Ridge Site Assessment Team Report*, dated July 29, 1994.

This document was produced at the Oak Ridge National Laboratory and went through the document release procedure associated with that site. That procedure includes either a classification review or a determination that a classification review is not necessary.

All necessary sign-offs with respect to classification reviews were obtained for release of the above-mentioned document as an unclassified document, including a review by the Oak Ridge Y-12 Plant Classification Office concerning Y-12 Plant matters.

Sincerely,

Arvin S. Quist

Arvin S. Quist, Classification Officer
Oak Ridge K-25 Site and Oak Ridge National Laboratory

ASQ:vb

c: File-K25CO-RC

Department of Energy
Plutonium ES&H Vulnerability Assessment
Oak Ridge Site Assessment Team (SAT) Report

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X-10	Vulnerability Evaluation Matrix Evaluator	C. K. Ford
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Y-12	Y-12 Source Control Program	G. M. Dick
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X-10	2007	R. E. Halliburton
X-10	2026	J. M. Keller
X-10	3003	M. D. Galloway
X-10	3019	K. R. Givens
X-10	3027	R. J. Robson J. H. Greene
X-10	3038	M. L. Evans
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X-10	7503	R. E. Swaja
X-10	7700	R. D. Dabbs
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X-10	7735	C. S. Dudney
X-10	7811	A. W. Lewis D. E. Fowler
X-10	7824	F. J. Schultz J. A. Chapman
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X-10	7900	R. D. Dabbs
X-10	7920	J. E. Bigelow L. K. Felker R. G. Stacy
X-10	7930	J. E. Bigelow L. K. Felker R. G. Stacy
X-10	Waste Management and Remedial Action Facilities	D. W. Turner F. Schultz C. Scott B. McClelland L. G. Hill A. J. Kuhaida
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Y-12	9204-1	W. G. Craddick
Y-12	9204-3	W. S. Aaron C. A. Sampson
Y-12	9212/9215	J. E. Vath

Site Assessment Team Coordinators		
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Y-12	9720-5	C. G. Walker

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Acronym List

C&ASD	Chemical and Analytical Services Division
CFR	*Code of Federal Regulations*
CH	contact-handled
COG	cell off-gas
CONOPS	concept of operations
CTD	Chemical Technology Division
DOE	U.S. Department of Energy
E&CD	Evaluations and Control Division
EPA	Environmental Protection Agency
EP&MD	Engineering Physics and Mathematics Division
ESD	Environmental Sciences Division
ES&H	environmental, safety, and health
ETD	Engineering Technology Division
FED	Fusion Energy Division
F&MD	Finance and Materials Division
HSE&AD	Health, Safety, Environment, and Accountability Division
HSRD	Health Sciences Research Division
I&CD	Instrumentation and Controls Division
LLLW	liquid low-level waste
M&CD	Metals and Ceramics Division
MMES	Martin Marietta Energy Systems, Inc.
MPD	Metal Preparation Division
NDA	nondestructive assay
NDE	nondestructive evaluation
OORFS	Office of Operational Readiness and Facility Safety
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORP	Office of Radiation Protection
PAD	Paducah Gaseous Diffusion Plant
PD	Physics Division
PORTS	Portsmouth Gaseous Diffusion Plant
QS	*Question Sets*
RADCON	*Radiation Control*
RCRA	Resource Conservation and Recovery Act
REDC	Radiochemical Engineering Development Center
RH	remote-handled
RRD	Research Reactors Division
SARUP	Safety Analysis Report Update Program
SC	special case
SNM	special nuclear material
SRCPRG	Source Control Program
SS	stainless steel
SSD	Solid State Division
SWSA	solid waste storage area
TRU	transuranic
VA	vulnerability assessment

VAF	vulnerability assessment form
WAG	waste area grouping
WGAT	Working Group Assessment Team
WM&RAD	Waste Management and Remedial Action Division

Executive Summary

This report provides the input to and results of the Department of Energy (DOE) — Oak Ridge Operations (ORO) DOE Plutonium Environment, Safety and Health (ES&H) Vulnerability Assessment (VA) self-assessment performed by the Site Assessment Team (SAT) for the Oak Ridge National Laboratory (ORNL or X-10) and the Oak Ridge Y-12 Plant (Y-12) sites that are managed by Martin Marietta Energy Systems, Inc. (MMES). As initiated (March 15, 1994) by the Secretary of Energy, the objective of the VA is to identify and rank-order DOE-ES&H vulnerabilities associated with plutonium storage and operations for the purpose of decision making on the interim safe management and ultimate disposition of fissile materials. This assessment is directed at plutonium and other co-located transuranics in various forms.

Guidance for conducting the VA was provided in the DOE Plutonium ES&H VA Project Plan and Assessment Plan and QS, dated April 25, 1994, and supplementary guidance provided at the May 19-21, 1994, Colorado Springs, Colorado, Team Training. Vulnerabilities were categorized as worker health and safety, public safety and health, and environmental damage. Each vulnerability category was evaluated according to "severity (H—high, M—medium, L—low)" of "Likelihood" and "Hazard."

A DOE Headquarters Working Group Assessment Team (WGAT) visited the Oak Ridge sites between June 20, 1994, and July 1, 1994, for the purpose of reviewing and validating a prior draft SAT report. The current document represents the final version of the SAT report and is the result of SAT revisions and interpretations by the WGAT.

A total of 59 responses to the Question Sets (QS) were collected from ORNL and Y-12 site personnel — 48 from ORNL and 11 from Y-12. The SAT identified 14 vulnerabilities from the 59 responses to the QS. Of these 59 responses and 14 identified vulnerabilities, the WGAT judged that only 19 responses and 9 vulnerabilities were "in-scope" by their interpretation of DOE Headquarters guidance. The WGAT independently identified 12 vulnerabilities, 4 of which concurred with SAT— identified vulnerabilities. Thus, between the SAT and WGAT, a total of 17 vulnerabilities were identified. Subsequently, DOE Headquarters suggested that the 40 "out-of-scope" QS responses and associated 5 vulnerabilities be included in the Attachment to this report. Of the 17 identified "in-scope" vulnerabilities, 6 are considered general at both X-10 and Y-12 site facilities, 8 are specific to X-10 site facilities, and 3 are specific to Y-12 site facilities.

Evaluation of the nine identified "in-scope" vulnerabilities separately by "Likelihood" and "Hazard" resulted in nine worker health and safety vulnerabilities (3—LL, 3—LM, 1—LH, 2—ML), two public safety and health vulnerabilities (2—LL), and two environmental damage vulnerabilities (2—LL). These vulnerabilities are generally characterized as low-frequency "unusual occurrence" events.

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DEPARTMENT OF ENERGY PLUTONIUM ES&H VULNERABILITY ASSESSMENT

DOE-ORO SITE ASSESSMENT TEAM REPORT

July 25, 1994

INTRODUCTION

This U.S. Department of Energy–Oak Ridge Operations (DOE—ORO) Site Assessment Team (SAT) report provides responses to the DOE Plutonium ES&H Vulnerability Assessment Question Set (QS) for the two sites within the DOE—ORO reservation visited by the DOE Headquarters (HQ) Working Group Assessment Team (WGAT). These sites are the Oak Ridge National Laboratory (ORNL or the Laboratory) and the Oak Ridge Y-12 Plant (coded in the QS responses as X-10 and Y-12). Both sites are managed for DOE by Martin Marietta Energy Systems, Inc. (MMES). The relative position of the sites to the city of Oak Ridge, Tennessee, is shown in Figure 1. The overall layouts for facilities at the ORNL are shown in Figure 2. The overall layout for the facilities at the Y-12 Plant are shown in Figure 3.

ORNL is a DOE multiprogram laboratory. The mission of the Laboratory is to conduct basic and applied research and development (R&D) to advance the nation's energy security, environmental quality, scientific knowledge, educational foundations, and technological competitiveness. The Laboratory is committed to excellence in all of its activities and is operated in compliance with ES&H laws and regulations. The Laboratory also performs work in collaboration with other federal agencies, industry, and universities.

The mission of the Oak Ridge Y-12 Plant is to serve as a key manufacturing technology center for the development and demonstration of unique materials, components, and services of importance to DOE and to the nation. For DOE's Defense Programs, the Y-12 Plant dismantles nuclear weapons, maintains nuclear weapons production capability and stockpile support, serves as the nation's storehouse of special nuclear materials, and provides special production support. The Y-12 Plant supports other federal agencies through a work-for-others program and contributes to the nation's industrial competitiveness through a technology transfer program that applies the unique expertise developed for military purposes to a wide range of manufacturing problems.

The preliminary scope of the SAT vulnerability assessment was based on guidance provided in the Department of Energy Plutonium ES&H Vulnerability Assessment Project Plan and Assessment Plan, dated April 25, 1994, and supplementary guidance provided at the May 19-21, 1994, Colorado Springs, Colorado, Team Training. Because transuranics are frequently co-located with plutonium at ORNL, the site assessment presumed the potential co-location of all transuranics with plutonium. Additionally, although the Assessment Plan does not include transuranic wastes (unless co-located in plutonium facilities) and buried materials within its scope, guidance at the Team Training indicated that the knowledge of ES&H vulnerabilities involving such materials requires that they be included "in scope." Subsequent to the issuance of the draft SAT vulnerability assessment, the WGAT required that results for all transuranic wastes (not present in plutonium facilities) and all facilities using transuranics (but not having plutonium) be reported in an Attachment.

No de minimis quantities were provided in the Project Plan or Assessment Plan. Therefore, "EPA Reportable Quantities" of transuranics, as defined in 40 CFR, Designation of Hazardous Substances, Appendix B to Section §302.4 — Radionuclides, were adopted to limit the scope and permit a manageable assessment. However, all "sealed sources" controlled under the requirements of DOE Notice 5400.9 were identified. As individually evaluated for storage, use, accountability, and integrity, these sources were judged not to pose vulnerabilities, and only questions 1, 2, and 2A of the QS were completed. However, accumulations of sources used or stored in a common location (storage room, operating area, etc.) having a sum of individual source fractional de minimis values exceeding 1.0 and having a common adverse condition or event that could create an ES&H vulnerability were judged to be "in-scope," thereby requiring completion of the full QS. De minimis values are tabulated in the table in column 2.

Information about the location and quantities of plutonium and other transuranics was obtained from (1) current nuclear material control and accountability records, (2) current radioactive source control program tabulations of plutonium and other transuranic sources, and (3) knowledge of operations by facility personnel. Additionally, various contributors to the assessment (facility managers, operating personnel, facility safety analysis staff, various safety discipline staff, etc.) have participated or continue to participate in similar external and internal safety reviews and assessments. These persons have provided additional perspective and knowledge of operations and materials relevant to the Pu ES&H Vulnerability Assessment.

Pu ES&H Vulnerability Assessment *De Minimis* Values*

Radionuclide	Ci	grams
^{236}Np	0.1	$1.02 \times 10^{+1}$**
^{237}Np	0.01	$1.42 \times 10^{+1}$
^{236}Pu	0.1	1.88×10^{-4}
^{237}Pu	1000	8.00×10^{-2}
^{238}Pu	0.01	5.80×10^{-4}
^{239}Pu	0.01	1.63×10^{-1}
^{240}Pu	0.01	4.40×10^{-2}
^{241}Pu	1.0	1.01×10^{-2}
^{242}Pu	0.01	$2.61 \times 10^{+0}$
^{244}Pu	0.01	$5.46 \times 10^{+2}$
^{241}Am	0.01	2.91×10^{-3}
^{242m}Am	0.01	9.54×10^{-4}
^{243}Am	0.01	5.01×10^{-2}
^{242}Cm	1.0	3.02×10^{-4}
^{243}Cm	0.01	1.94×10^{-4}
^{244}Cm	0.01	1.24×10^{-4}
^{245}Cm	0.01	5.83×10^{-2}
^{246}Cm	0.01	3.29×10^{-2}
^{247}Cm	0.01	$1.07 \times 10^{+2}$
^{248}Cm	0.001	2.36×10^{-1}
^{249}Cf	0.01	2.44×10^{-3}
^{250}Cf	0.01	9.16×10^{-5}
^{251}Cf	0.01	6.32×10^{-3}
^{252}Cf	0.1	1.86×10^{-4}
^{253}Cf	10.0	3.45×10^{-4}
^{254}Cf	0.1	1.18×10^{-5}
^{249}Bk	1.0	6.10×10^{-4}

* EPA Reportable Quantities as defined in 40CFR, ***Designation of Hazardous Substances***, **Appendix** B to Section §302.4 — *Radionuclides*.

** This value exceeds a selected subcritical 5 gram mass of ^{236}Np when optimumly moderated and reflected with water.

Table 1 provides a summary of information about the facilities identified for the vulnerability assessment based on the foregoing "in-scope" criteria. The table provides the facility

- building number or name
- mission or current use
- regulatory concerns that pertain
- current ES&H documentation
- design features
- uncertainties regarding the conditions of containment of plutonium and other transuranics
- relation to or distance from the site boundary
- type and/or composition of the plutonium and other transuranics
- aggregation areas

Various past, recent, and ongoing assessments and evaluation have direct or indirect relevance to the Pu ES&H Vulnerability Assessment. Some examples are

- DOE-EH Assessment of nuclear material trapped in ductwork and vent stacks
- Defense Nuclear Facility Safety Board (DNFSB) reviews of
  - nuclear criticality safety
  - safety analysis report update programs (SARUPs)
  - RADCON — health physics
  - waste tanks
- DOE-NS review of RADCON practices
- DOE-ORO Waste Operations conduct of operations (CONOPS) assessments
- Tennessee Department of Environment and Conservation review of the ORNL Tower Shielding Facility
- DOE-HQ spent nuclear fuel assessment
- Department of Energy — Environment and Health (DOE-EH) chemical vulnerability study
- Tomsk and Tomsk II Studies
- Reactive Metal Vulnerability Study
- DOE-EH Technical Safety Appraisals — Functional and Multidisciplinary
- MMES environmental compliance audits
- Environmental assessments for the storage of uranium
- DOE Tiger Team — Technical Safety Appraisal
- Tennessee Department of Environment and Conservation Resource Conservation and Recovery Act (RCRA) treatment, storage, and disposal facilities, and hazardous waste accumulations

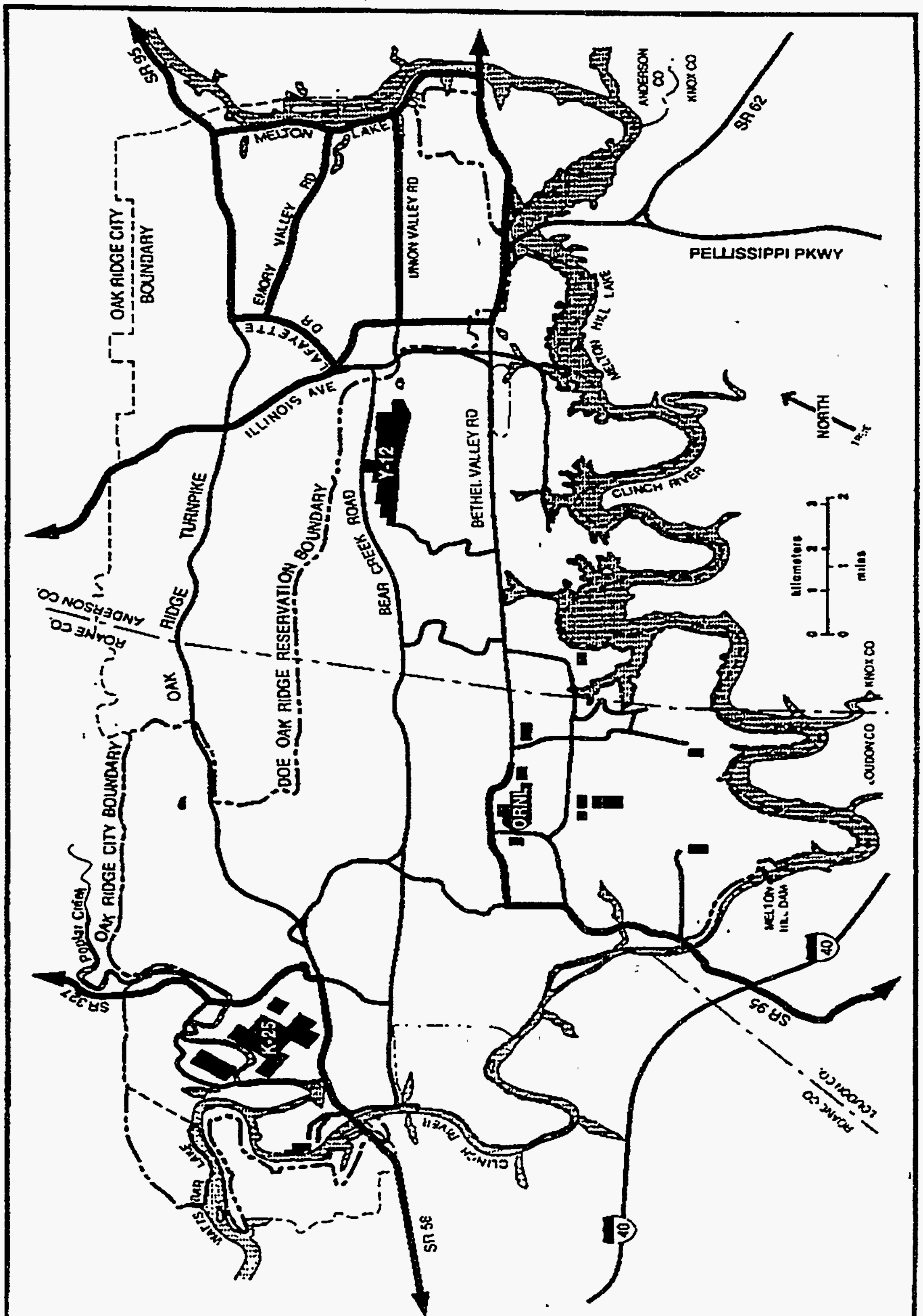
SR 95
MELTON LAKE
OAK RIDGE CITY BOUNDARY
EMORY VALLEY RD
UNION VALLEY RD
ANDERSON CO
KNOX CO
SR 62
PELLISSIPPI PKWY
LAFAYETTE DR
ILLINOIS AVE
MELTON HILL LAKE
Y-12
BETHEL VALLEY RD
NORTH
CLINCH RIVER
OAK RIDGE TURNPIKE
DOE OAK RIDGE RESERVATION BOUNDARY
BEAR CREEK ROAD
kilometers
miles
ANDERSON CO.
ROANE CO.
KNOX CO
LOUDON CO
ORNL
OAK RIDGE CITY BOUNDARY
Poplar Creek
MELTON HILL DAM
40
SR 327
K-25
SR 95
ROANE CO
LOUDON CO.
CLINCH RIVER
WATTS BAR LAKE
SR 58
40

Figure 1

ORNL DWG 94M-9760

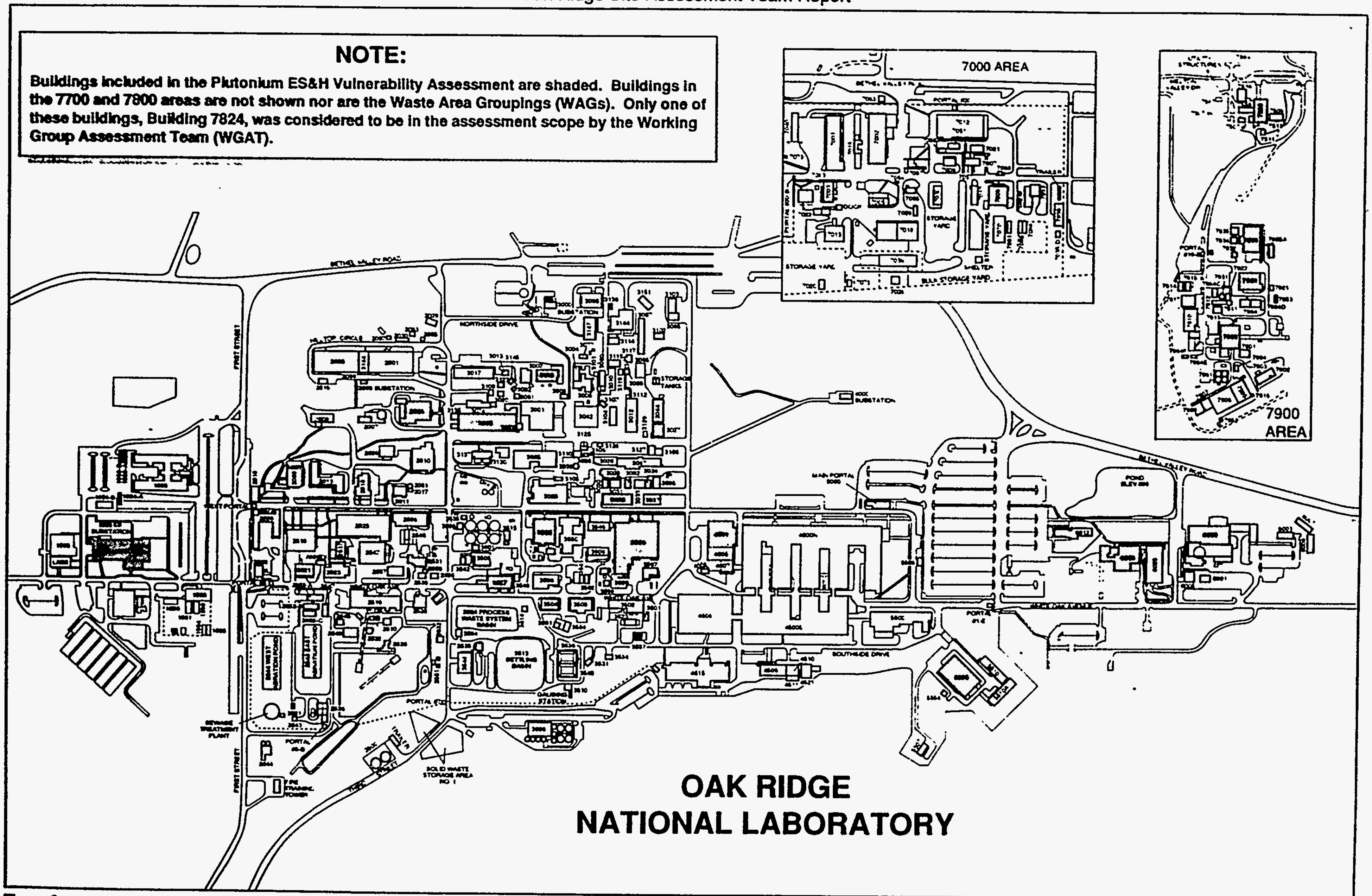

Figure 2

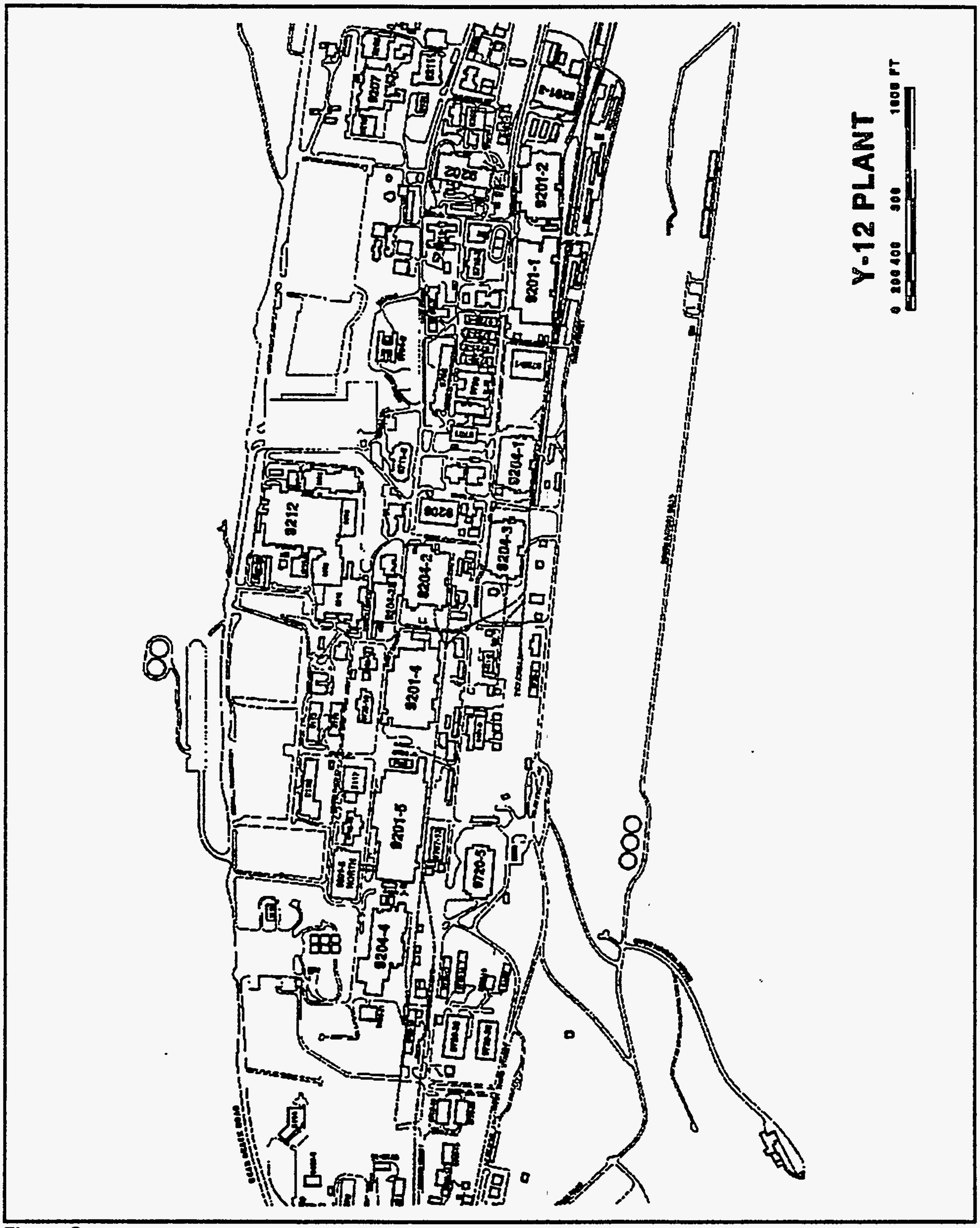
Y-12 PLANT
9201-1
9201-2
9204-1
9204-3
9204-2
9212
9201-4
9201-5
9204-4
9720-5

Figure 3

Table 1: Summary of Oak Ridge National Laboratory (ORNL) and Y-12 Plant Facility Descriptions

Building/ facility	Mission	Current use	Design features	Location (distance to site boundary)	Material Form and/or Composition	Aggregation areas
2007 RaSCal	Calibration of all ORNL health physics instruments		Five shielded calibration areas	Northwest quadrant of main ORNL complex (600 ft)	^{241}Am $^{238}PuBe$	Locked shielded vault Locked exposure room
2026	Treatment and analysis of highly radioactive alpha-, beta- and gamma-emitting materials		Concrete structure, hot cell block, glove box labs	Hillside Ave & Third Street within main ORNL complex	Radioactive materials being analyzed	Glove boxes and hot cells within controll—ed access building
3027 special nuclear materials vault	Receipt, shipment, & storage of nuclear materials	Since 1989, also storage of precious metals (Room 108 only)	Reinforced concrete; fire, earthquake, & wind protected; dual-system ventilation; multipoint alarm panel; continuous alpha air monitor in airlock	Center of main ORNL complex; (650 ft)	^{235}U (oxide) ^{236}U (fuel form) ^{233}U (oxide) $^{239/241}Pu$ (oxide) ^{242}Pu ^{238}Pu (oxide) Am oxide Th oxide Np oxide Cm, Bk, Cf (oxide) natural Th natural U	Room 104 Room 105 Room 107
3038	Store, process, & dispense radioactive isotopes	Shutdown	Cell ventilation; process off-gas and local ventilation systems; airlocks; fire protection			Shipping containers storage containers, & a safe
3500 Annex	Office, shop, and laboratory space for Instrumentation and Controls Division (I&CD) researchers and engineers		Sprinkler system & fire doors	Center of ORNL complex (300 ft)	PuBe	
3508	Formerly an alpha-isolation area	Office, shop, and lab space for I&C staff				Fissile materials vault (part of Material Balance Area 135); glove boxes
4501	High—Level Radiochemical Laboratory					

Table 1: Summary of Oak Ridge National Laboratory (ORNL) and Y-12 Plant Facility Descriptions

Building/ facility	Mission	Current use	Design features	Location (distance to site boundary)	Material Form and/or Composition	Aggregation areas
5505	Advanced chemical & physical research on heaviest elements, including transuranics			Main ORNL complex (300 ft)	Pu & other actinide materials	Glove boxes & double-locked cabinets inside a locked vault room
6000 Holifield	Research in nuclear and atomic physics		Standard protection features, including seismic shutdown	Immediately east of main ORNL complex (~100 ft)		
6010 ORELA	Pulsed, intense neutron source for basic & applied physics research		Fire protection shielded walls	East end of main ORNL complex (~100 ft)		Locked containers
7700 Tower Shielding Facility	Develop & test shielding design & effectiveness	Standby			PuBe in storage AmBe in storage AmB in reactor	Outdoor, locked underground pipe well & in reactor
7710, 7712, 7735	7735—provision of calibrated radiation exposures for personnel dosimetry research and developments, intercomparison studies, and programs; 7710—general purpose storage, labs, and supporting facilities; 7712—source storage		7712—metal walls and a high ceiling for source storage	1 mile from Melton Hill Lake, 1 mile from the nearest public highway	Calibration sources	Controlled-access buildings
7824 Waste Examination and Assay Facility	Nondestructive assay and examination of solid radioactive waste contained in drums and boxes		Steel-framed structure, aluminum siding, concrete floor	SWSA 5 (200 yards from Melton Valley entrance)	Sources used for calibration; TRU waste drums	
7900 High Flux Isotope Reactor	Isotope production		Seismic, missile, and rupture protection	~1 mile from main ORNL complex	Pu filters	HFIR Reactor Materials Storage

Table 1: Summary of Oak Ridge National Laboratory (ORNL) and Y-12 Plant Facility Descriptions

Building/ facility	Mission	Current use	Design features	Location (distance to site boundary)	Material Form and/or Composition	Aggregation areas
7920	Recovery & purification of trans-uranic elements	Remote fabrication & processing of Am & Cm; U fuel cycle development; Mark 42 target assembly processing	Concrete reinforced hot cells; glove boxes; vacuum off-gas & cell off-gas (COG) ventilation; fire protection; iodine retention; process rad block valves	~1.6 mile southest from main ORNL complex (~4900 ft)		Hot—cell tank pits, waste pit, hot cell cubicles, glove boxes, shielded caves
7930	Development and demonstration of remote processing of irradiated thorium-based fuel; fabrication of recycled material	Recovery of high-purity ^{248}Cm from ^{252}Cf; purification and packaging of ^{248}Cm and ^{252}Cf; fabrication of neutron sources containing Cf	Hot cells; glove boxes; COG exhaust; RHD-HOG system; RHDR system	1.6 miles southeast of main ORNL complex (~4900 ft)		Cell G waste pit third-floor glove box
9204-3 IEF	Calutron-enrichment of ^{235}U; electro-magnetic separation of stable isotopes	Safe standby	Glove box laboratories	Y-12 Plant		
9212	Casting uranium metal parts and billets; supplying fuel for Savannah River Plant reactors	Supply enriched U for research and experimental reactors and international market; determine ^{235}U content of salvage materials	Mechanically operated shielding; interlocks on furnace shielding doors; locator systems	Y-12 Site, 50 m from Bear Creek Road	PuBe AmLi	First floor
9213	Source storage		Concrete vault with steel door; access through building	South of Y-12 Plant		

RESULTS

A total of 19 "in-scope" responses to the QS were collected from staff members at the ORNL and Y-12 sites — 16 from ORNL and 3 from Y-12.

Of these 19 responses, 3 facilities primarily store plutonium and other transuranics, 6 facilities perform some type of storage and processing of plutonium or other transuranics, and 10 facilities are users of plutonium and other transuranic sealed sources for calibration or research purposes.

Responders to the QS and contributors to the Site Assessment Team Report are listed in Appendix A: Site Assessment Team members. These members are listed by building/facility name and organization.

Responses to the QS are provided in Appendix B: Responses to the QS by Facility. A generalized summary of the results of the QS is provided in Table 2. The tabulated information includes

- building/facility
- general location of the plutonium and other transuranics
- material types
- package types
- mass of material forms
- vulnerability by identification number and title

Nine "in-scope" vulnerabilities were identified by contributors of QS. Brief summaries of each vulnerability are provided in the index to Appendix C: ES&H Vulnerability Assessment Forms. Four of the SAT identified vulnerabilities were acknowledged and generalized by the WGAT. The WGAT additionally identified 8 more vulnerabilities. The twelve vulnerabilities identified by the WGAT are also provided in the summary table of Appendix C.

The vulnerabilities are classed as

- unknown quality and condition of packaging (two instances)
- low-frequency industrial, external, or natural phenomena mishaps resulting in a breach of glove box integrity and local contamination of workers and facility interior (six instances)
- deterioration of packaging used for source storage could result in worker exposure (one instance)

The nine vulnerabilities identified by the SAT were ranked according to a prioritization process provided by DOE-EH on May 20, 1994; results of these rankings are provided in Appendix D: Vulnerability Evaluation Matrix. Site Assessment Team members contributing to the ranking of the Vulnerability Evaluation Matrices were drawn form the membership list of Appendix A and staff experienced in facility safety analysis work. The evaluation matrices were categorized by worker safety and health, public safety and health, and environmental damage. Each category was then evaluated according to a comparative measure of "severity" and "likelihood" of the vulnerability. Descriptions of the comparative measures are provided in Appendix D: Vulnerability Evaluation Matrix.

Table 2: Summary of X-10 and Y-12 Holdings, Packagings and Vulnerabilities

Site	Building	Location	Material Types	Package Types (various sequences)	Total Masses (kg)	Vulnerabilities	
X-10	2007	Calibration Facility	Pu, ^{241}Am	V1	Sources - 0.002		
X-10	2026	Radiological Materials Analytical Laboratory	Weapons—Grade Pu	V6; C1	Sources - 0.002		
X-10	3027	Storage Rooms 104, 105, 107	$^{238,239,241,242}Pu$, $^{241,243}Am$, ^{237}Np	U1; V0,1,5,6; P3; C1,3; D2,3,4; B0,1 W1; X1	Metal - 0.241 Oxide - 0.483 Scrap/Res - 0.109 Sources - 0.126 Other - 0.426	X-10/3027/1:	Historically evolved uncertainty about packaging materials conditions
X-10	3038	Radioactive Isotope Storage/Disposal	^{237}Np, $^{238,239,240,241}Pu$, ^{241}Am	B0 C1,2 D1,2 G1 U0,1 V1	Metal - 0.012 Oxide - 0.369 Sources - <0.001	X-10/3038/1:	Unknown packaging materials may be deteriorating while awaiting disposition
X-10	3500	3500 Annex Room D-23	^{239}Pu	V1	Sources - 0.080		
X-10	3508	Material Balance Area 135	^{239}Pu	V1	Sources - 0.096		
X-10	4501	High Level Radiochemical Laboratory	$^{238, 239, 242}Pu$, ^{237}Np	P1 B1 B1 V4	Soln - 0.037 Other - 0.0014	X-10/4501/1:	Deterioration of plastic bottle within glove box resulting in contamination of a worker's protective clothing
X-10	5505	Transuranium Research Laboratory	^{237}Np, $^{239,240,242}Pu$, $^{241,242}Am$, ^{249}Bk	B1; G1; P1; V1,4,5,6,7	Metal - 0.191 Oxide - 0.083 Soln - 0.004 Other - 0.025		
X-10	6000	Hollfield Facility	Am, Pu	V1	Sources - 0.001		
X-10	6010	Laboratory E	$^{239,241}Pu$, ^{237}Np, ^{241}Am	C1,2; P5	Sources - 0.003		
X-10	7700	Tower Shielding Facility	$^{239,241}PuBe$, $^{241}AmBe$	V1, In-storage	Sources - 0.010		
X-10	7710,7712, 7735	Material Balance Area 131	^{241}Am, $^{238,239,241}Pu$, ^{237}Np, ^{252}Cf	X1; W3; F0; B3; V7	Sources - 0.419		

Table 2: Summary of X-10 and Y-12 Holdings, Packagings and Vulnerabilities

Site	Building	Location	Material Types	Package Types (various sequences)	Total Masses (kg)	Vulnerabilities
X-10	7824	None Destructive Assay (NDA)/None Destructive Evaluation (NDE)	$^{239,240,241}Pu$, ^{241}Am, ^{244}Cm, ^{252}Cf	C1,2; P4,5; V1	Sources - 0.100	
X-10	7900	First Floor Vault	Weapons Grade Pu	V2; B1; V5	Other - 0.043	
X-10	7920	Radiochemical Engineering Development Center (REDC)	^{237}Np, $^{239,240,242}Pu$, $^{241,242,243}Am$, Cm, $^{249,252}Cf$	B1; C1; G1; P1,5; U0; T3; V1,4,5,6,7; X1	Oxide - 0.147 Soln - 0.303 Sources - 0.001 Other - 5.012	X-10/7920/1: Breach of Glove Box (or Hood) Containment (due to internal pressurization or explosion) X-10/7920/2: Breach of Glove Box (or Hood) Containment (due to external energy source) X-10/7920/3: Breach of Glove Box (or hood) Containment (due to external events and natural phenomena) X-10/7920/4: Breach of internal containers and worker barriers as a result of a waste cask containing RH-TRU waste being dropped
X-10	7930	Cf Purification/Distribution	^{237}Np, ^{252}Cf	B1; C1; P1,3; T3; U2; V1,4,5	Metal - 0.032 Oxide - 0.038 Scrap/Res - <0.001 Sources - <0.001 Other - 0.001	X-10/7930/1: Breach of Glove Box (or Hood) Containment (due to external energy source)
Y-12	9204-3	Isotope Enrichment and Distribution	$^{239,240,241,242,244}Pu$	B1; G1; P4; V5	Soln - <0.001 Oxide - 0.262	
Y-12	9212	Casting and NDA	^{239}Pu, ^{241}Am	V1	Sources - 1.040	
Y-12	9213	Source Storage	$^{239,241}Pu$, ^{241}Am, $^{251,252}Cf$	F0,1,2; V1	Sources - 0.010	Y-12/9213/1: Aging and corrosion of source storage container might result in release of contamination to the worker

Appendix A: Site Assessment Team Members

Appendix A: Site Assessment Team Members

Site	Facility	Division	Name
Oak Ridge Question-Set and WGAT-Visit Sites			
DOE-ORO	Oak Ridge Operations Office Coordination	E&CD	G. R. Proco
X-10	Site Coordination	OORFS	C. M. Hopper E. C. Crume, Jr.
X-10	1505	ESD	A. W. Lewis
X-10	2007	ORP	R. E. Halliburton
X-10	2026	C&ASD	J. M. Keller
X-10	3003	SSD	M. D. Galloway
X-10	3019	CTD	K. R. Givens
X-10	3027	Vault	R. J. Robson J. H. Greene
X-10	3038	CTD	M. L. Evans
X-10	3500	I&CD	J. A. Williams
X-10	3508	I&CD	M. L. Bauer
X-10	3517	CTD	M. L. Evans
X-10	3525	M&CD	C. E. DeVore
X-10	4501	CTD	M. F. Osborne
X-10	5505	C&ASD	F. J. Smith
X-10	5507	C&ASD	F. J. Smith
X-10	6000	PD	C. M. Jones
X-10	6010	EP&MD	D. C. Larson
X-10	7503	HSRD	R. E. Swaja
X-10	7700	RRD	R. D. Dabbs
X-10	7710	HSRD	C. S. Dudney
X-10	7712	HSRD	C. S. Dudney
X-10	7735	HSRD	C. S. Dudney

Site	Facility	Division	Name
X-10	7811	ESD	A. W. Lewis D. E. Fowler
X-10	7824	WM&RAD	F. J. Schultz J. A. Chapman
X-10	7874	ESD	A. W. Lewis
X-10	7900	RRD	R. D. Dabbs
X-10	7920	CTD	J. E. Bigelow L. K. Felker R. G. Stacy
X-10	7930	CTD	J. E. Bigelow L. K. Felker R. G. Stacy
X-10	Waste Management and Remedial Action Facilities	WM&RAD	D. W. Turner F. Schultz C. Scott B. McClelland L. G. Hill A. J. Kuhaida
X-10	X-10 Source Control Program		K. R. Geber B. W. Ross
Y-12	Site Coordination	HSE&A	W. A. Heineken
Y-12	9201-2	FED	F. E. Gethers
Y-12	9204-1	ETD	W. G. Craddick
Y-12	9204-3	CTD	W. S. Aaron C. A. Sampson
Y-12	9212/9215	MPD	J. E. Vath
Y-12	9213	HSE&AD	D. A. Jones
Y-12	9720-5	F&MD	C. G. Walker
Y-12	Y-12 Source Control Program	HSE&AD	G. M. Dick

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Appendix B: Responses to the Question-Set by Facility

In the original version of the Oak Ridge SAT report, no site information for Oak Ridge was entered on a number of pages of the question set forms. These "blank" pages are not included in the following section. The full version of the original question set can be found in the Assessment Plan for the project, which is reproduced in Volume II, Appendix A, Section A.2, DOE Plutonium ES&H Vulnerability Assessment Plan, of this final report.

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SITE: X-10	(Building or Location): 2007
	FUNCTION: Calibration Facility

DOE HEADQUARTERS FACILITY LANDLORD EH

DOE HEADQUARTERS PROGRAM SPONSOR EH

FACILITY AGE 43 DESIGN LIFE 70

Question 1: Facility

The Radiation Standards and Calibration Laboratory (RaSCaL) is responsible for the calibration of all portable and stationary instruments used in the Oak Ridge National Laboratory (ORNL) radiation protection program.

The facility was constructed in 1951 and is located in the northwest quadrant of the ORNL complex approximately 600 feet from the site boundary.

The design mission for RaSCaL was the calibration of health physics survey instruments. This mission has not changed since the time of its construction.

RaSCaL uses a variety of highly characterized sealed sources, including a single ^{238}PuBe and a single ^{241}Am source, to expose instruments and personnel dosimeters to known radiation field.

When not in use, the ^{238}PuBe and ^{241}Am sources are stored in a locked, shielded vault and exposure room respectively. RaSCaL contains five shielded areas where calibration activities take place.

Applicable References:

NONE

SITE: X-10	FACILITY (Building or Location): 2007
	FUNCTION: Calibration Laboratory

Question 2: Holdings DOE Material Manager J. T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal				
Oxide				
Scrap/Residues[4]				
Solution[4]				
Sealed Sources	H	V1	N/A	25
	Am	V1	N/A	5
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]		5		
Unirradiated Reactor Fuel				
High-level Liquid Waste				

SITE: X-10	FACILITY (Building or Location): 2007
	FUNCTION: Calibration Laboratory

Question 2A: No. of Pkgs and Mass DOE Material Manager J. T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal			
Oxide			
Scrap/Residues			
Solution			
Sealed Sources	H	0.00047	1
	Am	0.00167	1
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			
Cumulative Inventory Difference			

SITE: X-10	FACILITY (Building or Location): 2007
	FUNCTION: Calibration Laboratory

Question 3: Physical Barriers DOE Material Manager J. T. Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) H

Barrier #	Worker Protection	Environment and Public Protection
1	WB-6	EB-7
2	WB-14	EB-1
3	WB-15	EB-4
4	WB-17	—
5	—	—

Material Aggregation (list material types included from Question 2) Am

Barrier #	Worker Protection	Environment and Public Protection
1	WB-6	EB-7
2	WB-14	EB-1
3	WB-15	EB-4
4	WB-17	—
5	—	—

SITE: X-10	FACILITY (Building or Location): 2007
	FUNCTION: Calibration Laboratory

Question 4: Adverse Conditions[1]

Indicate actual or potential adverse conditions that are applicable to those materials, packages and barrier aggregates developed in Questions 1, 2, and 3 by checking the appropriate items and describing below.

Adverse Condition

In-Facility

- ☐ Inadvertent Transfers
- ☐ Aging
- ☐ Organic Nitric Acid Reaction
- ☐ Equipment Failure
- ☐ Change in Mission
- ☐ Other Co-Located Hazards
- ☐ Corrosion
- ☐ Inadequate Configuration Knowledge
- ☐ Combustible Loading
- ☐ Inadequate Seals
- ☐ Potential Water Sources
- ☐ Inadequate Drains
- ☐ Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- ☐ Administrative Controls
- ☐ Other - Specify

Material

- ☐ Pressurization
- ☐ Pyrophoricity
- ☐ Radioactivity
- ☐ Chemical Reactivity
- ☐ Am Buildup
- ☐ Hydrogen Buildup
- ☐ Radiolysis
- ☐ Volumetric Expansion
- ☐ Oxidation
- ☐ Other - Specify

None

SITE: X-10	FACILITY (Building or Location): 2007
	FUNCTION: Calibration Facility
Describe Each Event: None	
Question 5 Continued:	

SITE: X-10	FACILITY (Building or Location): 2007
	FUNCTION: Calibration Facility

Question 6 Continued:

Compensatory Measure	Reference Document
None	

Uncertainty or Concern	Discussion

SITE: X-10	FACILITY (Building or Location): 2007
	FUNCTION: Calibration Laboratory

Explanation:

None

Question 7 Continued:

SITE: X-10	FACILITY (Building or Location): 2026
	FUNCTION: Radioactive Materials Analysis Lab

DOE HEADQUARTERS FACILITY LANDLORD Energy Research

DOE HEADQUARTERS PROGRAM SPONSOR Energy Research

FACILITY AGE 30 Years DESIGN LIFE Unknown

Question 1: Facility

The High Radiation Level Analytical Laboratory (HRML) is designed specifically for use in the treatment and analysis of highly radioactive alpha, beta and gamma emitting materials. It is a two story structure of poured concrete and concrete blocks with a gross floor area within the original constructed building of about 18,000 sq. ft. An in-a-line hot cell block is the center of the operation. Construction began in 1962 and was completed in the fall of 1964. Testing and cold shakedown tests were completed and the first hot sample was received in December 1964.

Three additions have been made to the building. In 1967, two laboratories were added to the south side of the building for work associated with the Molten Salt Reactor Program (MSRP). This annex is now used entirely for the assay of nonradioactive environmental samples. In 1969 two glovebox laboratories and a room for a spark source mass spectrometer were added to the west side of the building. The south addition has its own ventilating system, while the west addition uses the main building exhaust system. In 1984, a two-story addition was added to the facility to house radiochemical analysis operations.

The hot cells are located in the first floor of the facility. The first floor also contains four chemical laboratories, three glovebox labs, and a counting room. The second floor contains offices, a conference/lunch room, a control room, and a storage area. The latest addition consists of three chemical laboratories and an office. Routine access to the facility is gained through a badge-reading system installed on the door of the main lobby located on the east side of the facility. Only those persons who work within the facility or need to access the facility for work-related purposes are programmed to use this system. Only those persons who have had facility specific training are allowed to move within the facility unescorted.

The RMAL in Building 2026 is located at Oak Ridge National Laboratory on Hillside Avenue and Third Street. The 3019 Pilot Plant is to the east; the cafeteria, Building 2012, is to the south; the Health Physics Calibration Laboratory, Building 2007, is to the west; and Builsing 2001 is to the north.

The only unusual hazards identified for the RMAL are fissile materials and radiation sources. These hazards are associated with the chemical analysis and processing of radioactive materials. All other hazards identified for the facility are standard industrial hazards.

SITE: X-10	FACILITY (Building or Location): 2026
	FUNCTION: Radioactive Materials Analysis Lab

The RMAL contains an insufficient amount of fissile material for a criticality event to occur under any condition of moderation and/or reflection. The bounding consequences of accidents associated with the radiation source hazards results in the RMAL being classified as "Low" hazard facility. The potential health effects from both radiological and nonradiological hazards are reversible and limited to one or two persons on-site, with negligible off-site effect.

Applicable References:

Oak Ridge National Laboratory Site Data for Safety Analysis Reports, ORNL/ENG/TM-19

MMES Phase I Hazard Screening Document, 2026, HS/2026/F1/R0, June 23, 1992

Limiting Condition Document Building 2026, Radioactive Material Analytical Laboratory, (LCD/2026/01-01/REV3)

The ORNL Radioactive Material Analytical Laboratory Description and Safety Analysis, (ORNL/CF-82/31) - Retired

SITE: X-10	FACILITY (Building or Location): 2026
	FUNCTION: Radioactive Material Analysis Laboratory

Question 2: Holdings — DOE Material Manager James Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal	Weapons	G2, B1, V6, C1	10,10	
Oxide				
Scrap/Residues[4]				
Solution[4]				
Sealed Sources				
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]		[5]		
Unirradiated Reactor Fuel				
High-level Liquid Waste				

SITE: X-10	FACILITY (Building or Location): 2026
	FUNCTION: Radioactive Material Analysis Laboratory
Question 2 Continued:	
Applicable References: ORNL NMC&A Plan	

1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.
2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.
3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.
4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.
5 Holdup has no packaging. Identify location of holdup.

SITE: X-10	FACILITY (Building or Location): 2026
	FUNCTION: Radioactive Materials Analysis Laboratory

Question 2A: No. Pkgs and Mass   DOE Material Manager James Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal	Weapons	0.000496	1
Oxide			
Scrap/Residues			
Solution			
Sealed Sources			
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			

SITE: X-10	FACILITY (Building or Location): 2026 FUNCTION: Radioactive Materials Analysis Laboratory
Question 2A Continued:	
Applicable References: ORNL NMC&A Plan	

1 Identify probable location.

SITE: X-10	FACILITY (Building or Location): 2026
	FUNCTION: Radioactive Materials Analysis Lab

Question 3: Physical Barriers DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Metal

Barrier #	Worker Protection	Environment and Public Protection
1	WB-1	
2	WB-6	
3		EB-2
4		EB-1
5		EB-4

SITE: X-10	FACILITY (Building or Location): 2026
	FUNCTION: Radioactive Materials Analysis Lab

In-Facility

X Inadvertent Transfers
☐ Aging
☐ Organic Nitric Acid Reaction
☐ Equipment Failure
☐ Change in Mission
☐ Other Co-Located Hazards
☐ Corrosion
☐ Inadequate Configuration Knowledge
☐ Combustible Loading
X Inadequate Seals
☐ Potential Water Sources
☐ Inadequate Drains
☐ Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
☐ Inadequate Preventive Maintenance
X Administrative Controls
☐ Other - Specify

Material

☐ Pressurization
☐ Pyrophoricity
X Radioactivity
☐ Chemical Reactivity
☐ Am Buildup
☐ Hydrogen Buildup
☐ Radiolysis
☐ Volumetric Expansion
☐ Oxidation
☐ Other - Specify

Question 4 Continued:

SITE: X-10	FACILITY (Building or Location): 2026 FUNCTION: Radioactive Materials Analysis Lab

Describe Each Adverse Condition:

Applicable References:

Oak Ridge National Laboratory Site Data for Safety Analysis Reports, ORNL/ENG/TM-19

MMES Phase I Hazard Screening Document, 2026, HS/2026/F1/R0, June 23, 1992

Limiting Condition Document Building 2026, Radioactive Material Analytical Laboratory, (LCD/2026/01-01/REV3)

The ORNL Radioactive Material Analytical Laboratory Description and Safety Analysis (ORNL/CF-82/31) - Retired

1 An existing situation that gives rise to a potential event or concern.

SITE: X-10	FACILITY (Building or Location): 2026
	FUNCTION: Radioactive Matl. Anal. Lab

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- ☐ Fire
- ☐ Explosion
- X Worker Exposure
  - X External
  - X Internal
- X Contamination
- ☐ Flooding
- ☐ Leakage/Spills
- ☐ Other Accidents - Specify
- X Human Error

External
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
- ☐ Adjacent Facility Accident
- ☐ Power Failure
- ☐ Institutional/Regulatory Requirements
- ☐ Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify

Material
- ☐ Criticality
- ☐ Fissile Material Release
- X Breach of Container
- ☐ Fire
- ☐ Other - Specify

Natural Phenomena
- X Earthquake Damage
- ☐ Wind Damage
- ☐ Flood Damage
- ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

Describe Each Event:

The potential events checked are always present when working with radioactive materials. The Compensatory measures at the facility prevent and/or mitigate the adverse conditions. Due to the minute amount of material present and considering the compensatory measures currently in place, we feel there is no reasonable risk of events such as those listed in Item 5 occurring.

The potential for natural phenomena such as an earthquake is very rare. Although an earthquake could cause substantial structural damage to the facility, no mechanisms for transporting significant quantities of radioactive materials to the surrounding area would be present, and the event would affect only the operability of the facility. The concern for the safety of personnel during an earthquake is far greater than concerns on "Pu ES&H vulnerabilities as a consequence of an earthquake".

SITE: X-10	FACILITY (Building or Location): 2026
	FUNCTION: Radioactive Matl. Anal. Lab

Applicable References:

MMES Phase I Hazard Screening Document, 2026, HS/2026/F1/R0, June 23, 1992

Limiting Condition Document Building 2026, Radioactive Material Analytical Laboratory, (LCD/2026/01-01/REV3)

The ORNL Radioactive Material Analytical Laboratory Description and Safety Analysis (ORNL/CF-82/31) - Retired

SITE: X-10	FACILITY (Building or Location): 2026 FUNCTION: Radioactive Materials Analysis Lab
<u>Preventive</u> X Procedures: ops., maint., surveillance X Material Limits X Training X Quality Assurance X Conduct of Operations X Authorization Basis (safety analysis, BIOs) X Surveillance X Organization ☐ Structure X Management Involvement ☐ Staffing X Lessons Learned X Configuration Control of Design X Preventive Maintenance X Monitoring ☐ Trending (Performance Indicator) ☐ Testing/Verification of Integrity X Regulatory Requirements X Records X Personnel Exposure X Equipment X Waste Inventory X QA ☐ Personnel Reliability Assurance Program ☐ Other - Specify	<u>Mitigative</u> X Emergency Preparedness X Emergency Management X Emergency Planning X Emergency Procedures X Emergency Response X Safety Systems X Alarm Systems ☐ Other - Specify
<u>Question 6 Continued:</u>	

SITE: X-10	FACILITY (Building or Location): 2026
	FUNCTION: Radioactive Materials Analysis Lab

Compensatory Measure	Reference Document
Procedures	ORNL NMC&A Plan & RMAL SOPs
Material Limits	2026 LCD
Training	CASD Training Plan
QA	QAP/X/94-RMAL-001
Conduct of Operations	2026 & CASD Matrix 2/94
Auth. Basis	Limiting Conditions Doc. (LCD)
Surveillance	AC-OP-105-1401
Organization Management Involvement	CASD & 2026 QA Plan
Lessons Learned	ORNL Lesson Learned Sys.
Configuration Control	AC-OP-105-0308
Preventive Maintenance	LCD
Monitoring	LCD
Regulatory Requirements	NESHAP Monitoring
Records	
Personnel Exposure	Office of Radiation Protection
Equipment	OQE&I
Waste Inventory	Facility GCO
QA	2026 & CASD QA Plan
Emergency Preparedness	ORNL Em. Prep. Plan
Emergency Management	AC-OP-104-2202
Safety Systems	LCD
Alarm System	

SITE: X-10	FACILITY (Building or Location): 2026
	FUNCTION: Radioactive Materials Analysis Lab

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

	WORKER			ENVIRONMENT			PUBLIC		
EVENT	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
Human Error	N -	N	N	N	N	N	N	N	N
Worker Exposure	N	N	N	N	N	N	N	N	N
Contamination	N	N	N	N	N	N	N	N	N
Breach of Container	N	N	N	N	N	N	N	N	N
Natural Phenomena	N	N	N	N	N	N	N	N	N

Explanation:

Due to the minute amount of material present and considering the compensatory measures currently in place, we feel there is no reasonable risk of events such as those listed in Item 5 occurring. The bounding consequences of accidents associated with the radiation source hazards results in the RMAL being classified as "Low" hazard facility. The potential effects from both radiological and non radiological hazards are negligible.

SITE: X-10	FACILITY (Building or Location): 2026
	FUNCTION: Radioactive Materials Analysis Lab

<u>Applicable References:</u>

MMES Phase I Hazard Screening Document, 2026, HS/2026/F1/R0, June 23, 1992

Limiting Condition Document Building 2026, Radioactive Material Analytical Laboratory, (LCD/2026/01-01/REV3)

The ORNL Radioactive Material Analytical Laboratory Description and Safety Analysis (ORNL/CF-82/31) - Retired

SITE: X-10

Question 8: Overall Site Summary

Based on the Site Assessment Team report, provide an overall assessment of the site ES&H vulnerabilities.

The response to this question should address each of the elements listed below, and should not exceed 2 pages in length.

- A description of the site's most important ES&H concerns related to plutonium storage, handling, processing, and/or shipping.
- A description of which plutonium activities pose the highest risk to the environment, worker, and public at your site.
- A discussion of current planned actions to minimize worker exposure, reduce environmental risks, and protect the public at and near your site.
- Provide any noteworthy programs or practices related to plutonium storage, handling, processes, and/or shipping.

The only unusual hazards identified for the RMAL are fissile materials and radiation sources. These hazards are associated with the chemical analysis and processing of radioactive materials. All other hazards identified for the facility are standard industrial hazards.

The RMAL contains an insufficient amount of fissile material for a criticality event to occur under any condition of moderation and/or reflection. Due to the minute amount of material present and considering the compensatory measures currently in place, we feel there is no reasonable risk of events such as those listed in Item 5 occurring. The bounding consequences of accidents associated with the radiation source hazards results in the RMAL being classified as "Low" hazard facility. The potential health effects from both radiological and non radiological hazards are reversible and limited to one or two persons on site with negligible off site effect. There is a minimal risk to the environment and an almost non-existent threat to the public.

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

DOE HEADQUARTERS FACILITY LANDLORD ER

DOE HEADQUARTERS PROGRAM SPONSOR ER, NE

FACILITY AGE 15 years DESIGN LIFE N/A

Question 1: Facility

Building 3027 is a one-story vault structure 63 ft wide and 54 ft long. The facility consists of an entry Air Lock, a Receiving Room, five storage rooms or cells, and a mechanical equipment room for electrical and ventilation equipment. The Equipment Room is basically isolated from the seven rooms which make up the operating area. Each room is kept locked. The building was specifically designed and constructed for the receipt, shipment, and storage of nuclear materials. All nuclear materials are received in closed, sealed containers and are stored in the storage cells.

Completed in 1979, the vault is constructed of reinforced concrete 18 inches thick, with a 10-inch reinforced concrete roof. The building sits on a 18-inch reinforced concrete slab, which is integral with the exterior walls. Interior partitions are typically 8-inch reinforced concrete. The vault was designed and constructed to withstand both a 0.15g earthquake and a 360-mph wind. Figure 1 depicts the layout of the vault, and the location of equipment representative of the containment barriers.

The 3027 vault is located within the confined principal boundaries of Oak Ridge National Laboratory (ORNL). It is situated near the northwest corner of the intersection of Fifth Street and Hillside Avenue, as shown in Figure 2. (Note: For this document, compass directions are based on grid north for the ORNL site, which is approximately 34 degrees counterclockwise from true north.) From the vault centerpoint, it is approximately 770 ft north to the perimeter fence, and approximately 810 ft to Bethel Valley Road, a public thoroughfare through the U.S. DOE Oak Ridge Reservation. The closest point to ORNL's perimeter fence is to the NNE at a distance of approximately 650 ft. Outside the fence is an employee parking lot, which opens, however, onto Bethel Valley Road. To the WNW, at approximately 330 feet, is Building 3001. At the northeast corner of this building is the public access to the Graphic Reactor, a national landmark. This facility is open to the public from 9:00 AM to 5:00 PM, Monday through Saturday.

The vault was constructed originally to store nuclear materials. No material processing is performed. Materials handling involves only the receipt and removal of closed containers. No containers are to be opened inside the vault.

A minor mission change occurred in September 1989, when the storage of precious metals within the vault was allowed. Storage of precious metals is restricted to Room 108.

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

Question 1 Narrative Continued:

Another change occurred in October 1990. The original limits for stored material was established at a total inventory not to exceed a Criticality Index (CI) of 1000. Because many packages were being received identified with a Transportation Index (TI), total inventory was lowered to a combined CI plus TI of less than 100.

In April 1992, the Criticality Accident Alarm System was removed from service. A nuclear criticality accident was no longer deemed credible.

Facility design features are as follows:

- As noted above, the facility was designed to withstand a 0.15g earthquake and a 360-mph wind, including exterior doors.

- Fire protection is provided through a 6-inch supply, through parallel shutoff valves located 20 ft west of the vault. A separate supply is available from a hydrant located approximately 85 ft from the vault, to the southwest. Each room is furnished with an ionization smoke detector and four pendant-type sprinkler heads, except Room 105, which has two smoke detectors, because of its geometry. Besides a local alarm, an alarm is transmitted to the ORNL Fire Department at Building 2500. This alarm can be activated by the smoke detector, water-flow switch (from sprinkler activation), or from a manual pull box, located in the Air Lock. A separate pull box is located approximately 40 ft west from the vault, on the outside corner of the security post.

  All fire protection water is drained to a retention tank located in a pit along the south wall of the Air Lock (Room 101). Tank capacity was established based on an average response time of 4 minutes by the ORNL Fire Department, from Building 2500. Tank capacity is 1100 gallons with 725 gallons free space, a margin of more than 100%. The floor drain in each room will permit a flow of 160 gallons/minute to the tank. In addition, each storage cell has a 1 1/2 in. raised door sill to prevent cross-contamination. Each floor drain is elevated 3/4 in. from the base slab, to prevent the entry of casual water from cleaning operations. Flow to the drain tank is also minimized by the use of ON-OFF, temperature-controlled sprinkler heads. The presence of liquid in the tank actuates a liquid level alarm on the alarm panel located in the Air Lock, indicated in Figure 1.

- Ventilation to the vault interior is made up of two independent systems, Room 106, the Equipment Room has an air intake near the southeast corner of the building. Supply fan 2 (SF-2) draws air in through a dust filter and exhausts it directly into the Room. Adjacent to this intake is a separate intake for the rest of the vault. SF-1 draws air through a separate dust filter, into the distributing ventilation ducts to the operating area, consisting of the air lock, receiving room, and the five storage cells. Air from the operating area is exhausted through a bank of high-efficiency particulate air (HEPA) filters into the underground duct leading to the 3039 stack, which serves the main

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

Question 1 Narrative Continued:

- Control of radioactive contamination is maintained by balancing air supply against building exhaust. A negative pressure differential of 0.2 in. of water gauge (wg) is maintained between the Air Lock and the Receiving Room (102); and a negative pressure differential of 0.1 in. wg is maintained between the Receiving Room and each storage cell (103, 104, 105, 107, and 108). Differential pressure indicators (dpis) monitor these requirements. There are also dpis for the pressure drop across the air-intake filters for the Equipment Room, for the operating area, and across the HEPA filter banks. Air-flow indicators also monitor the air supply into the Equipment Room and the operating area, as well as the exhaust flow leaving the vault. All indicator readings are available on the gauge panel in Room 106, except the dpi between the Air lock and Receiving Room, which is located in the Air Lock. This dpi has a high-low alarm point which activates a visual-audible alarm on the alarm panel in the Air Lock, as indicated in Figure 1.

- Atmosphere control is limited to heating supply air for freeze protection. Electrical strip-heaters are mounted in the supply ducts. The temperature for the Equipment Room is controlled from that room. Temperature for the operating area is dual-controlled from Room 101 and Room 103. Low temperature sensors in these three rooms activate an freeze-warning alarm at 40 degrees F. The alarms appear on the alarm panel in the Air Lock.

- Radiation shielding is not a major feature of this facility due to the material and packaged amounts stored. The vault is constructed of reinforced concrete with exterior walls 18 inches thick, interior partitions 8 inches thick, and a roof slab 10 inches thick.

- The presence of airborne alpha contamination in the Receiving Room is monitored by a Continuous Alpha Air Monitor (CAAM) located in the Air Lock (see Figure 1). At this location, the audible and visual alarm are readily apparent before proceeding past the Air Lock.

  Sampling pumps located in the Equipment Room (see Figure 1) draw air samples from each storage cell across filter paper to detect the presence of airborne contamination within each cell. The pumps are operated with one pump running continuously and the second pump in stand-by mode. Before entry into any cell, the sampler filter for that cell is checked by a Health Physics technician.

- In the Air Lock (see Figure 1) is a multipoint alarm panel providing audible and visual alarms for essential building conditions. Conditions displayed are: High/low exhaust flow, differential pressure between Air Lock and Receiving Room, low flow on vault supply air, low flow on Equipment Room supply air, low temperature in Rooms 103 and 106, and liquid level in the drain task. From Building 3027, a single point alarm is monitored at the Waste Operation Control Center (WOCC), Building 3130. WOCC is

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

Question 1 Narrative Continued:

- The design-mission of Building 3027 was a Security Category I vault. It was never utilized as such, and is presently Security Category III. Magnetic switches are present on the entrance doors to the Equipment Room, the Air Lock, and the Receiving Room; the purpose of which is to provide a tamper-proof alarm signaling the opening of the door. A magnetic switch was added to Room 108, with the storage of precious metals. All switches send an alarm to the Emergency Communications Center (ECC) in Building 2500 which is the operations center for the ORNL Security Patrol. A combination of passive infra-red (PIR) and ultrasonic (US) motion detectors are utilized in the vault operating area. Each sends an alarm to the ECC, when activated. The Receiving Room contains one PIR detector, as do Rooms 103 and 104. Room 105 utilizes one PIR and one US detector. Room 107 contains an US detector. Room 108 contains two PIR detectors. One closed-circuit television (CCTV) camera covers the interior of the Receiving Room, and can be monitored at the ECC and the Laboratory Emergency Response Center (LERC). Two more CCTV cameras cover the entrance to the Air Lock and to the Equipment Room. These can be monitored from the LERC. All doors into the vault, as well as the interior doors, remain locked. The entrance into the Air Lock is locked and padlocked. The entrance into the Receiving Room is secured by a combination lock and a nonstandard-lock type maintained by the Security Patrol.

  The 3027 vault construction was completed in 1980, with the completion and approval of the "as-built" drawings. The vault has been in use since 1982. As noted in the ORNL Implementation Plan to meet the requirements of DOE 5480.23, "Nuclear Safety Analysis Reports", the facility had no significant incidents in the preceding 10 years (through April 1993), nor have there been any significant incidents to date.

  At the time of construction, no environmental assessment (EA) or environmental impact statement (EIS) was formally filed by DOE.

  There are no current unreviewed safety questions. The basis of interim operation is summarized in the implementation plan cited above. The history of the safety documentation is as follows:

  - "Operations Safety Requirements for the Building 3027 Nuclear Materials Storage Vault" (ORNL/CF-81/301), dated November 1981; these OSRs were retired with the issuing of the limiting conditions document (LCD).

  - "Final Safety Analysis Report for the Source and Nuclear Materials Vault (ORNL 3027)", (ORNL/ENG/INF-81/1) dated October, 1983; the confidential FSAR was retired with the issuing of the hazard screening document.

  - Nuclear Safety Review and Approval 0021LP00601C for the Nuclear Materials Storage Vault, Building 3027 (NSR), identifies limits, controls, and conditions which must be followed to ensure criticality safety. The NSR was issued in

SITE: X-10	FACILITY (Building or Location): Building 3027
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Question 1 Narrative Continued:

- Letter from M. W. Kohring to W. R. Rich, "Justification for Not Requiring a Criticality Accident Alarm System in Building 3027, Nuclear Materials Storage Vault", dated April 8, 1992; provides the basis and approval by the ORNL Office of Operational Readiness and Facility Safety, ORNL Criticality Review Committee, and ORNL Criticality Safety Officer for the facility not to have a criticality accident alarm system.

- "Limiting Conditions Document - Nuclear Materials Storage Vault", (LCD/3027/F/02/4-21-93) is Martin Marietta Energy Systems' equivalent to an OSR for a low hazard facility, based on the Safety Analysis Report Update Program (SARUP). The LCD was issued in April 1992, and last revised in April 1993.

- "Hazard Screening Report - Nuclear Materials Storage Vault", (HS/3027/F/02/4-19-93), prepared in accordance with SARUP guidelines, was issued in April 1991, and last revised in April 1993.

The 3027 Vault is not a processing facility. All material is for storage only. Containers cannot be opened in the vault. All nuclear materials stored in the vault are in solid form, and are contained in sealed, metallic containers. No liquids are accepted for storage.

Each closed and sealed container is surveyed and tagged by Health Physics before acceptance. No surface contamination above accepted limits is allowed. Each container has an attached inventory tag and/or bar code label with all pertinent information including criticality index (CI), or transportation index (TI). The Office of Operational Readiness and Facility Safety is made aware of any transfer of fissionable material, and must give prior approval to the receipt and storage of such material. In order to ensure adequate protection, some storage containers are placed in file cabinets (fireproof or equivalent) or in metal racks.

The following is a list of material and the maximum allowable amounts for storage in the Vault:

Material	Limits
^{235}U (Oxide)	15 kg
^{235}U (fuel form, 93.1%, ^{235}U)	1,000 kg
^{233}U (Oxide)	10 kg
^{239} & ^{241}Pu (Oxide)	25 kg
^{242}Pu	1 kg
^{238}Pu (Oxide)	10 kg
Am (Oxide)	1 kg
Th (Oxide)	10 kg
Np (Oxide)	10 kg

SITE: X-10	FACILITY (Building or Location): Building 3027
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Question 1 Narrative Continued:

Natural, depleted, or enriched uranium, and natural thorium are stored separately, away from the highly toxic alpha-emitters. Room 107 inside the vault has been designated and clearly identified for the storage of these materials. Inside the vault, the nuclear material has been aggregated as follows:

- Room 103 contains no nuclear materials. The room is empty except for a set of scales used to weigh packages over 50 pounds.
- Room 104 contains enriched ^{233}U, $^{239/241}Pu$, ^{242}Pu, ^{241}Am, ^{243}Am, and Np.
- Room 105 contains enriched ^{233}U, depleted ^{235}U, enriched ^{235}U, ^{238}Pu, $^{239/241}Pu$, and ^{242}Pu.
- Room 107 contains depleted ^{235}U, enriched ^{235}U, ^{238}U, $^{239/241}Pu$, and thorium.
- Room 108 now contains only precious metals.

The following facility design uncertainties/vulnerabilities were considered:

Facility proximity to Fifth Creek
Utility connections, as affected by natural phenomena
Emergency power availability as affected by natural phenomena
Facility equipment as affected by natural phenomena
Nuclear material storage as affected by natural phenomena.

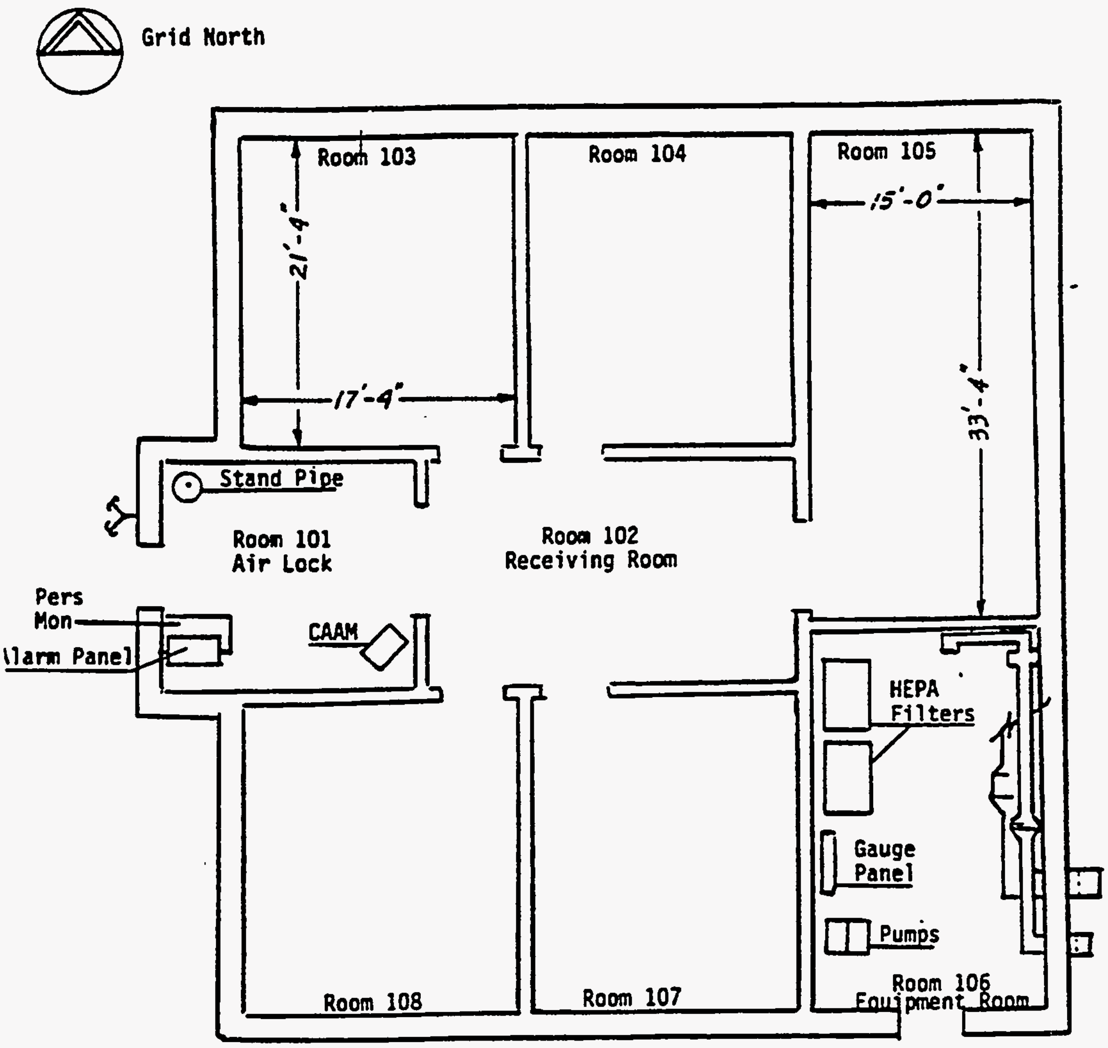

Figure 1. Building 3027 Layout

1-7

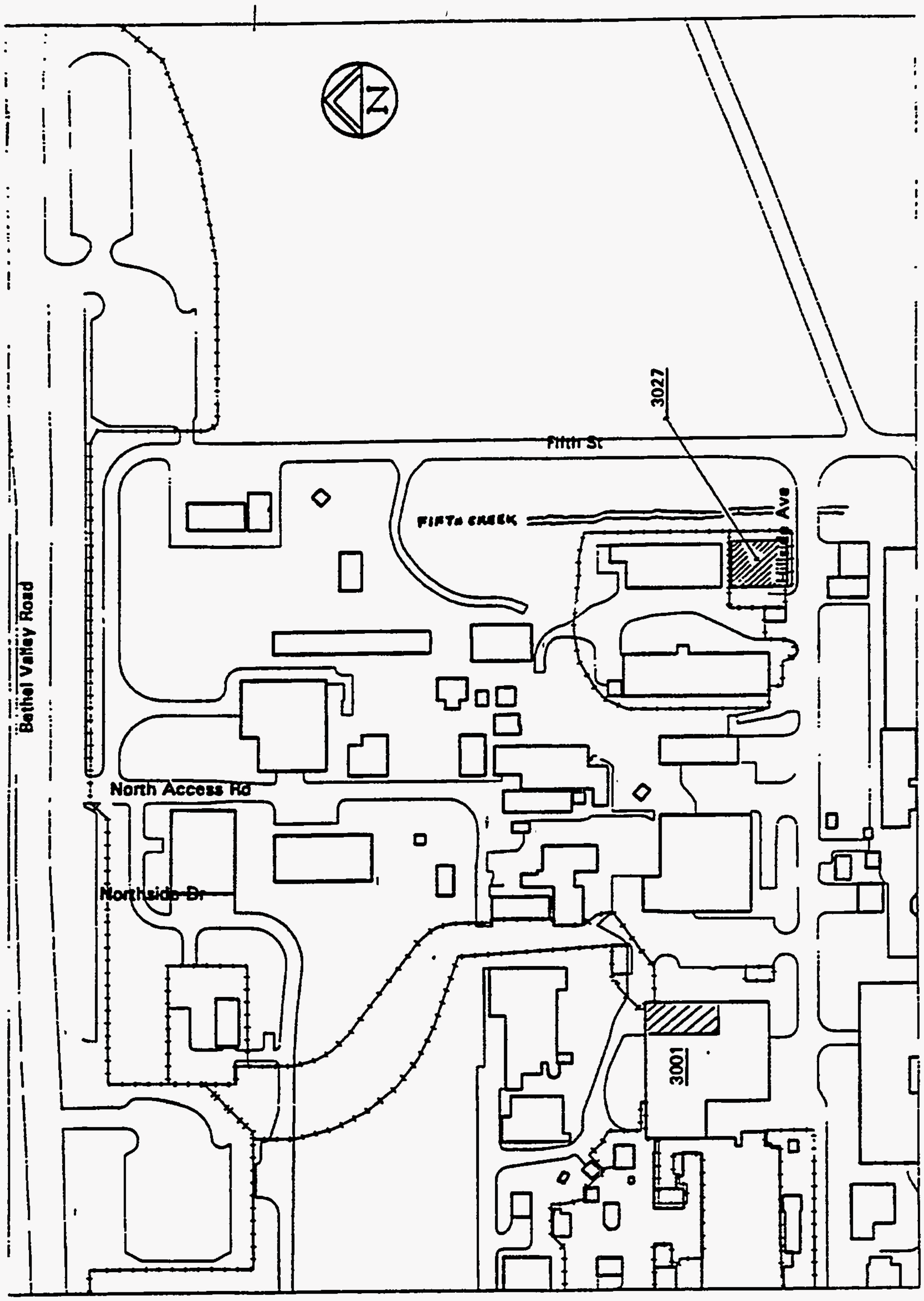

Figure 2. Building 3027 Location

1-8

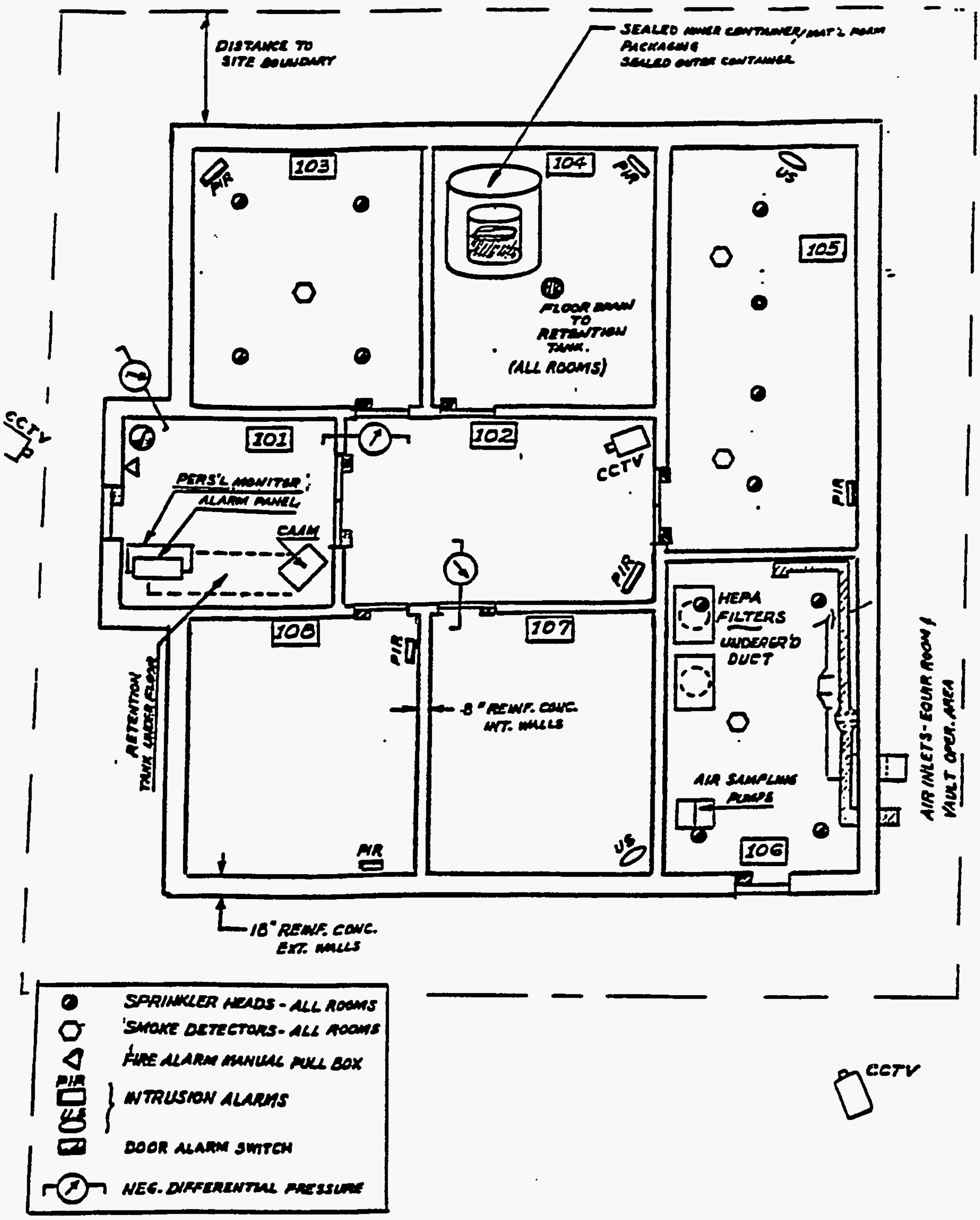

FIGURE 3. 3027 VAULT BARRIERS

1-9

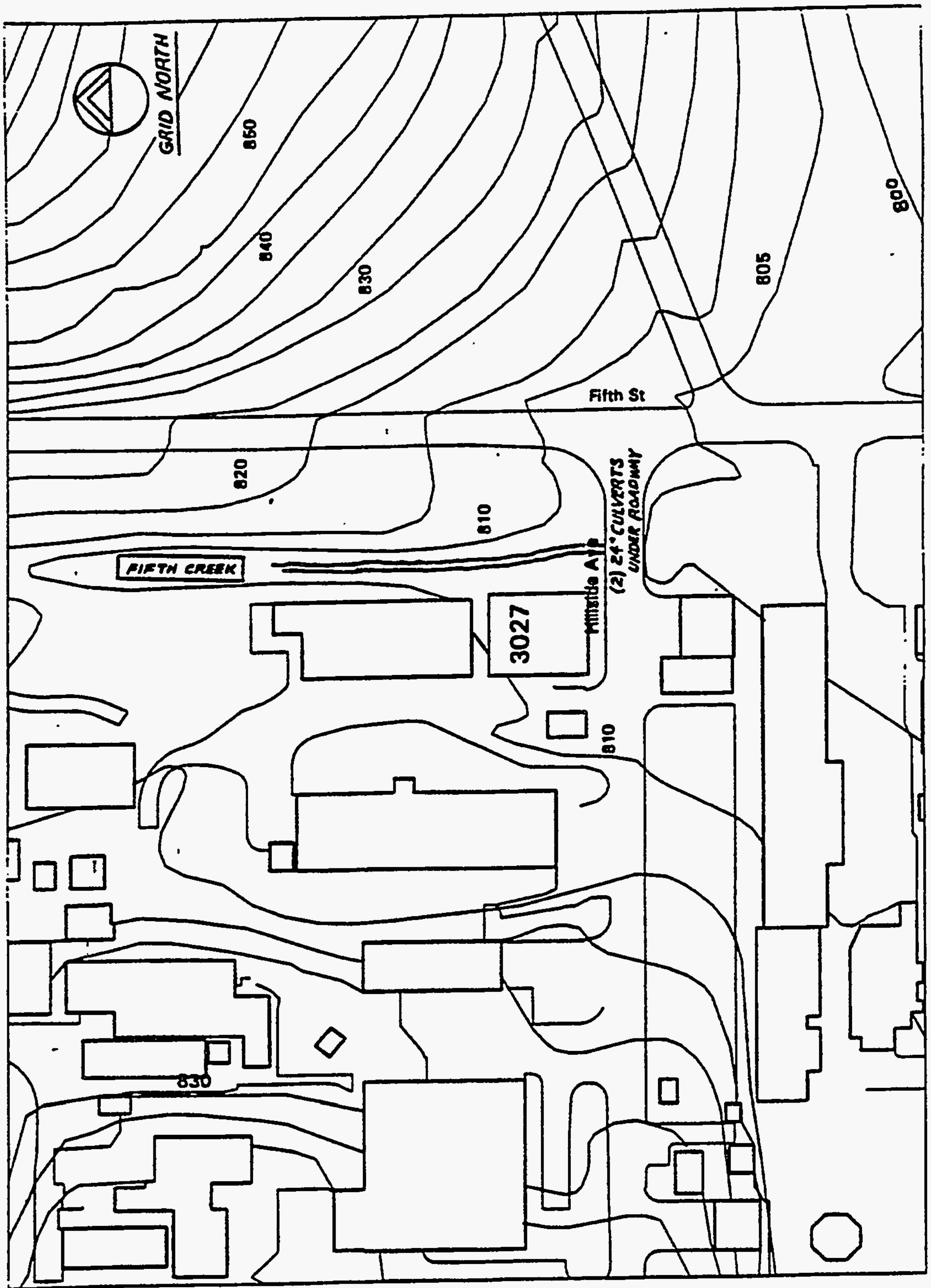

Figure 4. Area Topography

1-10

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M Storage Vault

Question 2: Holdings — DOE Material Manager J. T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal	^{239}Pu *(MBA-35)*	V0, C1	UNK.	UNK.
	^{240}Pu *(MBA-35)*	V0, C1	UNK.	UNK.
	^{242}Pu *(MBA-35)*	V0, C1	UNK.	UNK.
	Foils: ^{240}Pu; ^{242}Pu; ^{239}Pu *(MBA-101)*	C3, D3, D4	50, 40, 40	10, 18, 12, 20
	Evaporated: ^{240}Pu; ^{239}Pu; ^{241}Pu + ^{241}Am *(MBA-101)*	C3, D4	50, 40	11, 10, 21
	W *(MBA-110)*	V1, B1, C1, X1	Indefinite (all)	10, 1, 1, 1
	[P9001] } F [P9002] *(MBA-125)*	U1, B1, B1, X1	U, 10, 100	9
	[PU238RGH] H *(MBA-125)*	V1, B1, X1	100, 5, 5, 100	11
Oxide	Cm *(MBA-35)*	V6, C1	UNK.	UNK.
	Np *(MBA-35)*	V0, C1, D4	UNK.	UNK.
	Np *(MBA-35)*	V0, C1	UNK.	UNK
	Am *(MBA-35)*	V0, C1	UNK.	UNK.

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M Storage Vault

Question 2: Holdings DOE Material Manager J. T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
	Am *(MBA-35)*	V0, C2	UNK.	UNK.
	Am *(MBA-35)*	V0, C1, X1	UNK.	UNK.
	Am *(MBA-35)*	V0, C1, D4	UNK.	UNK.
	^{239}Pu *(MBA-35)*	V0, C1, X1	UNK.	UNK.
	^{240}Pu *(MBA-35)*	V0, C1, X1	UNK.	UNK.
	^{240}Pu *(MBA-35)*	V0, C1	UNK.	UNK.
	^{238}Pu *(MBA-35)*	V0, C1, X1	UNK.	UNK.
	^{239}Pu *(MBA-35)*	V0, C1, D2	UNK.	UNK.
	^{239}Pu *(MBA-35)*	V0, C1	UNK.	UNK.
	^{242}Pu *(MBA-35)*	V0, C1, D2	UNK.	UNK.
	^{242}Pu *(MBA-35)*	V0, C1, X1	UNK.	UNK.
	^{240}Pu *(MBA-35)*	V0, C1, D2	UNK.	UNK.
	C65PU: ^{240}Pu, 99.95% *(MBA-72)*	V1, B1, B1, V5, X1	UNK.	6.5
	^{241}Am, 99% *(MBA-101)*	D3	30	17
	^{241}Pu, 40% ^{241}Am, 60% *(MBA-101)*	D3, C3	30	23, 22
	^{238}Pu *(MBA-35)*	V1, W1 (lead-lined metal box)	UNK.	UNK.

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M Storage Vault

Question 2: Holdings

DOE Material Manager J. T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Scrap/Residues[4]	IO$_1$ *(MBA-70)*	P3, B0, B0, C1, D1	?	? 10
	IO$_2$ *(MBA-70)*	P3, B0, B0, C1, D1	?	? 10
	^{239}Pu > 99% (metal) *(MBA-101)*	D3, C1,	50	10
Solution[4]				
Sealed Sources				
	Pu Be source $^{239/241}$Pu (6.5% ^{240}Pu) *(MBA-20)*	V1, G1, C1, V0, X1	Indefinite	1
	$^{239/241}$Pu (1% ^{240}Pu) *(MBA-131)*	V1, D2	?	4
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]		[5]		
Unirradiated Reactor Fuel				
High-level Liquid Waste				

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M Storage Vault

Question 2: Holdings DOE Material Manager J. T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Other (specify) Pu heater assemblies	^{238}Pu oxide *(MBA-35)*	V6	UNK.	UNK.
	^{240}Pu; ^{241}Pu + ^{241}Am (oxides) *(MBA-101)*	C3, D3	40	20,23
	^{237}Np (metal, contains sulfur as a binder) *(MBA-101)*	C3	50	12

1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.
2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.
3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.
4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.
5 Holdup has no packaging. Identify location of holdup.

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: SNM Storage Vault

Question 2A: No. of Pkgs and Mass   DOE Material Manager J. T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal	^{239}Pu *(MBA-35)*	0.007	4
	^{240}Pu *(MBA-35)*	0.057	3
	^{242}Pu *(MBA-35)*	0.0068	1
	Foil: ^{240}Pu; ^{242}Pu; ^{239}Pu > 90% *(MBA-101)*	0.15	7
	Evaporated: ^{240}Pu; ^{239}Pu; ^{241}Pu + ^{241}Am *(MBA-101)*	0.004	3
	W *(MBA-110)*	0.001 kg	1
	[P9001] [P9002] } F *(MBA-125)*	0.014	1
	[PU238RGH] H *(MBA-125)*	0.0012	1
Oxide	Cm *(MBA-35)*	0.00113	1
	Np *(MBA-35)*	0.016	2
	Np *(MBA-35)*	0.024	7
	Am *(MBA-35)*	0.014	8
	Am *(MBA-35)*	0.001	1
	Am *(MBA-35)*	0.001	1

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: SNM Storage Vault

Question 2A: No. of Pkgs and Mass — DOE Material Manager J. T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
	Am *(MBA-35)*	0.004	3
	^{239}Pu *(MBA-35)*	0.1670	2
	^{240}Pu *(MBA-35)*	0.014	1
	^{240}Pu *(MBA-35)*	0.013	3
	^{238}Pu *(MBA-35)*	0.1044	6
	^{239}Pu *(MBA-35)*	0.008	3
	^{239}Pu *(MBA-35)*	0.062	4
	^{242}Pu *(MBA-35)*	0.0075	1
	^{242}Pu *(MBA-35)*	0.0019	1
	^{240}Pu *(MBA-35)*	0.003	1
	C65PU: ^{240}Pu, 99.95% *(MBA-72)*	0.024	1
	^{241}Am, 99% *(MBA-101)*	0.004	2
	^{241}Pu + ^{241}Am *(MBA-101)*	0.013	2
	^{238}Pu *(MBA-35)*	0.0307	17
Scrap/Residues	IO_1 *(MBA-70)*	0.031	5
	IO_2 *(MBA-70)*	0.063	2
	^{239}Pu > 99% (metal) *(MBA-101)*	0.015	3

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: SNM Storage Vault

Question 2A: No. of Pkgs and Mass — DOE Material Manager J. T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Solution			
Sealed Sources	[Pu Be source] $^{239/241}Pu$ *(MBA-20)*	0.015	1
	$^{239/241}Pu$ (1% ^{240}Pu) *(MBA-131)*	0.08	2
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			
Cumulative Inventory Difference		1	
Other (specify) Pu heater assemblies	^{238}Pu oxide *(MBA-35)*	0.3902	2
	^{240}Pu ^{241}Pu + ^{241}Am (oxides) *(MBA-101)*	0.020	2
	^{237}Np (metal) *(MBA-101)*	0.016	1

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: SNM Storage Vault

Question 2A: No. of Pkgs and Mass — DOE Material Manager J. T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages

Question 2A Continued:

NOTES:

(MB-20)

This is a Pu Be Source, Solid, Fissile Class1.

Packing details obtained from a conversation with the ORNL Transportation Department, who coordinated the interplant shipment.

(MBA-35)

Listed packaging for each item was revised after discussion with the Material Balance Area Representative, to include all packaging from the stand point of barriers, rather than just the stored package. Intermediate packaging is based on the representatives' memory and knowledge of common practice for the class of material.

The various radioisotopes were summarized differently for this question set, to reduce the paper involved.

(MBA-70)

IO_1 = This 55-gallon drum contains the following individually packaged items that can be found under MBA-70 SNNM inventory for the 3027 Vault. Drum #KAPL 63D = 165-371, 165-671, HUA-38B, HUA-38C, HUA-38D, and:IO_2 = This 55-gallon drum contains the following individually packaged items that can be found under MBA-70 SNNM inventory for the 3027 Vault. Drum # KAPL 68D = MHLPU5 and HUA-27.

(MBA-72)

Item name:	C65PU
Material type:	Pu oxide
Grade:	^{240}Pu, 99.95% purity
Quantity:	24 g (0.024 kg) of ^{240}Pu
Packaging:	V1 (welded SS capsule)
	B1 (polyethylene bagging)
	B1 (second polyethylene bagging)
	V5 (screwed pipe nipple)
	X1 (6M drum)
Design life:	unknown

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: SNM Storage Vault

Question 2A: No. of Pkgs and Mass DOE Material Manager J. T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages

(MBA-101)

I.D.	NUCLIDE	ASSAY wt%	DATE	MASS (g)	DESCRPTN	CHEM/PHYS FORM	LOCATION
HP712	241-Am	99.	03/18/77	2	Am(U)	pressed oxide	3027,104
SNM-309	241-Am	99.	08/10/90	2	Am(U)	pressed oxide	3027,104
PU405.SA	240-Pu	99.97	10/24/84	5	Pu(U)	metal	3027,105
SNM-283	240-Pu	95.	05/12/83	0.03	Pu(U)	metal, evap.	3027,105
SNM-283-1	239-Pu	99.9	01/30/84	4	Pu(U)	metal, scrap	3027,107
SNM-87	240-Pu	98.3	04/03/74	11	Pu(U)	oxide+sulfur	3027,105
P40274B	239-Pu	99.96	05/12/83	1	Pu(U)	metal, scrap	3027,107
SNM-4097	237-Np	99.	06/10/82	16	Np(U)	metal+sulfur	3027,104
SNM-284	242-Pu	92.55	10/02/75	8	Pu(U)	metal foil	3027,105
SNM-334	242-Pu	99.8	01/09/76	2	Pu(U)	metal foil	3027,105
239-5PUMF	239-Pu	99.3	09/01/82	5	Pu(U)	metal foil	3027,105
88-3-SCRP	239-Pu	99.12	04/08/93	9	Pu(U)	metal scrap	3027, 105
P39277M	239-Pu	99.96	08/28/84	72	Pu(U)	metal + 1% Al	3027, 105
SNM-163	241-Pu+	98	10/14/71	4	Pu(U)	oxide + sulfur	3027, 105
	(241-Am			5)			
SNM-201	239-Pu	99.12	10/24/84	2	Pu(U)	metal, evap.	3027,105
SNM-222	241-Pu+	90	04/10/73	2	Pu(U)	metal, evap.	3027,105
	(241-Am			2)			
SNM-250	239-Pu	99.1	04/15/74	37	Pu(U)	metal, foils	3027,105
SNM-81	241-Pu+	87	11/09/71	5	Pu(U)	oxide	3027,105
	(241-Am			6)			
SNM-82	241-Pu+	88	03/20/72	1	Pu(U)	oxide	3027,105
	(241-Am			1)			
SNM-88	239-Pu	99.1	09/01/82	21	Pu(U)	metal foils	3027,105

(MBA-131)

Packaging was revised from discussion with Material Balance Area Representative, to include barrier between material and possible exposure as opposed to the storage package.

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: SNM Storage Vault

Question 2A: No. of Pkgs and Mass — DOE Material Manager J. T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages

Applicable References:

(MBA-20)

Nuclear Material Authorization #4203, dtd. 5-30-91

(MBA-101)

IDENT. REFERENCE		STATUS
HP712	SNM 1092	Disposal requested
SNM-309	Letter J. T. Hargrove to T. H. Wynn	Disposal requested
PU405.SA	MC 02359	

(MBA-101) Continued

SNM-283	MC 01183	
SNM-283-1	Memo A. Zucker to R. L. Cline	
SNM-87	SNM-1061	
P40274B	MC 01183	
SNM-4097	MC 01185	Disposal requested
SNM-284	SNM-1075	
SNM-334	SNM-1084	
239-5PUMF	MC 02353	
88-3-SCRP	MC 14078	
P39277M	MC 02357; also MC 02365 (Undated)	
SNM-163	SNM 19536	Disposal requested
SNM-201	MC 02358	
SNM-222	SNM 1051	Disposal requested
SNM-250	SNM 1062	
SNM-81	SNM 19357	Disposal requested
SNM-82	SNM 19360	Disposal requested
SNM-88	MC 02353	

Applicable References:

1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.

2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.

3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.

IC NUMBER	IC DATE
4203	5-30-91

TO BE FILLED IN BY SSD

FORWARD TO: SAFEGUARDS AND SECURITY DEPARTMENT (SSD)
BLDG. 3037, MAIL STOP 6016

USE PROJECT No. F-KC-0000-000

1 PROGRAM	2 PERSON RESPONSIBLE	3 MBA NUMBER	4 CONTROL AREA
BASIC ENERGY SCIENCE	G. H. COLEMAN	06	3027 VAULT

5 BUDGET & REPORTING NO	6. CHARGE CODE NO	7. INCLUDED IN 16 - YEAR FORECAST OF REQUIREMENTS
KC0000000	3330-0430	☐ YES ☒ NO FOR FY

8 MATERIAL	9 CHEMICAL OR PHYSICAL FORM	10.
PU-BE	SOLID.	☒ UNIRRADIATED ☐ IRRADIATED

11 QUANTITY REQUESTED	12. QUANTITY ON HAND PU239/241	13. TOTAL	14. ISOTOPE %
ELEMENT WT 16 g	ELEMENT WT 732 g	ELEMENT WT 748 g	6.5g PU240
ISOTOPE WT 15 g	ISOTOPE WT 620 g	ISOTOPE WT 635 g	

15 PURPOSE AND DESCRIPTION OF PROPOSED USAGE

STORAGE UNTIL NEED EXISTS FOR USAGE.

16 ESTIMATED LENGTH OF TIME MATERIAL WILL BE IN USE	17. ESTIMATED QUANTITY WHICH WILL BE CONSUMED
Stored until declared excess	NONE

18 DISPOSITION OF MATERIAL	19. IN APPROXIMATELY
NOT KNOWN AT THIS TIME.	NOT KNOWN.

20. INTERNAL MOVEMENTS OF MATERIAL AND THE PURPOSE OF EACH TRANSFER

TRANSFER FROM Y-12 TO ORNL VAULT. SOURCE IS PRESENTLY NOT NEEDED.
BUT DECISION TO REACTIVATE FACILITY WOULD JUSTIFY THE NEED FOR SOURCE.

21 DESCRIPTION OF SAFETY, HEALTH, SECURITY, AND CONSERVATION PROVISIONS PLANNED

ACCORDING TO MBA 006 PROCEDURES ALREADY IN EXISTANCE.

22 ATTACH MATERIAL FLOW SHEET OR DIAGRAM IF APPROPRIATE

23. SIGNATURE OF REQUESTER (REQUIRED)
G.H. Coleman

24 SIGNATURE OF MATERIAL BALANCE AREA REPRESENTATIVE (REQUIRED)
G.H. Coleman / MBA 06 Frank J. Gryanis

25 SIGNATURE OF PROJECT MANAGER (REQUIRED)
G.H. Coleman

26 DIVISION DIRECTOR APPROVAL (REQUIRED)
H. A. Glovier

27 CRITICALITY COMMITTEE APPROVAL (REQUIRED)
Calvin M. Hopper for R.M. Westfall 5/30/91

28 OFFICE OF OPERATIONAL READINESS AND SAFETY APPROVAL (REQUIRED)
5/30/91

29. SAFEGUARDS AND SECURITY DEPARTMENT (REQUIRED)
J. T. Hargrove 5/30/91

30 ASSOCIATE DIRECTOR OF OPERATIONS (REQUIRED FOR QUANTITIES OF SPECIAL NUCLEAR MATERIAL OF 100 GRAMS OR MORE)

UCN-2471 (3 8-80)

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: SNM Storage Vault

Question 3: Physical Barriers — DOE Material Manager J. T. Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) See Note

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 Inner Container/ Material Form	
2	WB-18 Outer Container	
3	WB-9 Storage Cell	
4	WB-14 Inter-Cell Shielding	
Barriers 1 through 4 apply to workers inside the vault. The remaing barriers also apply to the plant populace.		
5	WB-5	
6	WB-14	
7	WB-18 Building Containment	
8	WB-4	
9	WB-18 Limited Access to Vault Interior	
10	EB-1 (Environment) EB-4 (Public)	

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: SNM Storage Vault

Question 3 Continued:

Additional barriers not incorporated in this list include the multi-layered security devices (e.g. limited access through three locked, alarmed doors to gain access to any material); air-sampling, CAAM, and H-P surveys before vault entry; the system alarms to continuously monitor for unusual equipment conditions in the vault; emergency procedures established to respond to equipment malfunction; and the fire-protection system, including the criticality-safe retention tank.

Administratively, several independent authorizations are required to transfer material, and vault operations are subject to independent audit for accountability, criticality safety, and maintenance.

NOTE: The barrier listing applies to all nuclear material stored in the 3027 Vault. Four listings in the vault inventory, encompassing six storage containers do not have an inner container and a sealed, outer storage container. In the inventory from MBA-101 are two packages containing metal, and one containing pressed oxide. In neither case should the material be readily dispersed. The inventory of MBA-35 contains 2 plutonium heaters, which are stored as assemblies; and a lead-lined steel box containing 17 sealed sources. The box is wrapped in a plastic bag and is relatively air-tight and water-tight. In any case where there are other than two basic containers, the number of intermediate containers varies from one to three.

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

Question 4: Adverse Conditions[1]

Indicate actual or potential adverse conditions that are applicable to those materials, packages and barrier aggregates developed in Questions 1, 2, and 3 by checking the appropriate items and describing below.

Adverse Condition

In-Facility
- X Inadvertent Transfers
- ☐ Aging
- ☐ Organic Nitric Acid Reaction
- X Equipment Failure
- ☐ Change in Mission
- ☐ Other Co-Located Hazards
- ☐ Corrosion
- X Inadequate Configuration Knowledge
- ☐ Combustible Loading
- ☐ Inadequate Seals
- X Potential Water Sources
- ☐ Inadequate Drains
- X Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- ☐ Administrative Controls
- X Other - Specify

Material
- ☐ Pressurization
- ☐ Pyrophoricity
- ☐ Radioactivity
- ☐ Chemical Reactivity
- ☐ Am Buildup
- ☐ Hydrogen Buildup
- ☐ Radiolysis
- ☐ Volumetric Expansion
- ☐ Oxidation
- ☐ Other - Specify

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

Question 4 Continued, Describe Each Adverse Condition:

1. Inadvertent Transfer was considered as a potential adverse condition; in which a sealed package is mistakenly received or removed from the 3027 Vault, or placed in an incorrect cell. Material removal is not a safety concern, and is documented by a material transfer form and separate receipt retained by the Security Patrol. Packages received for storage are approved by the Office of Operational Readiness and Facility Safety (OORFS), but approval is not documented on the transfer record (form UCN-2681), which is a generic form used for all Intra-Laboratory (ORNL) transfers. The OORFS review is to ensure that a given package meets the criteria for a Criticality Index (CI) of "zero", or is otherwise specified. The Operating Procedures

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

Question 4 Continued, Describe Each Adverse Condition:

do not specify this review, and UCN-2681 does not have a place for sign-off. The package's CI must be noted in the General Remarks Section. Limitations for total quantities of the materials in the vault are located at the vault, but current total inventory of these materials is not. No storage cell is specified for the package being received, on the transfer record.

2. Equipment Failure was considered from several standpoints:
   a. Simple mechanical failure
   b. Failure due to natural phenomena
   c. Failure due to co-located structures

All essential equipment is listed in the Limiting Conditions Document (LCD), being designated as those items essential to continued operation of the 3027 Vault. Items listed therein are:
   a. Continuous Alpha Air Monitor
   b. Presence of Rashig Rings in the floor drain tank
   c. Vault Containment System, which includes the supply fans and monitoring capabilities (i.e. differential pressure gauges)
   d. HEPA filters
   e. Air-sampling system
   f. Fire-suppression system
   g. Liquid level indicator for the drain tank

3. Inadequate Configuration Knowledge was applied to the contents of each sealed storage container. While the fissile material mass has been assayed, weighed, and certified packing material between the inner container and the sealed storage container is not known in every case.

4. Potential Water Sources was considered from within and without the facility. The fire-suppression system could be damaged by freezing, or by earthquake. Hazard screening documents have stated that the vault itself is capable of withstanding the design-basis seismic event, but utility connections were not described in this way.

Externally, weather-induced floods were looked at on the basis of mass-flooding at the ORNL Site, and possible flooding of the 3027 vault from flash-flood conditions on Fifth Creek.

5. Inadequacy of Design Basis was considered more as an unknown, as it affects the mechanical equipment and utilities connections to the vault. Due to natural phenomenon, services to essential equipment may be interrupted.

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

Question 4 Continued, Describe Each Adverse Condition:

6. Storage Racks and Cabinets are not tied to the vault structure, so as to be secure in a design-basis seismic event.

7. The Hazard Screening Document described the maximum credible accident as the deliberate compromise of storage container integrity within the vault. A malevolent act might involve all the containers in a storage cell. (The entire contents of the 3027 vault are never accessible simultaneously).

Applicable References:

1 An existing situation that gives rise to a potential event or concern.

SITE: X-10	FACILITY (Building or Location): 3027
	FUNCTION: S.N.M. Storage Vault

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- X Fire
- X Explosion
- X Worker Exposure
  - ☐ External
  - ☐ Internal
- X Contamination
- X Flooding
- ☐ Leakage/Spills
- ☐ Other Accidents - Specify
- X Human Error

Material
- X Criticality
- X Fissile Material Release
- X Breach of Container
- ☐ Fire
- ☐ Other - Specify

External
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
- X Adjacent Facility Accident
- X Power Failure
- ☐ Institutional/Regulatory Requirements
- X Personnel Radiation Exposure
- X Ex-facility Fire
- ☐ Other - Specify

Natural Phenomena
- X Earthquake Damage
- X Wind Damage
- X Flood Damage
  - ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE: X-10	FACILITY (Building or Location): 3027
	FUNCTION: S.N.M. Storage Vault

Describe Each Event:

There are no current events, nor are there any historical events, involving the 3027 Vault. Potential events have been explored for this vulnerability assessment, even though their probability appears extremely unlikely.

In-Facility

1. Fire in the 3027 Vault is of low probability, but must be considered as a possibility. The amount of combustible material is restricted and the structure will not support combustion. Any loose combustible material is removed. Fire, combined with a breached container, could lead to a secondary contamination concern or a nuclear criticality concern.

2. An explosion in the vault might be triggered by a chemical reaction within a storage container due to chemical reaction in the stored nuclear material or interaction with the packing material.

Question 5 Continued:

SITE: X-10	FACILITY (Building or Location): 3027
	FUNCTION: S.N.M. Storage Vault

Describe Each Event:

3. Worker exposure to internal or external contamination is extremely unlikely, because of administrative controls. The general plant population would not be exposed, but vault workers might be. As many as five workers are involved in a "vault detail." One scenario would be placing an already-contaminated storage container in the vault. The second scenario requires a deliberate or malevolent act in breaching a sealed container inside the vault.

4. Contamination of the facility could occur, based on the two scenarios described above. During a seismic event, storage racks and cabinets may tip over. Larger storage containers (e.g., 6-M drums) may also topple during a seismic event.

5. Flooding of the vault from inside could occur from the rupture of the fire-suppression system. Supply line, distribution piping, or sprinkler heads can freeze during cold weather. The supply line could rupture at the entry point to the vault during a seismic event. Small containers on cell floors may become buoyant enough to rearrange themselves from their stored array. Facility operations would be curtailed while the drain (retention) tank is sampled and pumped out for disposal.

6. Human error in the placement of storage containers could occur. On the material transfer form used for the receipt of material into the vault, there is no specified storage cell or location within the vault. Review of the description of the storage package and contents by the OORFS is to establish the criticality index (CI) for the individual package.

Material

1. Criticality can occur only if nuclear material is removed from both inner and outer storage containers. Such an occurrence would require a deliberate act.

2. Fissile material release would require the breaching of both inner and outer containers of a storage package. The resulting contamination will be confined to the interior of the vault.

3. Breach of containers, other than as a deliberate act, is not a likely event. Containers are routinely inspected for exterior signs of degradation, but containers are not to be opened in the vault. The use of the two-man rule counteracts the malevolent act of a single vault operator. Accidental breaching of the outer container was considered in conjunction with a seismic event.

External

1. Accidents in adjacent facilities could occur in Building 3044 or Building 3012. Building 3044 is located approximately 10 feet north of the 3027 vault. This building is a machine shop and currently is in limited use. Building 3012 is located approximately 70 feet west of the vault. This building is a rolling mill and is in limited use. An accident in this facility would not affect the vault structure, but might affect the operability of the vault's stand-by

SITE: X-10	FACILITY (Building or Location): 3027
	FUNCTION: S.N.M. Storage Vault

Question 5 Narrative Continued:

External (Continued)

2. Power failure to the 3027 Vault can occur through numerous scenarios. A simple power failure can occur through lightning strikes anywhere on the electrical supply circuit. Other scenarios are discussed under "Natural Phenomena."

3. Personnel radiation exposure would involve only vault workers, not the plant population. Such exposure could occur in the same scenario considered for contamination. It involves the deliberate breaching of a storage container.

4. Fires external to the facility were considered for Building 3012 and Building 3044, described above.

Natural Phenomena

1. Earthquake damage to the vault structure should be limited. The vault was designed and constructed to withstand a 0.15g earthquake. Structural integrity should not be compromised. Essential equipment within the vault, as detailed in Question 4, will probably be damaged or nonfunctional. Utility connections will probably be damaged, as will adjacent power poles and overhead lines. Collateral damage to Building 3012 will probably not affect the availability of the stand-by generator due to the building's construction (metal siding, steel frame) and the heavy housing on the generator. The generator fuel supply is furnished through relatively flexible metal taking from an underground tank to the "day tank" of approximately 20-gallon capacity. While the generator may remain operational, the underground electrical supply to the vault may not remain intact. The natural gas supply line to Building 3012 may be ruptured. Some interior flooding of the vault may occur if the fire-water supply line is broken inside the vault.

2. Wind damage to the vault structure should be minimal. The vault, exterior doors, and door hardware were designed and constructed to withstand 360 mph winds. Adjacent power poles and electrical lines to the vault may be disabled. Building 3012 may be demolished, but the stand-by generator and the underground electrical lines to the vault should survive. The heavy generator housing can probably survive impact from debris. Natural gas outlets inside Building 3012 will probably be ruptured.

3. Flood damage to the vault structure would be negligible, but vault operations may be affected. The proximity of the facility to Fifth Creek poses a possible pathway for the introduction of radioactive contamination to the environment. Fifth Creek is a tributary of White Oak Creek, which leads off-site to the Clinch River.

SITE: X-10	FACILITY (Building or Location): Building 3027 FUNCTION: S.N.M. Storage Vault
Preventive X Procedures: ops., maint., surveillance X Material Limits X Training X Quality Assurance X Conduct of Operations X Authorization Basis (safety analysis, BIOs) X Surveillance ☐ Organization ☐ Structure ☐ Management Involvement ☐ Staffing ☐ Lessons Learned X Configuration Control of Design X Preventive Maintenance X Monitoring ☐ Trending (Performance Indicator) X Testing/Verification of Integrity X Regulatory Requirements X Records X Personnel Exposure X Equipment ☐ Waste Inventory X QA ☐ Personnel Reliability Assurance Program X Other - Specify	Mitigative X Emergency Preparedness X Emergency Management X Emergency Planning X Emergency Procedures X Emergency Response X Safety Systems X Alarm Systems ☐ Other - Specify

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

Compensatory Measure	Reference Document
PREVENTIVE:	
Procedure: ops., maintenance, surveillance	Safeguards and Security Org. Procedure SSO-8; Limiting Conditions Document (LCD); NSR 002ILP00601A; 3027 Vault Facility Manager's Manual
Material Limits	Procedure SSO-8; LCD; NSR 002ILP00601A; NSR 002ILP00601B; NSR 002ILP00601C
Training	DOE Order 5480.5; Vault Operator Training Procedure (SSO-unnumbered); Training Program Checklist
Quality Assurance	
Conduct of Operations	LCD
Authorization Basis	ORNL Implementation Plan to Meet Requirements of DOE Order 5480.23
Surveillance	Procedure SSO-8; LCD
Configuration control of Design	Limiting Conditions Document (LCD); Former Laboratory Protection Division Procedure LP-2; Configuration Management Directive
Preventive Maintenance	LCD; Procedure SSO-8
Monitoring	Procedure SSO-8
Testing/Verification of Integrity - Vault	LCD; Procedure SSO-8
Testing/Verification of Integrity - Container	DOE Order 5480.5; Semiannual Inventory Checklist

SITE: X-10	FACILITY (Building or Location): Building 3027 FUNCTION: S.N.M. Storage Vault

Question 6 Narrative Continued:

Compensatory Measure	Reference Document
Regulatory Requirements	DOE Order 5480.1A; 5480.1B; 5480.3
Records	
Personnel Exposure	(maintained by Health Physics)
Equipment	Procedure SS0-8; LCD
Packaging	NSR 002ILP00601A
Oversight Requirements	LCD
Hazard Screening	ORNL Implementation Plan to Meet DOE 5480.23; Final Phase Evaluation; Hazard Screening HS/3027/F/02/4-19-93
MITIGATIVE	
Emergency Preparedness	X-10 Site Emergency Plan
Emergency Management	X-10 Site Emergency Plan
Emergency Planning	X-10 Site Emergency Plan
Emergency Procedure	Procedure SS0-8
Emergency Response	X-10 Site Emergency Plan
Safety Systems Alarm Systems	Limiting Conditions Document Procedure SS0-8

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

EVENT	WORKER			ENVIRONMENT			PUBLIC		
	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
Fire	N	N	N	N	N	N	N	N	N
Explosion	N	N	N	N	N	N	N	N	N
Worker Exposure	N	N	N	N	N	N	N	N	N
Contamination	N	N	N	N	N	N	N	N	N
Flooding	N	N	N	N	N	N	N	N	N
Human Error	N	N	N	N	N	N	N	N	N
Criticality	N	N	N	N	N	N	N	N	N

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

Question 7: Consequences (Continued)

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

	WORKER			ENVIRONMENT			PUBLIC		
EVENT	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
Release	N	N	N	N	N	N	N	N	N
Container Breach	N	N	N	N	N	N	N	N	N
Adj. Facility Accident	N	N	N	N	N	N	N	N	N
Power Failure	N	N	N	N	N	N	N	N	N
Pers. Radiation Exposure	N	N	N	N	N	N	N	N	N
Ex-Facility Fire	N	N	N	N	N	N	N	N	N
Earthquake	N	N	N	N	N	N	N	N	N
Wind	N	N	N	N	N	N	N	N	N
Flood	N	N	N	N	N	N	N	N	N

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

Question 7 Continued:

EXPLANATION:

1. Fire in the 3027 Vault is of low probability. The presence of combustible material in the vault is restricted and the structure will not support combustion. Every room in the vault is protected with fire sprinklers and smoke detectors. (See Figure 3). Activation of either system sounds a local alarm and a remote alarm at the ORNL central fire station. The average alarm-response time is approximately 4 minutes. All nuclear materials are stored in sealed, metallic containers, which should not be susceptible to rapid deterioration from fire. Vault construction and storage cell doors will prevent the general spread of a fire. The presence of a fire barrier in the main exhaust duct protects the HEPA filters from ignition by burning, airborne particulate matter. A secondary objective of the fire-suppression system is to wash down any entrained contamination from the room air. All run-off from the sprinkler system is contained in the under-floor retention tank. The use of ON-OFF sprinkler heads limits the amount of water entering the tank. Drains and piping were sized in consideration with nuclear criticality. The retention tank contains borosilicate glass Rashig rings to prevent criticality in the tank. A local and remote alarm signals the presence of liquid in the tank. Tank contents are sampled for the presence of nuclear material before being pumped out for disposal. No contamination will be released outside the vault, and no hazard exists for the plant populace, the environment, or the public.

2. Any uncertainties in the packaging of stored nuclear material poses the potential for an explosion due to chemical interaction or radiolysis. The amount of nuclear material in any sealed container is relatively small. The presence of back-draft dampers in both supply and exhaust ducts for each cell will prevent a major disruption of the vault ventilation and containment system. If the fire suppression system is not activated, radioactive contamination will be confined to the affected cell. Because of the small amount of material in each container and the total amount in each cell, criticality is not a major consideration. No contamination will be released from the vault.

3. Worker exposure to contamination can occur in one of two ways: The receipt of a storage container with surface contamination present or the breach of both inner and outer container of a stored package. Either must happen during an authorized vault entry because of the redundant security systems noted previously and also illustrated in Figure 3. "Vault entry" means proceeding past the Air Lock into the Receiving Room. The combination of the lock on the Receiving Room door is known only by the vault operators. It is available to the Laboratory Shift Superintendent (LSS) in case of Emergency or as noted below but is then changed by the next business day. The LSS can enter the Air Lock and Equipment Room to respond to any building alarms, but a Security Inspector must be present. Here, and in subsequent discussions, any deliberate or malevolent breaching of containers must occur during a vault entry and is thus limited to being done by the vault operators. None of the plant populace or any of the public can gain access to the vault, unless accompanied by one of the vault operators.

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

Exposure would be limited to the five members of the vault detail - two vault operators, two security inspectors, and a health-physics technician. Each container received for storage is checked for surface contamination and tagged by the health-physics technician before being placed in storage. Deliberate breach of a container is unlikely. The use of the two-man rule (two Q-cleared employees) is in effect for any vault entry. Two vault operators perform material transfers during normal business hours, being replaced by the Laboratory Shift Superintendent and Security Captain during off-shift hours. Each storage container is physically examined for exterior signs of deterioration during the semiannual vault inventory. A constant alpha air monitor positioned in the Air Lock monitors for the presence of airborne contamination in the Receiving Room. In addition, an air-sampling pump is in continuous operation, drawing air samples from each storage cell through filter paper. During the first vault entry of any day, and before any storage cell is opened, the health-physics technician scans the filter for that cell with a portable G-M meter to detect the presence of any contamination (above the usual background due to the presence of Radon). The filter is later checked on the bench, using a shielded, end-window G-M counter, after allowing for Radon decay. Lab coats and shoe covers are a requirement for entry into any storage cell. Before exiting the vault, all employees must monitor for contamination at the monitoring station adjacent to the exit door from the Air Lock. Any contamination detected will not leave the vault inadvertently, and the plant populace, the environment, and the public will not be exposed to the spread of contamination.

4. Contamination of the facility could occur in the same scenarios listed for worker exposure. The receipt of a contaminated container, or the breaching of both interior and exterior containers, could lead to facility contamination. The same procedures applied for protection of vault workers will detect any contamination in the facility. The vault's containment system will confine the contamination to the affected storage cell and inside the vault. The plant populace, the environment, and the public will not be exposed.

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

EXPLANATION (Continued):

5. Flooding of the vault from inside could occur from a rupture of the fire-suppression system due to freezing or seismic event. Low-temperature sensors in Rooms 101, 103, and 106 are set to alarm at 40 degrees Fahrenheit to allow time for remedial action before freeze-up occurs. The alarm is indicated on the local annunciator panel. This alarm condition is indicated at the WOCC, which is staffed at all times. The LSS will respond to the vault and take whatever action is needed to correct the situation. Possible causes and remedial actions are specified in the 3027 Vault Operating Manual. During a seismic event, the fire-water supply line will most likely break at the entrance to the vault, inside the Air-Lock. The supervisory alarm on the fire-suppression system should indicate the trouble. All rooms in the vault drain to the retention tank, which will hold approximately 1800 gallons. The floor drains will allow approximately 160 gpm flow rate. Due to the vault design features (raised door sills and door fit), water should remain in the room where the rupture occurs. The shutoff valves for the fire-water supply are located nearby-approximately 20 feet west of the vault entrance. An alternate line and fire hydrant are approximately 85 feet southwest of the vault. There is presently no loose contamination in the vault. Unless both containers of a storage package are breached simultaneously, no contamination should be spread. Small storage containers currently positioned on the cell floors may become buoyant enough to rearrange themselves. Each storage container in the vault has a CI of zero, due to the small amount of material compared to size of the outer container. Nuclear criticality within a storage cell is not a credible event.

6. Human error in the placement of storage containers inside the vault could occur. Although the OORFS receive each package and all material transfers require the approval of the ORNL Nuclear Materials Manager, there is no location for a given container specified on the material transfers from, nor is there a space on the form for such designation. Because all containers carry a CI of zero, or an equivalent TI, no criticality would result.

MATERIAL

1. A criticality event can only be initiated by deliberately breaching both the inner and outer containers of the stored packages. The amount of nuclear material in each package is small. The total amount of material in each cell is insufficient to achieve criticality. No more than one cell is usually open at a time. Breaching a container requires a deliberate act and is precluded by the use of the two-man rule. Vault entry requires the presence of two armed security inspectors and a health-physics technician. Their presence will counteract collusion on the part of the vault operators.

2. Fissile material release also requires the breach of both inner and outer containers, which requires a deliberate act. Sealed storage containers are not opened in the vault as an operating procedrue. The employment of the two-man rule is a deterrent, and the presence of the rest of the vault detail counteracts collusion between vault operators. Any material released will be confined to the vault interior because of the ventilation/containment. Assuming complete failure of the HEPA filters, the vaults exhaust air is ducted underground to the 3039 stack, which has its own filters and scrubbers.

3. Accidental breach of containers appears highly unlikely, and requires that both inner and outer containers be breached to be of major consequence. The storage (outer) containers are inspected every six months for visual signs of degradation. During a seismic event, container toppling is quite likely. Storage containers are of metallic construction, and are sealed before acceptance. Steel drums have lids which are retained by capture rings. Small containers are the food pack, sealed rim type. The large containers are heavy enough to withstand damage from toppling. Small containers are arrayed on the cell floor or stored in racks or fireproof cabinets. They are not stacked. In either case, they are of little mass. Toppling or falling should not rupture the outer container. Any nuclear material released will be confined

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

EXTERNAL

1. The end of Building 3044 nearest the 3027 Vault is a light machine shop, currently in limited use. No conceivable accident occurring in this area can affect the integrity of the 3027 Vault. The standby generator for the 3027 Vault sits just outside the east wall of Building 3012, the Rolling Mill. Inside 3012, adjacent to the generator's exterior location, is a small office space isolated by a concrete block partition. All heavy equipment is located away from this office space. An accident that could affect the generator's availability appears unlikely, but the loss of the generator means only the loss of the secondary electrical supply. Vault operations (i.e. material transfers) might be curtailed, but the vault's main function (i.e. storage) would not be affected.

2. Power failure to the 3027 Vault can occur by means of a lightning strike anywhere along the circuit supplying the building. Small but intense thundershowers are quite common in East Tennessee, and localized power outages at ORNL are not uncommon. Shift personnel are trained and experienced in getting power restored quite rapidly. In the meantime, standby generators are utilized as a secondary supply. Building 3132 standby generator does this for the 3027 Vault. Loss of the main power supply automatically starts the generator. The essential equipment in the vault (e.g. the ventilation fans) are tied into the emergency power supply. The generator is on a scheduled preventative maintenance program and is operated every 2 weeks.

3. Radiation exposure to which vault workers are subjected is quite limited. The 8-inch concrete walls provide intercell shielding. Most of the storage containers read 10mR/h or less. Only one container reads approximately 120mR/h at contact. Material transfers take very little time for a storage cell to be opened and vault operators to be exposed to the cell inventory. The semiannual audit, which also includes examination of the physical condition of the outer containers, takes two vault operators approximately 3 hours. Personnel dosimetry is checked quarterly, and have shown no unusual exposure for the current vault operators since they assumed operation of the vault in July 1993. In the case of a deliberate breaching of containers, package shielding would be lost. Cleanup of any loose nuclear material would be performed under the intense scrutiny of health-physics technicians, by utilizing several crews, and by keeping individual exposure time to a minimum. Radiation fields outside the vault are not expected to increase.

4. Fires in either of the nearest buildings (3012 and 3044) will have no effect on the 3027 Vault's integrity. Both buildings are protected by automatic fire-suppression systems, and response by the ORNL Fire Department is quite rapid, as noted above.

NATURAL PHENOMENA

1. A seismic event should have little effect on the integrity of the 3027 Vault because of its design and construction. With the loss of all electrical power and/or essential equipment, the 3039 stack still provides motive power for building containment by way of the vault exhaust duct, although differential pressures will be decreased from the normal range. Even with the loss of the 3039 stack, the vault is still a sealed building. For nuclear material to get outside the vault, there must be a simultaneous release of material from the storage containers and a motive force to get the material outside the vault. Without such an event, the plant populace, the environment, or the public cannot be exposed.

2. The ultimate wind storm would be a tornado, which the 3027 Vault was designed and constructed to withstand. The integrity of the structure should not be affected, but the loss of power poles and overhead wiring will cause the loss of primary electrical power. The stand-by generator, Building 3132, with its heavy cover

SITE: X-10	FACILITY (Building or Location): Building 3027
	FUNCTION: S.N.M. Storage Vault

NATURAL PHENOMENA (Continued)

approximately 600 feet south of the 3027 Vault. No information could be found concerning Fifth Creek. A site examination was made, considering the effects of a flashflood on this creek. As noted in Figure 4, the creek is located east of 3027. The creek watercourse is approximately 30 feet away and at an estimated elevation of 804 (compared to the vault base of approximately 810). Two 24-inch culverts cross under Hillside Avenue. A rapid torrent down Fifth Creek will carry with it much debris. It is not unlikely that the culverts will become restricted, with a rapid water-rise at this point. However, both roadways lie lower than elevation 820 and will promote rapid run-off. Any flooding near the vault entrance will be transitory and of relatively brief duration. Construction of the vault will retard water entry and restrict entry into the Receiving Room. Whatever water gets inside will drain to the retention tank. Due to the transitory nature of the flooding, and the delay of water entry afforded by the structure, flooding effect should be minimal. Without the simultaneous release of stored material from its containers, no material can escape from the vault interior, and no exposure to the plant populace, the environment, or the public can occur.

SITE: Building 3027, SNM Storage Vault

Question 8: Overall Site Summary

Based on the Site Assessment Team report, provide an overall assessment of the site ES&H vulnerabilities.

The mission function of the 3027 Vault is long-term storage of nuclear materials and precious metals. The only ES&H concern connected with the operation of the vault is the present uncertainty about the makeup of packaging inside the storage containers. Past operation of the vault has been primarily concerned with material accountability and nuclear criticality safety. The consequences of packaging incompatibility are deemed negligible as far as the effects on the environment or the public, because of the relatively small amount of material in each container and the total amount of material in each storage cell. If any or all of the essential equipment failed, vault operations (i.e. material transfer) would be curtailed but the vault would still function, without any material release to the environment.

The only activity at the vault is the transfer of material, which does not occur very often and the regular, scheduled surveillance activity of the vault and equipment. The highest-risk activity is the transfer of a sealed storage container in or out of the vault. The numerous HP surveillance activities protect the vault workers. The plant populace, environment, and the general public are exposed to a negligible risk.

The main planned activity for vault operations is to obtain a certification of the packing used, for any additional containers received for storage.

The independent authorization levels required for material transfer ensures good accountability, and the independent audits maintain this accountability, besides ensuring nuclear criticality safety. The level of security associated with the vault ensures that no casual, unplanned entries are made, and prevents a malevolent intrusion.

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location):3038
	FUNCTION: SHUTDOWN
DOE HEADQUARTERS FACILITY LANDLORD ER	
DOE HEADQUARTERS PROGRAM SPONSOR EM	
FACILITY AGE 45 YEARS	DESIGN LIFE UNKNOWN

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location):3038 FUNCTION: SHUTDOWN

Question 1:

The Isotope Development Laboratory (IDL) in Building 3038 is in a standby mode and is no longer utilized for processing, dispensing, and storage of radioactive materials. No operations are conducted within Building 3038 except for the activities necessary to stabilize the facility for acceptance by the Decontamination and Decommissioning (D&D) Program. All activities involving radioactive materials are covered by approved, written procedures.

The results from the latest hazard screening document indicate only a single, overall unusual hazard: presence of radioactive contamination. There are known, isolated areas of transferable contamination within the facility but these have been secured and are subject to restricted access. The presence of fixed contamination is addressed by isolation of those areas affected and good radiation protection (RP) practice. Thus, there is slight potential for radiation exposure to personnel working within and in the immediate vicinity Building 3038.

The Hazard Level Classification for this facility is "GENERALLY ACCEPTED." This classification is justified since there would only be negligible effects on any individual on-site or off-site.

The facility is located within the Oak Ridge National Laboratory (ORNL) main boundary. Building 3038 is in the middle area of ORNL. The building is located on the southwest corner of Isotope Circle and is a masonry structure. It is divided by concrete block interior walls into three separate facilities: 3038-E, 3038-M, and 3038-AHF [Alpha Handling Facility].

The IDL (Building 3038 - these terms are interchangeable) contains facilities that were utilized for storage, processing, conversion, and dispensing of radioactive isotopes. Recent uses of Building 3038 include the study of transuranic elements, fabrication of alpha- and neutron-emitting targets and sources, shipment of radioisotopes, and production of ^{90}Y for medical uses.

The building rooms and equipment are maintained in a "contained" condition using the ORNL cell ventilation and process off-gas systems and a local ventilation system. Various heating and cooling systems are provided in the different operating areas. Utilities for the facility include electrical power, steam, and plant air.

Building 3038-E (east laboratories) is provided with an air lock for personnel access. The personnel access to isotope shipping in 3038-M also has an air lock. Other personnel access entries and equipment access doors are not provided with air-lock capability, which results in upsets to the desired "contained" condition. The combination of local and process off-gas systems presents a potential for reversed flows and contamination if one of these systems should fail.

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location):3038
	FUNCTION: SHUTDOWN

Question 1 Narrative Continued:

The drains in the east and middle sections of the building, which were once connected to the liquid low-level waste (LLLW) system, have been sealed to prevent use because of leaks in the underground transfer lines. This includes, in addition to the hot cell in 3038-E, several bench and sink operations. There is no provision for washdown to decontaminate the hot cell or for cleanup in the event of a spill in the barricaded area. The hot drains for the alpha handling cells in 3038-W are on the WC-2 tank system.

The Isotope Research Materials Laboratory (IRML) formerly located in Building 3038-E consisted of glove boxes, hoods, and radioactivity-counting equipment. The glove boxes contained equipment for fabrication of targets and examination of materials. The principal materials utilized in the IRML were uranium, transuranic materials, and ^{147}Pm.

The Radioactive Materials Shipping and Packaging (RAMSPAC) area, located in Building 3038-M (see Fig. 4), consists of a concrete barricade formerly used for storage of radioactive materials, a dispensing station, the canning and packaging area, an Health Physics inspection area, and a package labelling area.

Isotope Technology had two laboratories; a process cell in Building 3038-E and a low-level laboratory in Building 3038-W. The manipulator process cell has a mineral-oil-filled, lead-glass window. The inner surface of the cell is painted steel. The cell is highly contaminated, but most of the contamination is assumed to be fixed in place. An estimate of the contamination has been made utilizing the cell access area levels of smearable (transferable) contamination. There are also hoods in this area. The low-level laboratory has hoods and an adjacent storage room. Only tracer levels of alpha and beta/gamma materials were handled in this area.

The Alpha Handling Facility (AHF, see Fig. 6), located in Building 3038-W, consists of five hot cells. There are seven glove boxes in an adjacent room, the AHF Annex. The hot cells are shielded by water-filled stainless-steel tanks, and each contains a viewing window and manipulator ports. The cells can be converted to glove boxes by replacement of the front shielding tank and manipulators with an approved window fitted with glove ports and a loadout station.

Building 3038 was constructed to house all the radioisotope shipping activities for ORNL. The building has been in operation since 1949. Originally, the entire facility was dedicated to radioisotope shipping as follows: the east portion (3038-E) contained the analytical chemistry laboratory to perform analyses of short-lived radioisotopes prior to shipment; the middle section (3038-M) housed the radioisotope handling and transfer barricade; and the west section (3038-AHF) housed the packaging, inspection, and shipping activities.

As the volume of radioisotopes being shipped decreased in the 1960s, the shipping area was reduced. In 1968, the west portion was converted into the AHF by adding water-shielded hot cells and glove boxes for fabrication of targets.

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location):3038
	FUNCTION: SHUTDOWN

Question 1 Narrative Continued:

The section of the building called 3038-M has always been the radioactive shipping operation for ORNL. Most of the shipments were for the isotopes sales program, but shipments of radioactive materials from other ORNL groups were also handled here. The glove boxes in the AHF Annex were used for loading out of isotopes for sales.

The analytical chemistry laboratories supporting isotopes sales were located in the east end until 1976. When the analytical function was transferred to other ORNL facilities, Building 3038-E was converted into an isotope production and development facility. In the late 1970s and early 1980s, there was a research program on plutonium alloys and compounds. The same glove boxes were used in the mid-1980s to perform research on ^{147}Pm-doped crystals and glasses for laser development studies. With these two exceptions, all work in the east end of the facility has been dedicated to isotopes efforts.

All process operations in Building 3038 have been shut down, and the building is in standby pending facility stabilization activities. A surplus facilities application has been prepared for the building.

A list of substances and hazardous materials that may be located within the facility was developed from information based on facility inventory records for all isotopes facilities and quantity estimates developed from operational information. A review of these hazards resulted in the determination that the only unusual hazard existing in the facility is due to the small quantities of residual radioactive contamination currently present in the facility. The quantity of transferable radioactive material is small enough and so well isolated (by restricting access) that it does not represent a significant hazard.

The legacy of many programs and processes previously conducted in this facility since its construction remains primarily as residual surface contamination of cells and process equipment (vessels, piping, vent ducts, etc.) and in the barricade/shipping area in the central portion of Building 3038. The residue is not considered significant due to the small amount of material involved, the immobility of the fixed contaminants, the identification and isolation of the small amounts of transferable contamination remaining, and the normal lack of personnel access to and activity (i.e., operations) in these areas.

All of the materials of concern are located in four general areas. A single batch is located in a TRU waste drum in AHF. Several items are inside of a safe in the north lab on the east end of the facility. A single batch is in a shielded drum in the counting room on the east end of the facility. The remaining five items are located in the AHF annex and contained in 6M shipping drums or a stainless steel water shielded drum.

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location): 3038
	FUNCTION: SHUTDOWN

Question 2: Holdings — DOE Material Manager J. T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal	^{241}Am (group 1)	U1, C1	UNKNOWN	UNK
Oxide	^{241}Am (group 2)	V1, D2	UNKNOWN	UNK
	^{241} Am(group 3)	U1, C1	UNKNOWN	UNK
	^{241}Pu(group 4)	U0, C1	UNKNOWN	UNK
	^{240}Pu (group 5)	U0, C2	UNKNOWN	UNK
	^{239}Pu (group 6)	U1, C2	UNKNOWN	UNK
	^{240}Pu (group 7)	U1, C1	UNKNOWN	UNK
	^{238}Pu (group 8)	V1, X1	INDEF.	> 14
	^{238}Pu (group 9)	V6, V1, C0, D1	INDEF.	2
	^{237}Np (group 10)	G1, C2, B0, D1	UNKNOWN	UNK
	^{238}Pu (group 11)	G1, C2, B0, D1	UNKNOWN	UNK
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]		[5]		
Unirradiated Reactor Fuel				

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location): 3038
	FUNCTION: SHUTDOWN
Question 2 Continued:	

Question 2 Notes:

The designation of group is to facilitate data comprehension only.

Applicable References:

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1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.

2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.

3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.

4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.

5 Holdup has no packaging. Identify location of holdup.

SITE:Oak Ridge National Laboratory	FACILITY (Building or Location): 3038
	FUNCTION: SHUTDOWN

Question 2A: Unclassified Holdings DOE Material Manager J. T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal	Am-241 (group 1)	0.0123 (kg) NET	1
Oxide	Am-241 (group 2)	0.0116 (kg) NET	1
	Am-241 (group 3)	0.0002 (kg) NET	1
	Pu-241 (group 4)	0.0002 (kg) NET	1
	Pu-240 (group 5)	0.0020 (kg) NET	1
	Pu-239 (group 6)	0.0614 (kg) NET	1
	Pu-240 (group 7)	0.0248 (kg) NET	3
	Pu-238 (group 8)	0.0970 (kg) NET	3
	Pu-238 (group 9)	0.1628 (kg) NET	1
	Np-237 (group 10)	0.0090 (kg) NET	1
	Pu-238 (group 11)	0.0006 (kg) NET	1
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			

SITE:Oak Ridge National Laboratory	FACILITY (Building or Location): 3038
	FUNCTION: SHUTDOWN

Question 2A Notes:

Total Mass amounts rounded from latest MBA inventory.

Applicable References:

1 Identify probable location.

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location): 3038
	FUNCTION: SHUTDOWN

Question 3: Physical Barriers DOE Material Manager J. T. Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Am-241 (metal), Am-241, Pu-241, Pu-240, Pu-239, Pu-238, and Np-237. All materials are oxide unless otherwise noted

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location): 3038
	FUNCTION: SHUTDOWN

Question 3: Physical Barriers

GROUPS #1, 3, 4, 5, 6, & 7 (SEE LISTS OF MATERIAL GRADES)

Barrier #	WORKER BARRIER	ENVIRONMENTAL AND PUBLIC BARRIER
1	WB-18 (PACKAGING)	WB-18 (PACKAGING)
2	WB-18 (SAFE)	WB-18 (SAFE)
3		EB-2 (HVAC/ CONTAINMENT)
4		EB-1 (FACILITY BOUNDARY/BUILDING)
5		EB-4 (SITE BOUNDARY)

GROUPS #2, 8, 9, 10, & 11 (SEE LISTS OF MATERIAL GRADES)

Barrier #	WORKER BARRIER	ENVIRONMENTAL AND PUBLIC BARRIER
1	WB-18 (PACKAGING)	WB-18 (PACKAGING)
2		EB-2 (HVAC/CONTAINMENT)
3		EB-1 (FACILITY BOUNDARY/BUILDING)
4		EB-4 (SITE BOUNDARY)

FOR INFORMATION RELATING GROUP NUMBERS TO SPECIFIC MATERIALS PLEASE REFER TO THE MATERIAL GRADES AREA OF QUESTIONS #1 AND #2

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location): 3038
	FUNCTION: SHUTDOWN

In-Facility

- ☐ Inadvertent Transfers
- ☐ Aging
- ☐ Organic Nitric Acid Reaction
- ☐ Equipment Failure
- ☐ Change in Mission
- ☐ Other Co-Located Hazards
- ☐ Corrosion
- ☐ Inadequate Configuration Knowledge
- ☐ Combustible Loading
- ☐ Inadequate Seals
- x Potential Water Sources
- ☐ Inadequate internal Drains
- ☐ Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- ☐ Administrative Controls
- ☐ Other - Specify

Material

- ☐ Pressurization
- ☐ Pyrophoricity
- x Radioactivity
- ☐ Chemical Reactivity
- ☐ Am Buildup
- ☐ Hydrogen Buildup
- ☐ Radiolysis
- ☐ Volumetric Expansion
- ☐ Oxidation
- x Other - INTERNAL PACKAGING UNCERTAINTY

The other adverse condition consists of lack of documentation related to internal packaging.

Question 4 Continued:

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location): 3038
	FUNCTION: SHUTDOWN

Describe Each Adverse Condition:

1. POTENTIAL WATER SOURCES

The building is fully sprinklered for fire protection, but since the material is well enclosed and there are adequate floor drains in the storage areas there is very little chance of significant interaction with the stored materials.

2. RADIOACTIVITY

The latest survey indicates dose rates between 0.2 mr/h and 18 mr/h directly attributable to the stored materials. Access to the immediate area is limited and the building has few inhabitants.

3. OTHER (INTERNAL PACKAGING UNCERTAINTY)

While there is a general lack of documentation of internal packaging, general practice in effect during active operations of this facility and statements provided by personnel who worked in this facility indicate that stable internal packaging materials were used. Major record keeping emphasis in the past has been for accountability purposes only. Physically opening the items would require moving them to an active facility that still maintains this capability.

All of these items are currently on Scrap Declarations and approval has already been given to dispose of several items.

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location): 3038
	FUNCTION: SHUTDOWN

Applicable References:

Phase I Safety Analysis Report Update Program (SARUP) Hazard Screening, 0HS/3038/F/RT-15/Rev 0 (February 14, 1992)

1 An existing situation that gives rise to a potential event or concern.

SITE:Oak Ridge National Laboratory	FACILITY (Building or Location): 3038
	FUNCTION:SHUTDOWN

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- ☐ Fire
- ☐ Explosion
- ☐ Worker Exposure
  - ☐ External
  - ☐ Internal
- ☐ Contamination
- ☐ Flooding
- ☐ Leakage/Spills
- ☐ Other Accidents - Specify
- ☐ Human Error

External
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
- ☐ Adjacent Facility Accident
- ☐ Power Failure
- ☐ Institutional/Regulatory Requirements
- ☐ Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify

Material
- ☐ Criticality
- ☐ Fissile Material Release
- ☐ Breach of Container
- ☐ Fire
- X Other - INTERNAL PACKAGING UNCERTAINTY

Natural Phenomena
- ☐ Earthquake Damage
- ☐ Wind Damage
- ☐ Flood Damage
- ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE:Oak Ridge National Laboratory	FACILITY (Building or Location): 3038
	FUNCTION:SHUTDOWN

Describe Each Event:

While there is a possibility of some of the other above events occurring, there is nothing about the present condition of the material or the facility that would be expected to cause one of the above events or would increase the effects of the event.

1 OTHER - INTERNAL PACKAGING UNCERTAINTY

Discontinuation of programs within the facility has resulted in surplus materials. The materials were packaged several years ago with the expectation that they would be used again and without realization that they would be in this condition for many years. The containers show no exterior signs of corrosion, deterioration, pressurization or external contamination as a result of the contained materials. Certain potentials naturally exist due to the presence of the stored material. The exact circumstances of a given incident would have to be known in order to estimate anticipated results.

The most probable adverse event in this facility would be worker external contamination not related to the materials of concern.

SITE:Oak Ridge National Laboratory	FACILITY (Building or Location): 3038
	FUNCTION:SHUTDOWN

Applicable References:

Phase I Safety Analysis Report Update Program (SARUP) Hazard Screening, OHS/3038/F/RT-15/Rev 0 (February 14, 1992)

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location): 3038 FUNCTION: SHUTDOWN

<u>Preventive</u>
 	
x Procedures: ops., maint., surveillance
x Material Limits
x Training
x Quality Assurance
x Conduct of Operations
x Authorization Basis (safety analysis, BIOs)
x Surveillance
x Organization
  x Structure
  x Management Involvement
  x Staffing
x Lessons Learned
x Configuration Control of Design
x Preventive Maintenance
x Monitoring
☐ Trending (Performance Indicator)
x Testing/Verification of Integrity
x Regulatory Requirements
x Records
  x Personnel Exposure
  x Equipment
  x Waste Inventory
  x QA
x Personnel Reliability Assurance Program
☐ Other - Specify
	<u>Mitigative</u>
	
	x Emergency Preparedness
	x Emergency Management
	  x Emergency Planning
	  x Emergency Procedures
	  x Emergency Response
	x Safety Systems
	x Alarm Systems
	☐ Other - Specify

<u>Question 6 Continued:</u>	

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location):3038
	FUNCTION: SHUTDOWN

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

	WORKER			ENVIRONMENT			PUBLIC		
EVENT	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
INTERNAL PACKAGING UNCERTAINTY	Y	Y	N	N	N	N	N	N	N

SITE: Oak Ridge National Laboratory	FACILITY (Building or Location):3038
	FUNCTION: SHUTDOWN

Explanation:

Discontinuation of programs within the facility has resulted in surplus materials. The materials were packaged several years ago with the expectation that they would be reused without realization that they would be stored in this packaging for many years. The containers show no exterior signs of corrosion, deterioration, pressurization, or external contamination from the contained materials. Certain potentials exist due to the presence of the stored material. The exact circumstances of a given incident would have to be known in order to estimate the anticipated results.

Only a remote possibility exists that internal packaging uncertainty could lead to a chemical reaction which in turn would lead to pressurization and rupture of the interior and exterior packaging. The material would then spread to the immediate vicinity and could contaminate a worker. The most probable adverse event in this facility however would be worker external contamination not related to the stored materials.

Question 7 Continued:

SITE: Oak Ridge National Laboratory

Question 8: Overall Site Summary

This facility is part of the Isotopes Facilities Deactivation Project and efforts are under way to eliminate the stored materials from the facility. All of the items are currently listed on Scrap Declarations or Requests For Disposal forms and approval has already been given to dispose of some of them.

The only activities planned for these materials within this facility is to package them for disposal or shipment. It is anticipated that this would require handling of the exterior packaging only.

The general perception is that if no degradation of the containers has occurred in the years since the original packaging that this would indicate stability of the internal packaging. Additional efforts to secure historical documentation of internal packaging would be overly expensive and not reliable. Physical examination of the internal packing would require moving them to an active facility with this capability. Since the current plan is to dispose of or relocate the items, it would not be productive to undertake a project to determine and document the internal packaging arrangement, except as required for shipment or storage in another facility.

SITE: X-10	FACILITY (Building or Location):3500
	FUNCTION: Multipurpose Instrumentation & Controls

DOE HEADQUARTERS FACILITY LANDLORD ER

DOE HEADQUARTERS PROGRAM SPONSOR ER

FACILITY AGE About 34 yr　　DESIGN LIFE 100 yr

SITE: X-10	FACILITY (Building or Location):3500
	FUNCTION: Multipurpose Instrumentation & Controls

Question 1: Facility

Provide a summary description of the facility, including description of processes, simplified process/material flow diagrams, operations, and storage where applicable. Also address the following in the descriptions.

- Design mission, interim mission, current use.
- Include historical information on Unusual Occurrence Reports, Unreviewed Safety Questions, Occurrence Reports, Defense Nuclear Facility Safety Board concerns, and other regulatory concerns. Attach documentation on this historical information.
- List pertinent ES&H documentation, such as SAR, EA, EIS, and Basis for Interim Operations, and the date of publication for this facility.
- Describe the location of the facility on the site and the distance to the site boundary.
- Identify general aggregation areas of plutonium within the facility (e.g., glovebox, vault, cell, room, tank, pad, burial ground, and holdup locations) and include a simplified sketch of the containment barriers present.

Question 1 Narrative Summary

The annex to Building 3500, in which this source resides, was erected in 1960. The annex is a two-story, brick-faced, concrete reinforced building with a basement area. The annex was added to the older single-storied, similarly constructed I&CD building to accommodate the basic R&D staff, reactor controls, and instrument development groups. The facility currently provides office, staff shop, and laboratory space for I&CD research and engineering personnel. The building has a sprinkler system plus fire doors for fire protection. It is located in the center of the ORNL site, approximately 300 ft from the southern boundary. The laboratory room D-23 contains sealed sources, fission chambers, special nuclear materials, and the Pu-Be source. All radioactive materials have been evaluated in accordance with DOE Standard DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, 'Nuclear Safety Analysis Reports.'" Sources exceeding the threshold values established in the Department of Energy (DOE) Radiation Control Manual are registered with the Health Physics Inventory Management System (HPIMS) through the ORNL Source Control Officer.

SITE: X-10	FACILITY (Building or Location):3500
	FUNCTION: Multipurpose Instrumentation & Controls

Applicable References:

Reference: ORNL/M-1396, HS/3500/F/1, HAZARD SCREENIN BUILDING 3500 INSTRUMENTATION AND CONTROLS DIVISION, PHASE 1 SAFETY ANALYSIS REPORT UPDATE PROGRAM, W. W. Koch, N. D. McCollough, G. K. Schultz, Date revised - February 1993.

SITE:X-10	FACILITY (Building or Location): 3500
	FUNCTION: Multipurpose Instrumentation & Controls

Question 2: Holdings DOE Material Manager: J. T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal				
Oxide				
Scrap/Residues[4]				
Solution[4]				
Sealed Sources	F: Alloyed Pu-Be	V-1: Welded Ta, SS	Probably 1000	> 35
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]				
Unirradiated Reactor Fuel				

SITE:X-10	FACILITY (Building or Location): 3500
	FUNCTION: Multipurpose Instrumentation & Controls

Question 2 Continued:

Applicable References: "Hazards Summary and Safety Procedures for Reactor Controls, Plutonium-Beryllium Neutron Source," J. L. Kaufman, ORNL-CF-60-6-20 (June 8, 1960)

1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.
2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.
3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.
4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.
5 Holdup has no packaging. Identify location of holdup.

SITE: X-10	FACILITY (Building or Location): 3500
	FUNCTION: Multipurpose I&C Laboratory

Question 2A: No. Pkgs and Mass DOE Material Manager J. T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal			
Oxide			
Scrap/Residues			
Solution			
Sealed Sources	F: Alloyed Pu-Be	0.080	1
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			
Cumulative Inventory Difference		1	

SITE: X-10	FACILITY (Building or Location): 3500
	FUNCTION: Multipurpose I&C Laboratory

Question 2A Continued:

Applicable References: "Hazards Summary and Safety Procedures for Reactor Controls Plutonium-Beryllium Neutron Source," J. L. Kaufman, ORNL-CF-60-6-20 (June 8, 1960)

1 Identify probable location.

SITE: X-10	FACILITY (Building or Location): 3500
	FUNCTION: I&C Multipurpose Laboratory

Question 3: Physical Barriers — DOE Material Manager J. T. Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Material type is AL (from Table A3), alloyed $PuBe_{13}$ metal. The source strength is 7.62 x 10^6 fast neutrons per second. The gamma emission measured by ORNL is 80 mr/hr at contact. The source is stored in a lead sleeve inside a paraffin-lined 55-gal drum and is removed from this housing when in use. Abnormal personnel exposure during transfer or use would result from a violation of procedure.

Barrier #	Worker Protection	Environment and Public Protection
1	WB- 13, two welded barriers	EB-1, EB-4: Building/Site boundary
2	WB- 14, lead shielding	
3	WB-11, locked in drum	
4	WB-15, distance; locked room	
5	Laboratory boundary	

Applicable Reference:

See 2A.

Question 3 Continued:

SITE:X-10	FACILITY (Building or Location):3500
	FUNCTION:INSTRUMENTATION AND CONTROLS

In-Facility

- ☐ Inadvertent Transfers
- ☐ Aging
- ☐ Organic Nitric Acid Reaction
- ☐ Equipment Failure
- ☐ Change in Mission
- ☐ Other Co-Located Hazards
- ☐ Corrosion
- ☐ Inadequate Configuration Knowledge
- ☐ Combustible Loading
- ☐ Inadequate Seals
- ☐ Potential Water Sources
- ☐ Inadequate Drains
- ☐ Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- ☐ Administrative Controls
- ☐ Other - Specify

Material

- ☐ Pressurization
- ☐ Pyrophoricity
- X Radioactivity
- ☐ Chemical Reactivity
- ☐ Am Buildup
- ☐ Hydrogen Buildup
- ☐ Radiolysis
- ☐ Volumetric Expansion
- ☐ Oxidation
- ☐ Other - Specify

SITE:X-10	FACILITY (Building or Location):3500 FUNCTION:INSTRUMENTATION AND CONTROLS
Question 4 Continued:	
Describe Each Adverse Condition: See Ref. 1	
Applicable References: See Ref. 1	

1 An existing situation that gives rise to a potential event or concern.

SITE: X-10	FACILITY (Building or Location):
	FUNCTION:

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- ☐ Fire
- ☐ Explosion
- ☐ Worker Exposure
  - X External
  - ☐ Internal
- ☐ Contamination
- ☐ Flooding
- ☐ Leakage/Spills
- ☐ Other Accidents - Specify

External
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
- ☐ Adjacent Facilit8y Accident
- ☐ Power Failure
- ☐ Institutional/Regulatory Requirements
- ☐ Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify☐ Human Error

Material
- ☐ Criticality
- ☐ Fissile Material Release
- ☐ Breach of Container
- ☐ Fire
- ☐ Other - Specify

Natural Phenomena
- ☐ Earthquake Damage
- ☐ Wind Damage
- ☐ Flood Damage
- ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE: X-10	FACILITY (Building or Location):
	FUNCTION:

Describe Each Event:

FAILURE TO FOLLOW CORRECT SOURCE HANDLING PROCEDURES COULD RESULT IN OVEREXPOSURE TO NEUTRON AND GAMMA RADIATION.

Question 5 Continued:

SITE: X-10	FACILITY (Building or Location):
	FUNCTION:

Describe Each Event:

Applicable References:

SEE REF 1.

SITE:X-10	FACILITY (Building or Location):3500 FUNCTION:INSTRUMENTATION & CONTROLS LABORATORY

<u>Preventive</u>
 	
X Procedures: ops., maint., surveillance
☐ Material Limits
X Training ,
☐ Quality Assurance
☐ Conduct of Operations
☐ Authorization Basis (safety analysis, BIOs)
☐ Surveillance
☐ Organization
  ☐ Structure
  ☐ Management Involvement
  ☐ Staffing
☐ Lessons Learned
☐ Configuration Control of Design
☐ Preventive Maintenance
X Monitoring
☐ Trending (Performance Indicator)
X Testing/Verification of Integrity
☐ Regulatory Requirements
X Records
  X Personnel Exposure
  ☐ Equipment
  ☐ Waste Inventory
  ☐ QA
☐ Personnel Reliability Assurance Program
☐ Other - Specify
	<u>Mitigative</u>
	
	☐ Emergency Preparedness
	☐ Emergency Management
	  ☐ Emergency Planning
	  ☐ Emergency Procedures
	  ☐ Emergency Response
	☐ Safety Systems
	☐ Alarm Systems
	☐ Other - Specify

SITE:X-10	FACILITY (Building or Location):3500
	FUNCTION:INSTRUMENTATION & CONTROLS LABORATORY

Question 6 Continued:

Compensatory Measure

Radiation Workers Training course

The Source is continuously monitored by a neutron monitor

The PuBe source is tested every 6 months by taking smears from the surface of the source and checking them.

Exposure records are made from the individual badges (neutron dosimeters).

ORNL Health Physics Manual Procedures and Practices for Radiation Protection and Radiation Monitoring

Procedure For Storing and Use of Sealed Radioactive in Rooms C-25, D-23, and C23

SITE:X-10	FACILITY (Building or Location):3500 FUNCTION:INSTRUMENTATION & CONTROLS LABORATORY
Uncertainty or Concern	Discussion
NONE	

SITE:X-10	FACILITY (Building or Location):3500
	FUNCTION:INSTRUMENTATION AND CONTROLS LABORATORY

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

	WORKER			ENVIRONMENT			PUBLIC		
EVENT	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
OVER EXPOSURE	N	Y	N	N	N	N	N	N	N

SITE:X-10	FACILITY (Building or Location):3500
	FUNCTION:INSTRUMENTATION AND CONTROLS LABORATORY

Explanation:

ANY EXPOSURE WOULD OCCUR WITHIN THE STORAGE ROOM AND WOULD BE VERY UNLIKELY TO CAUSE AN INJURY BECAUSE OF THE TIME REQUIRED FOR AN EXCESS DOSE.

CONTAMINATION OF THE WORKER FROM THE SOURCE IS ALMOST AN IMPOSSIBILITY SINCE THE SOURCE IS IN THE FORM OF A METAL WITH A 2000°C MELTING POINT, INSIDE A WELDED TANTALUM CAN WITH A MELTING OF 3000°C INSIDE A STAINLESS CAN, AND STORED IN A TUBE INSIDE A DRUM NEVER TOUCHED BY ANY EXTREMITIES OF THE WORKER.

SITE:X-10	FACILITY (Building or Location):3500
	FUNCTION:INSTRUMENTATION AND CONTROLS LABORATORY

Applicable References:

ref 1.

SITE:

Question 8: Overall Site Summary

Based on the Site Assessment Team report, provide an overall assessment of the site ES&H vulnerabilities.

The response to this question should address each of the elements listed below, and should not exceed 2 pages in length.

- A description of the site's most important ES&H concerns related to plutonium storage, handling, processing, and/or shipping.
- A description of which plutonium activities pose the highest risk to the environment, worker, and public at your site.
- A discussion of current planned actions to minimize worker exposure, reduce environmental risks, and protect the public at and near your site.
- Provide any noteworthy programs or practices related to plutonium storage, handling, processes, and/or shipping.

HANDLING OF THE PuBe SOURCE IS THE MOST NOTEWORTHY CONCERN WITH RISK ONLY TO THE WORKER AND NOT THE PUBLIC OR THE ENVIRONMENT. CURRENT PROGRAMS FOR SOURCE USE, STORAGE, MONITORING, AND THE PRACTICE OF ALARA ARE MORE THAN ADEQUATE FOR THE ES&H PROTECTION OF THE PUBLIC AND SITE WORKERS.

SITE:X-10	FACILITY (Building or Location): 3508
	FUNCTION: Multipurpose Instrumentation & Controls

DOE HEADQUARTERS FACILITY LANDLORD ER

DOE HEADQUARTERS PROGRAM SPONSOR ER

FACILITY AGE 42 DESIGN LIFE 100

Question 1: Facility

Erected in 1952, Building 3508 is a one-story, metal, Butler-style building with a limited-access attic. This facility was formerly an alpha isolation laboratory used by the Chemical Technology Division (until December 1985) and has residual alpha contamination as a result of this operation. Low-level alpha contamination has been fixed in place by paint to make it nondispersive, an accepted practice for controlling potential occupational exposure according to U.S. Department of Energy (DOE) Order 5480.11. The facility is regularly surveyed by the Health Physics staff. The facility currently provides office, shop, and laboratory space for I&C Division technical support and engineering personnel. The sealed sources, fission chamber, and special nuclear materials have been evaluated in accordance with DOE Standard DOE-STD-1027-92 **Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480,23, Nuclear Safety Analysis Reports.** Sources exceeding the threshold values established in Department of Energy (DOE) Radiation Control Manual are registered with the Health Physics Inventory Management System (HPIMS) through the ORNL Source Control Officer. Housed in this building are a fissile materials vault storage area, a part of Material Balance Area 135, and two glove boxes used for detector development involving special nuclear material (SNM). The SNM present in this facility exists in a sealed source form, as electrodeposited plates. Special operations have been controlled in such a manner to pose no unreasonable threat where the environment or general public would be negatively impacted. Therefore, according to CSET-2, "Hazard Screening Application Guide," December 1990, this facility is generally accepted.

SITE:X-10	FACILITY (Building or Location): 3508
	FUNCTION: Multipurpose Instrumentation & Controls

Applicable References:

Reference: ORNL/M-1397, HS/3508/F/2, HAZARD SCREENING BUILDING 3508 INSTRUMENTATION AND CONTROLS DIVISION, PHASE 1 SAFETY ANALYSIS REPORT UPDATE PROGRAM, W. W. Koch, B. J. Langford, N. D. McCollough, Date revised - August 1993.

SITE:X-10	FACILITY (Building or Location): 3508
	FUNCTION: Multipurpose Instrumentation & Controls

Question 2: Holdings DOE Material Manager ____________

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material	Grade of Plutonium[2]	Packaging Types[3] Welded	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal				
Oxide				
Scrap/Residues[4]				
Solution[4]				
Sealed Sources	F	V-1: Welded Ta & S.S.	1000	29
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]				
Unirradiated Reactor Fuel				
High-level Liquid Waste				

SITE:X-10	FACILITY (Building or Location): 3508
	FUNCTION: Multipurpose Instrumentation & Controls

Question 2 Continued:

Applicable References:

ORNL/CF 66-7-18, Rev. 1, 1975, "Hazards Summary and Safety Procedure for Use of Pu-Be Source in Custody of the Radiation Detection Section, Instrumentation and Controls Division."

1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.

2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.

3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.

4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.

5 Holdup has no packaging. Identify location of holdup.

SITE: X-10	FACILITY (Building or Location): 3508
	FUNCTION: Multipurpose I&C Lab

Question 2A: No. Pkgs and Mass DOE Material Manager ____________

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal			
Oxide			
Scrap/Residues			
Solution			
Sealed Sources	F	0.096	1
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			
Cumulative Inventory Difference			

SITE: X-10	FACILITY (Building or Location): 3508
	FUNCTION: I&C Multipurpose Lab

Question 3: Physical Barriers   DOE Material Manager _______

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) ____________________

Material type is AL, alloyed metal, high-activity plutonium-beryllium sealed source. As constructed, this source is a gamma emitter rated at 6.3 mR/h at 1 m unshielded. Source is maintained inside lead pig and transferred on an as-needed basis to or from storage (approximately one or two transfers per year). Pig weighs about 600 lb. and is moved by only specially trained crews. Abnormal personnel exposure by any of these sources would result from a violation of procedure during source transfer.

SITE: X-10	FACILITY (Building or Location): 3508
	FUNCTION: I&C Multipurpose Lab

Barrier #	Worker Protection	Environment and Public Protection
1	sealed source,	
2	WB-14, in locked shield,	
3	WB-6, in locked, secure, room,	
4	in secure facility,	
5	EB-1, within secured Laboratory boundary.	

SITE: X-10	FACILITY (Building or Location): 3508
	FUNCTION: I&C Multipurpose Lab

Question 3 Continued:

Applicable References:

See 2A.

SITE:	FACILITY (Building or Location):
	FUNCTION:

In-Facility

- ☐ Inadvertent Transfers
- ☐ Aging
- ☐ Organic Nitric Acid Reaction
- ☐ Equipment Failure
- ☐ Change in Mission
- ☐ Other Co-Located Hazards
- ☐ Corrosion
- ☐ Inadequate Configuration Knowledge
- ☐ Combustible Loading
- ☐ Inadequate Seals
- ☐ Potential Water Sources
- ☐ Inadequate Drains
- ☐ Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- X Administrative Controls
- ☐ Other - Specify

Material

- ☐ Pressurization
- ☐ Pyrophoricity
- ☐ Radioactivity
- ☐ Chemical Reactivity
- ☐ Am Buildup
- ☐ Hydrogen Buildup
- ☐ Radiolysis
- ☐ Volumetric Expansion
- ☐ Oxidation
- X Other - Specify

Development of leaks in welded capsules.

Question 4 Continued:

SITE:	FACILITY (Building or Location):
	FUNCTION:

<u>Describe Each Adverse Condition:</u>

Failure of administrative control to protect personnel from overexposure.

Failure of capsul integrity leading to surface contamination or capsule.

<u>Applicable References:</u>

See 2A.

1 An existing situation that gives rise to a potential event or concern.

SITE:	FACILITY (Building or Location):
	FUNCTION:

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- ☐ Fire
- ☐ Explosion
- ☐ Worker Exposure
  - ☐ External
  - ☐ Internal
- X Contamination
- ☐ Flooding
- ☐ Leakage/Spills
- ☐ Other Accidents - Specify
- ☐ Human Error

External
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
- ☐ Adjacent Facility Accident
- ☐ Power Failure
- ☐ Institutional/Regulatory Requirements
- ☐ Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify

Material
- ☐ Criticality
- ☐ Fissile Material Release
- ☐ Breach of Container
- ☐ Fire
- ☐ Other - Specify

Natural Phenomena
- ☐ Earthquake Damage
- ☐ Wind Damage
- ☐ Flood Damage
- ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE:	FACILITY (Building or Location):
	FUNCTION:

Describe Each Event:

Loss of capsule integrity in 1972 required source re-encapsulation.

Question 5 Continued:

Describe Each Event:

SITE:	FACILITY (Building or Location): FUNCTION:

<u>Preventive</u>
 	
X Procedures: ops., maint., surveillance
☐ Material Limits
X Training
☐ Quality Assurance
☐ Conduct of Operations
☐ Authorization Basis (safety analysis, BIOs)
☐ Surveillance
☐ Organization
  ☐ Structure
  ☐ Management Involvement
  ☐ Staffing
☐ Lessons Learned
☐ Configuration Control of Design
☐ Preventive Maintenance
☐ Monitoring
☐ Trending (Performance Indicator)
☐ Testing/Verification of Integrity
☐ Regulatory Requirements
☐ Records
  ☐ Personnel Exposure
  ☐ Equipment
  ☐ Waste Inventory
  ☐ QA
☐ Personnel Reliability Assurance Program
☐ Other - Specify
	<u>Mitigative</u>
	
	☐ Emergency Preparedness
	☐ Emergency Management
	  ☐ Emergency Planning
	  ☐ Emergency Procedures
	  ☐ Emergency Response
	☐ Safety Systems
	☐ Alarm Systems
	☐ Other - Specify

<u>Question 6 Continued:</u>	

SITE:	FACILITY (Building or Location):
	FUNCTION:

Compensatory Measure	Reference Document
Capsules are surveyed every 6 months for radioactive contamination leaks.	
Written procedure in place for use of source.	
Log book in place for documenting use of source.	
All personnel with access required to take Rad Worker training.	

Uncertainty or Concern	Discussion

SITE:	FACILITY (Building or Location):
	FUNCTION:

Explanation:

Consequences are minimal. Contamination would be localized to the carrier shield. Dose exposures would be modest due to moderate source size.

Question 7 Continued:

SITE:
Question 8: Overall Site Summary This PuBe source presents a minimal risk to personnel, inside and outside the Laboratory. The administrative controls and physical security are more than adequate for a source of its size.

SITE:
<u>Question 8 continued:</u> See reference 2A.

SITE: X-10	FACILITY (Building or Location): Building 4501, Alpha Lab (127)
	FUNCTION: High Radiological Laboratory

DOE HEADQUARTERS FACILITY LANDLORD L. Blankner

DOE HEADQUARTERS PROGRAM SPONSOR None

FACILITY AGE 43 years DESIGN LIFE Unknown

Question 1: Facility

The subject lab contains: (1) 37 grams (element weight) ^{239}Pu in 0.3 N HNO_3 stored in plastic bottles. (2) 1.3 grams (element weight) ^{242}Pu isotopically pure (99.93%) in HNO_3 solution (below deminimus); (3) 0.1 grams (element weight) ^{238}Pu isotopically pure (99.68%) in solidified molten salt matrix in a nickel sealed vessel. (4) 1 gram (element weight) ^{237}Np in HNO_3 (below deminimus). There are no plans for future R&D studies, and we have been preparing for the disposal of the 38.4 grams of Pu into the proper waste management system. This is an active effort to be implemented by August 1, 1994. The net result will be no Pu in this laboratory.

In compliance with the scope of the Pu ES&H Vulnerability Assessment, this laboratory and these materials are not subject to this analysis.

This laboratory is a glove-box facility which is isolated from the rest of the building by 2 ft concrete walls and ceiling and an air-lock entry. The exhaust is provided by the 3039 stack system, which has emergency back-up for both electrical and fan failures. Air supply is provided for by a once throught (100% outside air) HVAC unit with a seperate HEPA filtered recirculating HVAC unit for temperature. The area is monitored by Chemical Technology, Health Physics, Quality, and P&E personnel on a routine basis.

SITE: X-10	FACILITY (Building or Location): Bldg. 4501, Lab 127
	FUNCTION: High Radiological Laboratory

Question 2: Holdings — DOE Material Manager J. T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal				
Oxide				
Scrap/Residues[4]				
Solution[4]	W,N	P1, B1, B1	10	5
Sealed Sources				
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]				
Unirradiated Reactor Fuel				
High-level Liquid Waste				

SITE: X-10	FACILITY (Building or Location): Bldg. 4501, Lab 127			
	FUNCTION: High Radiological Laboratory			
Other (specify)	^{242}Pu, W, N, OT	P1, B1, B1	10	5
	^{238}Pu, W, OT	V4, B1, B1	20	5

SITE: X-10	FACILITY (Building or Location):Bldg. 4501,Lab127
	FUNCTION: High Radiological Laboratory

Question 2A: No. Pkgs and Mass DOE Material Manager J. T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal			
Oxide			
Scrap/Residues			
Solution	W (94.6%)	0.037	8
Sealed Sources			
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			

SITE: X-10	FACILITY (Building or Location):Bldg. 4501,Lab127		
	FUNCTION: High Radiological Laboratory		
Cumulative Inventory Difference		1	
Other (specify)	^{242}Pu (99.93%)	0.0013	1
	^{238}Pu (97.68%)	0.0001	1

SITE: X-10	FACILITY (Building or Location):Bldg. 4501,Lab127
	FUNCTION: High Radiological Laboratory

Question 2A Continued:

Applicable References:
Uncertainty in mass identified as being due to 6g sample record being counted twice. (A duplicate record existed because original record card had been inadvertantly moved from required glove-box site.)

During usage of these materials, aqueous acid solutions were produced by dissolving the oxide forms. Final processing and clean-up of these solutions has resulted in eight individual sample bottles (plastic). Six of those bottles are presently sealed together in a single polyethylene bag for added containment security. One remaining plastic bottle is placed in a teflon beaker for further containment.

1 Identify probable location.

SITE: X-10	FACILITY (Building or Location): Building 4501, Lab 127
	FUNCTION: High Radiological Laboratory

Question 3: Physical Barriers

DOE Material Manager ______

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) ____________________

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 Bottle/2 Plastic bags	EB-3
2	WB-1	EB-6.2
3	WB-4	EB-12 Glove Box
4	WB-6	EB-1
5	WB-18 Security (room locked to prevent inadvertent entry)	EB-4
6		EB-12 Security

SITE: X-10	FACILITY (Building or Location): Building 4501, Lab 127
	FUNCTION: High Radiological Laboratory

In-Facility

- ☐ Inadvertent Transfers
- x Aging
- ☐ Organic Nitric Acid Reaction
- ☐ Equipment Failure
- x Change in Mission
- ☐ Other Co-Located Hazards
- ☐ Corrosion
- ☐ Inadequate Configuration Knowledge
- ☐ Combustible Loading
- ☐ Inadequate Seals
- ☐ Potential Water Sources
- ☐ Inadequate Drains
- ☐ Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- ☐ Administrative Controls
- ☐ Other - Specify

Material

- ☐ Pressurization
- ☐ Pyrophoricity
- x Radioactivity
- ☐ Chemical Reactivity
- ☐ Am Buildup
- ☐ Hydrogen Buildup
- ☐ Radiolysis
- ☐ Volumetric Expansion
- ☐ Oxidation
- ☐ Other - Specify

SITE: X-10	FACILITY (Building or Location): Building 4501, Lab 127
	FUNCTION: High Radiological Laboratory

Question 4 Continued:

Describe Each Adverse Condition:

1. Plastic bottles may deteriorate after many years of storage. Changeout of containers planned on 2-3 year basis.

2. Change in mission has decreased need for the material.

3. Only small quantities of Pu and Np were stored in the glove box.

4. Corrosion due to box atmosphere, which contains traces of acid vapors, poses only nuisance clean-up - but no threat to containment integrity.

SITE: X-10	FACILITY (Building or Location): Building 4501, Lab 127 FUNCTION: High Radiological Laboratory

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- x Fire
- ☐ Explosion
- ☐ Worker Exposure
  - ☐ External
  - ☐ Internal
- x Contamination
- ☐ Flooding
- x Leakage/Spills
- ☐ Other Accidents - Specify
- x Human Error

External
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
- ☐ Adjacent Facility Accident
- ☐ Power Failure
- ☐ Institutional/Regulatory Requirements
- ☐ Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify

Material
- ☐ Criticality
- ☐ Fissile Material Release
- ☐ Breach of Container
- ☐ Fire
- ☐ Other - Specify

Natural Phenomena
- ☐ Earthquake Damage
- ☐ Wind Damage
- ☐ Flood Damage
- ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE: X-10	FACILITY (Building or Location): Building 4501, Lab 127
	FUNCTION: High Radiological Laboratory

Describe Each Event:

1. Low-level protective clothing contamination has occurred rarely during glove-box work.

2. Fire potential is reduced to minimum by safety procedures - no more than 10 mL flamable liquids permitted in glove box. Glove box atmosphere is so contained (due to limited air flow through glove box) that any fire is self-extinguished. CO_2 fire extinguishers are maintained so CO_2 can be purged directly through filter system into glove box without breaching containment - one case where CO_2 is superior to dry chemical extinguishers.

3. Leakage and human error events are minimized by strict standards of personnel training focused on supervised hands-on experience and not focused classroom instruction. Record for past 15 years has been flawless as a result.

4. External and Natural Phenomena are highly unlikely due to hardened nature of structure.

(See Q1 - description of facility)

Question 5 Continued:

SITE: X-10	FACILITY (Building or Location): Building 4501, Lab 127 FUNCTION: High Radiological Laboratory

Question 6: Compensatory Measure

Compensatory measures at the facility prevent and/or mitigate the adverse conditions and events identified in Questions 4 and 5. Check the applicable items in the table below and reference documents describing the compensatory measures. Identify any uncertainties or concerns in the checked compensatory measures.

Compensatory Measures

Preventive	Mitigative
x Procedures: ops., maint., surveillance x Material Limits x Training x Quality Assurance x Conduct of Operations x Authorization Basis (safety analysis, BIOs) x Surveillance x Organization ☐ Structure x Management Involvement x Staffing ☐ Lessons Learned ☐ Configuration Control of Design ☐ Preventive Maintenance x Monitoring ☐ Trending (Performance Indicator) x Testing/Verification of Integrity ☐ Regulatory Requirements x Records x Personnel Exposure ☐ Equipment x Waste Inventory ☐ QA ☐ Personnel Reliability Assurance Program ☐ Other - Specify	x Emergency Preparedness x Emergency Management x Emergency Planning x Emergency Procedures x Emergency Response ☐ Safety Systems x Alarm Systems ☐ Other - Specify

Question 6 Continued:

SITE: X-10	FACILITY (Building or Location): Building 4501, Lab 127 FUNCTION: High Radiological Laboratory
Compensatory Measure	Reference
All checked preventive and mitigative measures are dealt with in the listed reference documents. All personnel working in or entering the facility wear Thermal Luminescence Dosimeters that are periodically and routinely analyzed. Personnel exposure is recorder in the OHIS database. Facility is periodically and routinely monitored for contamination as required in the Radiological Control (RadCon) Manual and Health Physics (HP) Manual.	Operational Safety Requirements for Building 4501, Room 127, Alpha Facility. ORNL/CF-84/347. Alpha Facility, Room 127, is in standby. If work is resumed the OSR will be updated in correspondence with work tasks. Safety Practices and Operating Procedures for the High Alpha Facility, Room 127, Building 4501. ORNL/CF-89/37. Personnel Training Program for Glove Box Operations in Building 4501, Room 127, Alpha Facility. ORNL/CF-84/241. Limiting Conditions Document, Building 4501, High Level Radiochemical Laboratory, Chemical Technology Division. ORNL/LCD/4501/CTD-001/R0. Health Physics Procedure Manual, RP-2.1-C, Page 5. Health Physics Procedure Manual, Standard Operating Procedure No. 02-20-10, 7.3.4. DOE Radiological Control Manual, Article 554. Phase 1. Safety Analysis Report Update Program (SARUP) Hazard Screening. The High-Level Radiochemical Laboratory, Building 4501. HS/4501/F/CD-4/Rev 0. Quality Assurance Plan for Research and Development Activities Within the Chemical Technology Development Section of the Chemical Technology Division. QAP-X-88-CT-009. X-10 Site Emergency Plan, ORNL/CF-91/71/R1.

SITE: X-10	FACILITY (Building or Location): Building 4501, Lab 127
	FUNCTION: High Radiological Laboratory

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

	WORKER			ENVIRONMENT			PUBLIC		
EVENT	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
Contamination	Y	N	N	N	N	N	N	N	N
Fire	Y	Y	Y	N	N	N	N	N	N

SITE: X-10	FACILITY (Building or Location): Building 4501, Lab 127
	FUNCTION: High Radiological Laboratory
Explanation:	Minor personnel clothing contamination (work-issued clothing). No consequences to environment or public. Precautions as explained in Q5 have extremely minimized probability of small self-contained fires. Larger fires are virtually impossible due to nature of structure and absence of flamable materials. Leakage/spills/human error would result in contamination as explained above.

SITE: X-10

Question 8: Overall Site Summary

Based on the Site Assessment Team report, provide an overall assessment of the site ES&H vulnerabilities.

The response to this question should address each of the elements listed below, and should not exceed 2 pages in length.

This one room hardened facility is entirely self-contained with closed, recirculating airsupply and negative pressures progressively inwards towards glove box to ensure against airborne particle/vapor escape (inwards, i.e. glove box pressure < room atmosphere pressure). Most important BS&H concern is airborne release due to failure of containment and sudden release of materials into atmosphere. Design of facility with numerous redundant safety features makes probability of public exposure virtually impossible. Worker exposure is very unlikely due to safety practices and procedures which are strictly followed.

Fire is second most important concern for similar reasons but probability is highly unlikely 0 as explained previously. Small quantities of material handled also ensure against significant hazard and exposure - and minimize any potential exposure.

SITE: X-10

Question 8 continued:

Noteworthy programs -

Training of staff on personal basis focused on hands-on experience under direct supervision of scientific experts in the field of actinide research — not a classroom environment led by liberal arts instructors.

Fire protection based on compatibility with facility design — Minimal volumes (10 mL) of flammable liquids and CO_2 fire extinguishing equipment providing CO_2 penetration without breach of containment. (CO_2 is being largely replaced by dry chemicals in modern applications but is unsatisfactory in this application.)

Access to facility strictly limited to authorized persons. Facility kept under lock at all time.

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

DOE HEADQUARTERS FACILITY LANDLORD Energy Research

DOE HEADQUARTERS PROGRAM SPONSOR Energy Research

FACILITY AGE 27 years DESIGN LIFE 75 years

Question 1: Facility

The Transuranium Research Laboratory (TRL), Building 5505, is an office and laboratory building constructed for advanced chemical and physical research on the heaviest elements of the periodic table, including the radioactive transuranium elements. Today TRL serves as a center for cooperative actinide research for ORNL staff, university participants, and scientists from many other laboratories. Many of the materials used in these basic and technological studies are produced at the HFIR/REDC complex at ORNL.

Construction of the facility was completed in 1967. TRL is located within the principal boundaries of ORNL southeast of the High-Voltage Accelerator Laboratory, Building 5500, south of White Oak Creek in the plant area. All other pertinent site data can be obtained from "Oak Ridge National Laboratory Site Data for Safety Analysis Reports, ORNL/ENG/TM-19."

Historically the operation of the facility is described in "Operations Safety Requirements for the Transuranium Research Laboratory (ORNL/CF-84/85)" and the "ORNL Transuranium Research Laboratory Description and Safety Analysis (ORNL/CF-84/85)." These documents list and address the pertinent ES&H issues and identify the important facility design features. The limited-access facility is located at ORNL 100 yards inside of the perimeter fencing that is maintained by security personnel. The facility consists of regulated control room areas which house glove boxes and a separate special vault room. Plutonium and other actinide materials are maintained in these glove boxes and/or in double-locked cabinets inside of the locked vault room. The TRL contains an insufficient amount of fissile material for a criticality event to occur under any condition of moderation and/or reflection.

Assessment of the research and development activities conducted at TRL, Building 5505, was made as required for the "Phase I" hazards screening and safety documentation upgrade as outlined in Martin Marietta Energy Systems, Inc., documents ES/CSET-1/R2, Safety Analysis Report Update Program Overview and Phase I Implementation (August 1991) and CSET-2, Hazard Screening Application Guide (December, 1990). Using the referenced guides and the supporting analyses that follow, the Facility Safety Evaluation Team (FSET) concluded that TRL should be placed in the "Low" hazard class. The potential health effects from both radiological and nonradiological hazards are reversible and limited to one or two persons on site with negligible off-site effect. Detailed facility description and safety analysis information/documentation can be found in the MMES Phase I Hazard Screening Document, HS/5505/F/Rev. 0, June 21, 1991. TRL currently operates under a Limited Conditions Document (LCD/5505/CHEM-01/REV.0).

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Applicable References:

Field Work Proposal ERKCC09 of 4/15/94

Oak Ridge National Laboratory Site Data for Safety Analysis Reports, ORNL/ENG/TM-19

MMES Phase I Hazard Screening Document, HS/5505/F/Rev. 0, June 21, 1991

Limiting Condition Document Building 5505, Transuranium Research Laboratory, LCD/5505/CHEM-01/REV.0

Operations Safety Requirements for the Transuranium Research Laboratory (ORNL/CF-84/85)

The ORNL Transuranium Research Laboratory Description and Safety Analysis (ORNL/CF-84/85)

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 2: Holdings — DOE Material Manager James Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type		Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)					
Metal	1	^{239}Pu, F	G1	10	3
	2	^{237}Np	G1	10	2
	3	^{237}Np	V1,B1,B1	100,10,10	2
	4	^{242}Pu	V1,B1,B1	100,5,10	3
Oxide	1	^{242}Pu	G1, B1, V6	40,5,100	20
	2	^{242}Pu	G1, B1, V5	40,5,50	15
	3	^{242}Pu	G1,B1,V5,V4	40,5,100, 15	15
	4	^{241}Am	G1,V7,B1,B1	20,100,10 ,10	5
	5	^{241}Am	G1,B1,V5,V4	40,10,100 ,50	15
	6	^{243}Am	G1,B1,V7,B1	20,10,80, 10	15
	7	^{243}Am	G1	20	2
	8	^{243}Am	G1,B1,V5,B1,V6	10,5,100, 10,50	15
	9	^{249}Bk	V4	100	1
Scrap/Residues[4]					

SITE: X-10		FACILITY (Building or Location): 5505			
		FUNCTION: Transuranium Research			
Solution[4]	1	^{242}Pu	P1	10	2
	2	^{239,240}Pu, F	P1	5	1
Sealed Sources					
TRU Waste[4]					
Holdup (in ducts, pipes, etc.)[4]					
Unirradiated Reactor Fuel					
High-level Liquid Waste					
Other: Solid Chloride xide-Nitrate Product	1	^{249}Bk	G1,B1,B1,V7	20,10,10, 50	1
	2	^{239,240}Pu, F	G1,b1,V6	20,10,50	10

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 2 Continued:

Applicable References:

ORNL Nuclear Materials Inventory System

1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.
2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.
3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.
4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.
5 Holdup has no packaging. Identify location of holdup.

SITE: X-10		FACILITY (Building or Location): 5505	
		FUNCTION: Transuranium Research	

Question 2A: No. Pkgs and Mass DOE Material Manager James Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type		Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)				
Metal	1	^{242}Pu, F	0.007	3
	2	Np	0.062	2
	3	Np	0.114	1
	4	^{242}Pu	0.008	1
Oxide 1	1	^{242}Pu	0.010	2
	2	^{242}Pu	0.010	1
	3	^{242}Pu	0.038	1
	4	^{241}Am	0.001	1
	5	^{241}Am	0.001	1
	6	^{243}Am	0.002	1
	7	^{243}Am	0.001	1
	8	^{243}Am	0.020	1
	9	^{249}Bk	$1.2E^{-6}$	1
Scrap/Residues				
Solution	1	^{242}Pu	0.002	1
	2	$^{239,240}Pu$, F	0.002	1
Sealed Sources				
TRU Waste				
Holdup				
Unirradiated Reactor Fuel				

SITE: X-10		FACILITY (Building or Location): 5505		
		FUNCTION: Transuranium Research		
High-level Liquid Waste				
Cumulative Inventory Difference				
Other (specify) Solid Chloride Oxide Nitrate Product	1	^{249}Bk	1.3 x 10^{-6}	1
	2	^{239,240}Pu, F	0.025	1

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research
Question 2A Continued:	
Applicable References: ORNL Nuclear Materials Inventory System	

1 Identify probable location.

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers

DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Metal #1

Barrier #	Worker Protection	Environment and Public Protection
1	W-1	
2	WB-6	
3		EB-2
5		EB-1
6		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Metal #2

Barrier #	Worker Protection	Environment and Public Protection
1	W-1	
2	WB-6	
3		EB-2
5		EB-1
6		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers

DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Metal #3

Barrier #	Worker Protection	Environment and Public Protection
1	W-1	
2	WB-6	
3		EB-2
5		EB-1
6		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Metal #4

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 (locked cabinet 1)	
2	WB-18 (locked cabinet 2)	
3	WB-5 (locked vault)	
4	WB-6	
5		EB-12 (locked cabinet #1)
6		EB-12 (locked cabinet #2)
7		EB-7 (locked)
8		EB-2
9		EB-1
10		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers

DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Oxide #1

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 (locked cabinet 1)	
2	WB-18 (locked cabinet 2)	
3	WB-5 (locked vault)	
4	WB-6	
5		EB-12 (locked cabinet #1)
6		EB-12 (locked cabinet #2)
7		EB-7 (locked)
8		EB-2
9		EB-1
10		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers

DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Oxide #2

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 (locked cabinet 1)	
2	WB-18 (locked cabinet 2)	
3	WB-5 (locked vault)	
4	WB-6	
5		EB-12 (locked cabinet #1)
6		EB-12 (locked cabinet #2)
7		EB-7 (locked)
8		EB-2
9		EB-1
10		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Oxide #3

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 (locked cabinet 1)	
2	WB-18 (locked cabinet 2)	
3	WB-5 (locked vault)	
4	WB-6	
5		EB-12 (locked cabinet #1)
6		EB-12 (locked cabinet #2)
7		EB-7 (locked)
8		EB-2
9		EB-1
10		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Oxide #4

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 (locked cabinet 1)	
2	WB-18 (locked cabinet 2)	
3	WB-5 (locked vault)	
4	WB-6	
5		EB-12 (locked cabinet #1)
6		EB-12 (locked cabinet #2)
7		EB-7 (locked)
8		EB-2
9		EB-1
10		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers   DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Oxide #5

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 (locked cabinet 1)	
2	WB-18 (locked cabinet 2)	
3	WB-5 (locked vault)	
4	WB-6	
5		EB-12 (locked cabinet #1)
6		EB-12 (locked cabinet #2)
7		EB-7 (locked)
8		EB-2
9		EB-1
10		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Oxide #6

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 (locked cabinet 1)	
2	WB-18 (locked cabinet 2)	
3	WB-5 (locked vault)	
4	WB-6	
5		EB-12 (locked cabinet #1)
6		EB-12 (locked cabinet #2)
7		EB-7 (locked)
8		EB-2
9		EB-1
10		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Oxide #7

Barrier #	Worker Protection	Environment and Public Protection
1	WB-1	
2	WB-6	
3		EB-2
5		EB-1
6		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers

DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Oxide #8

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 (locked cabinet 1)	
2	WB-18 (locked cabinet 2)	
3	WB-5 (locked vault)	
4	WB-6	
5		EB-12 (locked cabinet #1)
6		EB-12 (locked cabinet #2)
7		EB-7 (locked)
8		EB-2
9		EB-1
10		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers

DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Oxide #9

Barrier #	Worker Protection	Environment and Public Protection
1	WB-1	
2	WB-14	
3	WB-6	
4		EB-2
5		EB-1
6		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers — DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Solution #1

Barrier #	Worker Protection	Environment and Public Protection
1	WB-1	
2	WB-6	
3		EB-2
4		EB-1
5		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Solution #2

Barrier #	Worker Protection	Environment and Public Protection
1	WB-1	
2	WB-6	
3		EB-2
4		EB-1
5		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers — DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Other #1

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 (locked cabinet 1)	
2	WB-18 (locked cabinet 2)	
3	WB-5 (locked vault)	
4	WB-6	
5		EB-12 (locked cabinet #1)
6		EB-12 (locked cabinet #2)
7		EB-7 (locked)
8		EB-2
9		EB-1
10		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 3: Physical Barriers — DOE Material Manager James Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Other #2

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 (locked cabinet 1)	
2	WB-18 (locked cabinet 2)	
3	WB-5 (locked vault)	
4	WB-6	
5		EB-12 (locked cabinet #1)
6		EB-12 (locked cabinet #2)
7		EB-7 (locked)
8		EB-2
9		EB-1
10		EB-4

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

In-Facility

☐ Inadvertent Transfers
X Aging
☐ Organic Nitric Acid Reaction
X Equipment Failure
☐ Change in Mission
X Other Co-Located Hazards
X Corrosion
☐ Inadequate Configuration Knowledge
☐ Combustible Loading
☐ Inadequate Seals
☐ Potential Water Sources
☐ Inadequate Drains
X Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
☐ Inadequate Preventive Maintenance
☐ Administrative Controls
☐ Other - Specify

Material

☐ Pressurization
☐ Pyrophoricity
X Radioactivity
☐ Chemical Reactivity
☐ Am Buildup
☐ Hydrogen Buildup
☐ Radiolysis
☐ Volumetric Expansion
☐ Oxidation
☐ Other - Specify

Question 4 Continued:

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Describe Each Adverse Condition:

Long-term aging and/or corrosion is a potential adverse condition. ^{242}Pu material represents a low specific radioactivity.

There is no evidence of quantitative seismic evaluations since the original design of the facility.

The first floor at an elevation of 801 ft could be flooded by a 100-year flood predicted to rise to an elevation of 801 ft or a 500-year flood predicted to rise to an elevation of 103 ft.

Hazards, such as hydrogen and flammables, are co-located within the 5505 facility.

Applicable References:

ORNL/CF-84/82
ORNL/CF-84/85

1 An existing situation that gives rise to a potential event or concern.

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

<u>In-Facility</u>
- X Fire
- X Explosion
- ☐ Worker Exposure
  - ☐ External
  - ☐ Internal
- X Contamination
- ☐ Flooding
- ☐ Leakage/Spills
- ☐ Other Accidents - Specify
- X Human Error

<u>External</u>
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
- ☐ Adjacent Facility Accident
- ☐ Power Failure
- ☐ Institutional/Regulatory Requirements
- X Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify

<u>Material</u>
- ☐ Criticality
- ☐ Fissile Material Release
- X Breach of Container
- ☐ Fire
- ☐ Other - Specify

<u>Natural Phenomena</u>
- X Earthquake Damage
- ☐ Wind Damage
- X Flood Damage
- ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Describe Each Event:

The potential for natural phenomena such as an earthquake is very rare. Although an earthquake could cause substantial structural damage to the facility, no mechanisms for transporting significant quantities of radioactive materials to the surrounding area would be present and the event would affect only the operability of the facility. The concern for the safety of personnel during an earthquake is far greater than concerns on "Pu ES&H vulnerabilities as a consequence of an earthquake."

Contamination and Radiation Areas are restricted to the hoods, glove boxes and vault storage areas in Building 5505. Flooding due to a 100-year or 500-year flood is not expected to create a hazardous situation in the facility or endanger nearby facilities, the environment, or the health and safety of the public.

Sequential failure of packing forms (due to corrosion, ageing, equipment failure, or natural phenomena) may release radioactive contamination to a localized area which has very limited accessibility.

Personnel radiation exposure is limited by monitoring areas and materials.

The Transuranium Research Facility also contains other potentially hazardous substances such as hydrogen gas and flammable chemicals. Use of these materials are closely monitored and regulated. All of these materials are considered standard industrial laboratory hazards. Potential of sequential involvement of plutonium due to an accident (fire, explosion, etc.) with these materials is possible but considered unlikely due to the administraive and engineering controls in place. Building 5505 has a fire-suppression system. Again, release of radioactive contamination is expected to be limited to a localized area with no significant transportation of significant quantities of radioactive materials to the surrounding area.

Many of the potential events checked are always present when working with radioactive materials. The Compensatory measures at the facility prevent and/or mitigate the adverse conditions. Due to the small amount of material present and considering the compensatory measures currently in place, we feel there is no reasonable risk of events such as those listed in Item 5 occurring.

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Applicable References:

MMES Phase I Hazard Screening Document, HS/5505/F/Rev. 0, June 21, 1991

Limiting Condition Document Building 5505, Transuranium Research Laboratory, LCD/5505/CHEM-01/REV.0

Operations Safety Requirements for the Transuranium Research Laboratory (ORNL/CF-84/85)—Retired

The ORNL Transuranium Research Laboratory Description and Safety Analysis (ORNL/CF-84/85)-Retired

SITE: X-10	FACILITY (Building or Location): 5505 FUNCTION: Transuranium Research
Preventive X Procedures: ops., maint., surveillance X Material Limits X Training X Quality Assurance X Conduct of Operations X Authorization Basis (safety analysis, BIOs) X Surveillance X Organization X Structure X Management Involvement X Staffing X Lessons Learned X Configuration Control of Design x Preventive Maintenance X Monitoring X Trending (Performance Indicator) X Testing/Verification of Integrity X Regulatory Requirements X Records X Personnel Exposure X Equipment X Waste Inventory X QA X Personnel Reliability Assurance Program ☐ Other - Specify	Mitigative X Emergency Preparedness X Emergency Management X Emergency Planning X Emergency Procedures X Emergency Response X Safety Systems ☐ Alarm Systems ☐ Other - Specify
Question 6 Continued:	

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Compensatory Measures	Reference Document
Compensatory measures include procedures, material limits, training, Q.A., surveillance and monitoring. In addition, organizational control and staffing, together with training, help prevent the occurrence of undesired events. Personnel exposure is closely controlled by H.P. program.	TRL Procedure Manual
Procedures	ORNL NMC&A Plan & TRL SOPs
Material Limits	5505 LCD
Training	CASD Training Plan
QA	QAP/X/94-CASD-001
Conduct of Operations	5505 & CASD Matrix 2/94
Auth. Basis	Limiting Conditions Doc. (LCD)
Surveillance	LCD
Organization: Management Structure/Involvement/Staffing	CASD QA Plan
Lessons Learned	ORNL Lesson Learned Sys.
Configuration Control	ORNL Procedure
Preventive Maintenance	LCD
Monitoring	LCD, ORNL HP Manual
Regulatory Requirements	ORNL Procedures, NESHAP
Records	
Personnel Exposure	Office of Radiation Protection
Equipment	OQE&I
Waste Inventory	Facility GCO
QA	CASD QA Plan
Emergency Preparedness/Management	ORNL & TRL Em. Manuals
Safety Systems	LCD

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

	WORKER			ENVIRONMENT			PUBLIC		
EVENT	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
Contamination/Breach of container	Y	N	N	N	N	N	N	N	N
Natural Phenomena	Y	N	N	N	N	N	N	N	N
Fire & Explosions	N	N	N	N	N	N	N	N	N
Human Error	N	N	N	N	N	N	N	N	N
Personnel Radiation Exposure	N	N	N	N	N	N	N	N	N

SITE: X-10	FACILITY (Building or Location): 5505
	FUNCTION: Transuranium Research

Explanation:

In-place administrative and engineering controls and barriers prevent environmental and public vulnerability incidents.

SITE: X-10

Question 8: Overall Site Summary

Based on the Site Assessment Team report, provide an overall assessment of the site ES&H vulnerabilities.

The response to this question should address each of the elements listed below, and should not exceed 2 pages in length.

- A description of the site's most important ES&H concerns related to plutonium storage, handling, processing, and/or shipping.
- A description of which plutonium activities pose the highest risk to the environment, worker, and public at your site.
- A discussion of current planned actions to minimize worker exposure, reduce environmental risks, and protect the public at and near your site.
- Provide any noteworthy programs or practices related to plutonium storage, handling, processes, and/or shipping.

In consideration of ES&H concerns, minimal, low-risk states for plutonium storage, handling, and shipping are advocated. Materials not in active research use are stored in a secured, limited-access vault that is not accessible to most workers and not accessible to the public. Shipping/receiving is limited to a very low frequency rate. Activities which pose the highest risk to workers are encountered in glove box operations with small (grams or less) quantities of plutonium or in inventory/accountability assessments. There is a minimal risk to the environment, and the threat to the public is almost nonexistent.

Future actions will continue to minimize potential ES&H concerns. Movements of these materials will be minimized. Storage of items not in active use in the isolated vault reduces worker exposure to radiation and also minimizes ES&H concerns. The inaccessibility of items in the vault area essentially reduces the public's risk of exposure to zero. The limited access to the facility reduces the number of personnel affected. Additionally, areas in which these materials are handled can only be entered by specially-trained personnel, further reducing the likelihood of nonworker/public exposures. Worker goals toward lower radiation exposure (ALARA program) and training are aimed at significantly reducing radiation exposures to these individuals. Current practices and monitoring techniques also are drivers to minimize ES&H concerns and problems. Training and improved handling procedures will continue to be implemented to reduce the remaining risk.

SITE: X-10	FACILITY (Building or Location): Bldg. 6000
	FUNCTION: Scientific Research

DOE HEADQUARTERS FACILITY LANDLORD ER

DOE HEADQUARTERS PROGRAM SPONSOR ER

FACILITY AGE 32 DESIGN LIFE 80

SITE: X-10	FACILITY (Building or Location): Bldg. 6000
	FUNCTION: Scientific Research

Question 1: Facility

The Holifield Radioactive Ion Beam Facility is a national user facility funded by the DOE for research in nuclear physics and atomic physics. Major components of the facility include a 25-MV tandem electrostatic accelerator, the Oak Ridge Isochronous Cyclotron (ORIC), beam lines and ion optic components used to transport energetic ion beams produced by these accelerators to various target stations, experimental apparatus, and data acquisition systems used for research with these ion beams. Major subsystems of the tandem accelerator include a 500-kV air-insulated injector platform, a 110-psig working pressure vessel, which contains the SF_6 used to insulate the high-voltage terminal and column structure, and an SF_6 transfer, recirculation, and storage system.

The facility is now being reconfigured to enable the production of radioactive beams. This reconfiguration will not affect the sealed sources which are the subject of this report.

The facility is located in the Building 6000 complex at the east end of the X-10 site. The Building 6000 complex is located at a distance of approximately 300 feet from Bethel Valley Road.

A detailed description of the Holifield Facility is provided in ORNL/CF-81/330/R1, "Facility Safety Analysis Report for Heavy Ion Facility," ORNL/CF-81/331, "Operational Safety Requirements for Heavy Ion Facility," and HS/6000F/1/RO, "Hazard Screening, Holifield Heavy Ion Research Facility."

The two sealed sources in question are used for the occasional testing and calibration of neutron detectors. Their use is incidental to the primary purpose of the facility which is research in nuclear and atomic physics. The sources are stored in secure locations and used entirely within a controlled area in accordance with ORNL Health Physics procedures.

No other special precautions or systems are required for the safe storage or use of these sources. There are no plutonium aggregation areas within the Holifield facility.

Occurrence Reports related to the Holifield facility are summarized in the following table.

Number	Description	Report Number	Date	Category
1	Contamination (^{154}Eu)	X10-90-0181	10/17/90	3
2	Contamination (^{106}Ru)	X10-90-0229	11/12/90	2
3	Power Failure (Lab-Wide)	X10-90-0269	12/14/90	2
4	Contamination (Found at HHIRF)	X10-91-0063	02/14/91	3
5	Accidental Actuation of Oxygen Monitoring System	X10-91-1001	09/27/91	3
6	Accidental Actuation of Oxygen Monitoring System	X10-91-1002	11/15/91	3
7	Accidental Actuation of Oxygen Monitoring System	X10-92-0001	07/22/92	3
8	Contamination (^{114}In)	X10-92-0002	07/31/92	3
9	Accidental Actuation of Oxygen Monitoring System	X10-93-00144	08/09/93	3
10	Personal Clothing Contamination	X10-94-0001	03/03/94	3
11	Loss of Control of Radioactive Materials	X10-94-0002	05/10/94	3

SITE: X-10	FACILITY (Building or Location): Bldg. 6000
	FUNCTION: Scientific Research

Question 1 Continued:

Brief descriptions of occurrences related to radiation safety are provided below:

X10-90-0181: A technician obtained low-level contamination from a low-level gamma-ray calibration source of ^{154}Eu which had become open. Contamination was found on hands, on clothes, and elsewhere in the vicinity.

X10-90-0229: Contamination of ^{106}Ru was found on floor within a radiation area and several spots immediately outside area. Shoes of people working inside the area and walking immediately outside the area were found to be contaminated.

X10-91-0063: Contamination of ^{106}Ru and ^{133}Ba was found on the sleeve of a researcher during a routine check on leaving HFIR. It was determined that he had been contaminated from radioactive material in a hot hood in the UNISOR area of Building 6000. The contamination was confined to a small spot on one sleeve of a jacket.

X10-92-0002: The left thumb of a researcher was contaminated with the radioactive material ^{114}In while in the process of preparing a ^{114}In source.

X10-94-0001: The shoe of a researcher was contaminated with ^{228}Th while handling radioactive waste being prepared for disposal.

X10-94-0002: ^{14}C contamination was discovered during a routine health physics survey. There was no contamination of personnel.

Applicable References:

SITE: X-10	FACILITY (Building or Location): Bldg. 6000
	FUNCTION: Scientific Research

Question 2: Holdings DOE Material Manager J. T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal				
Oxide				
Scrap/Residues[4]				
Solution[4]				
Sealed Sources	Am (#3214)	V-1	Indefinite	35
	Pu (#3723)	V-1	Indefinite	35
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]		5		
Unirradiated Reactor Fuel				
High-level Liquid Waste				
Other (specify)				

Oak Ridge Site Assessment Team Report

SITE: X-10	FACILITY (Building or Location): Bldg. 6000
	FUNCTION: Scientific Research

Question 2A: No. Pkgs and Mass DOE Material Manager J. T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal			
Oxide			
Scrap/Residues			
Solution			
Sealed Sources	Am (#3214)	0.00029	1
	Pu (#3723)	0.00043	1
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			
Cumulative Inventory Difference			

SITE:	FACILITY (Building or Location):
	FUNCTION:

Question 3: Physical Barriers DOE Material Manager J. T. Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Sealed Sources

Barrier #	Worker Protection	Environment and Public Protection
1	WB-14	EB-1
2	WB-14	EB-1
3		
4		
5		

SITE:	FACILITY (Building or Location): Bldg 6000
	FUNCTION: Scientific Research

Question 4: Adverse Conditions[1]

Indicate actual or potential adverse conditions that are applicable to those materials, packages and barrier aggregates developed in Questions 1, 2, and 3 by checking the appropriate items and describing below.

Adverse Condition

None Identified

In-Facility

- ☐ Inadvertent Transfers
- ☐ Aging
- ☐ Organic Nitric Acid Reaction
- ☐ Equipment Failure
- ☐ Change in Mission
- ☐ Other Co-Located Hazards
- ☐ Corrosion
- ☐ Inadequate Configuration Knowledge
- ☐ Combustible Loading
- ☐ Inadequate Seals
- ☐ Potential Water Sources
- ☐ Inadequate Drains
- ☐ Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- ☐ Administrative Controls
- ☐ Other - Specify

Material

- ☐ Pressurization
- ☐ Pyrophoricity
- ☐ Radioactivity
- ☐ Chemical Reactivity
- ☐ Am Buildup
- ☐ Hydrogen Buildup
- ☐ Radiolysis
- ☐ Volumetric Expansion
- ☐ Oxidation
- ☐ Other - Specify

SITE:	FACILITY (Building or Location): Bldg 6000
	FUNCTION: Scientific Research

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

None Identified

In-Facility
- ☐ Fire
- ☐ Explosion
- ☐ Worker Exposure
  - ☐ External
  - ☐ Internal
- ☐ Contamination
- ☐ Flooding
- ☐ Leakage/Spills
- ☐ Other Accidents - Specify
- ☐ Human Error

External
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
- ☐ Adjacent Facility Accident
- ☐ Power Failure
- ☐ Institutional/Regulatory Requirements
- ☐ Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify

Material
- ☐ Criticality
- ☐ Fissile Material Release
- ☐ Breach of Container
- ☐ Fire
- ☐ Other - Specify

Natural Phenomena
- ☐ Earthquake Damage
- ☐ Wind Damage
- ☐ Flood Damage
- ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE:	FACILITY (Building or Location): Bldg 6000
	FUNCTION: Scientific Research

Question 6: Compensatory Measure

Compensatory measures at the facility prevent and/or mitigate the adverse conditions and events identified in Questions 4 and 5. Check the applicable items in the table below and reference documents describing the compensatory measures. Identify any uncertainties or concerns in the checked compensatory measures.

Compensatory Measures

Preventive None required	Mitigative None Required

☐ Procedures: ops., maint., surveillance
☐ Material Limits
☐ Training
☐ Quality Assurance
☐ Conduct of Operations
☐ Authorization Basis (safety analysis, BIOs)
☐ Surveillance
☐ Organization
  ☐ Structure
  ☐ Management Involvement
  ☐ Staffing
☐ Lessons Learned
☐ Configuration Control of Design
☐ Preventive Maintenance
☐ Monitoring
☐ Trending (Performance Indicator)
☐ Testing/Verification of Integrity
☐ Regulatory Requirements
☐ Records
  ☐ Personnel Exposure
  ☐ Equipment
  ☐ Waste Inventory
  ☐ QA
☐ Personnel Reliability Assurance Program
☐ Other - Specify
	☐ Emergency Preparedness
	☐ Emergency Management
	  ☐ Emergency Planning
	  ☐ Emergency Procedures
	  ☐ Emergency Response
	☐ Safety Systems
	☐ Alarm Systems
	☐ Other - Specify

SITE:	FACILITY (Building or Location): Bldg 6000
	FUNCTION: Scientific Research

Question 7: Consequences **N/A**

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

EVENT	WORKER			ENVIRONMENT			PUBLIC		
	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY

SITE:

Question 8: Overall Site Summary

The two sealed sources which are the subject of this questionnaire are used for the occasional testing and calibration of neutron detectors. The sources are stored in secure locations and used entirely within a Controlled Area in accordance with ORNL Health Physics procedures. No significant vulnerabilities have been identified for these sources.

SITE: X-10	FACILITY (Building or Location): 6010; RAD. SOURCE CONTROL PGM.
	FUNCTION: SEALED/UNSEALED RAD. SOURCE ACCOUNTABILITY

DOE HEADQUARTERS FACILITY LANDLORD ER

DOE HEADQUARTERS PROGRAM SPONSOR ER

FACILITY AGE 26 years DESIGN LIFE open

Question 1: Facility

The Oak Ridge Electron Linear Accelerator (ORELA) facility is a pulsed, intense neutron source used for basic and applied physics research. As part of the cadre of research tools, small amounts of plutonium are present, for use both as neutron sources for calibration and as research samples. The amounts are small, as reflected by the "radiological facility" rating obtained from the analysis (April 1993) done for DOE-STD-1027-92. There are no regulatory concerns regarding the facility. The most recent hazard screening was done in conjunction with development of an Implementation Plan for ORELA to meet requirements of the new Accelerator Order and Associated Guidance, DOE 5480.25. This approved Hazard Screening Document (HS/6010-EPM/F/1/Rev1, April 1994) demonstrates that the facility falls under the "generally accepted" category. A Limiting Conditions Document has also been prepared (ORNL/CF-93/2, December 1992) and will be modified to be consistent with the new Accelerator Order 5480.25.

The building uses standard industrial fire protection systems, and building ventilation incorporates HEPA filters where required by Industrial Health. Sources are stored in shielded walls using locked containers.

Building 6010 is located at the east end of ORNL, north of White Oak Avenue and south of the Swan pond.

SITE: X-10	FACILITY (Building or Location): 6010; RAD. SOURCE CONTROL PGM.
	FUNCTION:SEALED/UNSEALED RAD. SOURCE ACCOUNTABILITY

Question 2: Holdings DOE Material Manager: J. T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal	239-Pu;241-Pu+241-Am	C2 in P5;C1-unopened	N/A;40	30;17
	237-Np	C2	30	20
Oxide				
Scrap/Residues[4]				
Solution[4]				
Sealed Sources	See Q2A response	See Q2A response	See Q2A response	See Q2A
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]				
Unirradiated Reactor Fuel				

SITE: X-10	FACILITY (Building or Location): 6010; RAD. SOURCE CONTROL PGM.			
	FUNCTION:SEALED/UNSEALED RAD. SOURCE ACCOUNTABILITY			
High-level Liquid Waste				
Other (specify)				

Question 2 Continued:

I.D. NUCLIDE ASSAY DATE MASS DSCRPTN CHEM/PHYS FORM LOCATION

AM-1 241-Am 99. 05/12/93 0.63 AM(S) pressed oxide 6010;165-deg station

AMBE-9955 241-Am 99. 12/04/86 1 AM(S) pressed oxide 6010;20-m corridor

6NP2.4 237-Np 99. 10/15/85 2.4 NP(U) metal + Cd 6010;B-11

P9-M3-2 239-Pu 99.27 00/00/64 1.9 PU(U) metal + 1% Al 6010; Basement: Safe #1

SNM-9523 239-Pu 97. 10/23/70 0.88 PU(S) oxide + Be 6010;40-m corridor

SNM-4091 241-Pu 44. 05/09/77 0.2 PU(U) metal 6010;B-11
(+ 241-Am 53. 0.2)
(+ 239-Pu 3. 0.01)

SITE: X-10	FACILITY (Building or Location): 6010; RAD. SOURCE CONTROL PGM.
	FUNCTION:SEALED/UNSEALED RAD. SOURCE ACCOUNTABILITY

Applicable References

I.D.	Reference	
AM-1	MC-11823	This is also source no. AM-241-3253
AMBE-9955	MC-7993	This is also source no. AM-241-3215
6NP2.4	MC-02366	A request for disposal is pending at DOE
P9-M3-2	Nuclear Science and Engineering vol 96, page 318-329 (1987)	This published reference gives isotopic composition and total mass. Material is enclosed in an aluminum sample holder, which is enclosed in a 1-qt can inside a Nalge plastic container.
SNM-9523		This is also source no. PU-239-3218. Information obtained from a detailed descrition attached to the source.
SNM-4091		(-3507) Lower portion of transfer sheet attached to the unopened isotopes shipment can. Radiation transfer tag is dated 5/9/77. A request for disposal is pending at DOE.

1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.
2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.
3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.
4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.
5 Holdup has no packaging. Identify location of holdup.

SITE: X-10	FACILITY (Building or Location): 6010; RAD.SOURCE CONTROL PGM.
	FUNCTION:SEALED/UNSEALED RAD. SOURCE ACCOUNTABILITY

Question 2A: No. of Pkgs and Mass DOE Material Mgr: J.T.Hargrove
Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal	239-Pu; 241-Pu + 241-Am	0.0023	2
	237-Np	0.0024	1
Oxide			
Scrap/Residues			
Solution			
Sealed Sources	241-Am	0.0016	2
	239-Pu	0.0009	1
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			

SITE: X-10	FACILITY (Building or Location): 6010; RAD. SOURCE CONTROL PGM.
	FUNCTION: SEALED/UNSEALED RAD. SOURCE ACCOUNTABILITY

Question 3: Physical Barriers DOE Material Manager ______

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Metals; Sources__________ ______________

Barrier #	Worker Protection	Environment and Public Protection
1	WB-5 (locked safe)	EB-1
2	WB-6 (locked)	
3	WB-14	
4	WB-15	
5	WB-18 (encased in fabricated holders)	

SITE: X-10	FACILITY (Building or Location): 6010; RAD. SOURCE CONTROL PGM.
	FUNCTION: SEALED/UNSEALED RAD. SOURCE ACCOUNTABILITY

Question 4 Continued:

Describe Each Adverse Condition:

None, beyond standard industrial and nuclear industry hazards

Applicable References:

1 An existing situation that gives rise to a potential event or concern.

SITE: X-10	FACILITY (Building or Location): 6010; RAD. SOURCE CONTROL PGM.
	FUNCTION: SEALED/UNSEALED RAD. SOURCE ACCOUNTABILITY

Question 5 Continued:

Describe Each Event:

None, beyond standard industrial and nuclear industry hazards

SITE: X-10	FACILITY (Building or Location): 6010; RAD. SOURCE CONTROL PGM. FUNCTION: SEALED/UNSEALED RAD. SOURCE ACCOUNTABILITY
Compensatory Measure	Reference Document
None required	

SITE:X-10	FACILITY (Building or Location): 6010; RAD. SOURCE CONTROL PGM.
	FUNCTION:SEALED/UNSEALED RAD. SOURCE ACCOUNTABILITY

Explanation:

None identified

<u>Question 7 Continued:</u>

SITE:X-10

Question 8: Overall Site Summary

Based on the Site Assessment Team report, provide an overall assessment of the site ES&H vulnerabilities.

Based on the Hazard Screening assessment, and the low inventory and form of the plutonium, no credible ES&H concerns can be identified beyond standard industrial and nuclear industry hazards. Worker risk is minimized through application of the ALARA principle. There is no identifiable risk to the public. The plutonium contained in sources undergoes regularly scheduled inspections for source integrity by ORNL personnel, as required. Handling of the nonsource plutonium is according to standard methods, as required.

SITE: X-10	FACILITY (Building or Location): 7700 Facility FUNCTION: Radiation Shielding Research

DOE HEADQUARTERS FACILITY LANDLORD NE

DOE HEADQUARTERS PROGRAM SPONSOR ER

FACILITY AGE 40 years. DESIGN LIFE Indefinite

Question 1: Facility, Tower Shielding Facility.

The Tower Shielding Facility was built to perform reactor shielding studies in air, away from ground and structure scattering of neutrons for the Aircraft Nuclear Propulsion Project in 1953. Also it has been used to develop basic shielding theory for and to check the design of shields for gas-cooled reactors, liquid-metal reactors, and space reactors and to check the effectiveness of shields providing protection from nuclear weapons for various government programs. Four different reactors have been used in these studies, the Tower Shielding Reactor II (TSR-II) being the final and most versatile. Currently the facility is in standby awaiting funding to remove the fuel from the TSR-II. Radioactive sources were used at the Facility for two purposes: (1) for calibration of detector systems and (2) for reactor startup.

The only occurrence report related to handling of radioactive sources is: Occurrence Report Number: ORO--MMES-X10 BREX-1992-0008, MMES-92-703ds X 20-92-136 TSR-92-004. This was a report of the loss of a 56 microcurie cobalt source in May 1992. Health physicists performed an extensive search for several months. The source was located by a TSF staff member in November 1992. As a result of this loss, procedures were changed and personnel were trained to reduce the likelihood of similar occurrences. Sources accountable because of the nuclear material they contained were already handled in a much more formal manner and stored in a secure area.

The Facility consists of four 315-ft-tall towers, hoists for lifting 50 ton loads to 200-ft, and underground control buildings with fire protection, HVAC, and shielded from radiation from the reactor. The reactor has the standard protection systems including seismic shutdown. Currently the TSR-II is located in a separate reinforced concrete, stainless steel, and water shield, one side which is shielded by a moveable lead shield. An americium beryllium source is located in the central control region of the reactor.

The reactor fuel is stored in the reactor vessel, and the reactor cooling system is operated as needed to maintain the quality of the cooling water to ensure the integrity of the fuel elements and to prevent freezing of the water during winter months. Checks of the quality of the cooling water attest to the integrity of the fuel element cladding and the americium beryllium source located in the central region of the reactor. Reduction in the quality of the demineralized cooling water is the only uncertainty that would affect the integrity of the fuel in the reactor. This uncertainty would have no bearing on sources stored at other locations at the facility.

SITE: X-10	FACILITY (Building or Location): 7700 Facility
	FUNCTION: Radiation Shielding Research

Question 1 Narrative continued

A 6 gram plutonium beryllium source is stored in an outdoor, well-drained*, locked, underground pipe well. The well is 2-inch-diameter heavy-walled pipe that extends 6-feet underground. Three americium beryllium sources each 3 grams of americium are stored in other wells in the same area.

The facility is located on a knoll with an elevation of 1069 ft 2.35 miles south-southeast of ORNL, 6 to 13 miles from the city of Oak Ridge, and 17 to 25 miles from the city of Knoxville. The Melton Hill Dam is located 0.8 miles south of the facility on the Clinch River, which forms a natural boundary of the restricted area.

* After drops of water were noted on a source during an observation, all of the source wells were examined the following day and no water was noted at the bottom of any well. The water drops were undoubtedly condensate, which is to be expected in underground wells in this area.

Applicable References:

Tower Shielding Reactor II Design and Operating Report, Vol. 1 - Description, ORNL TM-2893-Vol.1; Vol. 2 - Safety Analysis Report, ORNL/TM-2893, Vol. 2; and Technical Specifications, Tower Shielding Reactor II, ORNL/TM-4641/R, Rev. December 1990.

SITE: X-10	FACILITY (Building or Location): 7700 Facility
	FUNCTION: Radiation Shielding Research

Question 2: Holdings DOE Material Manager J. T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal				
Oxide				
Scrap/Residues[4]				
Solution[4]				
Sealed Sources	Other (Pu-239 & Pu-241)	V-1	Indefinite	33
	Other (3 Am-Be)	V-1	Indefinite	28, 28, 32
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]		[5]		
Unirradiated Reactor Fuel				
High-level Liquid Waste				

SITE: X-10	FACILITY (Building or Location): 7700 Facility
	FUNCTION: Radiation Shielding Research

Question 2 Continued:

Applicable References:

Shipping Data Pu-433 (OHIS?HPIMS No. 3876):

Plutonium Neutron Source	License No. Stat. CAL
Monsanto Research Corporation	SS Alot. Quota No. ORO-5000-60
Mound Laboratory	Withdrawn From: SBK 3101
Miamisburg, Ohio	28 August 1961

Shipping Data AmBe 445 (OHIS/HPIMS-3249):

Monsanto Research Corporation	ORNL Purchase Order No. 88X38574
Nuclear Sources Department	07 July 1966
1515 Nicholas Road	
Dayton, Ohio	

Shipping Order TSF-10(OHIS/HPIS-3248):

ORNL Isotopes Sales	08 Oct. 1962

Shipping Order AmBe-21 (OHIS/HPIMS-3216:

ORNL Isotopes Sales	31 Oct. 1962

ORNL Special Materials Management Department Report U9050-FZG April 1994

1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.
2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.
3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.
4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.
5 Holdup has no packaging. Identify location of holdup.

SITE: X-10	FACILITY (Building or Location): 7700 Facility
	FUNCTION: Radiation Shielding Research

Question 2A: No. Pkgs and Mass DOE Material Manager J. T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal			
Oxide			
Scrap/Residues			
Solution			
Sealed Sources	Other	0.006 kg ^{239}Pu & ^{241}Pu	One source
	Other	0.003 kg Am-241	Three sources
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			
Cumulative Inventory Difference			

SITE: X-10		FACILITY (Building or Location): 7700 Facility	
		FUNCTION: Radiation Shielding Research	
Other (specify)			
Question 2A Continued:			
Applicable References: ORNL Nuclear Special Materials Management Department Report U905 FZG			

___Building 7702, X-10___________________________

1 Identify probable location.

SITE: X-10	FACILITY (Building or Location): 7700 Facility
	FUNCTION: Shielding Research

Question 3: Physical Barriers DOE Material Manager J. T. Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Sealed Source

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18 Doubly Contained	EB-7
2	WB-14	EB-1
3	WB-15	EB-4
4	WB-17	

Question 3 Continued:

Applicable References:

Operating Manual for the Tower Shielding Facility, ORNL/TM-9900

SITE: X-10	FACILITY (Building or Location):7700 Facility
	FUNCTION: Shielding Research

In-Facility

- ☐ Inadvertent Transfers
- X Aging
- ☐ Organic Nitric Acid Reaction
- ☐ Equipment Failure
- ☐ Change in Mission
- ☐ Other Co-Located Hazards
- ☐ Corrosion
- ☐ Inadequate Configuration Knowledge
- ☐ Combustible Loading
- X Inadequate Seals
- ☐ Potential Water Sources
- ☐ Inadequate Drains
- ☐ Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- ☐ Administrative Controls
- ☐ Other - Specify

Material

- ☐ Pressurization
- ☐ Pyrophoricity
- ☐ Radioactivity
- ☐ Chemical Reactivity
- ☐ Am Buildup
- ☐ Hydrogen Buildup
- ☐ Radiolysis
- ☐ Volumetric Expansion
- ☐ Oxidation
- ☐ Other - Specify

Question 4 Continued:

SITE: X-10	FACILITY (Building or Location):7700 Facility
	FUNCTION: Shielding Research

Describe Each Adverse Condition:

Aging: The sources have been in use for calibration purposes for over 30 years and have been stored in well drained (see Question 1), outdoor wells in an elevated location.

Inadequate Seals: The sources are contained in welded, double-walled containers, which conceivable could fail.

Applicable References:

ORNL Health and Safety Division Radioactive Source Control Program

1 An existing situation that gives rise to a potential event or concern.

SITE: X-10	FACILITY (Building or Location): 7700 Facility
	FUNCTION: Radiation Shielding Research

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- ☐ Fire
- ☐ Explosion
- ☐ Worker Exposure
  - ☐ External
  - ☐ Internal
- ☐ Contamination
- ☐ Flooding
- ☐ Leakage/Spills
- ☐ Other Accidents - Specify
- ☐ Human Error

External
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
- ☐ Adjacent Facility Accident
- ☐ Power Failure
- ☐ Institutional/Regulatory Requirements
- ☐ Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify

Material
- ☐ Criticality
- ☐ Fissile Material Release
- X Breach of Container
- ☐ Fire
- ☐ Other - Specify

Natural Phenomena
- ☐ Earthquake Damage
- ☐ Wind Damage
- ☐ Flood Damage
- ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE: X-10	FACILITY (Building or Location): 7700 Facility
	FUNCTION: Radiation Shielding Research

Describe Each Event:

Breach of Container: Source containment could be breached by subjecting the sources to adverse environments or by improper handling. This has not been the case in the past and is unlikely to occur while the sources are stored as at present or during the minimal handling required for checking for leakage.

If a source were to leak and was submerged in water, any contamination present could be moved out of the storage well to the surrounding ground. The wells are above any conceivable flood level and have been checked to verify that there is no water at the bottom of any well, confirming that the drainage is effective. Sources and well wall show evidence of condensate, which is to be expected.

Question 5 Continued:

SITE: X-10	FACILITY (Building or Location): 7700 Facility
	FUNCTION: Radiation Shielding Research

Applicable References:

ORNL Health and Safety Division Radioactive Source Control Program

Tower Shielding Facility Log Books

Tower Shielding Facility Six Months Reports, 1960 - 1987

Research Reactors Division Monthly Reports, 1987 to present

SITE: X-10	FACILITY (Building or Location): 7700 Facility FUNCTION: Radiation Shielding Research

Preventive
X Procedures: ops., maint., surveillance
X Material Limits
X Training
X Quality Assurance
X Conduct of Operations
X Authorization Basis (safety analysis, BIOs)
X Surveillance
X Organization
  X Structure
  X Management Involvement
  X Staffing
X Lessons Learned
X Configuration Control of Design
X Preventive Maintenance
☐ Monitoring
X Trending (Performance Indicator)
X Testing/Verification of Integrity
X Regulatory Requirements
X Records
  X Personal Exposure
  X Equipment
  ☐ Waste Inventory
  X QA
X Personal Reliability Assurance Progdram
☐ Other - Specify
	Mitigative
	X Emergency Preparedness
	X Emergency Management
	  X Emergency Planning
	  X Emergency Procedures
	  X Emergency Response
	X Safety Systems
	X Alarm Systems
	☐ Other - Specify

Question 6 Continued:	

SITE: X-10	FACILITY (Building or Location): 7700 Facility
	FUNCTION: Radiation Shielding Research

Compensatory Measure	Reference Document
Preventive	
Procedures: ops., maint., surveillance	
Operating Manual for the Tower Shielding Facility,	ORNL/TM-9900
Material Limits:	
Material Limits for MBA 102, Control Area 7700OSSA, FZG	ORNL/SMMD/U9050-
Training:	
ORNL/RRD Training Implementation Manual,	ORNL/RRD/INT-60
Quality Assurance:	
RRD Quality Assurance Manual,	ORNL/RRD/INT-26
Conduct of Operations:	
Guidelines for the Conduct of Operations for the Tower Shielding Facility,	ORNL/RRD/INT-93
Authorization Basis:	
Tower Shielding Reactor II Design and Operation Report, Vol. 2	
Safety Analysis of the Tower Shielding Reactor II,	ORNL/TM/2893, Vol. 2
Surveillance:	
Tower Shielding Facility System Calibration Procedures,	ORNL/TM/INT-52
Nuclear Materials Inventories, Control Plan	ORNL Nuclear Materials and Accountability
Sealed Sources Inventory,	Health Physics Registry
Organization:	
Structure:	
RRD Administrative Policies and Procedures Manual, RRAP 1.2,	ORNL/RRD/INT-12
Management Involvement:	
RRD Administrative Policies and Procedures Manual, RRAP 1.3,	ORNL/RRD/INT-12
Staffing:	
Technical Specifications for the Tower Shielding Reactor II, Sec. 6.3,	ORNL/TM-4641/R3
Lessons Learned:	
B Reactors Required Reading,	TSF Required Reading Log
US DOE Operating Experience Weekly Summary,	US DOE Office of Nuclear Safety
Configuration Control of Design:	
RRD Administrative Policies and Procedures Manual, RRAP 3.2,	ORNL/RRD/INT-12
Trending:	
Performance Indicator Reporting and Tracking, RRAP-1.8.4.	ORNL/RRD/INT-12
Records	
Personnel Exposure:	
Procedures and Practices for Personnel Protection and Radiation Management, RP-3.3,	ORNL Health Physics Manual
Equipment: Records of Changes, RRAP-3.3.1, ORNL/RRD/INT- QA:	

SITE: X-10	FACILITY (Building or Location): 7700 Facility
	FUNCTION: Radiation Shielding Research

Uncertainty or Concern Discussion

There are no identified uncertainties or concerns relative to the sealed sources which are stored in secured, well drained underground pipes in the Tower Shielding Facility area.

SITE:1 X-10	FACILITY (Building or Location): 7700 Facility
	FUNCTION: Radiation Shielding Research

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

EVENT	WORKER			ENVIRONMENT			PUBLIC		
	CONT AMIN ATIO N	EXPO SURE	INJU RY	GRO UND	WATE R	AIR	CONT AMIN ATIO N	EXPO SURE	INJUR Y
None	N	N	N	N	N	N	N	N	N

SITE:1 X-10	FACILITY (Building or Location): 7700 Facility
	FUNCTION: Radiation Shielding Research

Explanation:

No credible event has been identified. Surveillance is performed as a precautionary measure to prevent any inadvertent exposure.

Question 7 Continued:

SITE:

Question 8: Overall Site Summary

Because the sources are no longer in use are stored in a safe and secure location, the main ES&H concern is the possibility of contamination from a leaking source while it is being checked for contamination. Such a leak is unlikely because the conditions for causing a breach of the double containment would not be present, and precautions would be in place to prevent any spreading of contamination during the checking.

Steps will be taken to dispose of the sources when a program is established to accept them.

SITE: X-10	FACILITY (Building or Location):7710, 7712, and 7735 within MBA 131
	FUNCTION: Scientific Research

DOE HEADQUARTERS FACILITY LANDLORD ER

DOE HEADQUARTERS PROGRAM SPONSOR ER

FACILITY AGE 40 years DESIGN LIFE 80 years

Question 1: Facility

MBA 131 is located in three buildings at ORNL. The buildings are about 1 mile from Melton Hill Lake (part of the ORNL boundary) and about 3 miles from the nearest public highway. One building is the site of the Radiation Calibration Laboratory, a special purpose facility, whereas the other buildings are general purpose buildings housing storerooms, laboratories, and offices supporting the activities of the Health Sciences Research and Instrumentation & Controls Divisions.

The ORNL Radiation Calibration Laboratory (RADCAL) provides calibrated radiation exposures for personnel dosimetry research, dosimetry intercomparison studies, dosimetry performance test programs, health physics personnel training, and instrumentation research and development. The 260-m^2 building, which was constructed in 1987, includes a control room, a γ-irradiation room, a β/X-ray room, and a low-scatter neutron room. Exposures are provided using only sealed isotopic sources and X-ray generators. Access to RADCAL is only available to personnel with proper training. Building access is administratively controlled by an electronic badge reader.

A more complete description of RADCAL and a detailed hazard screening for the facility are provided in HS/7735/F/1/RO, "FSET Report on Hazard Identification and Accident Scenario Development, RADCAL, Radiation Calibration Laboratory, Building 7735" (October 1991).

Building 7710 is a general purpose building built in the 1950s with an addition in the 1960s. The 750-m^2 building houses nine offices, six labs, and four specialty rooms including a reactor control room, a low-background counting room, and an environmental chamber. In addition, two chemical fume hoods are available for experimental work in the building. Activities in this building include: administration, radiochemical analysis, instrumentation calibration and support, and research and development in support of the programs of DOE's Office of Environmental Technology Development and Office of Health and Environmental Research. Administrative controls and a badge reader limit access to the building so that only employees of ORNL, ORISE, or their subcontractors can gain entry without an escort.

Building 7712 is a small building with two rooms. One room has metal walls, a high ceiling, and is used to store several sources in large (~30 gallons) cans or drums along with miscellaneous scientific equipment. The other room has cinder block walls and is used for equipment storage. Access to the building is limited to those with a key; doors are kept locked at all times.

SITE: X-10	FACILITY (Building or Location): 7710, 7712, and 7735 within MBA 131
	FUNCTION: Scientific Research
Question 2: Holdings	DOE Material Manager: J. T. Hargrove

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal				
Oxide				
Scrap/Residues[4]				
Solution[4]				
Sealed Sources	Am (3209 & 4626)	X1	100	10
	Np (4582 thru 4594)	W3, F0, B3	Unknown	10
	Cf (3287 & 3288))	V7	75	7
	^{239}Pu & ^{241}Pu (3208)	X1	100	10
	^{239}Pu & ^{241}Pu (4547 thru 4581)	W3, F0, B3	Unknown	10
	^{238}Pu (3286)	X1	100	10
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]				

SITE: X-10	FACILITY (Building or Location): 7710, 7712, and 7735 within MBA 131		
	FUNCTION: Scientific Research		
Question 2A: No. Pkgs and Mass	DOE Material Manager: J. T. Hargrove		
Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal			
Oxide			
Scrap/Residues			
Solution			
Sealed Sources	Am (3209 & 4626)	1.45×10^{-3}	2
	Np (4582 thru 4594)	0.005	1
	Cf (3287 & 3288)	757×10^{-9}	2
	^{239}Pu & ^{241}Pu (3208)	0.016	1
	^{239}Pu & ^{241}Pu (4547 thru 4581)	0.103	1
	^{238}Pu (3285)	0.6×10^{-3}	1
TRU Waste			
Holdup			

SITE: X-10	FACILITY (Building or Location): 7710, 7712, and 7735 within MBA 131
	FUNCTION: Scientific Research

Question 3: Physical Barriers — DOE Material Manager: J. T. Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2): Sealed Sources (^{241}Am, ^{239}Pu & ^{241}Pu, ^{237}Np, ^{238}Pu, and ^{252}Cf)

SITE: X-10	FACILITY (Building or Location): 7710, 7712, and 7735 within MBA 131
	FUNCTION: Scientific Research

Barrier #	Worker Protection	Environment and Public Protection
Sealed Sources Containing ^{241}Am (3209 & 4626)		
1	WB-15 Site Boundary of ORNL	EB-4 Site Boundary of ORNL
2	WB-15 Locked Door on Bldg 7712	EB-1 Locked Door onBldg 7712
3	WB-14 Locked in Heavy Cask	EB-7 Locked in Heavy Cask
Sealed Sources Containing ^{239}Pu & ^{241}Pu (3208)		
1	WB-15 Site Boundary of ORNL	EB-4 Site Boundary of ORNL
2	WB-15 Locked Door on Bldg 7712	EB-1 Locked Door onBldg 7712
3	WB-14 Locked in Heavy Cask	EB-7 Locked in Heavy Cask
Sealed Sources Containing ^{237}Np (4582 thru 4594)		
1	WB-15 Site Boundary of ORNL	EB-4 Site Boundary of ORNL
2	WB-15 Badge Reader on Bldg 7710	EB-1 Bldg 7710
3	WB-6 Locked Cage in Room 114	EB-7 Locked Cage in Room 114
4	WB-5 Safe in Locked Cage	EB-7 Safe in Locked Cage
5	WB-14 Wooden Tray	

SITE: X-10	FACILITY (Building or Location): 7710, 7712, and 7735 within MBA 131
	FUNCTION: Scientific Research

Question 3 Continued:

Sealed Sources Containing ^{239}Pu & ^{241}Pu (4547 thru 4581)

1	WB-15 Site Boundary of ORNL	EB-4 Site Boundary of ORNL
2	WB-15 Badge Reader on Bldg 7710	EB-1 Bldg 7710
3	WB-6 Locked Cage in Room 114	EB-7 Locked Cage in Room 114
4	WB-5 Safe in Locked Cage	EB-7 Safe in Locked Cage
5	WB-14 Wooden Tray	

Sealed Sources Containing ^{238}Pu (3285)

1	WB-15 Site Boundary of ORNL	EB-4 Site Boundary of ORNL
2	WB-15 Badge Reader on Bldg 7735	EB-1 Badge reader on Bldg 7735
3	WB-15 Locked door to neutron rm	EB-1 Locked door to neutron rm

Sealed Sources Containing ^{252}Cf (3287 & 3288)

1	WB-15 Site Boundary of ORNL	EB-4 Site Boundary of ORNL
2	WB-15 Badge Reader on Bldg 7735	EB-1 Badge reader on Bldg 7735
3	WB-15 Locked door to neutron rm	EB-1 Locked door to neutron rm
4	WB-14 Shielding pool	

SITE: X-10	FACILITY (Building or Location): 7710, 7712, and 7735 within MBA 131
	FUNCTION: Scientific Research

In-Facility

- ☐ Inadvertent Transfers
- ☐ Aging
- ☐ Organic Nitric Acid Reaction
- ☐ Equipment Failure
- ☐ Change in Mission
- X Other Co-Located Hazards
- ☐ Corrosion
- ☐ Inadequate Configuration Knowledge
- ☐ Combustible Loading
- ☐ Inadequate Seals
- ☐ Potential Water Sources
- ☐ Inadequate Drains
- X Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- ☐ Administrative Controls
- ☐ Other - Specify

Material

- ☐ Pressurization
- ☐ Pyrophoricity
- ☐ Radioactivity
- ☐ Chemical Reactivity
- ☐ Am Buildup
- ☐ Hydrogen Buildup
- ☐ Radiolysis
- ☐ Volumetric Expansion
- ☐ Oxidation
- ☐ Other - Specify

SITE: X-10	FACILITY (Building or Location): 7710, 7712, and 7735 within MBA 131
	FUNCTION: Scientific Research

Question 4 Continued:

Describe Each Adverse Condition:

Other Co-located Hazards: Most of the Pu-containing material within the scope of this assessment is located within a locked cage in room 114 of building 7710. One source is in building 7712 and the remaining material is in building 7735. Room 113 of building 7710 is a radiochemistry laboratory and contains a satellite accumulation area (as defined by the Resource Conservation and Recovery Act). It is remotely possible that a fire may start in room 113 and spread to the locked cage. This possibility is made more remote by the existance of another room between rooms 114 and 113.

Inadequacy of Design Basis: It is not known whether engineers responsible for designing buildings 7710 and 7712 adequately (as defined by current standards) considered building response to seismic activity.

SITE: X-10	FACILITY (Location):7710, 7712, and 7735 within MBA 131 FUNCTION: Scientific Research

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- X Fire
- ☐ Explosion
- ☐ Worker Exposure
  - ☐ External
  - ☐ Internal
- ☐ Contamination
- ☐ Flooding
- ☐ Leakage/Spills
- ☐ Other Accidents - Specify
- ☐ Human Error

External
- ☐ Aircraft Crash
  - ☐ Vehicle Accident
  - ☐ Explosion
  - ☐ Adjacent Facility Accident
  - ☐ Power Failure
  - ☐ Institutional/Regulatory Requirements
  - ☐ Personnel Radiation Exposure
  - ☐ Ex-facility Fire
  - ☐ Other - Specify

Material
- ☐ Criticality
- ☐ Fissile Material Release
- ☐ Breach of Container
- ☐ Fire
- ☐ Other - Specify

Natural Phenomena
  - X Earthquake Damage
  - ☐ Wind Damage
  - ☐ Flood Damage
- ☐ Erosion Damage
  - ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE: X-10	FACILITY (Location):7710, 7712, and 7735 within MBA 131
	FUNCTION: Scientific Research

Describe Each Event:

Fire: Flammable liquids in building 7710 may be ignited causing a fire that may spread to storage areas containing Pu-containing materials.

Earthquake: A substantial earthquake (>8 on the Richter scale) may destroy the integrity of the buildings.

SITE: X-10	FACILITY (Building or Location): 7710, 7712, and 7735 within MBA 131 FUNCTION: Scientific Research

<u>Preventive</u>
 	
☐ Procedures: ops., maint., surveillance
☐ Material Limits
X Training
☐ Quality Assurance
☐ Conduct of Operations
☐ Authorization Basis (safety analysis, BIOs)
☐ Surveillance
☐ Organization
  ☐ Structure
  ☐ Management Involvement
  ☐ Staffing
☐ Lessons Learned
☐ Configuration Control of Design
☐ Preventive Maintenance
☐ Monitoring
☐ Trending (Performance Indicator)
☐ Testing/Verification of Integrity
☐ Regulatory Requirements
☐ Records
  ☐ Personnel Exposure
  ☐ Equipment
  ☐ Waste Inventory
  ☐ QA
☐ Personnel Reliability Assurance Program
☐ Other - Specify
	<u>Mitigative</u>
	
	X Emergency Preparedness
	☐ Emergency Management
	  ☐ Emergency Planning
	  ☐ Emergency Procedures
	  ☐ Emergency Response
	☐ Safety Systems
	☐ Alarm Systems
	☐ Other - Specify

<u>Question 6 Continued:</u>	

SITE: X-10	FACILITY (Building or Location): 7710, 7712, and 7735 within MBA 131 FUNCTION: Scientific Research

Compensatory Measure | Reference Document

Training: Every employee and guest researcher is required to undergo extensive safety training before working with any hazardous (i.e., radioactive, toxic, flammable, or carcinogenic) material in buildings 7710, 7712, or 7735. For example, before working in the radiochemistry laboratory (room 113) individuals must complete both Radiological Worker II and Hazardous Waste Training. In addition, all newcomers to these buildings are briefed in detail by their immediate supervisor about the potential hazards to their health in this facility.

Emergency Preparedness: ORNL maintains a system of local emergency squads throughout its domain. One squad is based in building 7710 and is responsible for all three buildings. There are fire extinguishers distributed throughout the buildings, including one just outside the radiochemistry laboratory.

Uncertainty or Concern | Discussion

SITE: X-10	FACILITY (Building or Location): 7710, 7712, and 7735 within MBA 131
	FUNCTION: Scientific Research

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

EVENT	WORKER			ENVIRONMENT			PUBLIC		
	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
Fire in room 113	N	N	N	N	N	N	N	N	N
Earthquake	N	N	N	N	N	N	N	N	N

SITE: X-10	FACILITY (Building or Location): 7710, 7712, and 7735 within MBA 131
	FUNCTION: Scientific Research

Explanation:

Fire in room 113: All personnel are properly trained for work with flammable liquids. Flammable liquids are stored in a grounded storage cabinet. In addition, fire extinguishers for fire types A, B, or C, are available just outside the door of the laboratory.

Earthquake: In the forty-year history of the facility no earthquake capable of inducing structural damage has occurred. We believe there is an extremely small probability of a sufficiently strong disturbance. If it were to occur, the facility does participate in the ORNL emergency management plan.

SITE: 7710, 7712, and 7735 within MBA 131

Question 8: Overall Site Summary

Based on the Site Assessment Team report, provide an overall assessment of the site ES&H vulnerabilities.

MBA 131 is a facility with the general mission of using sealed sources to develop better approaches for the measurement of radiation fields (for personnel dosimetry) and radioactive contamination (for environmental remediation). The facility is housed in structurally sound, older buildings with badge readers and other administrative measures to limit facility access to those individuals with the proper training so that activities within the facility will continue to be carried out safely and without harm to the public or the environment.

Two scenarios were identified that might result in unnecessary exposures to workers or the public: fire and earthquake. Due to the small amount of radioactive material in the facility and its form (i.e., sealed sources) the consequences of either scenario will be limited in scope. Based on our experience to date and the plans for personnel training and emergency management, the probability of either scenario is very small.

SITE: X-10	FACILITY (Building or Location): Bldg. 7824
	FUNCTION: NDA/NDE rad waste and conduct NDA/NDE instrument R&D
DOE HEADQUARTERS FACILITY LANDLORD ER	
DOE HEADQUARTERS PROGRAM SPONSOR EM-30	
FACILITY AGE 12 yrs	DESIGN LIFE 30 yrs.

SITE: X-10	FACILITY (Building or Location): Bldg. 7824
	FUNCTION: NDA/NDE rad waste and conduct NDA/NDE instrument R&D

Question 1: Facility

The Waste Examination and Assay Facility (WEAF) is a 50 by 150 ft steel-framed structure with exterior corrugated aluminum siding and roof panels and a concrete slab floor. It is located within the confines of Solid Waste Storage Area (SWSA) 5 in the Melton Valley Area of ORNL (see Fig. 3.1 p. 417). Entrance to the SWSA is controlled by a chain-linked gate located approximately 200 yards from the WEAF that requires special training and approval for entry. Physical access through the gate is controlled by a badge reader.

The mission of the WEAF is to nondestructively assay (NDA) and nondestructively examine (NDE) solid radioactive waste contained in drums and boxes. NDE instruments include drum and box real-time radiography units used to verify the absence of prohibited items in solid radioactive waste. NDA instruments, which include neutron (APNEA)- and gamma-ray (GASP)-based systems, are used to determine the quantities of fissile material and spontaneously neutron-emitting isotopes and provide plutonium (Pu) and uranium (U) isotopic ratio data, respectively. Pulsed-neutron and induced gamma-ray research and development projects are also performed at the WEAF. These include the continued development of neutron- and gamma-ray-based NDA instruments as well as the development of explosives and drug detection and the on-line analysis of bulk coal using pulsed-neutron sources and gamma-ray detection methodologies. The WEAF is currently operating with a staff of nine.

Currently, only drums are examined at the WEAF. Drums are transported to the facility where they are first examined using one of the RTR units. If a drum fails this inspection, it is removed from the WEAF and returned to the generator for repackaging. If a transuranic (TRU) waste drum passes the inspection, it is transferred to the APNEA system, where its fissile mass content is determined. Occasionally, TRU waste drums are transferred to the GASP system for U and Pu isotopic analysis. During the course of instrument calibration and development, it is necessary to use a variety of sealed sources (e.g., Pu, U, ^{252}Cf). It is these sealed sources which constitute the WEAF Pu vulnerability assessment.

A field evaluation of the WEAF building structures was conducted by the Engineering Analysis Section of the Energy Systems Central Engineering Division. The facility was judged to be adequate to meet the structural load requirements of DOE 6430.1A for low-hazard-category facilities. It was judged that the main building structure would likely survive a much more severe earthquake than the earthquake specified for a low-hazard facility with no structural damage or failure. However, there are several non-load-bearing, unreinforced masonry walls in the interior of the building which would likely collapse in a seismic event. The likely failure modes of the building structure for winds in excess of the low-hazard-category wind speed (70 mph) is the removal of the corrugated aluminum roof and side panels, which would expose the unreinforced masonry walls and building contents to the wind.

SITE: X-10	FACILITY (Building or Location): Bldg. 7824
	FUNCTION: NDA/NDE rad waste and conduct NDA/NDE instrument R&D

Question 1 Narrative Continued:

The fire alarm system at the WEAF consists of tamper-sensing devices on water supply and shutoff valves, ceiling-mounted heat detectors, smoke detectors, sprinkler system, manual pullboxes, and a fire alarm panel that sends trouble and supervisory signals to the ORNL Fire Department over telephone lines. Backup power is provided to the fire alarm panel from batteries.

Building ventilation is supplied by three main recirculating central heating and air-conditioning systems and four "room size" wall units. Compressors for the three main systems are located outside the building on concrete pads.

WEAF has two constant alpha air monitors (CAAM) and a beta-gamma constant air monitor (CAM) used to alert operating personnel to unexpected increases in airborne concentrations of radioactive materials. A CAAM and the CAM are located next to the sealed-source storage cage (see Attachment 2). Detection of airborne radioactive materials by the CAAM's and CAM has not occurred in the history of the facility.

All sealed radioactive sources, when not in use, are stored within a locked metal cage. Only personnel trained in the handling of the sources are given the combination to the cage. The cage is located along the east wall near the middle of the building (see Attached 2).

Shielding is provided for the X-ray-generating devices, neutron generator, and "hotter" sealed sources. A solid concrete block wall between the control room and the instrument area provides additional shielding for operators from radiation sources.

There are no required special safety support systems that need to operate continuously to support operations involving sealed sources and the storage, examination, and assay of waste containers. Utilities such as electrical power and lighting, ventilation, and radiation monitors are used to support examination and assay operations; however, an unscheduled outage of any of these systems will not result of an unsafe condition to personnel, the public, or the environment and will only result in possible termination of WEAF operations.

Six Unusual Occurrence/Occurrence Reports have been generated at the WEAF since April 1982. Below is a brief description of each occurrence. See Attachment 3 for report details.

1) 03/05/85 55-gal mild steel drum leaked transuranic solid waste material.
2) 10/16/86 55-gal stainless steel drum leaked transuranic solid waste material.
3) 06/22/90 Personnel contaminated when handling a contaminated source holder (lead pig).
4) 12/07/92 Personnel contaminated when enriched ^{235}U source leaked.
5) 03/11/94 Omission of sealed-source text in the Nuclear Safety Review for the facility.
6) 04/12/94 Construction on the west side of the building blocked a drain, causing water to enter the facility.

SITE: X-10	FACILITY (Building or Location): Bldg. 7824
	FUNCTION: NDA/NDE rad waste and conduct NDA/NDE instrument R&D

Question 1 Narrative Continued:

HS/7824/F/1/R0 — Phase I Safety Analysis Report Update Program, Hazard Screening, Waste Examination and Assay Facility, Building 7824. 2/27/92.

Oak Ridge National Laboratory Local Emergency Manual, Revision 0, November 1992.

Applicable References:

ES&H documents listed above
Unusual Occurrence Report - ORNL-84-32-OP-84-7, 03/05/85
Unusual Occurrence Report - ORNL-86-16-OP-86-6, 10/16/86
Unusual Occurrence Report - ORNL-90-29-EHP-90-005, 06/22/90
Occurrence Report - ORO-MMES-X10WSTEMRA-1992-0007, 12/07/92
Occurrence Report, I0015880, 03/11/94
Occurrence Report, I0016539, 04/12/94

SITE: X-10	FACILITY (Building or Location): WEAF/ Bldg. 7824
	FUNCTION: NDA/NDE rad waste and conduct NDA/NDE instrument R&D

Question 2: Holdings DOE Material Manager ________________

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal				
Oxide				
Scrap/Residues[4]	Pu-239-3874	P5	Unknown	29y 7mo
	Grade Unknown			
Solution[4]				
Sealed Sources	WG-239	C2		8y 8mo
	W			
Sealed Sources	TDU-9	V1	Unknown	14y 1mo
	W			
Sealed Sources	P40-TRU	C1	Unknown	12y 10 mo
	W			
Sealed Sources	SNM-350	C1	Unknown	14y 1mo
	W			
Sealed Sources	Am-241-3855	P4	Unknown	2y 10mo

SITE: X-10	FACILITY (Building or Location): WEAF/ Bldg. 7824 FUNCTION: NDA/NDE rad waste and conduct NDA/NDE instrument R&D			
	Am			
Sealed Sources	Cf-252-3522	V1	Unknown	11y 10mo 8y 8mo
	Cf			
Sealed Sources	Cf-34.35	V1	Unknown	1mo
	Cf			
Sealed Sources	DZA-11	C1	Unknown	8y 4mo
	W			
Sealed Sources	Cm-244-3525	V1	Unknown	6y 9mo
	Cm			
TRU Waste[4]	C1,C2,C3 (drums)	C2	Unknown	2y 4mo
	W/R			
Holdup (in ducts, pipes, etc.)[4]				
Unirradiated Reactor Fuel				
High-level Liquid Waste				
Other (specify)				

SITE: X-10	FACILITY (Building or Location): WEAF/ Bldg. 7824
	FUNCTION: NDA/NDE rad waste and conduct NDA/NDE instrument R&D

Question 2 Continued:

Applicable References:

1. Nuclear Material Control and Accountability computer report U9050-FZG.
2. ORNL Nuclear Materials Intra-laboratory Transfer UCN-2681.
3. OHIS/HPIMS Radioactive Source Inventory Report S108.
4. Sealed Source Registration Forms.
5. Intralaboratory Correspondence J.B. Knauer 9-25-85.
6. Intralaboratory Correspondence J.B. Knauer 3-28-94.
7. Schematic Packing Details form for Cm-244-3525, S.A. Richardson 9-15-89.

1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.
2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.
3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.
4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.
5 Holdup has no packaging. Identify location of holdup.

Question 2 (continued)

NMC&A* ID	Nuclide	Assay (wt%)	Date	Mass (g)	Description	Chem/Phys Form	Location
WG-239	Pu-239	93.3%	9-85	17	45 "Quinby" calibration sources: Pu-nitrate adsorbed onto Al substrate, wrapped in a plastic bag and then placed in 4-liter Al cans. 6.7% Pu240, the remainder is Pu239 and Pu241 (S)	Pu-nitrate	Bldg7824, metal cabinet, source cage
TDU-9	Pu-239	93%	7-9-92 4-80 ^ (ORNL)	26	26 cylindrical calibr.sources (2in OD, 3in H). doublyencapsulated SS. Buttons are placed inside a slip-top button container, placed inside a spherical 2° container, then placed in cylind. SS container (welded shut). 7% Pu240, 10% Np237 3 g (S)	oxide^^	Bldg7824, metal cabinet, source cage
P40-TRU	Pu-240	99.86%	4-13-83 7-81 ^ (ORNL)	4	1 source in radioisotope shipping can (yellow). Powder placed in small capsule with 2 plugs at aperture. Capsule suspended in low-Z mat'l within ORNL shipping can.(S)	oxide	Bldg7824, metal cabinet, source cage
SNM-350	Pu-239	97%	7-9-92 4-80^ (ORNL)	2	1 source in radioisotope shipping can (yellow). Source in 20-ml glass vial w/ lid, placed in 50-ml crimp sealed container, suspended in shipping can by homo., low-Z material (S)	oxide	Bldg7824, metal cabinet, source cage
exempt NM C&A (HPIMS: Am-241-3855,3857 }	Am-241	100%	7-15-91	5.8E-06	3 black plastic vials within heat-sealed bags, from Isotope Products Inc. (S)	oxide^^	Bldg7824, metal cabinet, source cage
exempt NM (HPIMS:Cf-252-3522, 3524}	Cf-252	80%	7-12-82 7-12-82 9-12-85	1.4E-07 7.0E-10 1.4E-09	3 doubly-encapsulated sources with fiber plug. Incl. most isotopes of Cf. (S)	Chloride	Bldg7824, metal cabinet, source cage
exempt NMC (HPIMS: CF-34, CF-35}	Cf-252	82%	4-15-94	2.2E-08	2 charged particle detectors with electrodeposited Cf source inside. (S)	Chloride	Bldg7824, metal cabinet, source cage
exempt from NMC&A control OHIS: Pu-239-3874	Pu-239	Don't Know	10-64	1.6E-04	Button source in small plastic snap-box inside a plastic bag, inside a 1-gal can with press-top seal. (U) {In process of disposal}	oxide and/or metal ^^	Bldg7824, metal cabinet, source cage

DZA-11	^{239}Pu	94%	7-16-92 1-86 ^ (ORNL)	27*	2 PuF_4 radioisotope cans containing a sealed glass jar enclosing 10 vials of powder. Jar is suspended in vacuum-packed steel can. (S)	Pu-fluoride vials	Bldg7824, 80-gal paraffin drum, source cage
C1, C2, C3 glove-box samples ID is historical	^{239}Pu	90%	1-31-92	60**	3 samples of glove-box sweepings from NFS Inc. Samples in 50in^3 glass beaker with lid, sealed in 3 bags, placed in 1-gal can, then in a 5-gal can. (S)/(U)?	Pu-oxide	Bldg 7824, source cage
^{244}Cm 3525 (AUA-90B)	^{244}Cm	Don't Know	8-12-87	1.2E-05	1 source sealed in a SS capsule, and placed in a plastic container. (S)	encapsul-ated oxide	Bldg7824, metal cabinet, source cage

\+ NMC&A ID is provided when source is tracked by NMC&A, otherwise the HPIMS # or sample # applies.

^ top date: 7824 receipt date; bottom date: NMC records date showing the source at ORNL site.

^^ Records don't indicate chemical/physical form (tabled value is estimate)

* The 27-g value is undergoing confirmatory measurements using the APNEA system. Preliminary analysis indicates a mass as large as 50 g.

** The 60-g value is undergoing confirmatory measurement using the APNEA system.

Summary of Plutonium Sources

The table shows that Building 7824 houses 11 different types of plutonium sources used for calibrating nondestructive assay instruments. These sources total 86. The majority of the sources are completely encapsulated. A few have at least tertiary containment but are not completely welded shut to ASTM standards. All the sources are stored within a locked source cage within the regulated area of the facility. The facility is located in a controlled area (Solid Waste Storage Area 5) that requires Melton Valley Access via a card reader. To access the source cage and use sources, the sealed-source user must complete requisite training and be placed on authorized personnel list.

The designation of S (Sealed) or U (Unsealed) for the sources listed in the table above is made on the basis of the definitions presented in ORNL Health Physics Procedure RP-2.14 (DOE Order 5400.90 is radioactive material that is contained in a sealed capsule, sealed between layers of nonradioactive material, or firmly fixed to a nonradioactive surface by electroplating or other means. Many of the 7824 sources are sealed between layers of nonradioactive material (e.g. a Pu-oxide powder placed in a glass vial with a screw-top lid, bagged out with a heat seal, then placed in can with a food-pack/rim seal. An unsealed source is any contained radioactive material that does not meet the definition of a sealed source (ESS-RP-902).

In addition to the sources listed above, Building 7824 is permitted to stage drums of transuranic waste for evaluation by nondestructive means (real time radiography and assay by neutron and gamma-ray methods). The Nuclear Safety Review of Building 7824 specifies a facility limit for fissionable material of 5000 g (^{235}U fissionable gram equivalents). This corresponds to roughly 3200 g of ^{239}Pu equivalent.

SITE: X-10	FACILITY (Building or Location): WEAF/Bldg. 7824
	FUNCTION: NDA/NDE rad waste and conduct NDA/NDE instrument R&D

Question 2A: No. Pkgs and Mass   DOE Material Manager ____________________

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal			
Oxide			
Scrap/Residues			
Solution			
Sealed Sources			
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			

SITE: X-10	FACILITY (Building or Location): Weaf/Bldg. 7824
	FUNCTION: NDA/NDE rad waste and conduct NDA/NDE instrument R&D

Barrier #	Worker Protection	Environment and Public Protection
1	WB-15 WB-18	EB-1 EB-4

The majority of the sources are completely encapsulated. A few have at least tertiary containment but are not completely welded shut to ASTM standards: All the sources are stored within a locked source cage within the regulated area of the facility. The facility is located in a controlled area (Solid Waste Storage Area 5) that requires Melton Valley Access via a card reader. To access the source cage and use sources, the sealed-source user must complete requisite training and be placed on authorized personnel list.

SITE: X-10	FACILITY (Building or Location): WEAF/Bldg. 7824
	FUNCTION: NDA/NDE rad waste and conduct NDA/NDE instrument R&D

In-Facility

- [x] Inadvertent Transfers
- [x] Aging
- [ ] Organic Nitric Acid Reaction
- [x] Equipment Failure
- [ ] Change in Mission
- [ ] Other Co-Located Hazards
- [x] Corrosion
- [ ] Inadequate Configuration Knowledge
- [ ] Combustible Loading
- [x] Inadequate Seals
- [x] Potential Water Sources
- [ ] Inadequate Drains
- [ ] Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- [x] Inadequate Preventive Maintenance
- [ ] Administrative Controls
- [ ] Other - Specify

Material

- [ ] Pressurization
- [ ] Pyrophoricity
- [x] Radioactivity
- [ ] Chemical Reactivity
- [ ] Am Buildup
- [ ] Hydrogen Buildup
- [ ] Radiolysis
- [ ] Volumetric Expansion
- [ ] Oxidation
- [ ] Other - Specify

Question 4 Continued:

SITE: X-10	FACILITY (Building or Location): WEAF/Bldg. 7824
	FUNCTION: NDA/NDE rad waste and conduct NDA/NDE instrument R&D

Describe Each Adverse Condition:

In-Facility
Inadvertent transfers of fissile material is a concern which could result in exceeding allowable facility limits for fissile material.

Adverse conditions such as aging and corrosion of the sealed sources is a concern possibly resulting in the leakage of the source material contents and exposure of personnel.

Adverse conditions such as failure of radiation monitoring equipment could result in an undetected spread of contamination.

Inadequate seals on sources could allow material out into the environment, potentially exposing workers to the material.

Adverse conditions such as water sources are now present at the WEAF. A fire-suppression (water sprinkler) system was recently installed in the facility. All potential criticality scenarios assume full-reflecting and fully moderating conditions.

Inadequate preventive maintenance could allow sealed source containers to degrade to the point whereby probability of leakage increases.

Inadequate design basis was not selected on the basis that chapter 4 of ref. 5 "Principle Design Bases and Criteria" addresses design specifications for wind loading, tornado, flood, rain/ice/snow, seismic, and combined load criteria. These specification satisfy referenced DOE Orders and Uniform Building Codes.

Material
Radioactivity of the sealed sources is another potential adverse condition.

SITE: X-10	FACILITY (Building or Location): WEAF/Bldg. 7824
	FUNCTION: NDA/NDE rad waste and conduct NDA/NDE instrument R&D

Applicable References:

1. WEAF NSR 0031WM040009
2. WEAF Procedure: WM-SWO-803.1, Storage, Handling, and Use of Radioactive Material and Sealed Sources
3. Waste Management and Remedial Action Division Training Plan, WMRAD-TR-101
4. ORNL Health Physics Manual, Proc. 2.4
5. ORNL/ENG/SS-5, Safety Study, Waste Examination and Assay Facility, Building 7824. 6/30/92

SITE:	FACILITY (Building or Location):
	FUNCTION:

Question 5: Events

Identify those historical, current, or potential events causing consequences that are exacerbated by the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- ☒ Fire
- ☐ Explosion
- ☐ Worker Exposure
  - ☐ External
  - ☐ Internal
- ☐ Contamination
- ☒ Flooding
- ☒ Leakage/Spills
- ☒ Other Accidents - Specify
- ☒ Human Error

Material
- ☐ Criticality
- ☒ Fissile Material Release
- ☒ Breach of Container
- ☐ Fire
- ☐ Other - Specify

External
- ☒ Aircraft Crash
  - ☐ Vehicle Accident
  - ☐ Explosion
  - ☐ Adjacent Facility Accident
  - ☐ Power Failure
  - ☐ Institutional/Regulatory Requirements
  - ☐ Personnel Radiation Exposure
  - ☒ Ex-facility Fire
  - ☐ Other - Specify

Natural Phenomena
- ☒ Earthquake Damage
- ☒ Wind Damage
- ☒ Flood Damage
- ☐ Erosion Damage
- ☒ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE:	FACILITY (Building or Location):
	FUNCTION:

Describe Each Event:

In-Facility:
A fire could cause several of the adverse conditions to become more severe. The fire-suppression system is a compensatory measure (question 6).

Explosion is not considered because the flammable storage and chemical storage cabinets are not stored in the vicinity of the sealed sources. The amount of flammable/combustible material in the facility is very small.

In-facility flooding could cause several of the adverse conditions to become more severe. The drainage system around the facility is a compensatory measure.

A spill in the vicinity of the sealed-source cage or in the vicinity of a source use area could exacerbate an adverse condition. Only solid radioactive waste is handled in the facility; very few liquid sources are present.

Human error is an always-present potential and could cause adverse conditions to become more severe. Errors could result in contamination of the facility and workers and exposure of workers to internal and external radiation. Mitigation efforts include an operator training program and administrative controls such as facility operating procedures and monitoring requirements when exiting controlled areas. Radiation monitoring equipment can also mitigate exposure to workers.

Other accidents include those related to kinetic and potential energy (i.e. something falls on a source, a forktruck runs over a source, compressed-air system breaks, LN2 leak). These events would exacerbate an adverse condition, although they are not highly likely.

Material:
The release of fissile material and/or breach of a sealed-source container may exacerbate existing adverse conditions, but to a very small degree.

External:
An aircraft crash or an ex-facility fire are unlikely events but would exacerbate adverse conditions listed in question 4.

Natural Phenomena:
Earthquake damage, wind damage, flood damage, and snow/ash loading damage are discussed in the WEAF safety study. The building is designed to sustain a design basis accident as described in the reference.

SITE:	FACILITY (Building or Location):
	FUNCTION:

Applicable References:

ORNL/ENG/SS-5, Safety Study, Waste Examination and Assay Facility, Building 7824. 6/30/92

WM-SWO-7824LCD-R0, Limiting Conditions Document, Building 7824, Waste Examination and Assay Facility, Waste Management and Remedial Action Division. 8/24/92.

HS/7824/F/1/R0, Phase I Safety Analysis Report Update Program, Hazard Screening, Waste Examination and Assay Facility, Building 7824. 2/27/92.

SITE:	FACILITY (Building or Location): FUNCTION:

Preventive
 	
☒ Procedures: ops., maint., surveillance
☒ Material Limits
☒ Training
☒ Quality Assurance
☒ Conduct of Operations
■ Authorization Basis (safety analysis, BIOs)
☒ Surveillance
☒ Organization
  ☒ Structure
  ☒ Management Involvement
  ☒ Staffing
☒ Lessons Learned
☐ Configuration Control of Design
☒ Preventive Maintenance
☒ Monitoring
☐ Trending (Performance Indicator)
☒ Testing/Verification of Integrity
■ Regulatory Requirements
☒ Records
  ☒ Personnel Exposure
  ☒ Equipment
  ☒ Waste Inventory
  ☒ QA
☐ Personnel Reliability Assurance Program
☐ Other - Specify
	Mitigative
	
	☒ Emergency Preparedness
	☒ Emergency Management
	  ☒ Emergency Planning
	  ☒ Emergency Procedures
	  ☐ Emergency Response
	☐ Safety Systems
	☒ Alarm Systems
	☐ Other - Specify

SITE:	FACILITY (Building or Location):
	FUNCTION:

Compensatory Measure	Reference Document
Inadvertent transfer of fissile material is mitigated by	UCN-2681 Form, Internal Transfers
the NMC&A accountability control system and ORNL Criticality Review Committee review of fissile material in excess of specified quantities.	HP Manual 2.4.
Aging and corrosion of sealed sources are addressed	Health Physics Procedure RP-2.14.
by the biannual sealed source inventory, inspection, and leak test, which is conducted by the ORNL Radiation Source Control Group. In addition, each quarter a report generated by Radiation Source Control is compared with the actual physical sealed source inventory by the WEAF Sealed Source Custodian as per procedure.	
Operability of constant air monitors, constant alpha air monitors, laboratory monitors alpha, and laboratory monitors beta-gamma are addressed by (1) the daily inspections performed by WEAF personnel, (2) biannual Health Physics instrument calibrations, and (3) biannual Instrumentation and Control inspections and instrument calibrations.	WEAF-SWO-803.1 HP Procedure 2.4 I&C Procedure
Inadequate seals on sources are mitigated by the fact that a sealed-source leak test and inspection is performed biannually.	HP Procedure 2.4
The WEAF Nuclear Safety Review is currently undergoing revision to account for sealed source criticality potential, including potential flooding from fire suppression system.	WEAF NSR 0031WM040009
Inadequate preventive maintenance is mitigated by the fact that a sealed-source leak test and inspection is performed biannually.	HP Procedure 2.4
Radioactivity of the sealed sources is addressed by WEAF operating procedures and ORNL Health Physics procedures which dictate proper handling, storage, and use of radioactive sealed sources. Also, the As Low As Reasonably Achievable (ALARA) principle is practiced at the WEAF. All facility personnel are made aware of these procedures via documented training courses.	WM-SWO-803.1 HP Procedure 2.4 WMRAD-TR-101

SITE:	FACILITY (Building or Location):
	FUNCTION:

Uncertainty or Concern | Discussion

Compensatory Measure (continued)

Safety class systems are not required for a facility identified as a low hazard category. Refer to the safety study, sec. 5.4.

SITE: X-10	FACILITY (Building or Location): WEAF/Bldg. 7824
	FUNCTION: NDA/nde rad waste and conduct NDA/NDE instrument R&D

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

EVENT	WORKER			ENVIRONMENT			PUBLIC		
	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
In-Facility									
Fire	N	N	N	N	N	N	N	N	N
Flooding	N	N	N	N	N	N	N	N	N
Leakage/Spills	N	N	N	N	N	N	N	N	N
Human Error	N	N	N	N	N	N	N	N	N
Other-Kinetic/Potential Energy	N	N	N	N	N	N	N	N	N
Material: Fissile Mat'l Release	N	N	N	N	N	N	N	N	N
Breach of Container	N	N	N	N	N	N	N	N	N

SITE: X-10	FACILITY (Building or Location): WEAF/Bldg. 7824								
	FUNCTION: NDA/nde rad waste and conduct NDA/NDE instrument R&D								
External: Aircraft Crash	N	N	N	N	N	N	N	N	N
Ex-Facility Fire	N	N	N	N	N	N	N	N	N
Earthquake Damage	N	N	N	N	N	N	N	N	N
Wind Damage	N	N	N	N	N	N	N	N	N
Flood Damage	N	N	N	N	N	N	N	N	N
Snow/Ash Loading Damage	N	N	N	N	N	N	N	N	N

Explanation:

Compensatory measures for the unlikely events described above are sufficient to protect workers, environment, and the public.

SITE:

Question 8: Overall Site Summary

The most important concerns related to plutonium storage, handling, and processing of the WEAF Pu sealed sources are the (1) proper handling and storage and (2) sealed-source container integrity. Each of these concerns is adequately addressed by the following procedures and mandatory inspections:

1. WEAF Procedure WM-SWO-803.1, "Storage, Handling, and Use of Radioactive Material and Sealed Sources."

2. ORNL Health Physics Manual, Procedure RP-2.4, "Fissile Material Safety."

3. ORNL Health Physics Manual, Procedure RP-2.14, "Control of Sealed and Unsealed Radioactive Sources."

4. WEAF Nuclear Safety Review NSR 0031WM040009.

5. Biannual leak tests of sealed sources by the ORNL Radiological Protection Dept.

6. Running inventory of accountable sealed sources by ORNL Safeguards and Security Dept. (Occupational Health Information System (OHIS) / Health Physics Instrument Management System (HPIMS) Source Inventory System).

7. Running inventory of all sealed sources by designated WEAF personnel (i.e., WEAF Material Balance Area Representative and Sealed Source Custodian).

An accident scenario involving the damage of sealed sources wherein the contents are leaked exposing workers and the environment to the radioactive contents would pose the highest risk to the environment, worker, and public at our site. In our "qualitative" judgement, however, we believe the likelihood of the afformentioned events occurring is acceptably small.

Current practice to minimize worker exposure, reduce environmental risks, and protect the public at or near our site include continuation of the practices and procedures listed above. Also, currently a review of the WEAF NSR is ongoing to assess criticality safety of the WEAF sealed-source inventory.

As a result of a reevaluation of question 5, no vulnerabilities were determined on the basis of reasonable likelihood parameters that describe the probability of a given event occurring. Those events that would cause an adverse condition to become more severe are believed to be very unlikely under existing conditions—the events/outcomes described previously are considered to be no greater than standard/common industrial hazards.

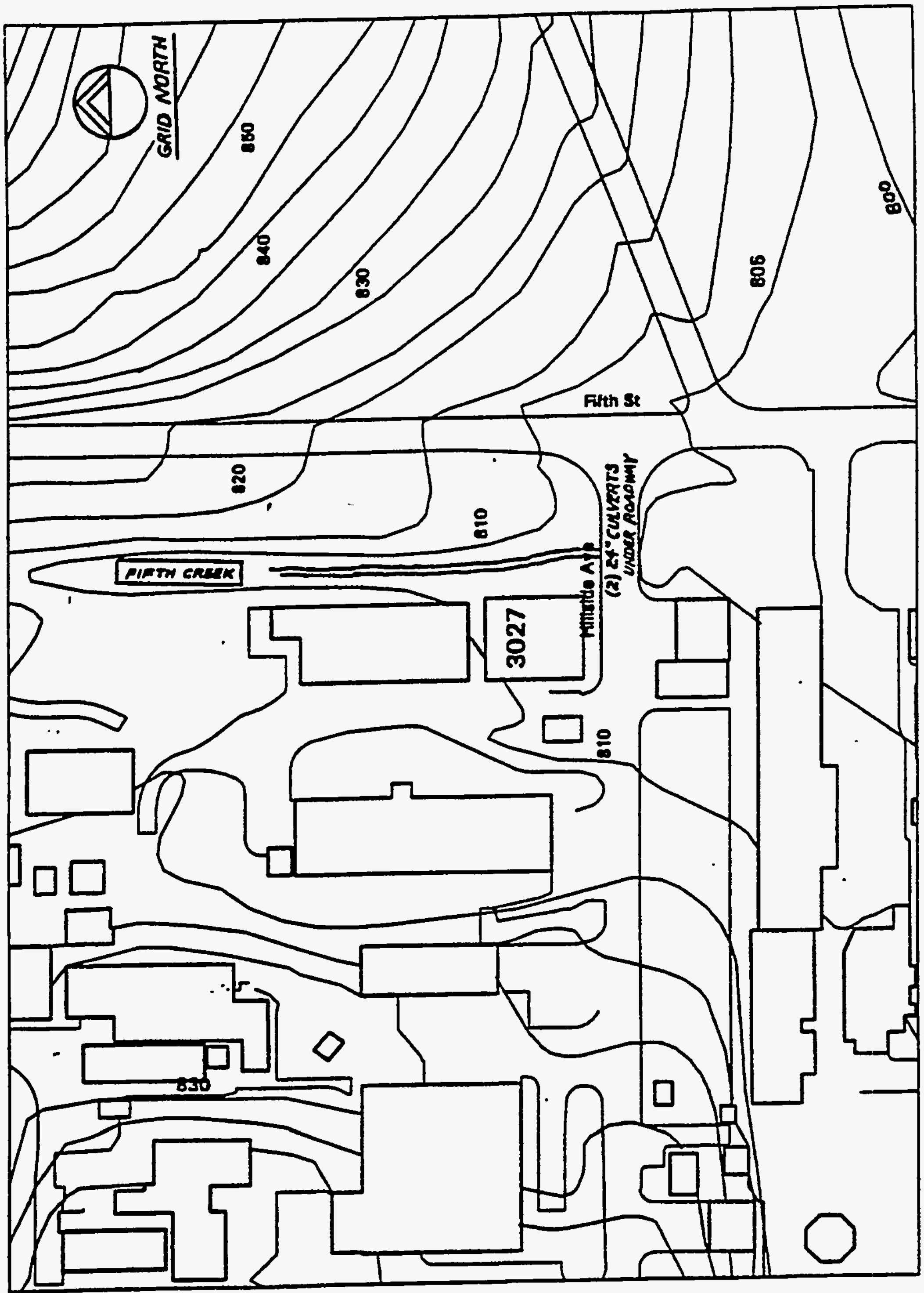


Figure 4. Area Topography

1-10

NUCLEAR MATERIAL AUTHORIZATION

IC NUMBER	IC DATE
4203	5-30-91

TO BE FILLED IN BY SSD

FORWARD TO: SAFEGUARDS AND SECURITY DEPARTMENT (SSD)
BLDG. 3037. MAIL STOP 6016

USE PROJECT No. F-KC-0000-000

1. PROGRAM: BASIC ENERGY SCIENCE
2. PERSON RESPONSIBLE: G. H. COLEMAN
3. MBA NUMBER: 06
4. CONTROL AREA: 3027 VAULT
5. BUDGET & REPORTING NO.: KC0000000
6. CHARGE CODE NO: 3330-0430
7. INCLUDED IN 10 - YEAR FORECAST OF REQUIREMENTS: ☐ YES ☒ NO FOR FY
8. MATERIAL: PU-BE
9. CHEMICAL OR PHYSICAL FORM: SOLID.
10. ☒ UNIRRADIATED ☐ IRRADIATED

11. QUANTITY REQUESTED	12. QUANTITY ON HAND PU239/241	13. TOTAL	14. ISOTOPE %
ELEMENT WT. 16 g	ELEMENT WT 732 g	ELEMENT WT 748 g	6.5g PU240
ISOTOPE WT 15 g	ISOTOPE WT 620 g	ISOTOPE WT 635 g	

15. PURPOSE AND DESCRIPTION OF PROPOSED USAGE

STORAGE UNTIL NEED EXISTS FOR USAGE.

16. ESTIMATED LENGTH OF TIME MATERIAL WILL BE IN USE: Stored until declared excess
17. ESTIMATED QUANTITY WHICH WILL BE CONSUMED: NONE
18. DISPOSITION OF MATERIAL: NOT KNOWN AT THIS TIME.
19. IN APPROXIMATELY: NOT KNOWN.

20. INTERNAL MOVEMENTS OF MATERIAL AND THE PURPOSE OF EACH TRANSFER

TRANSFER FROM Y-12 TO ORNL VAULT. SOURCE IS PRESENTLY NOT NEEDED.

BUT DECISION TO REACTIVATE FACILITY WOULD JUSTIFY THE NEED FOR SOURCE.

21. DESCRIPTION OF SAFETY, HEALTH, SECURITY, AND CONSERVATION PROVISIONS PLANNED

ACCORDING TO MBA 006 PROCEDURES ALREADY IN EXISTANCE.

22. ATTACH MATERIAL FLOW SHEET OR DIAGRAM IF APPROPRIATE

23. SIGNATURE OF REQUESTER (REQUIRED): G.H. Coleman
24. SIGNATURE OF MATERIAL BALANCE AREA REPRESENTATIVE (REQUIRED): G.H. Coleman / MBA 06 [signature]
25. SIGNATURE OF PROJECT MANAGER (REQUIRED): G.H. Coleman
26. DIVISION DIRECTOR APPROVAL (REQUIRED): H. A. Glovier [signature]
27. CRITICALITY COMMITTEE APPROVAL (REQUIRED): Calvin M. Hopper for R.M. Westfall 5/30/91
28. OFFICE OF OPERATIONAL READINESS AND SAFETY APPROVAL (REQUIRED): [signature] 5/30/91
29. SAFEGUARDS AND SECURITY DEPARTMENT (REQUIRED): [signature] 5/30/91
30. ASSOCIATE DIRECTOR OF OPERATIONS (REQUIRED FOR QUANTITIES OF SPECIAL NUCLEAR MATERIAL OF 100 GRAMS OR MORE)

UCN-2471 (3 8-90)

2-4

Attachment 1

ORNL AREA

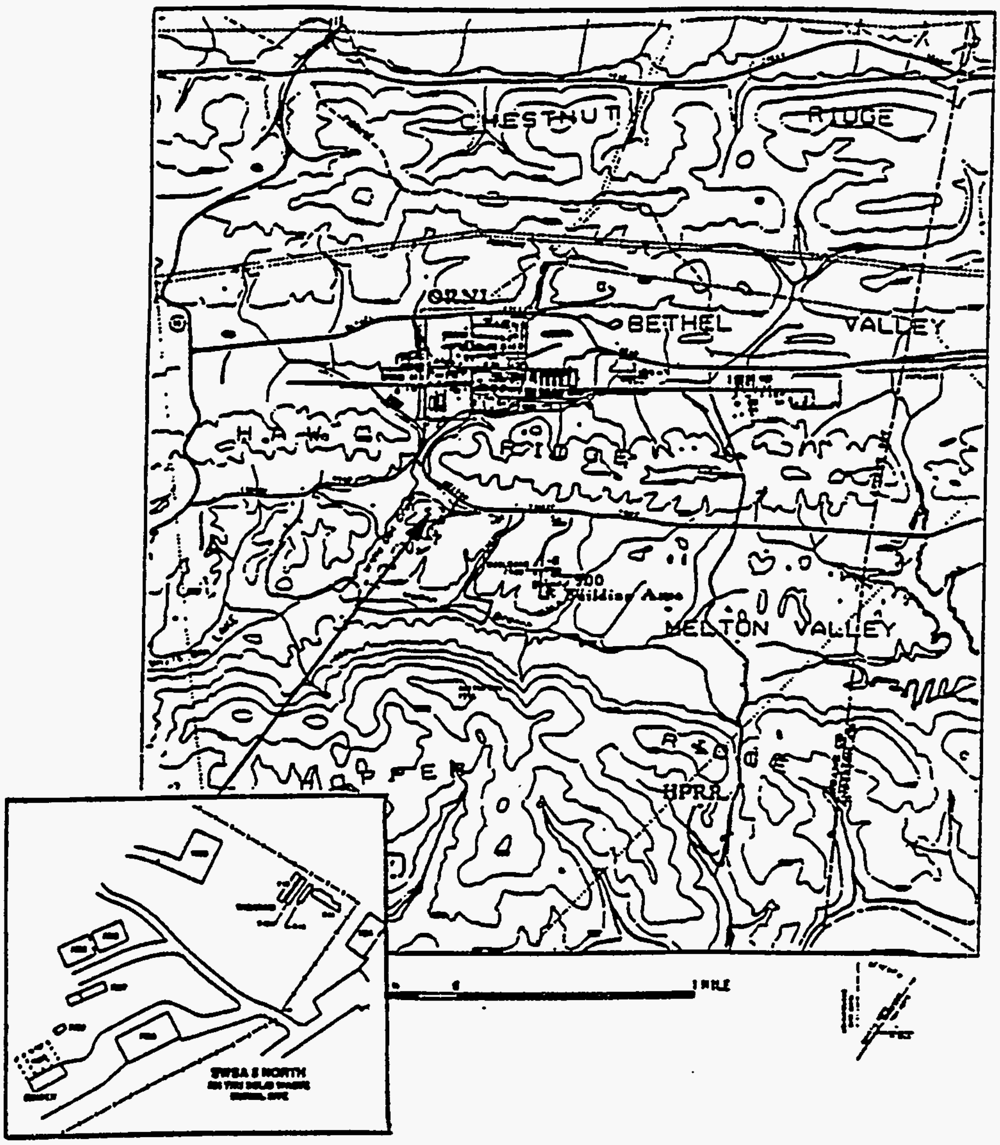
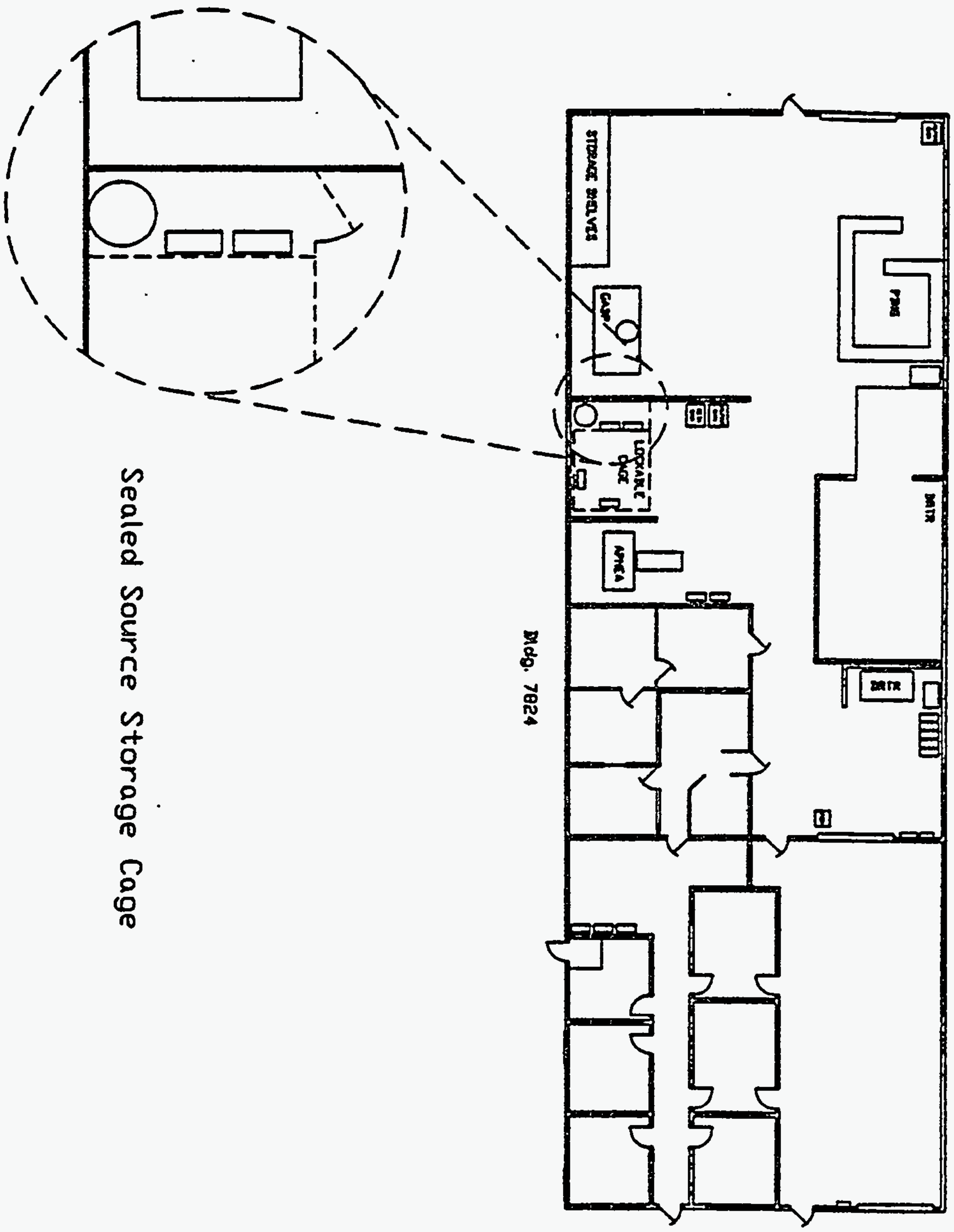


Fig. 3.1. Building 7824 location.

2

Attachment 2



Sealed Source Storage Cage

Attachment 3

Final Report
Page 1 of 5

OCCURRENCE REPORT

X10WSTEMRA - Waste Mgt. & Remedial Action

(Name Of Facility)

Nuclear Waste Operations/Disposal

(Facility Function Involved)

Oak Ridge National Laboratory

(Name of Laboratory Site or Organization)

Name: H L ADAIR
Title: DEPT. HEAD SWO
Telephone No. (615)574-5901

(Facility Manager/Designee)

Name: F J SCHULTZ
Title: GROUP LEADER, RSWIG
Telephone No. (615)576-6870

(ORIGINATOR)

1. OCCURRENCE REPORT NUMBER:
MMES Occurrence Number: MMES-92-011246 X10 -92-08213 (I0003939)
Action Item Reference ID:
Source ID Number:

2. REPORT TYPE AND DATE:

	Date	Time
[ ] Notification Report	12/18/1992	17:26
[ ] 10 Day Report		
[ ] 10 Day Update (latest)		
[X] Final Report	/ /	

3. OCCURRENCE CATEGORY:

[ ] Emergency
[ ] Unusual
[ ] Off-Normal
[X] Non-Routine

4. DIVISION OR PROJECT:

Wst Mgmt & Rem Act

5. DOE PROGRAM OFFICE:

EM - Environmental Restoration

OCCURRENCE REPORT

6. SYSTEM, BLDG., OR EQUIPMENT:
7824

7. UCNI?
NO

8. PLANT AREA:
Waste Examination Assay Facility (WEAF)/SWSA-5N

9. DATE AND TIME DISCOVERED:
12/07/1992 15:45

10. DATE AND TIME CATEGORIZED:
12/07/1992 17:30

11. DATE AND TIME OF DOE NOTIFICATION:

12. DATE AND TIME OF OTHER NOTIFICATIONS:

13. SUBJECT OR TITLE OF OCCURRENCE:

Personnel Contamination from U-235

14. NATURE OF OCCURRENCE:

4B Personnel Rad Protection - Pers. Contamination

15. DESCRIPTION OF OCCURRENCE:

Occurrence Condition:

At approximately 15:45 on December 7, 1992, two Waste Examination Assay Facility (WEAF) personnel were contaminated with a small amount of U-235. The two WEAF personnel were preparing to make measurements with the Active Passive Neutron Examination and Assay (APNEA) Unit using an enriched U-235 foil at the WEAF, Building 7824. The U-235 foil was inside a plastic bag and rolled up with the edges of the roll taped together to prevent unrolling of the foil. The diameter of the rolled U-235 foil was too large to place inside a one inch test hole in a 55 gallon drum which had been filled with concrete. While using protective gloves and leaving the plastic wrapping in place, one of the two WEAF personnel removed the tape and the foil was rolled to a smaller diameter to allow placement inside the test hole of the concrete drum. After rerolling, tape was reattached to keep the roll secure. Small amounts of dark powder were observed on the platform in the immediate area where the rolling had taken place. Follow-up investigation by the two WEAF personnel detected alpha contamination on the shoes and the hands of one of the employees and contamination on the shoes of the other

OCCURRENCE REPORT

employee. Health Physics personnel were contacted to assist in the assessment of the contamination.

16. OPERATING CONDITIONS OF FACILITY AT TIME OF OCCURRENCE:

Normal

17. ACTIVITY CATEGORY:

Normal Operations

18. IMMEDIATE ACTIONS TAKEN AND RESULTS:

Protective Action Recommendations: None

Two Health Physics personnel conducted whole body surveys of the two WEAF personnel. An additional WEAF employee had entered the area to assist and also had slight contamination on his shoes. One of the WEAF employees directly involved in the operation had 2000 dpm, alpha, on the shoes and 1000 dpm above the knee on the right leg of the pants. The other WEAF employee directly involved in the operation had 2200 dpm, alpha, on the shoes and 500 dpm on the hands. The WEAF employee who assisted after contamination was detected had 500 dpm, alpha, on the shoes. The floor area around the APNEA probed 2000 dpm, alpha, per 100 sq. cm. and 3300 dpm, alpha, for a swipe over a large area (>> 100 sq. cm.).

Nasal smears taken of both WEAF employees directly involved in the operation were negative. Soap and water were used to decontaminate the hands of one employee and the shoes of three WEAF employees.

19. DIRECT CAUSE:

20. CONTRIBUTING CAUSE(S):

21. ROOT CAUSE:

22. DESCRIPTION OF CAUSE:

CORRECTIVE ACTION RESPONSE and STATUS Form
Envi ntal, Safety, and Health Compliance

Current Date: 08/07/90

Corrective Action No.: CAR-ENP-000-129 Activity No.: ENP-000 Evaluation No.: UOR-90-29-ENP-90-005 Evaluation Date:

Evaluation Title: Clothing Contamination at WEAF
Finding/Recommendation:

: 1:30 p.m., June 22, 1990, a Solid Waste Operations (SWO) Department employee discovered contamination on the left hand by robing with a lab monitor beta/gamma (LBM) located at the south entrance to the WEAF, Solid Waste Storage Area (SWSA) No. 5. The mount detected was 300 cpm. Immediately prior to the discovery of the contamination, the employee had opened a lead pig as a part an ongoing sealed source inventory. The sealed sources are located in a lockable cage next to the passive-active neutron assay ystem, which is located along the west wall of the facility. The sources are used for measurement control checks for the WEAF gmented gamma scanner.

e immediate evaluation was that a leaking source was the source of contamination. The source being checked at the time the ployee was contaminated was a 152/154Eu mixed oxide singly encapsulated in stainless steel. The capsule is approximately 0.5 . long with a 10-mil-thick window. The body of the capsule is composed of 1/16 in. stainless steel. The capsule was obtained in e early 1980s and was prepared by Isotopes Section personnel from waste material that resulted from 153Gd production operations. e source was located inside a lead pig and has a radiation reading at contact of approximately 600 mR/h. sequent investigation revealed the contamination was 60Co and did not originate from the 152/154Eu source. The contamination e from inside the lead pig. The employee was contaminated when the lead pig top was removed and inventory data retrieved. The ployee did not directly handle the source. A string was attached to the source and is used in removing the source from the lead for visual inspection or when it is used for measurement control checks for the WEAF segmented gamma scanner. The employee's ket dosimeters indicated no detectable personnel exposure had occurred. Upon detecting the contamination, the SWO employee uested and received assistance from two Radiation Protection personnel. Resulting probes of the SWO employee identified two itional areas of contamination. 15,000 cpm on a spot of the left cheek and 3,000 cpm on left pants leg below the knee.

rect tion:

The remaining lead pigs containing sealed sources will be examined in a hood and in accordance with instructions documented on diation work permit.

duled Completion Date: 08/31/90

on Responsible: Dan E. Coffey Date 07/03/90 Schultz, F ~~Scanlan, T. F.~~

evel Supervisor: F. J. Schultz 2nd Level Supervisor

Chairperson/DOE Representative J. A. Setaro Date 06/25/90
Action addresses finding

Person Responsible for Action Dan E. Coffey Date Scanlan, T. F.
Accepts and Understands Task of Assignment

Responsible Manager Date
Commits Resources to Corrective Action

QA Specialist Date Boules, G. F.
Assures Adequacy of Action

COMPLETION DATE: 07/03/90 PERSON RESPONSIBLE: Dan E. Coffey Scanlan, T. F.

ERIFI ON DATE: QA SPECIALIST: Boules, G. F.

ntered into ESOIS Date Entered into OIS

MARTIN MARIETTA

MARTIN MARIETTA ENERGY SYSTEMS, INC.

MARTIN MARIETTA ENERGY SYSTEMS, INC.
OAK RIDGE NATIONAL LABORATORY
UNUSUAL OCCURRENCE REPORT

Page 1 of 2

1. Report No. ORNL-86-16-OP-86-6
2. Report Date
   Initial October 16, 1986
   Interim
   Final November 26, 1986

3. Division or Project

Operations Division

4. Facility, System, and/or Equipment

Waste Examination Assay Facility (WEAF), Building 7824

5. Date of Unusual Occurrence	6. Time of Unusual Occurrence
October 16, 1986	11:30 a.m.

7. Unusual Occurrence Subject

Contamination

8. Apparent Cause: Design ______ Material x Personnel ______ Procedure x
   Other ______, Explain in Item 14

9. Description of Unusual Occurrence

Alpha contamination from a transuranic waste drum was discovered in areas of the WEAF after a technician had checked his hands and feet upon exiting the Transuranium Processing Plant. Contamination was discovered in the following areas: real-time radiography (RTR) unit's drum pad, RTR turntable, on top of a waste drum, floor of personal vehicle, brake pedal of personal vehicle, floor of company truck, and general bay area.

10. Operating Conditions of the Facility at Time of Unusual Occurrence (if applicable)

Normal operations - examining drums

11. Immediate Evaluation

Contamination was encountered by a technician in WEAF prior to his going to the Transuranium Processing Plant. The WEAF did not have hand/foot monitors but did have available portable alpha probes. The WEAF did not have an established policy or procedure for self-checking when exiting the facility; therefore, contamination was not discovered until the technician exited a facility that requires self-checking. Drums which have previously been checked for contamination and found clear are normally brought into WEAF for RTR checking. They are then moved out without having been opened.

UCN-11180
(3 3-84)

UNUSUAL OCCURRENCE REPORT

Page 2 of 2

Report No. ORNL-86-16-OP-86-6

Report Date November 26, 1986

12. Immediate and/or Temporary Corrective Action Taken and Results

Nasal smears of personnel - 3 negatives, 1 positive (40 dpm); whole body counter - 4 negatives; WEAF surveyed - source not discovered - building sealed until next workday.

13. Is Further Evaluation and/or Corrective Action Necessary? Yes ____ No x

If Yes: Before Further Operation

By Whom? __________

When __________

14. Final Evaluation and/or Corrective Action

The facility was decontaminated, the floor surface was coated with two layers of epoxy paint, alpha and beta-gamma instruments were located at north and south exits, and procedures were modified to include personnel monitoring upon exiting WEAF and for routine monitoring of RTR during normal operations.

A committee was formed to investigate this incident to determine the cause and to recommend measures to prevent recurrence. The recommendations of this committee have been accepted and implemented.

Examination of the suspected waste drum immediately prior to initiation of WEAF decontamination indicated the bottom of the stainless steel drum had been corroded by an internal agent. The leakage and subsequent contamination were not caused by mishandling of the drum.

Taken x Recommended ____ To be supplied ____

15. Programmatic Impact

Minimal impact on program.

16. Impact Upon National Codes and Standards, Including RDT Standards

N/A

17. Similar Unusual Occurrence Reports [indicate report no.(s)]

ORNL-84-32-OP-84-7

18. Suggested Laboratory-wide Application of Corrective Action Taken for this Unusual Occurrence

N/A

19. Signatures:

Originator F. J. Schultz — F. J. Schultz — Date 12/5/86

Approved by J. A. Setaro — J. A. Setaro, Section Head, Isotopes — Date 12/5/86

Approved by J. H. Swanks — J. H. Swanks, Director, Operations Division — Date 12/31/86

Approved by R. S. Wiltshire — R. S. Wiltshire, Executive Director — Date 1/14/87

MARTIN MARIETTA
MARTIN MARIETTA ENERGY SYSTEMS, INC.

MARTIN MARIETTA ENERGY SYSTEMS, INC.
OAK RIDGE NATIONAL LABORATORY
UNUSUAL OCCURRENCE REPORT

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1. Report No. ORNL-84-32-OP-84-7
2. Report Date
   Initial 3/7/85
   Interim
   Final

3. Division or Project
   Operations Division

4. Facility, System, and/or Equipment
   TRU Waste Drum Assay Facility, Building 7824 (SWSA 5)

5. Date of Unusual Occurrence
   March 5, 1985

6. Time of Unusual Occurrence
   1:30 p.m.

7. Unusual Occurrence Subject
   Release of alpha-contaminated material.

8. Apparent Cause: Design ____ Material X Personnel ____ Procedure ____
   Other ____, Explain in Item 14.

9. Description of Unusual Occurrence
   Partial loss of integrity of a 208-liter (55-gallon) mild steel drum during drum transfer operations inside assay facility. Contamination spill was first noticed when rigger operating forklift turned to check forklift clearance. He noticed a trail of brown particles following the path of the drum's movements. Rigger ceased forklift operations and called Health Physics office.

10. Operating Conditions of the Facility at Time of Unusual Occurrence (if applicable)
   Riggers were collecting TRU drums onto a wooden skid in preparation for transfer from the assay facility, Building 7824, to the drum staging area, Building 7823. No other operations were in progress at the time.

11. Immediate Evaluation
   Bottom of the 208-liter (55-gallon) mild steel had developed corrosion along a 10"-12" arc adjacent to the bottom ring. It was not apparent whether the corrosion was caused by external or internal agents. The exact time the contamination was released from the drum could not be determined, but the activity was confined to the assay facility south of the office complex. The drum was delivered to the assay facility two days prior to the incident. As a result of the release, one rigger's clothing was slightly contaminated, and the facility floor, equipment, and instrumentation located south of the office complex were contaminated to varying degrees. Initial smears indicated alpha contamination levels ranging from 50 d/m/100 cm^2 to 175,000 d/m/100 cm^2. The hottest spots were those containing the brown-colored dust.

UCN-11100
(3 9-84)

UNUSUAL OCCURRENCE REPORT

Page 2 of

Report No. ________

Report Date 3/7/85

12. Immediate and/or Temporary Corrective Action Taken and Results
All personnel were evacuated from the facility. The facility entrance was marked with No Entrance signs by Health Physics personnel. Management was notified. Riggers were probed to detect any contamination. Nasal smears were obtained. No personnel were found to have been contaminated. Decontamination procedures were initiated at 4:45 p.m., 3/5/85.

13. Is Further Evaluation and/or Corrective Action Necessary? Yes X No ____
If Yes: Before Further Operation : Corrective action - clean facility and drums in area as required.
By Whom? Assay facility operators and burial ground personnel.
When Immediately

14. Final Evaluation and/or Corrective Action
Decontamination of the assay facility will continue. Completion date is estimated to be 3/15/85. Decontamination procedures will include: 1) hand-scrubbing of hot spots (>5000 d/m/100 cm^2) on assay facility floor; 2) mechanical scrubbing of floor followed by wet vacuum using a wet/dry vacuum; 3) damp wipe all flat surfaces south of office complex; 4) periodic smears of selected surfaces will be obtained during all decontamination operations; and 5) remaining activity on floor will be sealed by a floor coating.

Taken X Recommended ____ To be supplied ____

15. Programmatic Impact
If present estimation of decontamination operations is accurate, the delay will have minimal programmatic impact.

16. Impact Upon National Codes and Standards, Including RDT Standards
None.

17. Similar Unusual Occurrence Reports [indicate report no.(s)]
None.

18. Suggested Laboratory-wide Application of Corrective Action Taken for this Unusual Occurrence
Periodic detailed inspection of all waste containers.

19. Signatures:

Originator F. J. Schultz F. J. Schultz Date 3/7/85

Approved by ________ Date ________

Approved by ________ Date ________

Approved by ________ Date ________

RI No. 3-2-85

PRELIMINARY REPORT OF RADIATION INCIDENT

Basis for Report: H.P. Manual, Procedure 2.6, 3.__.

Division: Operations Bldg. or Area: 7824

Date of Incident: 3/5/85 Time of Incident: Approx. 2:00 p.m.

Date Reported: 3/5/85 Time Reported: 6:00 p.m.

Probable type of Incident: Minor X Radiation Event ____

Type of Hazard: Contamination X Personnel Contamination ____ Personnel Exposure ____

Type of Material: Alpha X β,γ ____ Other ____ Unknown ____

Division Director(s) J. H. Swanks, G. W. Oliphant Supervisor F. J. Schultz

Description:

Detectable levels of alpha-emitting contamination were found on surfaces in Building 7824 following relocation of some drums (55-gallon black iron) containing solid transuranic-contaminated waste. One of the drums being moved had developed a small leak and is thought to be responsible for the presence of the contamination. The area initially found contaminated was small (∼100 ft²) with the highest probe reading in area being 75,000 cd/m. Smears of the area counted up to 12,000 cd/m.

Those involved in the relocation of the drums (all P&E personnel) were surveyed and found to be free of contamination with the exception that Hawkins had a small spot which probed ∼1,000 cd/m present on his khaki trousers. Nasal smears taken from all three individuals counted background.

Even though there was no evidence of internal exposure, all three will be evaluated at the Whole Body Counter and will submit urine samples for analyses.

Decontamination efforts, for the purposes of restoring the area to a contamination-free condition, commenced on 3/5/85 and continues.

Personnel Involved:	Name	Badge Number	Division
	B. J. Bruce	13541	P&E
	J. T. Byrge	14717	P&E
	W. D. Hawkins	16937	P&E

Reported: R. L. Jeffers

998c:ac

cc: C. D. Berger
G. H. Burger
H. M. Butler
A. S. Garrett, Jr.
M. W. Knazovich
D. C. Parzyck
P. S. Rohwer
Division Director(s)
HPR
RCO(s)
Supervisor(s)

Final Report
Page 1 of 5

OCCURRENCE REPORT

X: STEMRA - Waste Mgt. & Remedial Action

(Name Of Facility)

Nuclear Waste Operations

(Facility Function)

Oak Ridge National Laboratory

(Name of Laboratory Site or Organization)

Name: F J SCHULTZ
Title: ~~GROUP LEADER, RSWIG~~ DEPT. HEAD, ARMD
Telephone No. (615)576-6870

(Facility Manager/Designee)

Name: F J SCHULTZ
Title: ~~GROUP LEADER, RSWIG~~ DEPT. HEAD, ARMD
Telephone No. (615)576-6870

(ORIGINATOR)

1. OCCURRENCE REPORT NUMBER:
   Action Item Reference ID: I0016539 -
   Source ID Number:

2. REPORT TYPE AND DATE:

	Date	Time
[ ] Notification Report	04/20/1994	13:21
[ ] 10 Day Report		
[ ] 10 Day Update (latest)		
[X] Final Report	04/20/1994	13:28

3. OCCURRENCE CATEGORY:

   [ ] Emergency
   [ ] Unusual
   [ ] Off-Normal
   [X] Non-Routine
   [ ] Void

4. DIVISION OR PROJECT:
   Wst Mgmt & Rem Act

5. DOE PROGRAM OFFICE:
   EM - Environmental Restoration and Waste Management

Final Report
Page 2 of 5

OCCURRENCE REPORT

SYSTEM, BLDG., OR EQUIPMENT:
7824

7. UCNI?
NO

8. PLANT AREA:
Waste Examination and Assay Facility

9. DATE AND TIME DISCOVERED:
04/12/1994 21:20

10. DATE AND TIME CATEGORIZED:
04/12/1994 21:20

11. DATE AND TIME OF DOE NOTIFICATION:

12. DATE AND TIME OF OTHER NOTIFICATIONS:

13. SUBJECT OR TITLE OF OCCURRENCE:

Inadequate Drainage Causes Water to Enter Facility

14. NATURE OF OCCURRENCE:

8A Fac. Status - Fac/Proc Securing/Curtailing Ops.

15. DESCRIPTION OF OCCURRENCE:

At approximately 9:20 p.m. on April 12, 1994, a large stream of water entered the Waste Examination Assay Facility (WEAF) through the west wall adjacent to the box real-time radiography reinforced concrete pad. The water entered during a heavy rain. The stream was approximately 4 feet wide and 1 inch deep. It traversed the building from the west wall and exited at the far east wall for a total distance of approximately 50 feet. No permanent damage to the facility or equipment was observed during the event. The situation was brought under control by WEAF personnel with the assistance of construction personnel from Milbourn Construction Company. Milbourn Construction is currently responsible for a facility upgrade project.

16. OPERATING CONDITIONS OF FACILITY AT TIME OF OCCURRENCE:

Normal

17. ACTIVITY CATEGORY:

Normal Operations

18. IMMEDIATE ACTIONS TAKEN AND RESULTS:

WEAF and construction personnel acted to clear the dirt and mud away from the facility and relieve the water backup. The inside of the facility was cleaned & vacuumed. MK-Ferguson is currently

OCCURRENCE REPORT

esponsible for the final assessment and correction of the ituation.

19. DIRECT CAUSE:
6B Mgmt. Problem - Work Organ/Planning Deficiency

20. CONTRIBUTING CAUSE(S):

21. ROOT CAUSE:

22. DESCRIPTION OF CAUSE:

Inadequate drainage outside the building caused the water to enter the building during a heavy rain. The drainage problem was caused by a large pile of dirt ~~located~~ adjacent to the facility. The dirt was piled there during excavation activities as part of the facility upgrade project. During the heavy rain some of the dirt slid down and blocked a storm drain causing the water to pool beside the building. Eventually the water entered the facility at that location.

23. EVALUATION: (by Facility Manager/Designee) COST EVALUATION:

24. IS FURTHER EVALUATION REQUIRED: Yes [ ] No [X]
IF YES, BEFORE FURTHER OPERATION: Yes [ ] No [X]
IF YES, BY WHOM? BY WHEN?

25. CORRECTIVE ACTIONS:

26. IMPACT ON ENVIRONMENT, SAFETY, AND HEALTH:

PROGRAMMATIC IMPACT:

28. IMPACT UPON CODES AND STANDARDS:

29. FINAL EVALUATION AND LESSONS LEARNED:

30 IMILAR OCCURRENCE REPORT NUMBERS:

OCCURRENCE REPORT

A. JIRECT CAUSE:

/20. CONTRIBUTING CAUSE(S):

21. ROOT CAUSE:

22. DESCRIPTION OF CAUSE:

A failure to provide detailed information in NSR 0031WM040009 that listed the WEAF calibration sources as a component of the total facility inventory.

23. EVALUATION: (by Facility Manager/Designee)   COST EVALUATION:

24. IS FURTHER EVALUATION REQUIRED: Yes [ ] No [X]
IF YES, BEFORE FURTHER OPERATION: Yes [ ] No [X]
IF YES, BY WHOM? BY WHEN?

25. CORRECTIVE ACTIONS:

SEQUENCE NUMBER: 001   ACTION ID: A0043906

Prepare an "NSR Request for Minor Modification to NSR 0031WM040009" to include the calibration source inventory as part of the facility inventory.

TARGET COMPLETION DATE: 05/01/1994   COMPLETION DATE:

26. IMPACT ON ENVIRONMENT, SAFETY, AND HEALTH:

27. PROGRAMMATIC IMPACT:

28. IMPACT UPON CODES AND STANDARDS:

29. FINAL EVALUATION AND LESSONS LEARNED:

30 'IMILAR OCCURRENCE REPORT NUMBERS:

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR) FUNCTION : Isotope Production and Experiments

DOE HEADQUARTERS FACILITY LANDLORD : NE

DOE HEADQUARTERS PROGRAM SPONSOR : ER

FACILITY AGE : 27 years — DESIGN LIFE : Indefinite

Question 1 : Facility

The High Flux Isotope Reactor (HFIR), which began operation in September 1966, is a beryllium-reflected, light-water cooled and moderated, flux-trap reactor. The cylindrical reactor core consists of two aluminum-structure fuel elements (inner and outer), each having a set of radially involuted fuel plates. Each fuel plate is aluminum-clad, highly enriched uranium oxide (U_3O_8). The HFIR operates at 85 MW on 23 day cycle.

The HFIR is designed to accept production targets in its central core region to produce a number of isotopes (including transuranics). Additionally, the reactor is equiped with a several experiment positions in its beryllium reflector and several beam tubes to facilitate neutron experiments.

The HFIR is located in the Roane County portion of the DOE Oak Ridge Reservation (ORR) in eastern Tennessee. The Melton Valley location of the HFIR is separated (about 1 mile) from the main ORNL site by the Haw Ridge. HFIR shares the site with the Radiochemical Engineering Development Center (REDC). Perimeter fencing protects the HFIR site.

The closest city is Oak Ridge (about 8 miles) to north and east. Projected from 1980 census data, the average population density within a 50-mile radius is about 120 persons per square mile. About 4,000 persons work daily within a 1-mile radius of the HFIR. Melton Valley drains into White Oak Creek, which drains into the Clinch River. Wind and weather are predominately mild.

The HFIR site includes the reactor building itself (7900), an electrical building, an off-gas stack, a cooling tower, and various support structures. The reactor building is poured concrete. All parts of the reactor system that contain significant quantities of radioactive material reside within this reinforced-concrete confinement.

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR)
	FUNCTION : Isotope Production and Experiments

Question 1 Narrative Continued:

The authorization basis for the HFIR is its Safety Analysis Report (SAR). The SAR is currently in the final stages of DOE review and is expected to be approved this fiscal year. Until the SAR is approved, the current set of safety documentation serves as the HFIR authorization basis.

As shown in the SAR, the HFIR is designed to conform to numerous NRC General Design Criteria. Specifically, the HFIR is designed to withstand design-basis seismic events, wind loadings, tornado loadings, flood, missile protection, and dynamic rupturing of system components. Structures and components that are required to avoid or mitigate the consequences of abnormal operational transients or accidents are classified as safety related and are designed appropriately. Various design-basis accidents and their mitigation methods are detailed in the SAR.

The only material eligible for the current Plutonium ES&H Vulnerability Assessment is a set of plutonium filters used in conjunction with HFIR neutron-scattering experiments. When not in use, the filters are housed in a vault (safe) on the first floor (beam-tube facilities) of building 7900. Otherwise, they are mounted in the neutron-scattering equipment adjacent to the storage vault. Both areas are within the HFIR confinement.

The filters are of three types. The first type (1 piece) is less than 4% ^{240}Pu (about 0.000 kg) with a combined ^{239}Pu and ^{241}Pu mass of 0.007 kg. The second type (1 piece) is less than 7% ^{240}Pu (about 0.001 kg) with a combined ^{239}Pu and ^{241}Pu mass of 0.007 kg. The third type (4 pieces) is less than 13% ^{240}Pu (about 0.004 kg) with a combined ^{239}Pu and ^{241}Pu mass of 0.029 kg (total). All of the filters are in one aggregation.

Applicable References:

"High Flux Isotope Reactor Safety Analysis Report, Volumes 1 through 5," ORNL/M-2344.

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR)
	FUNCTION: Isotope Production and Experiments

Question 2: Holdings — DOE Material Manager : J.T. Hargrove

Characterize facility plutonium [1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium [2]	Packaging Types [3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal	W (All pieces)	V2, B1, V5	Indefinite	About 20
Oxide				
Scrap/Residues [4]				
Solution [4]				
Sealed Sources				
TRU Waste [4]				
Holdup (in ducts, pipes, etc.) [4]				
Unirradiated Reactor Fuel				
High-level Liquid Waste				

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR)
	FUNCTION: Isotope Production and Experiments
Question 2 Continued:	
Applicable References: Safeguards and Security Report, U9050-FZG, "Itemized Inventory Listing for Material Balance Area 026 (HFIR)," May 5, 1994.	

1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.
2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.
3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.
4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.
5 Holdup has no packaging. Identify location of holdup.

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR)
	FUNCTION : Isotope Production and Experiments

Question 2A: No. Pkgs and Mass — DOE Material Manager : J.T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal	W (≤4wt.% ^{240}Pu)	0.007	1
	W (≤7wt.% ^{240}Pu)	0.007	1
	W (≤13wt.% ^{240}Pu)	0.029	1
Oxide			
Scrap/Residues			
Solution			
Sealed Sources			
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			
Cumulative Inventory Difference		1	

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR) FUNCTION : Isotope Production and Experiments

Question 3 : Physical Barriers

DOE Material Manager : J.T. Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) : Metal (W, all pieces)

Barrier #	Worker Protection	Environment and Public Protection
1	WB-5	EB-7
2	WB-6	EB-2
3	WB-13	EB-1
4	WB-15	
5		

Question 3 Continued:

None.

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR)
	FUNCTION : Isotope Production and Experiments

Applicable References:

HFIR SAR

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR)
	FUNCTION : Isotope Production and Experiments

Question 4: Adverse Conditions [1]

Indicate actual or potential adverse conditions that are applicable to those materials, packages and barrier aggregates developed in Questions 1, 2, and 3 by checking the appropriate items and describing below.

Adverse Condition

In-Facility

- Inadvertent Transfers
- Aging
- Organic Nitric Acid Reaction
- Equipment Failure
- Change in Mission
- X Other Co-Located Hazards
- Corrosion
- Inadequate Configuration Knowledge
- Combustible Loading
- Inadequate Seals
- Potential Water Sources
- Inadequate Drains
- Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- Inadequate Preventive Maintenance
- Administrative Controls
- Other - Specify

Material

- Pressurization
- Pyrophoricity
- X Radioactivity
- Chemical Reactivity
- Am Buildup
- Hydrogen Buildup
- Radiolysis
- Volumetric Expansion
- Oxidation
- Other - Specify

Question 4 Continued:

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR)
	FUNCTION : Isotope Production and Experiments

Describe Each Adverse Condition:

The Pu filters are occasionally removed from their storage vault and used in various neutron-scattering experiments that are part of the HFIR beam-tube facilities. These facilities are located within the HFIR reactor building and are subject to potential threats that may affect not only the beam-tube facilities but the entire building. Because of their stable metallic form (plated on an aluminum matrix), the only significant threat to the filters is a fire in the beam-tube facitlities. These facilities are protected with sprinkler systems and other fire-prevention mechanisms.

When the filters are in service, they are directly exposed to the neutron beams exiting the HFIR. This exposure produces nuetron-induced reactions that result in radioactive isotopes. Over their service lifetimes of about 20 years, the filters produce a contact dose rate of significantly less than 1 rem/h. The vault in which they are stored act as a personnel shield when the filters are not in service. Designated radiation areas are defined where the filters are used.

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR)
	FUNCTION : Isotope Production and Experiments

<u>Applicable References:</u>

HFIR SAR

1 An existing situation that gives rise to a potential event or concern.

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR) FUNCTION : Isotope Production and Experiments

Question 5 : Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- X Fire
- Explosion
- X Worker Exposure
- External
- Internal
- Contamination
- Flooding
- Leakage/Spills
- Other Accidents - Specify
- Human Error

Material
- Criticality
- Fissile Material Release
- Breach of Container
- Fire
- Other - Specify

External
- Aircraft Crash
- Vehicle Accident
- Explosion
- Adjacent Facility Accident
- Power Failure
- Institutional/Regulatory Requirements
- Personnel Radiation Exposure
- Ex-facility Fire
- Other - Specify

Natural Phenomena
- Earthquake Damage
- Wind Damage
- Flood Damage
- Erosion Damage
- Snow/Ash Loading Damage
- Extreme Temperature Damage
- Other - Specify

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR)
	FUNCTION : Isotope Production and Experiments

Describe Each Event:

When in service, the Pu filters (being part of the neutron-scattering experiments) are removed from their storage vault and are, therefore, susceptable to abnormal conditions occurring in the beam-tube facilities. The only signficant threat to the filters would be a major fire in the beam-tube facilities. There is no known mechanism for initiating this event (the filters themselves will not initiate a fire).

When in service, the Pu filters may affect personnel working on the neutron-scattering experiments bacause of their radioactivity. These personnel are trained to work in radiation areas and are protected by various physical barriers (i.e., shielding, distance, etc.) as well as administrative controls defined by health physics personnel. Therefore, they are only affected if these mechanisms fail.

Question 5 Continued:

Describe Each Event:

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR)
	FUNCTION : Isotope Production and Experiments

<u>Applicable References:</u>

HFIR SAR

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR) FUNCTION : Isotope Production and Experiments
<u>Preventive</u> X Procedures: ops., maint., surveillance Material Limits X Training Quality Assurance X Conduct of Operations X Authorization Basis (safety analysis, BIOs) Surveillance Organization Structure Management Involvement Staffing Lessons Learned X Configuration Control of Design X Preventive Maintenance Monitoring Trending (Performance Indicator) X Testing/Verification of Integrity Regulatory Requirements Records Personnel Exposure X Equipment Waste Inventory QA Personnel Reliability Assurance Program Other - Specify	<u>Mitigative</u> X Emergency Preparedness X Emergency Management X Emergency Planning X Emergency Procedures X Emergency Response X Safety Systems X Alarm Systems Other - Specify
<u>Question 6 Continued:</u>	

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR) FUNCTION : Isotope Production and Experiments
Uncertainty or Concern	Discussion
None.	

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR)
	FUNCTION : Isotope-Production and Experiments

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

	WORKER			ENVIRONMENT			PUBLIC		
EVENT	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
Fire	N	N	N	N	N	N	N	N	N
Worker Exposure	N	N	N	N	N	N	N	N	N

SITE : X-10	FACILITY (Building or Location) : 7900 (HFIR)
	FUNCTION : Isotope Production and Experiments

Explanation:

The policies and procedures that govern the conduct of operation of the HFIR and its experiments satisfactorily prevent (1) damage to the Pu filters resulting from a major fire in the beam-tube facilities and (2) worker exposure from the radioactivity associated with the Pu filters. The maintenance and surveillance programs supplement these policies and procedures.

SITE : X-10

Question 8: Overall Site Summary

The HFIR facility currently poses no threat to the worker or environment from its Pu filters. The current procedures for storing, handling, and using the Pu filters are satisfactory. No actions are planned regarding the storage, handling, or use of the Pu filters.

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

DOE HEADQUARTERS FACILITY LANDLORD ER
DOE HEADQUARTERS FACILITY OVERSIGHT NE

DOE HEADQUARTERS PROGRAM SPONSOR ER, DP

FACILITY AGE 29 years DESIGN LIFE ______

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 1: Facility

Mission, History, Current Use

Building 7920 of the Radiochemical Engineering Development Center (REDC) is a remotely operated hot-cell facility. Major activities include the recovery and purification of transuranium elements, which are primarily alpha emitters of high specific activity, and the development of processing and separations flowsheets.

Since the mid-1960s, the REDC has been the production, storage, and distribution center for the heavy-element research program of the United States Department of Energy (DOE). Target rods containing americium and curium (earlier target rods contained ^{242}Pu) are remotely fabricated in Building 7920, irradiated in the High Flux Isotope Reactor (HFIR), and then processed in the Building 7920 hot cells for the separation and purification of heavy actinide elements (Bk, Cf, Es, and Fm).

Transuranium chemical processing includes the dissolution of irradiated targets, the separation of the actinide elements from impurities and fission products, and the separation of the actinide elements from each other. These steps are accomplished by the application of dissolution, solvent extraction, precipitation, and ion exchange processes that are performed in a sequence called a processing campaign. Ancillary operations such as evaporation, filtration, precipitation, and furnace heating operations are also performed during the processing sequence. A functional flow diagram is shown in Figure 1.

From the late-1970s until the mid-1980s, a moderate level of uranium fuel cycle development effort was maintained in specially designed equipment in one of the hot cells in Building 7920. Solvent extraction flowsheets for processing irradiated fuels from commercial light-water reactors and fast-breeder reactors were developed and tested, and plutonium recovery schemes were demonstrated. Although no longer used for the original purpose, this equipment remains in place and has been adapted and used for other processing and development activities.

Since 1991, the REDC has processed Mark 42 target assemblies that were irradiated at the Savannah River Site (SRS). High-purity ^{243}Am (plus ^{242}Pu and ^{244}Cm) are separated and recovered for shipment to Los Alamos National Laboratory (LANL). The Mark 42 activities include many of the same operational steps that are used in transuranium target processing, thus permitting dual use of the same hot-cell equipment. A functional flow diagram is shown in Figure 2. Scheduling of operations and equipment is managed to ensure efficient coexistence with the Transuranium Element Processing (TEP) Program.

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 1 Narrative Continued:

Facility Location

Building 7920 is located at the 7900 area of the ORNL. It is sited on the DOE Oak Ridge Reservation approximately 13 km (8 miles) from the population center of the city of Oak Ridge and about 1.6 km (1 mile) southeast of the main ORNL complex. The facility is situated on a low ridge in Melton Valley. The nearest public access is Bethel Valley Road about 1500 m (~4900 ft) to the north. The nearest residential area is about 4100 m (~13,500 ft) to the southwest. The 7900 complex includes HFIR (Bldg. 7900) and Bldg. 7930 of the REDC. The exhaust fan systems serving the cell-off-gas (COG) and vessel-off-gas (VOG) ventilation systems are located about 35-m (~115 ft) southwest of Bldg. 7920, adjacent to the 7911 stack.

Facility Description

Building 7920 is a three-level structure housing a shielded cell bank, hot-cell support areas, laboratories, an office wing, and building support services. The building is a steel-framed structure with concrete-block walls. The original part of the building that houses the hot-cell and laboratory areas is constructed with steel reinforcement in the exterior walls. The floors are reinforced-concrete slabs, and the roofs are precast concrete planks with tar and gravel roofing. Floor plan layouts for Building 7920 are shown in Figures 3 and 4.

The facility contains a bank of heavily shielded, reinforced-concrete hot cells, which contain equipment for high-radiation-level radiochemical processing and target fabrication activities. Removable top plugs provide access to the cells. Service lines enter the cells through removable plugs in the back walls and top.

Within each shielded cell is a fixed containment box, the cubicle, which is equipped with a viewing window and a pair of manipulators. Process operations/equipment that are more likely to result in occasional leaks or spills and process equipment that might require frequent maintenance or replacement are contained in the cubicles. A tank pit housing process and storage tanks and piping is located behind and below the cubicles in Cells 1 through 7. In December 1993, construction was completed on a facility in the Cell 1 tank pit for the dry storage of segments of Mark 42 targets and similar irradiated materials.

There are three alpha laboratories equipped with glove boxes for chemical development work and special projects, three analytical chemistry laboratories, and two general chemistry laboratories. One laboratory contains two small hot cells, called shielded caves, that provide small radiochemical processing areas with sufficient shielding for final purification of various transuranium elements and special projects. Each cave has an internal alpha containment box and a viewing window. Operations are performed with manipulators.

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 1 Narrative Continued:
Major Design Features for Safety

Ventilation and containment - Primary and secondary containment barriers are provided to prevent the release of radioactive materials. Heavily shielded hot cells provide the primary containment for operations involving large quantities of radioactive materials. Shielded caves are used for smaller amounts, and glove boxes and hoods for activities with small quantities. The building walls around the laboratory and hot-cell areas constitute the secondary containment barrier.

The building ventilation systems are designed to maintain pressure differentials that cause air to flow from nonradioactive areas toward areas that are more likely to contain radioactive materials. The VOG and COG ventilation systems are used to maintain the desired negative pressures in the shielded cell bank and to collect and treat the gaseous waste. The VOG system collects off-gas from the process vessels, cubicles, shielded caves, and the building vacuum system. The VOG exhaust air is treated by an alkaline scrubber to remove acidic gases (e.g., HNO_3 and HCl), a roughing filter, and two stages of HEPA filters. The COG system collects the exhaust air from the cells, the Limited Access Area (LAA) behind the cells, and the laboratory glove boxes. The COG exhaust air is filtered via a roughing filter and two stages of HEPA filters. After filtration, the exhaust air from the VOG and COG systems is discharged to the atmosphere through a 76.2-m (250-ft)-tall stack (7911).

The walls of the laboratory and processing areas of the building constitute the secondary containment. The normal ventilation for these areas is designed to maintain a vacuum with respect to the atmosphere. The purge air from the laboratories, hot-cell support areas (except the LAA), and the offices in the processing area of the building is exhausted through two exhaust systems on the roof. Each system contains one set of roughing filters and one set of HEPA filters.

Fire protection systems - The hot cell cubicles are equipped with pneumatic heat actuated devices (HADs). The cells outside the cubicles have HADs, and there are fixed thermal switches (FTSs) in the cells (above the cubicles and in the tank pits) for fire detection and actuation of water sprinkler systems. The laboratory areas are on a separate fire detection-protection system.

Iodine retention systems - When irradiated materials containing significant amounts of ^{131}I are being processed, several iodine retention systems are used. These systems include a scrubber on the dissolver off-gas before it joins the VOG, plus a Hopcalite-charcoal iodine retention system and backup charcoal beds for the full VOG stream.

Process radiation block valves - Process and service lines from outside the cells to certain critical equipment in the cubicles (e.g., dissolver tanks, dissolver off gas system, and associated equipment) are monitored and are provided with automatic block valves to provide protection against the transfer of large quantities of radioactive process liquids or gases out of the hot cell bank.

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 1 Narrative Continued:

Safety Experience: Significant Incidents and Findings

There have been no safety-related accidents at Building 7920 that caused significant injury or harm to workers or posed any sort of harm to the off-site public.

In recent years, there have been two significant events (both Level II - unusual occurrences) regarding safety at Building 7920. Both occurrences involved conditions of operability and maintainability for safety-related systems. Neither incident involved an immediate threat to worker safety or a threat to safety of the public. The unusual occurrences are summarized as follows:

ORO--MMES-X10REDC-1990-0118: (September 27, 1990) - The pressure relief/regulating valves on shielded Caves A and B in Room 111 of Building 7920 were set above the Limiting Safety System Setting (LSSS) value of 1.0 in. H_2O.

ORO--MMES-X10REDC-1992-0007: (July 7, 1992) - During a Fire Department surveillance, it was discovered that the fire-protection alarm system for Building 7920 would not function as designed because of failure of its battery backup charger system.

Descriptions of causes and response actions taken for these occurrences are reported in the respective occurrence reports. In both instances, investigating committees performing root cause analyses, determined that operational/procedural deficiencies were either direct or contributing factors and that there was some evidence of contributing management problems where policies and requirements were not adequately defined, disseminated, or enforced.

In 1990, two Tiger Team findings (Category II concerns) involved (1) the ORNL failure to test the fire-detection and fine-suppression systems protecting the hot cells and cubicles in Building 7920 and (2) the failure to provide supporting documentation for the conclusion that a fire originating in the cells or cubicles at Building 7920 would not result in the loss of high-efficiency particulate air (HEPA) filters and an unacceptable radiological release. (See Attachment 1 for response actions to the Tiger Team findings.)

Status of Safety Documentation: (See list of references)

1. ***Draft Safety Analysis:***[1] The Draft Safety Analysis Report (SAR) was written to meet the requirements of DOE Order 5480.1A, Chapter V. The SAR describes the facility as it existed in 1984, which is principally the same as it is today. Detailed descriptions of equipment, systems, and operations in Building 7920 are included. Information is presented concerning the risks involved in the facility's operation and the measures undertaken to mitigate those risks. [This report was submitted to the DOE, but the approval process was set aside in favor of the SAR Upgrade Program.]

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 1 Narrative Continued:

[A major revision of the OSR document (ORNL/CF-81/242/R3) has been prepared based on existing information and new considerations and analyses resulting from Phases I and IA of the Safety Analysis Report Update Program (SARUP). The revised OSR was submitted to DOE for approval in March 1994.]

3. *Hazard Screening:*[3] The Hazard Screening (HS) document evaluates the hazards associated with Building 7920. Several bounding accident scenarios for the radioactive material hazards were developed, and unmitigated consequences were determined for the scenarios.
[The HS document is currently being revised against DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23".]

4. *Nuclear Safety Review and Approval:*[4] This is a criticality safety analysis and MMES approval of operations and handling of nuclear materials in Building 7920. This continuing approval expires in April 1995. [A revision of the Building 7920 Nuclear Safety Review and Approval is pending which includes storage of multiple Mark 42 target assemblies in the newly installed wells in the Cell 1 tank pit.]

5. *Logic Models:*[5] This report describes the qualitative logic modeling and evaluation done in Phase I of SARUP. It addresses the initiating events and preventative and mitigative features associated with several bounding accident scenarios in Building 7920.

6. *Phase IA Report:*[6] In Phase IA of SARUP, candidate Safety Class Items (SCIs), Administrative Controls for Safety (ACSs), and Design Features for Safety (DFSs) were identified and the updated OSR was prepared. [As noted above, this OSR was submitted in a transitional format, but has not yet been approved.]

7. *Pilot Basis for Interim Operation:*[7] This "pilot" BIO was prepared as part of the DOE pilot program for implementation of the Price Anderson Amendment Act proposed rules (Safety Analysis Reports, 10CFR830.110, and Technical Safety Requirements, 10CFR830.320).

General Aggregation Areas of Plutonium

Hot cell tank pits:
1. Storage of irradiated Mark 42 target segments
2. Solutions in tanks (solutions in storage and solutions during processing operations)

Waste pit:
1. Solutions in waste collection tanks

Hot cell cubicles:

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 1 Narrative Continued:

Laboratories:

1. Glove boxes
2. Shielded caves (Lab 111)

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Applicable References:

1. L. J. King, J. E. Bigelow, E. D. Collins, and W. T. McDuffee, *Safety Analysis: Transuranium Processing Plant, Building 7920,* Draft Report ORNL/TM-7688, Oak Ridge National Laboratory, December, 1984.

2. L. J. King, J. E. Bigelow, F. R. Chattin, and E. D. Collins, *Operational Safety Requirements: Building 7920 Radiochemical Engineering Development Center*, ORNL/CF-81/242/R2, Oak Ridge National Laboratory, April 15, 1991.

3. Martin Marietta Energy Systems, Inc., *Phase I Safety Analysis Report Update Program Hazard Screening: Building 7920 Radiochemical Engineering Development Center,* HS/7920/F/IT-4/RO, Oak Ridge, TN, June 1, 1992.

4. Martin Marietta Energy Systems, Inc., *Request for Nuclear Safety Review and Approval for Hot Cell Operations in Building 7920 of the Radiochemical Engineering Development Center*, NSR No. 0019CT07205A, Oak Ridge, TN, March 16, 1990.

5. Martin Marietta Energy Systems, Inc., *Phase I Safety Analysis Report Update Program Logic Models*, LM/7920/F/IT-4/RO, Oak Ridge, TN, November 19, 1992.

6. Martin Marietta Energy Systems, Inc., *Phase IA Safety Analysis Report Update Program: Phase IA Report*, PHIA/7920/F/IT-4/RO, Oak Ridge, TN, March 1, 1993.

7. Martin Marietta Energy Systems, Inc., *Basis for Interim Operation: Building 7920 Radiochemical Engineering Development Center*, Pilot Report, Oak Ridge National Laboratory, December, March 17, 1994.

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 2: Holdings

DOE Material Manager James T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal				
Oxide	^{237}Np	G1,B1		5.2
	^{238}Pu	U0,X1		0.2
	^{240}Pu (w/Cm)	V5		0.6-12
	^{242}Pu	G1,V5		21.5
	^{241}Am (w/Cm)	C1		7.5
	^{243}Am	U2,X1		3.7-15
	^{243}Am	V5		0.9-15
	^{243}Am (w/Cm)	V5		0.6
	Cm	C1		7.5
	Cm	V1,V1		0.4
	Cm	V5		0.6-12
	^{252}Cf	V1		24.3
	^{252}Cf	V1,V4		8.3
	^{252}Cf	V4		8.7-17
	^{252}Cf	V4,V5		7.7-17

SITE: X-10	FACILITY: REDC Bldg. 7920			
	FUNCTION: Separation of Transuranium Elements			
Scrap/Residues[4]				
Solution[4], Cl	Pu-240 (w/Cm)	T3[6]		2.1
	Pu-242	T3[6]		1.4
	Am-243 (w/Cm)	T3[6]		0.3-4.3
	Cm	T3[6]		0.3-4.3
	Cf-249	G1,B1,B1,C1		0.9-7.6
Solution, Cl (continued)	Cf-249	G1		0.9
	Cf-249 (w/Cm)	T3[6]		2.3
	Cf-252 (w/Cm)	T3[6]		0.3-4.3
	Cf-252	P1,P5		8.5
Solution, N	Pu-240	P1,V7		5.4
	Pu-242 (w/Cm)	T3[6]		0.6
	Am-243	P1		3.9-4.3
	Am-243 (w/Cm)	T3[6]		0.6
	Cm	T3[6]		0.6
Solution, OT	Am-243 (w/Cm)	T3[6]		1.6
	Cm	T3[6]		1.6
	Cf-249	G1		.06
	Cf-249	G1,B1,B1,C1		0.9-8.9
	Cf-252	G1,B1,B1,C1		3.4-3.8
Sealed Sources	Cf-252	V1		20-21
	Cf-252	V1,V1		19.1
	Cf-252	V1,G1		25.7
	Cf-252	V1,V1,V5		11-23

SITE: X-10	FACILITY: REDC Bldg. 7920			
	FUNCTION: Separation of Transuranium Elements			
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[5]				
Unirradiated Reactor Fuel				
High-level Liquid Waste				
Other (specify) Irrad. React. Fuel	U(16)	C1,V5		13.7
	Pu F (w/U)	C1,V5		13.7
	Am (w/U)	C1,V5		13.7
Irrad. Targets	Pu-242	V1		0.4
	Am (w/Pu)	V1		0.4
	Cm (w/Pu)	V1		0.4
	Pu-242	V1,V6		2.6
Irrad. Targets, cont.	Am (w/Pu)	V1,V6		2.6
	Cm (w/Pu)	V1,V6		2.6
Chloride Salt	Cf-249	G1		3.6
	Cf-249	G1,B1,B1		1.3

1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.

2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.

3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.

4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.

5 Holdup has no packaging. Identify location of holdup.

6 T3 refers to a variety of small, metal tanks located in the hot cells for which criticality controls are not exercised due to the small inventory of fissile materials. The tanks may be fabricated of

Hastelloy C, Zircaloy-2, or Hastelloy with Tantalum liners, as required for corrosion control, as described in Table 4.1 of the Draft Safety Analysis, ORNL/TM-7688.

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 2A: No. Pkgs and Mass DOE Material Manager James T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal			
Oxide	^{237}Np	1 g	1
	^{238}Pu	12 dg	2
	^{240}Pu (w/Cm)	39 g	4
	^{242}Pu	1 g	1
	^{241}Am (w/Cm)	3 g	1
	^{243}Am	7 g	2
	^{243}Am	19 g	4
	^{243}Am (w/Cm)	10 g	2
	Cm	2 g	1
	Cm	7 g	1
	Cm	57 g	5
	^{252}Cf	1 μg	1
	^{252}Cf	0 μg	1
	^{252}Cf	3,481 μg	15
	^{252}Cf	4,681 μg	7
Scrap/Residues			

SITE: X-10	FACILITY: REDC Bldg. 7920 FUNCTION: Separation of Transuranium Elements		
Solution, Cl	^{240}Pu (w/Cm)	1 g	1
	^{242}Pu	24 g	1
	^{243}Am (w/Cm)	67 g	6
	Cm	67 g	6
	^{249}Cf	10,430 μg	3
	^{249}Cf	1599 μg	1
	^{249}Cf (w/Cm)	2097 μg	1
	^{252}Cf (w/Cm)	10 μg	2
Solution, N	^{240}Pu	5 g	1
	^{242}Pu (w/Cm)	101 g	1
	^{243}Am	2 g	2
	^{243}Am (w/Cm)	19 g	1
	Cm	4 g	1
Solution, OT	^{243}Am(w/Cm)	0 g	1
	Cm	13 g	1
	^{249}Cf	96 μg	1
	^{249}Cf	1,854 μg	3
	^{252}Cf	4 μg	2
Sealed Sources	^{252}Cf	16 μg	2
	^{252}Cf	6 μg	1
	^{252}Cf	0 μg	1
	^{252}Cf	614 μg	12
TRU Waste			
Holdup			

SITE: X-10	FACILITY: REDC Bldg. 7920 FUNCTION: Separation of Transuranium Elements		
Unirradiated Reactor Fuel			
High-level Liquid Waste			
Cumulative Inventory Difference		1	
Other (specify) Irrad. React. Fuel	U(16)	4 kg	1
	Pu F (w/U)	32 g	1
	Am (w/U)	2 g	1
Irrad. Targets	^{242}Pu	339 g	1
	Am (w/Pu)	85 g	1
	Cm (w/Pu)	64 g	1
	^{242}Pu	337 g	1
	Am (w/Pu)	84 g	1
	Cm (w/Pu)	69 g	1
Chloride Salt	^{249}Cf	10,401 μg	1
	^{249}Cf	16.974 μg	3
Question 2A Continued:			

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18, Storage Rack	EB-2
2	WB-8	EB-1
3	WB-14	EB-4

Material Aggregation (list material types included from Question 2) Solutions (Cl, N, OT).

Barrier #	Worker Protection	Environment and Public Protection
1	WB-8	EB-2
2		EB-1
3		EB-4

Material Aggregation (list material types included from Question 2) Oxides, Solutions (Cl, N, OT), Sealed Sources, Irrad. Targets.

Barrier #	Worker Protection	Environment and Public Protection
1	WB-8	EB-2
2		EB-1
3		EB-4

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 3 Continued:

Material Aggregation (list material types included from Question 2) Oxides, Solutions (Cl, N, OT), Chloride Salt.

Barrier #	Worker Protection	Environment and Public Protection
1	WB-1	EB-2
2	WB-6	EB-1
3		EB-4

Material Aggregation (list material types included from Question 2) Oxides, Solutions (Cl, N, OT).

Barrier #	Worker Protection	Environment and Public Protection
1	WB-9	EB-2
2	WB-6	EB-1
3		EB-4

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

In-Facility

- X Inadvertent Transfers
- X Aging
- X Organic Nitric Acid Reaction
- X Equipment Failure
- X Change in Mission
- X Other Co-Located Hazards
- X Corrosion
- ☐ Inadequate Configuration Knowledge
- X Combustible Loading
- ☐ Inadequate Seals
- X Potential Water Sources
- ☐ Inadequate Drains
- ☐ Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- ☐ Administrative Controls
- ☐ Other - Specify

Material

- X Pressurization
- ☐ Pyrophoricity
- X Radioactivity
- X Chemical Reactivity
- X Am Buildup
- X Hydrogen Buildup
- X Radiolysis
- ☐ Volumetric Expansion
- X Oxidation
- X Other - Specify

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 4 Continued:

Describe Each Adverse Condition:

In-Facility:
There are no existing (or actual) conditions in the facility that are currently storage or operational vulnerabilities. Some conditions, if left unattended for an extended period or allowed to worsen in degree, might become vulnerabilities.

Facility Conditions
Several conditions (e.g., general aging, corrosion, equipment, and seal failures) have potential for reaching a degree of severity at which storage or operational problems might occur.

Organic Nitric Acid Reaction
Self-assessments and hazards analyses for vulnerability to nitrate-organic reactions at REDC Building 7920 have been performed (see Attachment 2). The specific types and small quantities of organic reagents that are used in chemical processes minimize the likelihood of adverse reactions. Strict process controls, safety requirements, and other administrative measures (e.g., detailed procedures and operating instructions) further mitigate the risk that such reactions might occur.

Energy Sources/Co-Located Hazards
Damage to primary barriers is possible in situations where light-duty containers and small equipment (e.g., glass and plastic) are exposed to energy sources or to other co-located hazards.

Combustible Loading
Two concerns from the ORNL Tiger Team Assessment in November 1990 involved the effectiveness of the cell and cubicle fire protection systems and the integrity of the HEPA filters during a fire. These two issues are addressed in Attachment 1, where the authors concluded that soot/smoke would only add 5% to the filter capacity and that hot gases could only reach a temperature of 162°F, which is within the service range of the HEPA filters. The survey was based on an estimate of the maximum quantity of combustibles and/or organic solvents present in a hot cell.

Flooding
A possibility exists for flooding to occur inside the hot cells, either from potential operational errors or from damaged water sources.

Operational Errors
Some possibility exists for operational errors (e.g., inadvertent transfers) in which materials (solutions) might be placed in unintended locations.

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 4 Continued:

Changes in Mission
Changes in mission always have potential for the creation of adverse conditions, particularly where major decreases in funding and staffing might result in the severe curtailment of facility maintenance and support services. Inadequate preventative maintenance and upkeep of the facility could result in deterioration of essential equipment and systems required for control and confinement of radioactive materials.

Material:
Packaging, containers, adjacent materials, and equipment are continually subjected to conditions caused by the properties of radioactive materials. While radioactive materials are in process, the effects of radiolysis, hydrogen (gas) buildup, and pressurization are pronounced enough to require measures for venting and off-gassing. None of these conditions is adverse enough to be the cause of accidents involving appreciable release of materials beyond primary worker protection barriers.

Radiolytic damage and degradation to process organic solvents and resins may have an adverse effect upon product separations and purity. Consequently, there is sufficient impetus to minimize these effects before they may also affect packaging and barrier integrity.

The effects of chemical reactivity and oxidation are also present, although not so much from the radioactive materials as from the chemical constituents of the process solutions. Liquid materials in interim storage are similar to solutions in process.

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Because we do not handle actinides in metallic form, most materials in storage are present as oxides in closed metal containers or as sealed-sources. These materials are relatively stable if air is excluded. Some materials are irradiated Mark-42 assemblies that have been segmented into 20-inch lengths. These segments are stored in air in welded stainess-steel cans. It is expected that these materials will be processed over the next 10 years. Inventories of Pu

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 5: Events

Identify those historical, current, or potential events causing consequences that are exacerbated by the Adverse Conditions identified in Question #4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- X Fire
- X Explosion
- X Worker Exposure
  - X External
  - X Internal
- X Contamination
- X Flooding
- X Leakage/Spills
- X Other Accidents - Cask Drop
- X Human Error

External
- X Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
- ☐ Adjacent Facility Accident
- ☐ Power Failure
- ☐ Institutional/Regulatory Requirements
- ☐ Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify

Material
- ☐ Criticality
- X Fissile Material Release
- X Breach of Container
- ☐ Fire
- ☐ Other - 'Specify

Natural Phenomena
- X Earthquake Damage
- X Wind Damage
- ☐ Flood Damage
- ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 5 Continued:

Describe Each Event:

In-Facility:

Leakage/Spills

Several conditions (e.g., general aging, corrosion, and equipment and seal failures) have potential for reaching a degree of severity at which storage or operational problems might occur. In such cases, the resulting process or operational upsets would not be expected to have major effects on the integrity of packaged materials. Releases of materials from storage or process vessels (e.g., tanks, equipment, and solution transfer lines) would be confined within primary worker barriers (hot cells and glove boxes). Consequences to such events would probably result in minimal if any exposure or contamination to facility workers. There are no foreseen effects on the environment or the public.

Pressurizations/Explosions (Contaminations and Worker Exposures)

Damage to primary barriers is possible in situations where light-duty containers and small equipment (e.g., glass and plastic) are exposed to energy sources or to other co-located hazards. Typically, all such containers and vessels are inside additional worker barriers. Sealed metal containers are not likely to be damaged. Materials from breached containers in hot cells would probably be confined to those areas. There would be no exposure to workers. Material released from glove boxes and hoods would be into rooms located within contained areas of the facility. Similar breaches and releases from glove boxes and hoods might be expected to occur if these barriers were severely impacted by external energy sources. Exposure/contamination to workers in these rooms would probably occur from such a release. The HVAC/confinement and facility structure barriers would keep materials from spreading to other facility areas or to the environment. [Note that fire (not accompanied by an explosion) inside a hot cell or a glove box is not considered a highly dispersive event because of the presence of fire protection equipment within the primary worker barriers.]

Flooding

Some potential exists for flooding to occur inside the hot cells, either from potential operational errors or from damaged water sources. Most packaging barriers (e.g., sealed packages) would not be affected. By design, the hot cells can contain large volumes of water. The presence of "optimum" moderation is always considered in criticality analyses. Leakage of contaminated water and radioactive materials from the hot cells is not expected to occur before facility instrumentation and surveillance could detect abnormal conditions.

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 5 Continued:

Other Accidents - Cask Drop

Concrete casks containing RH-TRU waste are filled in the Limited Access Area of Bldg. 7920 and transferred through the air lock to a transport vehicle located outside. If the cask were dropped in the Limited Access Area a failure of the cask is likely and a portion of the contents may be released into the immediate area. There would be some contamination and exposure of the workers. If the cask were dropped when being transferred from the loading dock to the transport vehicle, the same release would likely occur, but now the contamination might extend to areas where there is public access. Analysis of this accident in the Draft Safety Analysis[1] showed that numbers of the public would not be exposed to a significant degree. However, we are in the process of designing an overpack to reduce the likelihood of cask failure and contamination spread.

Human Errors

Some possibility exists for operational errors (e.g., inadvertent transfers) in which materials (solutions) might be placed in unintended locations. However, the total amount of materials in process at any one time is always less than critically safe amounts. Damage to packaging barriers is not likely. Spills and releases are expected to remain confined within primary containment barriers.

Material:

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Applicable References:

Same as Ref. 1 in Question 1.

SITE: X-10	FACILITY: REDC Bldg. 7920 FUNCTION: Separation of Transuranium Elements
Preventive X Procedures: ops., maint., surveillance X Material Limits X Training X Quality Assurance X Conduct of Operations X Authorization Basis (safety analysis, BIOs) X Surveillance X Organization X Structure X Management Involvement X Staffing X Lessons Learned X Configuration Control of Design X Preventive Maintenance X Monitoring X Trending (Performance Indicator) X Testing/Verification of Integrity X Regulatory Requirements X Records X Personnel Exposure X Equipment X Waste Inventory X QA X Personnel Reliability Assurance Program ☐ Other - Specify	Mitigative X Emergency Preparedness X Emergency Management X Emergency Planning X Emergency Procedures X Emergency Response X Safety Systems X Alarm Systems ☐ Other - Specify
Question 6 Continued:	

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Compensatory Measure | Reference Document

Preventative Measures and Mitigative Factors

General descriptions of preventative measures and mitigative factors indicated for the facility are in the following documents:

L. J. King, J. E. Bigelow, E. D. Collins, and W. T. McDuffee, *Safety Analysis: Transuranium Processing Plant, Building 7920*, Draft Report ORNL/TM-7688, Oak Ridge National Laboratory, December, 1981.

L. J. King, J. E. Bigelow, F. R. Chattin, and E. D. Collins, *Operational Safety Requirements: Building 7920 Radiochemical Engineering Development Center*, ORNL/CF-81/242/R2, Oak Ridge National Laboratory, April 15, 1991.

Martin Marietta Energy Systems, Inc., *Phase IA Safety Analysis Report Update Program: Phase IA Report*, PHIA/7920/F/IT-4/R0, Oak Ridge, TN, March 1, 1993.

Martin Marietta Energy Systems, Inc., *Basis for Interim Operation: Building 7920 Radiochemical Engineering Development Center*, Pilot Report, Oak Ridge National Laboratory, December, March 17, 1994.

Additional description of Emergency Preparedness/Management may also be found in the following:

Local Emergency Manual: REDC Bldg. 7920, REDC AP/EP-5500, (1993).

Isotope Technology Section Procedure: *Emergency Readiness and Safety*, IT-AD-1, (1994).

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Uncertainty or Concern — Discussion

Personnel Reliability Assurance

This is not a designated REDC Program. Specific areas such as training, staffing, qualifications, training, fitness for duty, and conduct of operations are aimed at ensuring that Building 7920 is staffed with capable and qualified personnel.

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

	WORKER			ENVIRONMENT			PUBLIC		
EVENT	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
Leakage/Spills	N	N	N	N	N	N	N	N	N
Pressurizations/Explosions in Hot Cell	N	N	N	N	N	N	N	N	N
Pressurizatons/Explosions in Glove Box	Y	Y	Y	N	N	N	N	N	N
Flooding	N	N	N	N	N	N	N	N	N
Inadvertent Transfers	N	N	N	N	N	N	N	N	N
Breach of Glove Box (or Hood) from External Energy Source	Y	Y	Y	N	N	N	N	N	N
Breach of Glove Box (or Hood) by Natural Phenomena	Y	Y	Y	Y	Y	Y	Y	N	N
Drop of a Waste Cask Containing RH-TRU Waste	Y	Y	Y	Y	Y	Y	Y	N	N

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Explanation:

Events:

Leakage/Spills
Process and operational upsets caused by equipment and seal failures within primary worker barriers would not have major effects on the integrity of packaged materials. Releases of materials from storage or process vessels (e.g., tanks, equipment, and solution transfer lines) or from small equipment inside glove boxes are expected to be confined within the primary worker barriers. Consequences to such events would probably likely result in no significant exposure or contamination to facility workers. Containment within worker and environmental barriers adequately protects the environment and public from the effects of this type of event.

Pressurizations/Explosions in Hot Cell
Damage to primary barriers is possible in situations where light-duty containers and small equipment (e.g., glass and plastic) are exposed to energy sources or to other co-located hazards. Typically, all such containers and vessels are inside additional worker barriers. Sealed metal containers are not likely to be damaged. Materials from breached containers in hot cells would be confined to those areas. There would be no exposure to workers. The HVAC/confinement and facility structure barriers would keep materials from spreading to other facility areas or to the environment.

Flooding
During inadvertent or accidental flooding inside a hot cell, it is expected that most packaging barriers (e.g., sealed packages) in the cell would not be affected. By design, the hot cells can contain large volumes of water. No leakage of contaminated water or radioactive materials from the hot cells or damage to the ventilation filtration system is expected to occur before facility instrumentation and surveillance could detect abnormal conditions.

SITE: X-10	FACILITY: REDC Bldg. 7920
	FUNCTION: Separation of Transuranium Elements

Question 7 Continued:

Inadvertent Transfers

In the event of an inadvertent transfer, a process solution might be placed in an unintended location (e.g., the wrong tank or overfilling and spilling from a tank or other equipment). [Note that total amount of materials in process is always less than critically safe amounts.] Damage to packaging barriers is not likely during such an event. Spills and releases are expected to remain confined within primary containment barriers (i.e., the hot cell).

Question 8: Overall Site Summary (REDC Bldg. 7920)

- The most important ES&H concerns related to "plutonium" storage, handling, processing, and/or shipping.

  By far, the major radionuclide handled in REDC Bldg. 792ᴗ (mainly in · hot cells) is ^{244}Cm. All other materials handled collectively contribute less than 10% to total inhalation hazard. Plutonium, itself, is of ES&H significance only when separatec from the curium and is located in a less-well-protected area, such as a glove box.

- Which "plutonium" activities pose the highest risk to the environment, worker, and public at this site.

  The greatest risk to a worker is the pressurization of a glove box discussed in Vulnerability #7920-1. It is believed that the force of a credible explosion would not be sufficient to breach the secondary containment or damage the ventilation systems, resulting in little risk to the environment or public.

  The greatest hazard to workers, the environment, and the public would result from natural phenomena (wind and earthquake) or an aircraft crash into the building, any of which would result in breach of secondary containment and probably release of radioactive materials from laboratories or glove boxes. It is not expected that significant quantities would be released from the hot cells. The probability of these events actually occurring is quite low, making the overall risk low.

  A possibily higher risk to workers, the environment, and the public would occur if a cask were dropped during the transfers of casks of RH TRU waste from the Limited Access Area within the building to a transport vehicle outside. As indicated in the Preceding question the inhalation hazard in a typical waste cask would be dominated by ^{244}Cm, but the direct radiation hazard (to workers only) would be dominated by ^{252}Cf. An analysis of this event in the Draft SAR (Ref. 1 of Question 1) indicated that the potential for exposure and contamination of the workers immediately at the site is significant, but at a greater distance, where access is uncontrolled, the exposures would be insignificant.

- Current planned actions to minimize worker exposure, reduce environmental risks, and protect the public at and near this site.

  Planned actions include the minimization of the use of glove boxes (in favor of hot cells or strong enclosures) for processing of plutonium or possibly to eliminate such use.

  Design of an overpack for the waste caks is under way. This overpack would minimize the likelihood that the cask would fail, if dropped, and release radioactive material.

Question 8 continued:

- Noteworthy programs or practices related to "plutonium" storage, handling, processes, and/or shipping.

  Plutonium, americium, and curium oxides are welded into strong stainless-steel containers and leak tested prior to storage or shipment. We are designing a system for helium leak testing these containers as a replacement for the tedious boiling liquid and vacuum bubble leak tests currently performed.

  Processed plutonium inventories are kept to a minimum because of our low safeguards category.

Attachment 1:

During the ORNL Tiger Team Assessment in November 1990, there were two significant concerns involving REDC Building 7920. Both were Category II concerns raised from findings about fire protection capability for the cells and cubicles and about the survivability of off gas system HEPA filters in the event of a fire in the cells or cubicles.

Concern FP.3-1 - ORNL has not tested, in accordance with recognized practices, the detection and suppression systems protecting cells and cubicles at Building 7920 to assure that the devices will function as intended in the event of a fire.

Concern FP.3-2 - Documentation provided by ORNL and DOE Headquarters does not support the conclusions that a fire originating in the cells or cubicles of Building 7920 at ORNL would not result in the loss of HEPA filters and an unacceptable radiological release to the environment.

Major Safety Related Changes

The most recent and significant safety-related changes at Building 7920 were those resulting from response measures to the 1990 Tiger Team findings. The major actions taken are summarized:

1. A program was established to do a one-time test and maintenance of the in-cell and out-of-cell components of the fire detection system and the out-of-cell portion of the water supply preaction/deluge system. Following this test/maintenance period, a program has been set up to functionally test the systems from the cells on a routine basis, to test from within the cells when possible, and to maintain the systems when deficiencies are found.

   a. The cubicle pneumatic heat actuated devices (HADs), HADs in the cell outside the cubicles, and fixed thermal switches (FTSs) in the cells (above the cubicles and in the tank pits) were tested and repaired or replaced as necessary during the period from December 1990 through mid 1991.

   b. Auxiliary valving was installed in the fire water systems (in the Chemical Make Up Area) for each cubicle and hot cell, to allow testing for water flow through each solenoid valve (cubicle) and deluge valve (cell). The solenoid valves and deluge valves were refurbished during 1991, and the first test was made in early 1992.

   c. As back up to the FTSs in the cubicle pits (under the cubicle) which cannot be tested, auxiliary thermocouples (or resistance thermometer devices, RTDs) were installed and alarmed in the control room.

   d. Out of cell portions of the fire detection and preaction/deluge supply systems will be tested on a specified schedule (testing intervals to vary depending on the components involved).

   e. Response of the in-cubicle detectors can be tested at convenience using a heat source and the manipulators. Testing of the in-cell detectors (exterior to the cubicles) requires removal of the cell shielding blocks. As these blocks are removed for maintenance and installation purposes within the cells, efforts will be made to test and maintain the in-cell HADs and FTSs.

2. Lockwood Greene Engineers, Oak Ridge, TN, were retained to examine the effect of cell and cubicle fires on the vessel off-gas (VOG) and cell off-gas (COG) ventilation systems. The primary emphasis of the study was to assess the effect of fires on the integrity of HEPA filters. Their report concluded that soot/smoke would only add 5% to the filter capacity and that hot gases could only reach a temperature of 162°F, which is within the service range of the filters. Lawrence Livermore National Laboratory (LLNL) was commissioned to perform full-scale mockup tests. The Lockwood Greene Engineers report on this portion of the evaluation is entitled, *Evaluation of HEPA Filter Integrity in Containment Ventilation Systems When Assaulted by Fire Conditions at REDC Building 7920*. The LLNL report, UCRL-CR-114339, is entitled, *Fire Tests to Evaluate the Potential Fire Threat and its Effect on HEPA Filter Integrity in Cell Ventilation at the Oak Ridge National Laboratory Building 7920*. The findings included these determinations:

   a. A fire in the tank pit would not cause the loss of ventilation system containment due to the thermal destruction or breaching of the prefilters or HEPA filters. Oxygen rate of depletion was the controlling factor that limited the action of the fire.

   b. The prefilters and HEPA filters remained in service for multiple tests with excellent residual filtering capabilities. DOP filter penetration tests before and after each fire test showed 0.01% penetration. The filter loadings included soot and smoke from the fire as well as water droplets from sprinkler action.

   c. The VOG duct work will not ignite nor contribute to a tank pit fire.

   d. A fire in a cubicle would have no effect on the VOG duct. Gas burner tests conducted in the sensitive elbow area (without the asbestos liner) showed the material would not ignite.

   e. The fire in the tank pit was easily quenched by simply cutting off the inlet air flow.

   f. The epoxy coating on the walls of the concrete tank pit would degrade somewhat in the fire tests but would not contribute to the fire.

   g. The fire-detection and suppression system responded quickly and efficiently.

3. A new sprinkler head was designed and tested to replace the sprinkler heads originally installed in the hot-cell cubicles. The original sprinkler heads or spray nozzles are prone to plugging from the scale found in black iron water pipes. The unique design of the new heads was necessary because commercially available sprinkler heads are too long and would interfere with operation of in-cell cranes in at least three of the cubicles and because of the difficulty of replacing the heads remotely. A prototype nozzle was fabricated and flow tested using a wood-frame and plastic-sheet mockup of a cubicle. Fire Department and DOE personnel observed the testing and have approved the spray nozzle design and performance. Nozzles have been fabricated for all the cubicles and are awaiting installation.

OCCURRENCE REPORT

6 SYSTEM, BLDG., OR EQUIPMENT:
7824

7. UCNI?
NO

8. PLANT AREA:
Waste Examination and Assay Facility

9. DATE AND TIME DISCOVERED:
03/11/1994 08:30

10. DATE AND TIME CATEGORIZED:
03/11/1994 08:30

11. DATE AND TIME OF DOE NOTIFICATION:

12. DATE AND TIME OF OTHER NOTIFICATIONS:

---

13. SUBJECT OR TITLE OF OCCURRENCE:

Omission of Text from the Nuclear Safety Review (NSR 0031WM040009) for Building 7824.

---

14. NATURE OF OCCURRENCE:

1A Nuclear Criticality Safety

---

15. DESCRIPTION OF OCCURRENCE:

3R 0031WM040009 states that the weight percent fissile otope limit for the entire facility is "No more than 5 Kg U-235 Equivalent" for "Dry Solid Waste Materials Contaminated with Measurable Quantitities of Various Fissionable Nuclides." The personnel at the WEAF had taken a conservative approach and included their calibration source inventory when calculating the total fissile quantity in the facility. Two personnel from the X-10 Radiation Protection Office reviewed the subject NSR and determined that the calibration source inventory needed to be included in the NSR document. Although this was already standard practice it needs to be documented in the NSR.

---

6. OPERATING CONDITIONS OF FACILITY AT TIME OF OCCURRENCE:

Normal

---

7. ACTIVITY CATEGORY:

Normal Operations

---

3. IMMEDIATE ACTIONS TAKEN AND RESULTS:

Initiate preparation of a "Request for Minor Modification" to : 0031WM040009".

OCCURRENCE REPORT

X10WSTEMRA - Waste Mgt. & Remedial Action

(Name Of Facility)

Nuclear Waste Operations

(Facility Function)

Oak Ridge National Laboratory

(Name of Laboratory Site or Organization)

Name: F J SCHULTZ
Title: GROUP LEADER, RSWIG
Telephone No. (615)576-6870

(Facility Manager/Designee)

Name: J A CHAPMAN
Title:
Telephone No. (615)574-5729.

(ORIGINATOR)

1. OCCURRENCE REPORT NUMBER:
   Action Item Reference ID: I0015880 -
   Source ID Number:

2. REPORT TYPE AND DATE:

	Date	Time
[ ] Notification Report	03/11/1994	15:53
[ ] 10 Day Report		
[ ] 10 Day Update (latest)		
[X] Final Report	03/14/1994	12:53

3. OCCURRENCE CATEGORY:

   [ ] Emergency
   [ ] Unusual
   [ ] Off-Normal
   [X] Non-Routine
   [ ] Void

4. DIVISION OR PROJECT:
   Wst Mgmt & Rem Act

5. DOE PROGRAM OFFICE:
   EM - Environmental Restoration and Waste Management

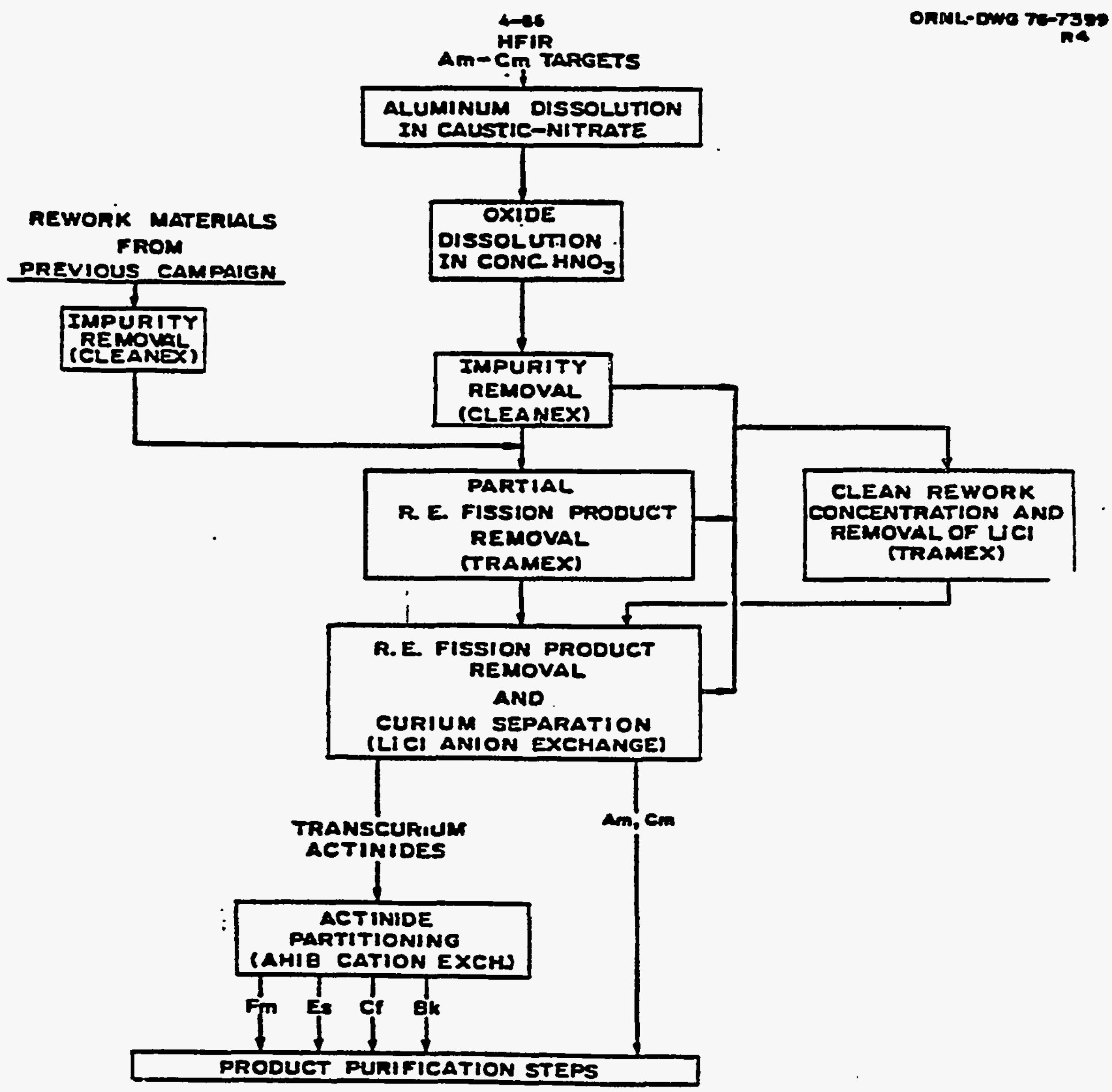

Fig. 1. Sequence of steps used to process HFIR targets in the shielded cell bank.

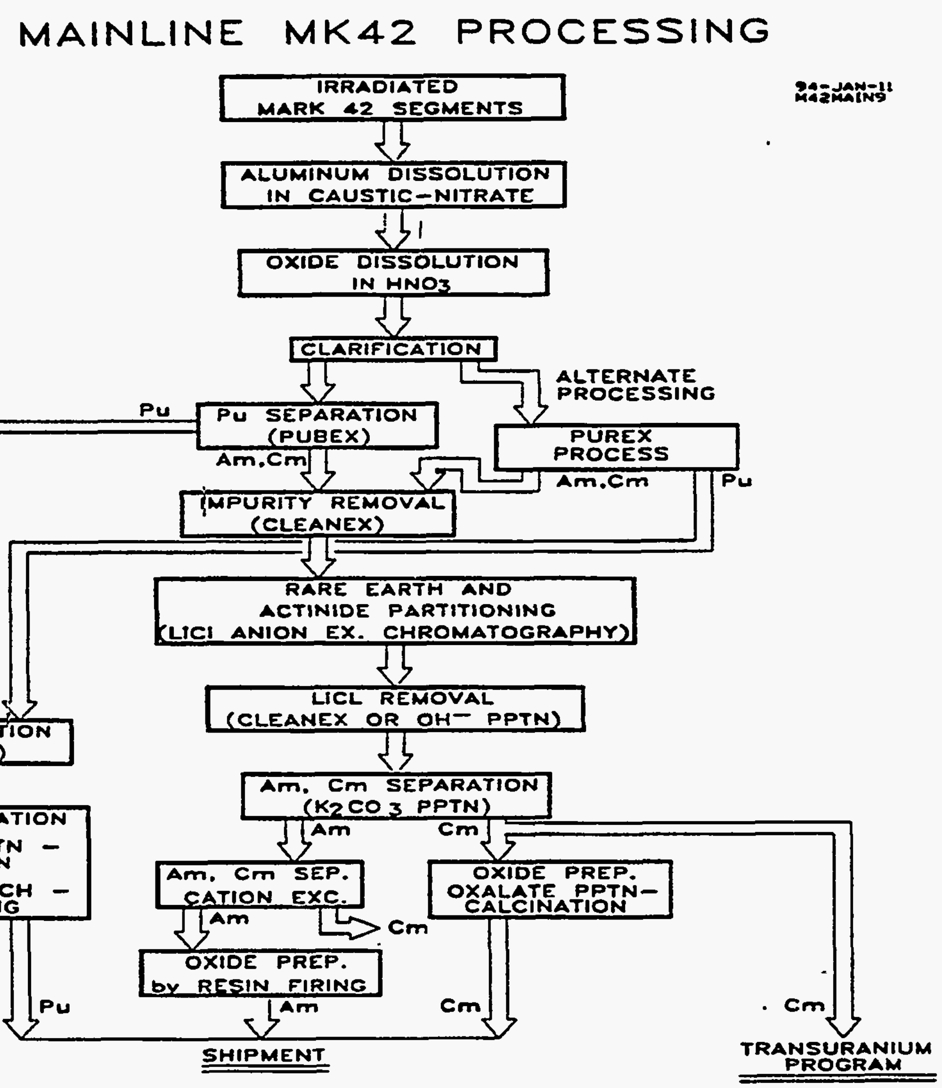

Fig. 2. Sequence of steps used to process Mark 42 segments in the shielded cell bank.

Attachment 2

SUMMARY INFORMATION SHEET

For each process/operation/system analyzed during the self-assessment, the following summary information should be provided along with answers to the questions that follow. Some of the summary information can only be provided after the assessment has been completed.*

Summary Information: Date: 5/20/94

Have all the operating personnel been familiarized with the contents of Safety Information Letter (SIL) 93-04 on Lessons Learned from the Tomsk-7 Accident and its follow-up letter regarding application of the SIL to laboratory operations?

Site: Oak Ridge National Laboratory

M&O Contractor: Martin Marietta Energy Systems, Inc.

DOE Field Office: Oak Ridge

DOE Responsible CSO:

Facility/Operation: Radiochemical Engineering Development Center (REDC)

Location: Building 7920

Point of Contact: R. G. Stacy

Phone: (615) 574-7071

Nitrate compound(s)*: $NaNO_3$, Nitric Acid

Organic compound(s)*: di(2-ethylhexyl) phosphoric acid (HDEHP extractant): Adogen (extractant); n-paraffin hydrocarbon (NPH diluent); diethylbenzene (DEB diluent); 2,5-dibutylhydroquinone (DBHQ reductant); nitrated anion exchange resin (used in less than 10-L sized batches)

Type of potential interaction(s):

Radiolytic degradation of process organics
Hydrolysis reactions
(Unintentional) heating of organic solutions in low-capacity evaporators

Actions planned as a result of assessment: (See Attachment)

Step 1. Determining Existence of Nitrate-organic Hazard

1.a Is nitric acid or other nitrate materials (i.e., potassium nitrate, sodium nitrate, ammonium nitrate, etc.) located in the facility, process, or operations in quantities greater than 25 liters?

Yes	X
No	

If YES, identify (Table 1.a.1) material type, volumes, locations and define that environment in which the material is contained (i.e., storage tanks, storage drums, process tanks, etc.).

1.b Are organic materials (greater than 25 liters) and/or ion exchange resins (greater than 10 liter) located at the facility, process, or operation?

Yes	X
No	

If YES, identify (Table 1.b.1) material type, volumes, locations and define that environment in which the material is contained (i.e., storage tanks, storage drums, process tanks, waste tanks, etc.)

1.c If any of these processes, volumes, and locations were previously reported and evaluated in the survey conducted during the initial Tomsk-7 Lessons Learned Review, drop them from consideration in this assessment. (See Attachment)

1.d Are these organic and nitrate materials located in proximity to each other which creates the potential for these materials being mixed in volumes greater than 25 liters or is there potential for ion exchange resin materials being present with nitrates (e.g., nitric acid) in volumes greater than 10 liters?

YES	X	Go to Step 2.a
NO		No further assessment required

7/11/94
Original form retyped for inclusion in the Pu ES&H vulnerability assessment.

Attachment 2

Self-Assessment of Vulnerability to Nitrate-Organic Reactions at Radiochemical Engineering Development Center (Building 7920)

Building 7920 of the REDC incorporates dissolution, solvent extraction, and ion exchange operations to separate, recover, and purify transuranic isotopes from irradiated targets. The target dissolutions are carried out in specialized equipment and do not involve the use of organic reagents. The ion exchange operations typically employ small (~5 L-sized) batches of resin.* The solvent extraction processes, along with the associated feed preparation and waste handling operations, are the only concern for potential nitrate-organic reactions.

[Note that solvent extraction operations performed in small mixer-settler banks in a single hot cell at Building 7920 were previously examined during the initial Tomsk-7 Lessons Learned Review. The review concluded that the possibility of occurrence of nitrate-organic reaction and explosion is "nearly infinitesimal" and that the safety of the operations is "well established."]

The other type of solvent extractions used in the Building 7920 hot cells are batch operations carried out in small tanks (typical capacities 20 - 150 L). All process tanks, including reagent preparation tanks, are vented to the Vessel Off-Gas System. Amounts of reagents are usually a few tens of liters. Organic extractant solutions and low acid (<1 M) feeds are contacted using air-sparged mixing at ambient temperature. The organic and aqueous phases are then separated (aqueous is moved to a separate tank). The organic solutions are contacted with dilute (0.04 M) acid, which ensures that no substantial nitric acid remains with the organic phase. Subsequent recovery of extracted actinide isotopes from the organic solution is done using ambient temperature contacts with concentrated acid (typically HCl). Spent organic solutions are neutralized prior to disposal to the waste collection tank in Building 7920. Neutralized liquid waste is transferred from the facility on a regular basis via a direct line connection to the ORNL Melton Valley Waste System.

The likelihood of occurrence of nitrate-organic explosive reactions is greatly reduced by the controls that are in place for these processes. Detailed operational procedures for the process steps require precise control and tracking of solution volumes in the equipment and tanks. Radiolysis and degradation effects from extended radiation exposures to organics are minimized by tracking exposure times and the amount of thermal damage (watt-h/liter) from ^{244}Cm. Frequent sampling of solutions is done for process control (fast turnaround is available from a dedicated analytical laboratory). Other safety controls are also in place, including temperature control, ventilation, and mixing of feed solutions. The use of glass phase-separation tanks permits "eyes-on" determinations to ensure that organic and acid phases are completely separated. Controls and precautions are written into the operational procedures. Emergency response and process shutdown measures are included in each procedure. Personnel are trained in response to off-normal procedures. The operating personnel understand the process and the safety concerns.

* One tank no longer involved in processing use contains about 150 L of chlorinated ion exchange resin waste from past operations. Current practice is to dispose of used resin as solid waste when it is generated. Discarded resin is water-washed to remove excess acid, solidified as a grouted concrete mixture, and removed from the hot cells in solid waste form.

A safety analysis (FSAR) has been prepared for Building 7920 that includes analyses of various parts of operations at the facility, including chemical processing operations in the hot cells. The FSAR supports the other safety documentation that has been generated (e.g., the hazard screening and logic modeling documents, which consider the consequences and risks for possible accident scenarios). In 1994, a draft Basis for Interim Operation for Building 7920 was generated, which includes specific hazard analyses for the hot-cell operations (dissolution, solvent extraction, and ion exchange operations.) No high-consequence accidents were identified. No major risks were identified.

A safety envelope has been established that includes parameters of concern for potential nitric acid-organic reactions. Risks for the hazards and consequences that were analyzed are within the bounds of the safety envelope. No added controls, restrictions, or compensatory measures appear to be needed for continuation of current operations involving organics and nitrate-based compounds. Administrative procedures and mitigative control factors are in place. The greatest assurance of safety; however, comes from the demands of the process, and from its limited size.

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

DOE HEADQUARTERS FACILITY LANDLORD: ER
DOE HEADQUARTERS FACILITY OVERSIGHT: NE

DOE HEADQUARTERS PROGRAM SPONSOR: ER, DP

FACILITY AGE 27 years DESIGN LIFE ______

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Question 1: Facility

Mission, History, Current Use

Building 7930 is a three-level structure with partial basement that houses hot cells, laboratories, support areas, and office areas. Major activities include the processing of ^{252}Cf and its alpha decay product, ^{248}Cm, and the fabrication of neutron sources from ^{252}Cf. Californium-252 is primarily an alpha emitter of high specific activity, but it also decays by spontaneous fission producing neutrons and fission products.

Building 7930 is a heavily shielded hot-cell facility designed for remote operation using manipulators. It was constructed in 1964–67 to develop and demonstrate methods for the remote processing of irradiated thorium-based fuel, and for refabricating the recovered materials into fuel for recycle back into a power reactor. However, the program was canceled prior to the installation of any processing equipment, and the building was never used for the purpose for which it was built.

Major activities are chemical processing of californium to recover high isotopic purity ^{248}Cm from ^{252}Cf, purification and packaging of ^{248}Cm and ^{252}Cf, and the fabrication of neutron sources containing californium. A functional flow diagram is shown in Fig. 1. In addition, smaller special projects and research and development studies may be performed. One of the special projects is the fabrication of neutron dosimeters from actinide (e.g., ^{235}U, ^{238}U, ^{237}Np, ^{239}Pu) oxides.

Facility Location

Building 7930 is located at the 7900 area of ORNL. It is sited on the U.S. Department of Energy (DOE) Oak Ridge Reservation approximately 13 km (8 miles) from the population center of the city of Oak Ridge, and about 1.6 km (1 mile) southeast of the main ORNL complex. The facility is situated on a low ridge in Melton Valley. The nearest public access is Bethel Valley Road about 1500 m (~4900 ft) to the north. The nearest residential area is about 4100 m (~13,500 ft) to the southwest. The 7900 complex includes the HFIR (Bldg. 7900) and Bldg. 7920 of the REDC. Building 7932, the waste sampling building, is located about 15-m (~50 ft) southwest of Bldg. 7930. The exhaust fan system for Bldg. 7930 is located about 120-m (~400 ft) southwest of Bldg. 7930, adjacent to the 7911 stack.

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Question 1 Narrative Continued:

Facility Description

The building is divided into four major areas: (1) a cell complex having seven cells — six shielded and one unshielded, (2) maintenance and service areas surrounding the cell complex, (3) an operating control area, and (4) an office area adjacent to, but isolated from, the operating areas.

Building 7930 is a steel-framed structure with concrete-block walls. Perimeter walls are of reinforced-concrete block, and floors are reinforced-concrete slabs. The roof is metal decking covered with built-up roofing.

The general layout of the first floor is shown in Figure 2. A cross-sectional view of the cell bank is illustrated in Figure 3. The first floor provides space for personnel offices, hot-cell operations, maintenance and utility areas, a receiving area, and a water-filled storage basin. On the second floor are equipment rooms, a laboratory area, maintenance shop, and working space around the cells. The third floor, a high bay, includes the cell roof area and provides facilities for entry of cell services and cell access. The high bay is equipped with a 50-ton traveling bridge crane with a 5-ton auxiliary hoist. Some of the third-floor space is used for cell and building ventilation equipment. A partial basement contains a glove-box laboratory and provides access to Cell F (a storage cell).

Californium Facility

The californium activities are conducted primarily in Cells B, C, and G. Work stations are provided with viewing windows and manipulators. Cell G is the only hot cell in which significant amounts of unencapsulated radioactive materials are handled. Cell C is used for assembling and welding outer capsules, final decontamination, testing, and loading/unloading shipping casks. Shipping casks can be moved in/out of Cell C through a hatch in the cell roof using the building crane. Cell B is used only for loading/unloading small shipping casks. Cell A and the vestibule entry are unshielded and serve as a passageway to Cell B. Personnel entry into Cells B and C is permitted for shipping cask setup, equipment maintenance, and waste removal. The cell doors are interlocked to prevent personnel entry if significant sources of radiation are present and to deenergize the X-ray unit power supply.

A storage facility for capsules of ^{252}Cf is installed in the water-filled basin. The water in the basin provides a shielding function (rather than a cooling function). The basin is constructed of monolithic concrete and is located below grade. The storage rack for the ^{252}Cf capsules is located within an open-top aluminum tank that serves as a catch pan if a storage capsule is dropped during handling and would retain a modest quantity of water for shielding if water should drain from the main body of the basin. Pneumatic transfer systems are used to transfer neutron sources and packages among work stations in Cells B, C, and G and the ^{252}Cf storage rack in the storage basin. There is also a separate pneumatic transfer system between Cell G and Building 7920.

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Question 1 Narrative Continued:

Containment and Ventilation

The operations in Bldg. 7930 that involve radioactive materials are quite different from the thorium-uranium fuel recycle operations for which the facility was built. In the original plan, all of the hot cells were to be used for primary containment of radioactive materials during high-level fuel recycle operations. However, in californium facility operations, only Cell G is used for handling significant quantities of unencapsulated radioactive materials in solution or powder form that are readily dispersable. Thus, Cell G is the only hot cell used for the primary containment of operations with large quantities of radioactive materials. Cells B and C merely provide shielding for the operations performed there. Radioactive operations are not performed in Cells A, D, E, and F. Cell D is a large cell that is currently empty. A totally enclosed, separately ventilated cubicle in Cell C provides primary containment for certain operations performed there, which include welding outer capsules on sealed source capsules and shipping packages, as well as decontamination of inner and outer capsules. Sealed-source capsules provide primary containment for the transfer, testing, and carrier loading operations performed elsewhere in Cells C and B and for the ^{252}Cf in the underwater storage facility. Glove boxes and hoods provide primary containment for operations with small amounts of radioactive materials. The physical barriers and ventilation systems provide containment or confinement of the radioactive materials. Cell G constitutes the primary containment barrier for the large quantities of radioactive materials in solution or powder form. During normal operations, Cell G is maintained at a vacuum of at least 1-in. water gauge (w.g.) with respect to the secondary containment spaces. Cells A, B, C, D, E, and F, and the building walls surrounding the cell bank constitute the secondary containment barrier, which is maintained at a vacuum of at least 0.3-in. w.g. with respect to the environment. The ventilation air distribution systems maintain pressure differentials that cause air to flow from nonradioactive areas toward areas that are more likely to contain radioactive materials.

All cells are ventilated by air drawn from the occupied areas of the building through high-efficiency particulate air (HEPA) filters and back-flow preventers and then through the cells on a once-through basis. The air from the third-floor high-bay area and the first-and second-floor transfer and storage areas is exhausted via the cells. The purge air leaving the cells is filtered at the point of exit by high-capacity roughing filters. Cell C has HEPA filters at this point since it shares a common exhaust manifold with the contaminated Cell G. After leaving the cells, the air is filtered through two stages of HEPA filters and discharged to the atmosphere through a 76.2-m (250-ft) tall stack (7911). The cell exhaust system (cell off-gas, COG) HEPA filters are in a shielded concrete pit located southwest of Bldg. 7930. The COG system is provided with a spare exhaust fan that is switched into service automatically if the operating unit fails and is backed by a diesel-powered generator.

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Question 1 Narrative Continued:

Vessel hot off-gas (HOG) capability was provided for thorium-uranium fuel cycle studies as part of the combination radioactive hot drain—hot off-gas (RHD-HOG) system. It was also intended that vessels containing high concentrations of fissile materials would be vented to the criticality safe radioactive hot drain recoverable (RHDR) system. There are no process vessels in the californium facility vented through these systems. The waste tanks are vented through the RHD-HOG system. The sample loading glove box over Cell G is normally vented through a connection with the cell, but off-gas is provided through the RHDR when the glove box is disconnected from the cell. Gases are drawn off the top of the waste tanks through a prefilter and two stages of HEPA filters and, subsequently, discharged to the COG system upstream of the COG exhaust filters. The RHD-HOG system has a spare exhaust fan and is backed by a diesel-powered generator.

Status of Safety Documentation: (See list of references)

1. ***Draft Safety Analysis:***[1] The Draft Safety Analysis Report (SAR) was written to meet the requirements of DOE Order 5480.1A, Chapter V. The SAR describes the facility as it existed in 1987, which is principally the same as it is today. Detailed descriptions of equipment, systems, and operations in Building 7930 are included. information is presented concerning the risks involved in the facility's operation and the measures undertaken to mitigate those risks. [This report was submitted to the DOE, but the approval process was set aside in favor of the SAR Upgrade Program.]

2. ***Operational Safety Requirements:***[2] The Operational Safety Requirements (OSR) Document describes operating requirements derived from information within the Draft SAR. It defines the limiting conditions for operation at Building 7930 and specifies administrative systems and controls necessary to ensure safety of the facility and operating personnel. **[A major revision of the OSR document (ORNL/M-2552/R1) has been prepared. The revised OSR was submitted to DOE for approval in March 1994.]**

3. ***Hazard Screening:***[3] The Hazard Screening (HS) document evaluates the hazards associated with Building 7930. Several bounding accident scenarios for the radioactive material hazards were developed, and unmitigated consequences were determined for the scenarios.

    1. Sample handling glove box

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Question 1 Narrative Continued:

General Aggregation Areas of Plutonium

Cell G:
1. Interim storage of ^{252}Cf awaiting processing
2. Intermediate forms in process
3. Product materials and neutron sources

Storage facility (water-filled basin)

Laboratories

Waste pit:
1. Solutions in waste collection tanks

Third-floor operating area:

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Applicable References:

1. L. J. King, K. J. Notz, and J. E. Bigelow, *Safety Analysis: TURF, Building 7920* (Draft Report), ORNL/TM-9505, Oak Ridge National Laboratory, August 1987.

2. L. J. King, K. J. Notz, and J. E. Bigelow, *Operational Safety Requirements: TURF Building 7930*, ORNL/CF-84/446, Oak Ridge National Laboratory, August 1987.

3. Martin Marietta Energy Systems, Inc., *Phase I Safety Analysis Report Update Program Hazard Screening: Building 7930 Radiochemical Engineering Development Center*, HS/7930/F/IT-6/R0, Oak Ridge, TN, October 21, 1992.

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Question 2: Holdings — DOE Material Manager: James T. Hargrove

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal	^{237}Np	P1,C1		2
	^{237}Np	P1,V1		2
Oxide	^{237}Np	P1,B1,G1		2
	^{237}Np	U2,X1		1.7
	^{252}Cf	V1,P1		11.8
	^{252}Cf	V1,V5		0.3-6.6
	^{252}Cf	V4		4.7-6
	^{252}Cf	V4,V1,V1,V5		13.6-14
	^{252}Cf	V4,V5		15.5
Scrap/Residues[4] Soln/N or Oxide	^{252}Cf	T3		3.1
	^{252}Cf	V4,P3		0.6-3.6
Solution[4]				
Sealed Sources	^{252}Cf	V1,V1,P1,V5		2.2
	^{252}Cf	V1,V1		5.9-6.1
	^{252}Cf	V1,V1,V5		0-24
	^{252}Cf	V1,V1,V5		0.3-10.4

SITE: X-10	FACILITY: REDC Bldg. 7930			
	FUNCTION: Californium Purification and Distribution			
	^{252}Cf	V1,V5		0.8-25
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]				
Unirradiated Reactor Fuel				
High-level Liquid Waste				
Other (specify) Metal & Oxide	Pu(<4%240)	P1,B1		2
Nitrate Salt	^{252}Cf	V1		14.8
Question 2 Continued:				

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Question 2A: No. Pkgs and Mass DOE Material Manager James T. Hargrove

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal	^{237}Np	11 g	1
	^{237}Np	21 g	1
Oxide	^{237}Np	27 g	5
	^{237}Np	11	1
	^{252}Cf	45 μg	3
	^{252}Cf	672 μg	2
	^{252}Cf	1044 μg	2
	^{252}Cf	7969 μg	8
	^{252}Cf	328 μg	1
Scrap/Residues Soln/N or Oxide	^{252}Cf	4 μg	1
	^{252}Cf	38,514 μg	8
Solution			
Sealed Sources	^{252}Cf	327 μg	13
	^{252}Cf	3 μg	4
	^{252}Cf	52,869 μg	101
	^{252}Cf	870 μg	2
	^{252}Cf	694 μg	20
TRU Waste			

SITE: X-10	FACILITY: REDC Bldg. 7930 FUNCTION: Californium Purification and Distribution		
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			
Cumulative Inventory Difference			
Other (specify) Metal & Oxide	Pu (<4%240)	1 g	1
Nitrate Salt	^{252}Cf	0 μg	1
Question 2A Continued:			

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Question 3: Physical Barriers DOE Material Manager James T. Hargrove

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Np metal, Np oxide, Pu metal & oxide.

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Barrier #	Worker Protection	Environment and Public Protection
1	WB-6	EB-2
2		EB-1
3		EB-4

Material Aggregation (list material types included from Question 2) Cf oxide, Cf Sealed Sources, Cf Scrap Residues: Solution/N

Barrier #	Worker Protection	Environment and Public Protection
1	WB-8	EB-2
2		EB-1
3		EB-4

Material Aggregation (list material types included from Question 2) Cf oxide, Cf Sealed Sources

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18,(Pool)	EB-3
2		EB-2
3		EB-1
4		EB-4

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Question 3 Continued:

Material Aggregation (list material types included from Question 2) Cf Scrap/Residues: Solution/N

Barrier #	Worker Protection	Environment and Public Protection
1	WB-18, Tank Pit	EB-2
2	WB-14	EB-4

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

In-Facility

- x Inadvertent Transfers
- x Aging
- ☐ Organic Nitric Acid Reaction
- x Equipment Failure
- x Change in Mission
- x Other Co-Located Hazards
- x Corrosion
- ☐ Inadequate Configuration Knowledge
- ☐ Combustible Loading
- ☐ Inadequate Seals
- x Potential Water Sources
- ☐ Inadequate Drains
- ☐ Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- ☐ Administrative Controls
- ☐ Other - Specify

Material

- x Pressurization
- ☐ Pyrophoricity
- x Radioactivity
- x Chemical Reactivity
- x Am Buildup
- x Hydrogen Buildup
- x Radiolysis
- ☐ Volumetric Expansion
- x Oxidation
- ☐ Other - Specify

Question 4 Continued:

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Describe Each Adverse Condition:

In-Facility:
There are no existing (or actual) conditions in the facility which are currently storage or operational vulnerabilities. Some conditions have potential for becoming vulnerabilities.

Facility Conditions
Several conditions (e.g., general aging, corrosion, and equipment and seal failures) have potential for reaching a degree of severity at which storage or operational problems might occur.

Energy Sources/Co-Located Hazards
Damage to primary barriers is possible in situations where light-duty containers and small equipment (e.g., glass and plastic) are exposed to energy sources or to other co-located hazards.

Flooding
A limited possibility exists for flooding to occur inside the hot cells, either from potential operational errors or from damaged water sources.

Operational Errors
A small potential exists for operational errors (e.g., inadvertent transfers) where radioactive materials (sealed ^{252}Cf sources) might be placed in unintended locations.

Changes in Mission
Changes in mission always have potential for the creation of adverse conditions, particularly where major decreases in funding and staffing might result in the severe curtailment of facility maintenance and support services. Inadequate preventative maintenance and upkeep of the facility could result in deterioration of essential equipment and systems required for control and confinement of radioactive materials.

Material:
Packaging, containers, adjacent materials, and equipment are continually subjected to conditions caused by the properties of radioactive materials. While radioactive materials are in process, the effects of radiolysis, hydrogen (gas) buildup, and pressurization are pronounced enough to require measures for venting and off-gassing. None of these conditions is adverse enough to be the cause of accidents involving appreciable release of materials beyond primary worker protection barriers.

Radiolytic damage and degradation to process organic solvents and resins may have an adverse effect upon product separations and purity. Consequently, there is sufficient impetus to minimize these effects before they affect packaging and barrier integrity.

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

The effects of chemical reactivity and oxidation are also present, although not so much from the radioactive materials as from the chemical constituents of the process solutions. Liquid materials in interim storage are similar to solutions in process.

Most materials in storage are present as oxides in metal containers or as sealed source forms. These materials are considered inherently stable.

Applicable References:

1 An existing situation that gives rise to a potential event or concern.

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- x Fire
- x Explosion
- x Worker Exposure
  - x External
  - x Internal
- x Contamination
- x Flooding
- x Leakage/Spills
- ☐ Other Accidents - Specify
- x Human Error

Material
- ☐ Criticality
- x Fissile Material Release
- x Breach of Container
- ☐ Fire
- ☐ Other - Specify

External
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
- ☐ Adjacent Facility Accident
- ☐ Power Failure
- ☐ Institutional/Regulatory Requirements
- ☐ Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify

Natural Phenomena
- ☐ Earthquake Damage
- ☐ Wind Damage
- ☐ Flood Damage
- ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Describe Each Event:

In-Facility:

Leakage/Spills

Several conditions (e.g., general aging, corrosion, and equipment and seal failures) have potential for reaching a degree of severity at which storage or operational problems might occur. In such cases, the resulting process or operational upsets would not be expected to have major effects on the integrity of packaged materials. Releases of materials from storage or process vessels (e.g., tanks, equipment, and solution transfer lines) would be confined within primary worker barriers (hot cells and glove boxes). Consequences to such events would probably result in minimal if any exposure or contamination to facility workers. There are no foreseen effects on the environment or the public.

Pressurizations/Explosions (Contaminations and Worker Exposures)

Damage to primary barriers is possible in situations where light-duty containers and small equipment (e.g., glass and plastic) are exposed to energy sources or to other co-located hazards. Typically, all such containers and vessels are inside additional worker barriers. Sealed metal containers are not likely to be damaged. Materials from breached containers in hot cells would probably be confined to those areas. There would be no exposure to workers. Material released from glove boxes and hoods would be into rooms located within contained areas of the facility. Similar breaches and releases of materials from glove boxes could occur if the worker barrier (glove box) were subjected to a strong force by an external energy source. Exposure/contamination to workers in these rooms would probably occur from such a release. The HVAC/confinement and facility structure barriers would keep materials from spreading to other facility areas or to the environment. [Note that fire (not accompanied by an explosion) inside a hot cell or a glove box is not considered a highly dispersive event because of the presence of fire protection equipment within the primary worker barriers.]

Flooding

Some potential exists for flooding to occur inside the hot cells, either from potential operational errors or from damaged water sources. Most packaging barriers (e.g., sealed packages) would not be affected. By design, the hot cells can contain large volumes of water. Leakage of contaminated water and radioactive materials from the hot cells is not expected to occur before facility instrumentation and surveillance could detect abnormal conditions.

Human Error: Inadvertent Transfer

A very limited possibility exists for operational errors (e.g., inadvertent transfers) where materials (particularly sealed ^{252}Cf sources) might be placed in unintended locations using the intercell pneumatic transfer systems. The quantity of materials in this facility is always less than critically safe amounts. Damage to packaging barriers is not likely. In-cell and other local radiation alarms/monitors and interlock systems are designed to prevent radiation exposures to facility workers in all areas adjacent to the cell bank.

SITE: X-10	FACILITY: REDC Bldg. 7930 FUNCTION: Californium Purification and Distribution

<u>Preventive</u>
 	
x Procedures: ops., maint., surveillance
x Material Limits
x Training
x Quality Assurance
x Conduct of Operations
x Authorization Basis (safety analysis, BIOs)
x Surveillance
x Organization
  x Structure
  x Management Involvement
  x Staffing
x Lessons Learned
x Configuration Control of Design
x Preventive Maintenance
x Monitoring
x Trending (Performance Indicator)
x Testing/Verification of Integrity
x Regulatory Requirements
x Records
  x Personnel Exposure
  x Equipment
  x Waste Inventory
  x QA
☐ Personnel Reliability Assurance Program
☐ Other - Specify
	<u>Mitigative</u>
	
	x Emergency Preparedness
	x Emergency Management
	  x Emergency Planning
	  x Emergency Procedures
	  x Emergency Response
	x Safety Systems
	x Alarm Systems
	☐ Other - Specify

<u>Question 6 Continued:</u>	

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Compensatory Measure — Reference Document

Preventative Measures and Mitigative Factors

General descriptions of preventative measures and mitigative factors indicated for the facility are in the following documents:

L. J. King, K. J. Notz, and J. E. Bigelow, *Safety Analysis: TURF, Building 7920* (Draft Report), ORNL/TM-9505, Oak Ridge National Laboratory, August 1987.

L. J. King, K. J. Notz, and J. E. Bigelow, *Operational Safety Requirements: TURF Building 7930*, ORNL/CF-84/446, Oak Ridge National Laboratory, August 1987.

Additional description of Emergency Preparedness/Management may also be found in the following:

Local Emergency Manual: REDC Bldg. 7930

Isotope Technology Section Procedure: *Emergency Readiness and Safety*, IT-AD-1, (1994).

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

EVENT	WORKER			ENVIRONMENT			PUBLIC		
	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
Leakage/Spills	N	N	N	N	N	N	N	N	N
Pressurizations/Explosions in Hot Cell	N	N	N	N	N	N	N	N	N
Pressurizations/Explosions in Glove Box (or Hood)	Y	Y	Y	N	N	N	N	N	N
Flooding	N	N	N	N	N	N	N	N	N
Inadvertent Transfers	N	N	N	N	N	N	N	N	N
Breach of Sample Handling Glove Box from External Object	Y	Y	N	N	N	N	N	N	N

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Explanation:

Events:

Leakage/Spills
Process and operational upsets caused by equipment and seal failures within primary worker barriers would not have major effects on the integrity of packaged materials. Releases of materials from storage or process vessels (e.g., tanks, equipment, and solution transfer lines) or from small equipment inside glove boxes are expected to be confined within the primary worker barriers. Consequences to such events would probably result in no significant exposure or contamination to facility workers. Containment within worker and environmental barriers adequately protects the environment and public from the effects of this type of event.

Pressurizations/Explosions in Hot Cell
Damage to primary barriers is possible in situations where light-duty containers and small equipment (e.g., glass and plastic) are exposed to energy sources or to other co-located hazards. Typically, all such containers and vessels are inside additional worker barriers. Sealed metal containers are not likely to be damaged. Materials from breached containers in hot cells would be confined to those areas. There would be no exposure to workers. The HVAC/confinement and facility structure barriers would keep materials from spreading to other facility areas or to the environment.

Flooding
During inadvertent or accidental flooding inside a hot cell, it is expected that most packaging barriers (e.g., sealed packages) in the cell would not be affected. By design, the hot cells can contain large volumes of water. No leakage of contaminated water or radioactive materials from the hot cells or damage to the ventilation filtration system is expected to occur before facility instrumentation and surveillance could detect abnormal conditions.

SITE: X-10	FACILITY: REDC Bldg. 7930
	FUNCTION: Californium Purification and Distribution

Question 7 Continued:

Inadvertent Transfers

In the event of an inadvertent transfer, a sealed ^{252}Cf source might be placed in an unintended locations using the intercell pneumatic transfer system. Damage to packaging barriers is not likely during such an event. In-cell and other local radiation alarms/monitors and interlock systems are designed to prevent radiation exposures to facility workers in all areas adjacent to the cell bank. There would be no release of material beyond the primary containment barriers (i.e., the hot cell).

Question 8: Overall Site Summary (REDC Bldg. 7930)

- The most important ES&H concerns related to "plutonium" storage, handling, processing, and/or shipping.

  By far, the major radionuclide handled in REDC Bldg. 7930 is ^{252}Cf. This material is of concern both because of its potential inhalation hazard and its penetrating radiations (fast neutrons). However, the majority of the ^{252}Cf is present as sealed sources or at least in welded containers that essentially eliminate the possibility of dispersal. Usually less than 100 Ci of ^{252}Cf is undergoing processing in Cell G at any one time, and the excellent ventilation/containment system would prevent the dispersal of this material to the worker or to the environment under all credible scenarios.

  The most important concern is that sufficient financial resources continue to be available so that operation and maintenance of the facility remain sufficient to protect the large amount of ^{252}Cf in storage underwater in this facility.

- Which "plutonium" activities pose the highest risk to the environment, worker, and public at this site.

  The greatest potential risk to a worker would be the direct exposure to a large ^{252}Cf neutron source or shipping container. There are interlocks and operating procedures designed to reduce the probability of this occurrence to a very small value, but if it did occur, the resulting dose to the total body could easily amount to 25 rem.

- Current planned actions to minimize worker exposure, reduce environmental risks, and protect the public at and near this site.

  We believe that all operations are being conducted at an acceptable level of risk to the worker, the environment, and the public.

- Noteworthy programs or practices related to "plutonium" storage, handling, processes, and/or shipping.

  Much of the ^{252}Cf which we have produced in the past is on loan to numerous government agencies and their contractors. Upon the expiration of these loans, we are obligated to receive back the remaining ^{252}Cf. If there is no other use of this source, it will be placed in a storage rack in a water pool. Thus, ORNL is the *de-facto* "warehouse" for ^{252}Cf in the USA.

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

DOE HEADQUARTERS FACILITY LANDLORD NE

DOE HEADQUARTERS PROGRAM SPONSOR NE

FACILITY AGE 50 years DESIGN LIFE Indefinite

Question 1: Facility

The Isotope Enrichment Facility (IEF), Building 9204-3 at the Y-12 Site, is operated by the Chemical Technology Division of the Oak Ridge National Laboratory. It is one of many calutron facilities built at the Y-12 Plant in 1943 for the enrichment of ^{235}U. After WWII, other processes were used for the enrichment of uranium. At that time the calutrons in this building were used for the electromagnetic separation of stable isotopes, which continues to the present. In 1962, a contained facility was constructed around eight calutrons to improve the safety of the enrichment and processing of alpha-emitting actinide isotopes. This contained facility was operated until 1979, when it was placed in safe standby and, currently, remains under surveillance as part of the Isotope Facility Deactivation Project (EM). Glove-box laboratories are used on a limited basis to dispense small quantities of actinides for shipment to customers. The enrichment and processing of stable isotopes and the dispensing of actinide isotopes are part of the Isotope Production and Distribution Program.

The *Phase 1 - Safety Analysis Report (SAR) Update Program-Hazard Screening (HS/9204-3/F/IT-13/R0)*, dated 5/27/93, serves as the Basis for Interim Operation document for this building. This study concluded that the facility is classified in the "Low" hazard category. The contained calutrons and associated support and laboratory areas are described in the 1973 document entitled *"Radiation Safety and Control for the Electromagnetic Isotope Separation of the Heavy Elements in Building 9204-3, Y-12 Plant, Including Operational Procedures and Facility Layouts,"* ORNL-TM-4013. The *Nuclear Safety Review for the Isotope Enrichment Facility, Building 9204-3,* (NSR 0030-CT-Y12-07A, March 20, 1992) and a variety of internal operating and surveillance procedures complement the ES&H documentation for this facility.

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Question 1 Narrative Continued:

Building 9204-3 has a steel superstructure with masonry walls and concrete floors. Heavy, reinforced-concrete columns support the massive calutron magnets in the south part of the building. The building contains approximately 216,200 square feet (5 acres) of floor space. It is located on the southern edge of the main Y-12 Plant, approximately in the middle of its east-west axis. It is in the extreme southeast corner of the Perimeter Intrusion Detection Assessment System (PIDAS) "Protected Area." This location is 730 m from the nearest public access on Bear Creek Road.

All plutonium is stored in metal pipe nipples with screw-on metal caps. Inside these pipe nipples, the plutonium is contained within glass bottles. The glass bottles are located within plastic bags for ease of handling. All of the plutonium in this facility is located in stainless steel glove boxes. The area were contained was constructed in the early 1960s by building containment wall partitions using hollow, red-clay tile blocks. The laboratory is kept locked whenever it is unoccupied. All of the glove boxes have untested inlet and exhaust HEPA filters at the box and tested HEPA filters on the main glove-box exhaust header. A modified constant alpha air monitor is plumbed into the glove-box exhaust system to monitor that stack for alpha activity. A separate, interlocked ventilation system with tested HEPA filters provides room containment for this laboratory. Auxiliary fans and a back-up generator provide redundancy for the ventilation systems. A wide variety of facility parameters are monitored on an alarm panel in the laboratory, with several key parameters on a telealarm system to the Plant Shift Superintendent's Office for continuous monitoring. The area is protected by a conventional dry-pipe sprinkler system. Two-inch elevated door thresholds at each entrance to the laboratory would contain approximately 2,200 gallons of water in the event of a sprinkler discharge. A manually operated (screw plug) floor drain in the laboratory discharges to storage tanks in the basement.

Applicable References:

HS/9204-3/F/IT-13/R0 May 27, 1993	The Phase 1 - Safety Analysis Report (SAR) Update Program-Hazard Screening, Isotope Enrichment Facility, Building 9204-3
ORNL-TM-4013 March 1973	Radiation Safety and Control for the Electromagnetic Isotope Separation of the Heavy Elements in Building 9204-3, Y-12 Plant, Including Operational Procedures and Facility Layouts
NSR 0030-CT-Y12-07A March 20, 1992	The Nuclear Safety Review for the Isotope Enrichment Facility. Facility, Building 9204-3

FUNCTION: Isotope Enrichment and Distribution

Question 2: Holdings DOE Material Manager W. H. Hopwood

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal				
Oxide Packages Included below	Other (^{239}Pu)	G1/B1/V5 80 mg Pu	Indefinite	2
1	Other (^{239}Pu)	G1/B1/V5 40.274 gm Pu	Indefinite	2
1	Other (^{240}Pu)	G1/B1/V5 12.989 gm Pu	Indefinite	2
1 3	Other (^{241}Pu)	G1/B1/V5 1.938 gm Pu	Indefinite	2
1	Other (^{242}Pu)	G1/B1/V5 192.516 gm Pu	Indefinite	2
	Other (^{244}Pu)	G1/B1/V5 14.637 gm Pu	Indefinite	2
Scrap/Residues[4]				
Solution[4] Packages 1	Other (Pu-239)	G1/B1/V5 78 mg Pu	Indefinite	2
(N) 1	Other (Pu-244)	G1/B1/V5 250 mg Pu	Indefinite	2

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Question 2 Continued:

Applicable References:

Current nuclear materials inventory maintained for MBA 66.

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1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.

2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.

3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.

4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.

5 Holdup has no packaging. Identify location of holdup.

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Question 3: Physical Barriers DOE Material Manager W. H. Hopwood

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) All Pu

Barrier #	Worker Protection	Environment and Public Protection
1	WB-13	EB-2
2	WB-4	EB-1
3	WB-1	EB-4
4	WB-6	
5	WB-18 (Ventilation System)	

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Question 3 Continued:

Applicable References:

HS/9204-3/F/IT-13/R0 — The Phase 1 - Safety Analysis Report (SAR) Update Program-Hazard Screening, Isotope Enrichment Facility, Building 9204-3.

ORNL-TM-4013 — Radiation Safety and Control for the Electromagnetic Isotope Separation of the Heavy Elements in Building 9204-3, Y-12 Plant, Including Operational Procedures and Facility Layouts

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Question 4: Adverse Conditions[1]

Indicate actual or potential adverse conditions that are applicable to those materials, packages and barrier aggregates developed in Questions 1, 2, and 3 by checking the appropriate items and describing below.

Adverse Condition

In-Facility

- ☐ Inadvertent Transfers
- X Aging
- ☐ Organic Nitric Acid Reaction
- X Equipment Failure
- X Change in Mission
- ☐ Other Co-Located Hazards
- ☐ Corrosion
- X Inadequate Configuration Knowledge
- ☐ Combustible Loading
- ☐ Inadequate Seals
- X Potential Water Sources
- ☐ Inadequate Drains
- X Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- X Inadequate Preventive Maintenance
- X Administrative Controls
- ☐ Other - Specify

Material

- ☐ Pressurization
- ☐ Pyrophoricity
- ☐ Radioactivity
- ☐ Chemical Reactivity
- ☐ Am Buildup
- ☐ Hydrogen Buildup
- X Radiolysis
- ☐ Volumetric Expansion
- ☐ Oxidation
- ☐ Other - Specify

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Question 4 Continued:
Describe Each Adverse Condition:

In-Facility

Aging: The facility housing the plutonium is over 30 years old and has not had any significant upgrades during that period. It has not been in an operating mode in over 10 years. Possible adverse conditions associated with aging were recognized when the facility was placed in standby, and many actions (turning off water and power sources to the glove-box equipment, etc.) were taken to minimize the development of these conditions. Regular surveillance is intended to detect any problems associated with aging.

Equipment Failure: Although the bulk of the material is in pipe nipples, contamination does exist in the glove boxes. Equipment failures, such as those involving the ventilation system (motor or belt failures, back-up generator failure, etc.), could compromise the quality of the physical barriers. Likewise, failure of a glove or bag could jeopardize the physical barrier from a contamination standpoint, but not involving the bulk material in the pipe nipples.

Change in Mission: As mentioned in the facility description, the contained facility was built in the early 1960s and operated through the late 1970s on a routine basis. Since that time, it has been maintained under surveillance, and limited materials dispensing operations have been performed. In 1989, it was placed in the Isotope Facilities Shutdown Program and more recently in the Isotope Facility Deactivation Project. The ultimate disposition of this part of the IEF and the support for that disposition has not been finalized.

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Potential Water Sources: All processing water sources were turned off when the facility was placed in standby. A conventional dry-pipe sprinkler system is present, which could become a source of water in the facility. Elevated thresholds would contain a relatively large quantity of water and manually controlled floor drains and sprinkler cut-off valves provide further control over accidental water release. The IEF building is located one block from the Y-12 Fire Department, ensuring a prompt response to this type of adverse condition.

Inadequacy of Design Basis: Building 9204-3 was built as part of the WWII War effort. With it's classification as a "Low Hazard" facility and the fact that the contained facility has been in standby since 1979, many of the design-basis evaluations that have been performed in more recent years for higher hazard or fully operating facilities have not been performed for this facility. In general discussions with facility safety engineering personnel, the evaluations performed for similarly designed facilities at this site indicate that this facility may meet or approach the seismic and wind design bases appropriate for a low-hazard facility.

Inadequate Configuration Knowledge: With the increasing length of time that the facility is in standby and the retirement of personnel who were present when the facility was operating, it is conceivable that future adverse conditions could develop as a result of inadequate configuration knowledge on the part of replacement personnel dealing with a shutdown versus operating facility.

Inadequate Preventative Maintenance: Surveillance of a shutdown facility entails different preventative maintenance needs than an operating facility, and there may be a greater potential for adverse conditions to develop the longer a facility remains inactive.

Administrative Controls: Similarly; as personnel experienced with the facility when it was built and operated are replaced by new personnel, there is a potential that knowledge of informal or undocumented controls may not be passed on to new personnel.

Material:

Radiolysis: In the past, very small (one 80 mg sample of oxide in a plastic bottle and one solution sample, containing 78 mg, stored in a plastic bottle) samples of plutonium have been stored in plastic. Both of these have been repackaged in glass primary containers, as all other plutonium in the facility have. Contamination levels of Pu exist in the glove boxes, along with small quantities of organics (gloves, plastic bags, etc.). Considering the small quantities, no significant adverse condition is thought to exist. Efforts are under way to obtain final approval on a TRU waste generation operating procedure that will permit removal of the small amount of accumulated organic materials present in the glove boxes.

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- X Fire
- ☐ Explosion
- X Worker Exposure
  - X External
  - X Internal
- X Contamination
- ☐ Flooding
- ☐ Leakage/Spills
- ☐ Other Accidents - Specify
- X Human Error

Material
- ☐ Criticality
- X Fissile Material Release
- ☐ Breach of Container
- ☐ Fire
- ☐ Other - Specify

External
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
- ☐ Adjacent Facility Accident
- ☐ Power Failure
- X Institutional/Regulatory Requirements
- ☐ Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify

Natural Phenomena
- X Earthquake Damage
- X Wind Damage
- ☐ Flood Damage
- ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Describe Each Event:

In-Facility

Fire: Although a fire is possible, it is not considered likely because an effort to minimize combustibles and eliminate ignition sources was made when the facility was placed in standby. The laboratory containing the plutonium is protected with a dry-pipe sprinkler system and is located one block from the Y-12 Fire Department. Elevated door thresholds provide a significant water storage capability within the laboratory, and manually operated floor drains permit transfer of water to storage tanks in the basement.

Worker Exposure: This facility has an excellent record in the area of controlling worker exposure, but there is always a potential for internal and exposure contamination when handling materials in a glove-box laboratory. The quantities of material available for involvement in an event are limited by storing individual or groups of batches in pipe nipples.

Contamination: Same as above. Also, air monitoring, personnel monitoring, and other administrative controls are used to minimize the spread of contamination.

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Question 5 Continued:

Describe Each Event:

Human Error: There is always a potential for human error in handling material, executing administrative controls, or in configuration management and control. Once again, the impact of these types of events are minimized by minimizing the quantity of material potentially available in an event.

Material

Fissile Material Release:

The small quantities, distribution, and packaging of fissile material limit the impact of any fissile material release.

External

Institutional/Regulatory Requirements:

Maintaining surveillance of the actinide portion of the facility and its ultimate disposition requires a financial commitment. It is difficult to ensure that long-term support will be available for the upkeep and upgrade of a facility that has been in long-term standby and will probably, never operate again. Recent institutional emphasis has been toward doing the absolute minimum.

Natural Phenomena

Earthquake and Wind Damage:

As decribed under Adverse Conditions, a formal, modern evaluation of Building 9204-3 for potential damages from earthquake or wind events has not been performed. Informal comparisons with similarly designed buildings indicate that the facility may meet the design criteria for a "Low Hazard" facility. The Phase 1 Hazard Screening for this facility assumed a

SITE: Y-12	FACILITY (Building or Location): 9204-3 FUNCTION: Isotope Enrichment and Distribution

complete release of the entire inventory and resulted in a Low Hazard rating. Considering that all of the plutonium is contained in pipe nipples, the consequences of an actual event should be much lower than those postulated in the hazard screening analysis that did not consider the confinement provided by these rugged containers.

Applicable References:

None

SITE: Y-12	FACILITY (Building or Location): 9204-3 FUNCTION: Isotope Enrichment and Distribution

Question 6: Compensatory Measure

Compensatory measures at the facility prevent and/or mitigate the adverse conditions and events identified in Questions 4 and 5. Check the applicable items in the table below and reference documents describing the compensatory measures. Identify any uncertainties or concerns in the checked compensatory measures.

Compensatory Measures

Preventive	Mitigative
X Procedures: ops., maint., surveillance X Material Limits X Training X Quality Assurance X Conduct of Operations X Authorization Basis (safety analysis, BIOs) X Surveillance ☐ Organization ☐ Structure ☐ Management Involvement ☐ Staffing X Lessons Learned ☐ Configuration Control of Design ☐ Preventive Maintenance X Monitoring ☐ Trending (Performance Indicator) X Testing/Verification of Integrity X Regulatory Requirements X Records X Personnel Exposure ☐ Equipment X Waste Inventory ☐ QA ☐ Personnel Reliability Assurance Program ☐ Other - Specify	X Emergency Preparedness X Emergency Management X Emergency Planning X Emergency Procedures X Emergency Response ☐ Safety Systems X Alarm Systems X Other - Specify: - Back-up Systems - Critical Motor Pool

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Compensatory Measure		Reference Document
Procedures	IEF-GP-1.1	Inventory of Nuclear Materials
	IEF-GP-4.1	Surveillance and Monitoring of Controlled Areas and Equipment in the Isotope Enrichment Facility
	IEF-GP-5.0	Fissile Material Control in the IEF
	IEF-GP-7.0	Solid Low-Level Waste
	IEF-EPP-1.0	Administration of Emergency Procedures
	IEF-EPP-2.0	Building Daily Emergency and "In-Place" Accountability of Personnel
Material Limits	NSR-0030-CT-Y12-07A	The Nuclear Safety Review for the Isotope Enrichment Facility, Building 9204-3
Training		Individual Training Records
Conduct of Operations	CTD/OP-1,2,3	Chemical Technology Division Standard, Policy and Procedure for Conduct of Operations.
Quality Assurance	QAP-X-89-CT-006/R0	Quality Assurance Plan for Isotope Enrichment, Recovery,and Purification Operations, Maintenance and Modifications at the Isotope Enrichment Facility
Authorization Basis	HS/9204-3/F/IT-13/R0	Phase 1 - Safety Analysis Report (SAR) Update Program Hazard Screening
Surveillance	IEF-GP-4.1	Surveillance and Monitoring of Controlled Areas and Equipment in the Isotope Enrichment Facility
Lessons Learned	Y60-164	Formal Green/Yellow/Red Alert System
	Review of ONS *Operating Experience Weekly Summary* by IEF Radiation Control Officer	
Monitoring	ORNL-TM-4013	Radiation Safety and Control for

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Testing/Verification of Integrity	Facility logs for HEPA filter testing and instruments calibrations and testing.	
Regulatory Requirements	A wide variety of DOE, Energy Systems, ORNL and Y-12 requirements apply.	
Records		
Personnel Exposure	Health Physics Records	
Waste Inventory	IEF-GP-7.0	Solid Low-Level Waste
Emergency Preparedness	IEF-EPP-1.0	Administration of Emergency Procedures
	IEF-EPP-2.0	Building daily emergency and "In Place" accountability of personnel
Emergency Management	This is under the responsibility of the Plant Shift Superintendent's Office and their particular documents.	
Alarm Systems	ORNL-TM-4013	Radiation Safety and Control for the Electromagnetic Isotope Separation of the Heavy Elements in Building 9204-3, Y-12 Plant, Including Operational Procedures and Facility Layouts
Other - Back-up Systems	ORNL-TM-4013	Same as above
Critical Motor Pool	A list of critical motors for which spares are maintained.	

Uncertainty or Concern	Discussion
None	

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

	WORKER			ENVIRONMENT			PUBLIC		
EVENT	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
Fire	Minor	Minor	Minor-None	None	None	Minor	Negligible	Negligible	None
Exposure external	Minor	Negligible-alpha	None	None	None	None	None	None	None
Exposure-internal	N	N							
Contamina tion	Minor	Negligible-alpha	None	None	None	None	None	None	None
Human Error	Minor	Negligible-alpha	Minor or limited involvemen t						
Fissile Material Release	Minor	Negligible-alpha	None						
Institutiona l/ Regulatory Requireme nts	Unknown								
Earthquake Damage	Minor	Negligible-alpha	Un-known	Minor	Minor	Minor	Negligible	Negligible	None
Wind Damage	Minor	Negligible-alpha	Un-known	Minor	Minor	Minor	Negligible	Negligible	None

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Explanation:

In all cases, a relatively small amount of material is involved. When it is considered that the bulk of the material is confined in pipe nipples, the severity of consequences from potential events is reduced even further. In the hazard-screening document, a Low Hazard rating was concluded after considering that the entire inventory was released.

Question 7 Continued:

Applicable References:

HS/9204-3/F/IT-13/R0 The Phase 1 - Safety Analysis Report (SAR) Update Program-Hazard Screening

SITE: Y-12	FACILITY (Building or Location): 9204-3
	FUNCTION: Isotope Enrichment and Distribution

Question 8: Overall Site Summary

Based on the Site Assessment Team report, provide an overall assessment of the site ES&H vulnerabilities.

In all cases, a relatively small amount of material is involved. When it is considered that the bulk of the material is confined in pipe nipples, the severity of consequences from potential events is reduced even further. In the hazard screening document, a Low Hazard rating was given, even considering that the <u>entire</u> inventory was released.

Reference Documents for Building 9204-3
Isotope Enrichment Facility

DOE Pu ES & H Vulnerability Assessment
June 1994

Number	Title
IEF-GP-1.1	Inventory of Nuclear Materials
IEF-GP-4.1	Surveillance and Monitoring of Controlled Areas and Equipment in the Isotope Enrichment Facility
IEF-GP-5.0	Fissile Material Control in the IEF
IEF-GP-7.0	Solid Low-Level Waste
IEF-EPP-1.1	Administration of Emergency Procedures
IEF-EPP-2.0	Building Daily Emergency and "In-Place" Accountability of Personnel
NSR-0030-CT-Y12-07A	Request for Nuclear Safety Review and Approval
QAP-X-89-CT-006/RO	Quality Assurance Plan for Isotope Enrichment, Recovery and Purification Operations, Maintenance and Modifications at the Isotope Enrichment Facility
HS/9204-3/F/IT-13/RO	Phase 1 - Safety Analysis Report (SAR) Update Program -Hazard Screening
Y60-164	Quality Assurance Procedure
ORNL-TM-4013	Radiation Safety and Control for the Electromagnetic Isotope Separation of the Heavy Elements in Building 9204-3, Y-12 Plant, Including Operational Procedures and Facility Layouts

SITE: Y-12	FACILITY: 9212
	FUNCTION: Enriched Uranium Casting

DOE HEADQUARTERS FACILITY LANDLORD DP

DOE HEADQUARTERS PROGRAM SPONSOR DP

FACILITY AGE ~40 DESIGN LIFE Estimated greater than 50 years

Question 1: Facility

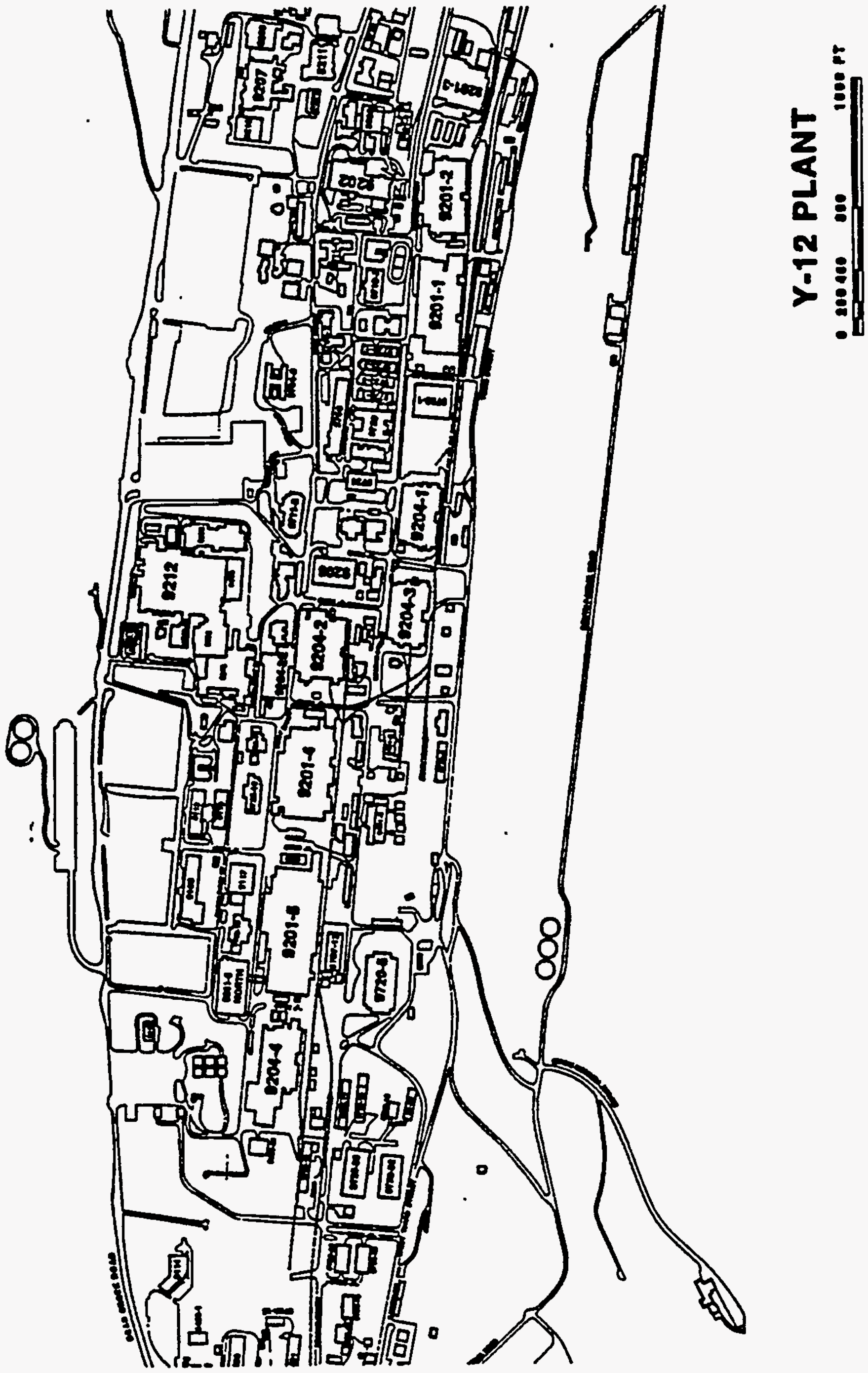
The design mission for the E-Wing Casting facility is to cast near finished shaped enriched uranium metal parts for nuclear weapons, cast metal billets for forming into metal plate stock, and supplying enriched uranium-aluminum alloy fuel for the Savannah River Production Reactors (this process has been discontinued). This facility continues to supply enriched uranium metal for use in research and experimental (test) reactors, and material for other nations programs. E-Wing actively supports the dismantlement and storage of decommissioned nuclear weapons through teardown, size reduction, material declassification, and packaging of materials for long term storage.

The design features of greatest interest to the existing transuranic materials involve: (1) the use of the neutron sources to limit the magnitude of the unlikely criticality, mechanically operated shielding of these neutron sources when the furnace is open, interlocks on the furnace shielding doors that require the doors to be closed when the furnace is in operation. The location of the neutron sources are indicated by multiple systems involving mechanical switches that indicate when the sources are within the shielding or against the furnace, neutron detectors that monitor the count rate and signal when the sources are fully retracted or fully exposed, and an indication of the relative neutron source strength.

There have been no concerns indicated for the covered material.

SITE: Y-12	FACILITY: 9212
	FUNCTION: Enriched Uranium Casting

Question 1 Narrative Continued:



SITE: Y-12	FACILITY: 9212
	FUNCTION: Enriched Uranium Casting

Applicable References:

Y/TS-59, *Operational Safety Requirements (OSR) for the Enriched Uranium Parts Manufacturing Project*, Revision A, February 25, 1991.

Y/TS-54, *Final Safety Analysis Report for the Enriched Uranium Parts Manufacturing Project* (U), Classified, 1982.

Y/ENG/OSR-63, *Operational Safety Requirements, E-Wing Dry Vacuum System, Building 9212*, May 1991.

IA/9212/FSET/OSR1/Rev 0, Safety Analysis Report Upgrade Program (SARUP) Phase IA, *Operational Safety Requirements for the 9212 Complex*, 1993 Draft.

SARUP Phase II, *Predecisional Draft: Facility and Process Descriptions for the Building 9212 Complex Safety Analysis Report Update Program (U)*, Classified, February 1994.

Highly Enriched Uranium Environmental Assessment, 1994. (DRAFT)

Oak Ridge Y-12 Plant, Site Development and Facilities Utilization Plan, Y/EN-954, 1986.

SITE: Y-12	FACILITY: 9212
	FUNCTION: Enriched Uranium Casting

Question 2: Holdings DOE Material Manager W. H. Hopwood

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal				
Oxide				
Scrap/Residues[4]				
Solution[4]				
Sealed Sources	W (with Be)	Tantalum/Stainless Steel Welded Source Containers	~50 years	30 years
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]				
Unirradiated Reactor Fuel				

SITE: Y-12	FACILITY: 9212			
	FUNCTION: Enriched Uranium Casting			
High-level Liquid Waste				
Other (specify)				

Applicable References:

See list of references for Question 1.

Dwg J2D62050,*Safety Systems Identification, Neutron Sources*

Drawing, *Standard Numec Plutonium-Beryllium Neutron Source*

1 Include isotopes of transuranic elements that are co-mingled (i.e., intermixed or grown in) or co-located in the facility, such as Neptunium, Americium, Curium, Californium, or U-233 as a decay product.
2 Using the information on grades of plutonium in Table A1, enter the code letter in the block to identify the plutonium grade of each material type.
3 Using the list of packaging types in Table A2, enter the code number or numbers in the adjacent block that identify the packaging type(s) for each material type.
4 For Scrap/Residues, Solution, TRU Waste, and Holdup, add the code letters as defined in Table A3.
5 Holdup has no packaging. Identify location of holdup.

SITE: Y-12	FACILITY: 9212
	FUNCTION: Enriched Uranium Casting

Question 2A: Classified Holdings DOE Material Manager W. H. Hopwood

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal			
Oxide			
Scrap/Residues			
Solution			
Sealed Sources	W (with Be)	1.04	8 sealed sources
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			
Cumulative Inventory Difference			

SITE: Y-12	FACILITY: 9212
	FUNCTION: Enriched Uranium Casting

Question 2A Continued:

I.D	Nuclide	Date	Mass(g)	Dscrptn	Chem/Phys Form	Location
PuBe- (8)	^{239}Pu	1963	~130 ea.	PuBe(S)	Encapsulated Mix	B-9212

Applicable References:

See list of references for Questions 1 and 2.

1 Identify probable location.

SITE: Y-12	FACILITY: Building 9212
	FUNCTION: Enriched Uranium Casting and NDA Laboratory

Question 3: Physical Barriers DOE Material Manager W. H. Hopwood

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Sealed Sources

Material Type Sealed Sources - W

Barrier #	Worker Protection	Environment and Public Protection
1	WB-14	EB-12, Cell
2	WB-17	EB-2
3	WB-9	EB-1
4	WB-15	EB-4

SITE: Y-12	FACILITY: Building 9212 FUNCTION: Enriched Uranium Casting and NDA Laboratory

Question 3 Continued:

Barriers for W (PuBe Sources)

Worker Protection:

WB-14, Shielding - the sources, when not in use or exposed to the casting furnace, are stored at the bottom of their source tubes within the concrete floor.

WB-17, Remote Handling - except when the sources are individually removed and smeared to check for maintenance of sealing, they are manipulated remotely from outside the casting furnace sell.

WB-9, Cell - the casting furnaces and the PuBe sources are used within a shielded cess. The shield doors to these cells (2) are however left open then the sources are retracted and material is no material present in the furnaces.

WB-15, Distance - the sources are isolated from personnel by sheild doors and internal cess spacing, operation from the floor level above the sources, having personnel outside the cells when the sources are in the operating position, and being located in the corner of the building that has limited access on at least one out-side wall.

Public/Environment Barrier:

EB-12, Cell - the casting furnace cell provides horizontal shielding between the PuBe sources and the outer side of Building 9212.

EB-2, HVAC/Confinement - the cell is swept by a HEPA filter protected exhaust system. The exhaust stack contains a real time radiometric monitoring system that is tied to alarms in the Plant Shift Superintendents (PSS) Office. This monitor is also alarmed within the building.

EB-1, Facility Boundary - Building 9212 is about 50 meters south of the limited access road that passes by the building.

EB-4, Site Boundary - is about 280 meters north and north-west of Building 9212. The land across the road from the building rises to a wooded area that is a buffer from access by the public on the other side of the hill.

Applicable References:

See list of references for Question 1.

SITE: Y-12	FACILITY: 9212
	FUNCTION: Enriched Uranium Casting and NDA Lab

In-Facility

- ☐ Inadvertent Transfers
- ☐ Aging
- ☐ Organic Nitric Acid Reaction
- X Equipment Failure
- ☐ Change in Mission
- ☐ Other Co-Located Hazards
- ☐ Corrosion
- ☐ Inadequate Configuration Knowledge
- ☐ Combustible Loading
- ☐ Inadequate Seals
- ☐ Potential Water Sources
- ☐ Inadequate Drains
- ☐ Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- ☐ Administrative Controls
- ☐ Other - Specify

Material

- ☐ Pressurization
- ☐ Pyrophoricity
- ☐ Radioactivity
- ☐ Chemical Reactivity
- ☐ Am Buildup
- ☐ Hydrogen Buildup
- ☐ Radiolysis
- ☐ Volumetric Expansion
- ☐ Oxidation
- ☐ Other - Specify

Question 4 Continued:

SITE: Y-12	FACILITY: 9212
	FUNCTION: Enriched Uranium Casting and NDA Lab

Describe Each Adverse Condition:

Equipment Failure - (Pu Sources) The sources could in the event of mechanical failure remain outside their shielding when the cell door is open and allow workers to be exposed to a portion of the source neutron flux. The potential for the exposure is reduced through two independent control panel indicator systems. Failure for the system to operate as designed, is mitigated by an neutron count interlock in addition to visual indicators on the control panel.

Applicable References:

See list of references for Questions 1.

1 An existing situation that gives rise to a potential event or concern.

SITE: Y-12	FACILITY: 9212 FUNCTION: Enriched Uranium Casting and NDA Laboratory

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- ☐ Fire
- ☐ Explosion
- X Worker Exposure
  - X External
  - ☐ Internal
- ☐ Contamination
- ☐ Flooding
- ☐ Leakage/Spills
- ☐ Other Accidents - Specify
- ☐ Human Error

Material
- ☐ Criticality
- ☐ Fissile Material Release
- ☐ Breach of Container
- ☐ Fire
- ☐ Other - Specify

External
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
  - ☐ Adjacent Facility Accident
  - ☐ Power Failure
- ☐ Institutional/Regulatory Requirements
  - ☐ Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify

Natural Phenomena
- X Earthquake Damage
- ☐ Wind Damage
- ☐ Flood Damage
  - ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

Question 5 Continued:
Describe Each Event:

Worker Exposure - Worker external exposure may also result from equipment failure as indicated in Question 4.

Earthquake Damage - An earthquake, while generally expected to initiate little building damage, could cause bending or flexing of the source tubes under the casting furnaces. This could possible inhibit the passage of the source holde and require maintenance activity to straighten the source tube(s). During this activity, maintenance and other personnel might be exposed to additional radiation. An earthquake is not expected to provide sufficient damage to rupture the source containers.

SITE: Y-12	FACILITY: 9212
	FUNCTION: Enriched Uranium Casting and NDA Laboratory

Applicable References:

See reference list for Questions 1.

SITE:	FACILITY (Building or Location): FUNCTION:
Preventive X Procedures: ops., maint., surveillance ☐ Material Limits X Training ☐ Quality Assurance X Conduct of Operations X Authorization Basis (safety analysis, BIOs) X Surveillance X Organization ☐ Structure X Management Involvement ☐ Staffing ☐ Lessons Learned X Configuration Control of Design X Preventive Maintenance X Monitoring ☐ Trending (Performance Indicator) X Testing/Verification of Integrity X Regulatory Requirements Records X Personnel Exposure X Equipment ☐ Waste Inventory ☐ QA X Personnel Reliability Assurance Program ☐ Other - Specify	Mitigative X Emergency Preparedness X Emergency Management X Emergency Planning ☐ Emergency Procedures X Emergency Response X Safety Systems X Alarm Systems X Other - Specify- Automatic Sprinkler Systems
Question 6 Continued:	

SITE:	FACILITY (Building or Location):
	FUNCTION:

<u>Compensatory Measure</u>	<u>Reference Document</u>
<u>Procedures: ops., maint., surveillance</u>	Y-12 Plant Procedure, 10-102, *Operating Procedure Development, Revision, and Control*, 6-25-91.
	Y-12 Enriched Uranium Operations Procedure, 60-37-004, *Surveillance*, 2-14-92.
<u>Training</u>	Y-12 Plant Procedure 10-027, *Plant Training Program*, 7-10-92.
<u>Authorization Basis</u>	Y-12 Plant Procedure, Y-70-800, *Safety Analysis and Review System, 7-10-92.*
	Y-12 Plant Procedure, Y-70-805, *Facility Safety Review Program, 3-12-93.*
	Y/TS-54, *Final Safety Analysis Report for the Enriched Uranium Parts Manufacturing Project* (U), Classified, 1982.
<u>Conduct of Operations</u>	*Y-12 Plant Conduct of Facility Operations (COFO) Implementation Plan*, 1991
	Y-12 Plant Operations, Leadership Training, 1991
	Y-12 Plant Enriched Uranium Operations, Series 10-37-EU-XX Procedures.
<u>Organization - Management Involvement</u>	Martin Marietta Energy Systems Standard ESS-OP-1, *Standard for Conduct of Operations*, March 1991
<u>Configuration Control of Design</u>	Y-12 Plant Proceure, 10-137, Configuration Management of Y-12 Facilities, 6-25-92.
<u>Testing/Verification of Integrity</u>	Y-12 Plant Procedure, 10-039, *Maintenance Recall Programs A, B, and C*, 9-1-89
<u>Personnel Exposure</u>	Y-12 Plant Procedure, 70-100, *Personnel Protection in Radiological in Radiological Areas*, 11-15-91.
	Y-12 Plant Procedure, 70-105, *Health Physics Control Standards*, 12-30-91.

SITE:	FACILITY (Building or Location):
	FUNCTION:
Personnel Reliability Assurance Program	Y-12 Plant Procedure, 70-033, *Employees Who Must Meet Physical Control Standards*, 12-30-91
Emergency Preparedness	Y-12 Emergency Plan, Volumes 1 and 2, *Emergency Operations Plan*.
Emergency Management	Y-12 Plant Procedure, 40-002, Personnel Evacuation, 4-29-94.
Emergency Response	Y-12 Enriched Uranium Operations Procedure, 40-37 -EU-001, *9212 Local emergency Response*, 5-31-92
	Y-12 Plant Procedure, 40-003, *Response of Plant Emergency Personnel*, 2-5-94
	Y-12 Enriched Uranium Operations Procedure, 40-37-002, *Response to Loss of Utility Services*, 1-16-90
Alarm Systems and Automatic Sprinkler	Y-12 Plant Procedure 70-250, *Fire Protection and Suppression*, 8-1-88

SITE: Y-12	FACILITY: 9212
	FUNCTION: Enriched Uranium Casting

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

	WORKER			ENVIRONMENT			PUBLIC		
EVENT	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
Worker Exposure	N	N	N	N	N	N	N	N	N
Earthquake	N	N	N	N	N	N	N	N	N

SITE: Y-12	FACILITY: 9212
	FUNCTION: Enriched Uranium Casting

Explanation:

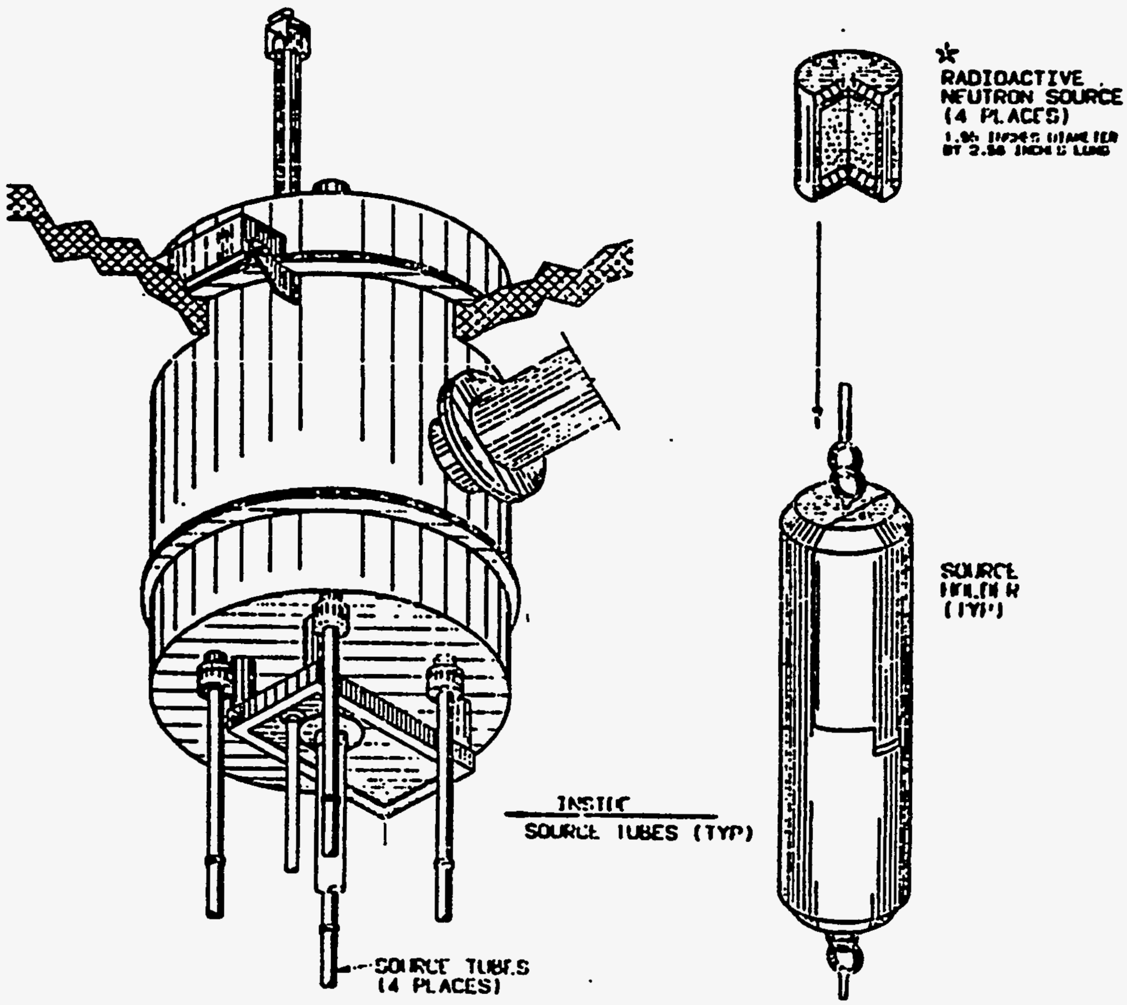
The PuBe sources do not pose a significant consequences due to the encapsulation (with routine material checking), and protected locations within the equipment and facilities.

An earthquake, while generally expected to initiate little building damage, could cause bending or flexing of the source tubes under the casting furnaces. This could possible inhibit the passage of the source holde and require maintenance activity to straighten the source tube(s). During this activity, maintenance and other personnel might be exposed to additional radiation, but would mot be signficant. An earthquake is not expected to provide sufficient damage to rupture the source containers.

<u>Question 7 Continued:</u>

See list of references for Questions 1 and 2.

SITE:
Question 8: Overall Site Summary The PuBe sources do not pose a significant consequences due to the encapsulation (with routine material checking), and protected locations within the equipment and facilities.



Placement of PuBe Sources

SITE: Y-12	FACILITY: 9213
	FUNCTION: Long and Short Term Storage

DOE HEADQUARTERS FACILITY LANDLORD DP

DOE HEADQUARTERS PROGRAM SPONSOR DP

FACILITY AGE 50 DESIGN LIFE Unknown

Question 1: Facility

The source storage vault in Building 9213 is the primary source storage facility for the Y-12 Plant. We continue to wait for DOE instruction regarding the very-long-range disposition of these radioactive sources.

Building 9213 is located south of the Y-12 Plant over a ridge at a relatively remote location approximately 100 feet from the site boundary and guard station. The building is constructed of brick and concrete. The building is currently unoccupied. Previously, the building was used as a site for criticality studies.

The storage vault is approximately 15 by 25 ft. The vault walls and ceiling are constructed of concrete, with a vault steel door operated by a combination lock.

Sources are kept in a variety of packages including 5 gallon drums with packing and cans filled with paraffin which surrounds the source. The cans are on shelves behind approximately 6 in. 4 by 4 ft of polyethylene sheets.

The sources are inventoried quarterly. Inventory and all other required data has been maintained since 1990 on a Flow-Gemini database but is currently being transferred to an ORACLE database.

SITE: Y-12	FACILITY: 9213
	FUNCTION: Long and Short Term Storage

Question 1 Narrative Continued:

Applicable References:

Y-12 Plant 70-102 and 50-66-HP-108, "Radioactive Sources and Source Facilities"

SITE: Y-12	FACILITY (Building or Location): 9213
	FUNCTION: Long and Short Term Storage

Question 2: Holdings DOE Material Manager W. H. Hopwood

Characterize facility plutonium[1] holdings by completing the appropriate blocks in the table below. Use a separate line entry for each packaging type with a common grade of plutonium. Identify the design life and current age for each packaging type.

Material Type	Grade of Plutonium[2]	Packaging Types[3]	Design Life (yrs)	Current Age (yrs)
Disassembled Weapons Components (Pits)				
Metal				
Oxide				
Scrap/Residues[4]				
Solution[4]				
Sealed Sources	Pu	C0,D4,X1	unknown	20+
	See Q2A			
TRU Waste[4]				
Holdup (in ducts, pipes, etc.)[4]				
Unirradiated Reactor Fuel				
High-level Liquid Waste				
Other (specify)				

SITE: Y-12	FACILITY (Building or Location):
	FUNCTION:

Question 2A: No. Pkgs and Mass DOE Material Manager ____________

Characterize facility plutonium holdings by filling in the appropriate blocks in the table below. Use the same groupings as in Question 2.

Material Type	Grade of Plutonium	Total Mass Pu (kg)	Number of Packages
Disassembled Weapons Components (Pits)			
Metal			
Oxide			
Scrap/Residues			
Solution			
Sealed Sources	See Q2A continuation		
TRU Waste			
Holdup			
Unirradiated Reactor Fuel			
High-level Liquid Waste			
Cumulative Inventory Difference		1	

SITE: Y-12	FACILITY (Building or Location):
	FUNCTION:

Question 2A Continued:

********** ********** ********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - (SHELF
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Pu-239-0350
SERIAL NUMBER: S-3736 CROSS REFERENCE:

Pu-239 ASSAY: 4.00E-02 uCi (08/14/84)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: 1.75" electroplated disc

********** ********** ********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - (
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Pu-238-0307
SERIAL NUMBER: CROSS REFERENCE: PU-238002

PU-238 ASSAY: 2.00E-02 uCi (05/17/78)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** ********** ********** **********

See listing following Question 8 for co-located transuranics in Bldg 9213.

1 Identify probable location.

SITE: Y-12	FACILITY: 9213
	FUNCTION: Long and Short Term Storage

Question 3: Physical Barriers DOE Material Manager W. H. Hopwood

Characterize facility physical barriers by completing the appropriate blocks in the table below. Complete a separate table for each material aggregation.

Material Aggregation (list material types included from Question 2) Sealed Sources

Barrier #	Worker Protection	Environment and Public Protection
1	WB-13	EB-7
2	WB-14	EB-1
3	WB-15	EB-4
4		
5		

SITE: Y-12	FACILITY: 9213
	FUNCTION: Long and Short Term Storage

In-Facility

- ☐ Inadvertent Transfers
- X Aging
- ☐ Organic Nitric Acid Reaction
- ☐ Equipment Failure
- ☐ Change in Mission
- ☐ Other Co-Located Hazards
- X Corrosion
- ☐ Inadequate Configuration Knowledge
- ☐ Combustible Loading
- ☐ Inadequate Seals
- ☐ Potential Water Sources
- ☐ Inadequate Drains
- ☐ Inadequacy of Design Basis (e.g., seismic, fire, wind, etc.)
- ☐ Inadequate Preventive Maintenance
- ☐ Administrative Controls
- ☐ Other - Specify

Material

- ☐ Pressurization
- ☐ Pyrophoricity
- ☐ Radioactivity
- ☐ Chemical Reactivity
- ☐ Am Buildup
- ☐ Hydrogen Buildup
- ☐ Radiolysis
- ☐ Volumetric Expansion
- X Oxidation
- ☐ Other - Specify

Question 4 Continued:

SITE: Y-12	FACILITY: 9213 FUNCTION: Long and Short Term Storage

Describe Each Adverse Condition:

Aging and corrosion are related. Time is required to degradate the source containment boundary, leading to potential leaks. Environmental conditions may be present that promote corrosion (i.e. humidity). However, there is no water supply in storage room to lead to flooding.

Oxidation could occur to source material, or containment material leading to potential leaks or flaking of material.

Applicable References:

1 An existing situation that gives rise to a potential event or concern.

SITE: Y-12	FACILITY: 9213
	FUNCTION: Long and Short Term Storage

Question 5: Events

Identify those historical, current, or potential events that have or may result from the adverse conditions identified in Question 4. Similar events for different material, package and barrier aggregates may be grouped together on a single form. Check the appropriate blocks and describe below.

POTENTIAL EVENTS

In-Facility
- ☐ Fire
- ☐ Explosion
- ☐ Worker Exposure
  - ☐ External
  - ☐ Internal
- ☐ Contamination
- ☐ Flooding
- ☐ Leakage/Spills
- ☐ Other Accidents - Specify
- ☐ Human Error

Material
- ☐ Criticality
- ☐ Fissile Material Release
- X Breach of Container
- ☐ Fire
- ☐ Other - Specify

External
- ☐ Aircraft Crash
- ☐ Vehicle Accident
- ☐ Explosion
  - ☐ Adjacent Facility Accident
  - ☐ Power Failure
- ☐ Institutional/Regulatory Requirements
  - ☐ Personnel Radiation Exposure
- ☐ Ex-facility Fire
- ☐ Other - Specify

Natural Phenomena
- ☐ Earthquake Damage
- ☐ Wind Damage
- ☐ Flood Damage
  - ☐ Erosion Damage
- ☐ Snow/Ash Loading Damage
- ☐ Extreme Temperature Damage
- ☐ Other - Specify

SITE: Y-12	FACILITY: 9213
	FUNCTION: Long and Short Term Storage

Describe Each Event:

Breach of Container/Contamination - a source leak develops, and the radioactive material within the container/source spreads to adjacent equipment or material.

Personnel radiation exposure - personnel working entering the area are exposed to the radiation from the sources. This exposure is minimal due to the shielding provided and the many half-life decays that have transpired for many of the sources.

Question 5 Continued:

Describe Each Event:

SITE: Y-12	FACILITY: 9213
	FUNCTION: Long and Short Term Storage

Question 6: Compensatory Measure

Compensatory measures at the facility prevent and/or mitigate the adverse conditions and events identified in Questions 4 and 5. Check the applicable items in the table below and reference documents describing the compensatory measures. Identify any uncertainties or concerns in the checked compensatory measures.

Compensatory Measures

Preventive	Mitigative
X Procedures: ops., maint., surveillance	☐ Emergency Preparedness
☐ Material Limits	☐ Emergency Management
X Training	☐ Emergency Planning
☐ Quality Assurance	☐ Emergency Procedures
☐ Conduct of Operations	☐ Emergency Response
☐ Authorization Basis (safety analysis, BIOs)	☐ Safety Systems
X Surveillance	☐ Alarm Systems
☐ Organization	☐ Other - Specify
☐ Structure	
☐ Management Involvement	
☐ Staffing	
☐ Lessons Learned	
☐ Configuration Control of Design	
☐ Preventive Maintenance	
X Monitoring	
☐ Trending (Performance Indicator)	
☐ Testing/Verification of Integrity	
☐ Regulatory Requirements	
☐ Records	
☐ Personnel Exposure	
☐ Equipment	
☐ Waste Inventory	
☐ QA	
☐ Personnel Reliability Assurance Program	
☐ Other - Specify	

Question 6 Continued:

SITE: Y-12	FACILITY: 9213
	FUNCTION: Long and Short Term Exposure

Question 7: Consequences

For each event identified in Question 5, and taking into account compensatory measures described in Question 6, identify potential consequences to the worker, environment, or public. If a vulnerability exists, record a Y and complete the VAF. If a vulnerability does not exist, record an N and explain below.

	WORKER			ENVIRONMENT			PUBLIC		
EVENT	CONTAMINATION	EXPOSURE	INJURY	GROUND	WATER	AIR	CONTAMINATION	EXPOSURE	INJURY
Breach of Container	Y	Y	N	N	N	N	N	N	N

Explanation:

Due to the small quantities of material, double encapsulation of many sources, and protective packaging, the exposure and contamination potential is minimal.

SITE: Y-12

Question 8: Overall Facility Summary

The source storage vault in Building 9213 is the primary source storage facility for the Y-12 Plant. The vault walls and ceiling are constructed of concrete, with a vault steel door operated by a combination lock. Many of the sources are kept in a variety of packages including 5-gallon drums with packing and cans filled with paraffin which surrounds the source. The cans are on shelves behind approximately 6 in. of 4 by 4 ft polyethylene sheets.

The sources are inventoried quarterly, which helps reduce the vulnerabilities with the operation of the storage vault. Inventory and all other required data has been maintained since 1990 on a database.

Final disposition of the sources is unknown; the plant continues to wait for DOE instruction regarding the very-long-range disposition of these radioactive sources.

LISTING OF TRANSURANICS CO-LOCATED
WITH

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-B-0206
SERIAL NUMBER: · CROSS REFERENCE: AM-B-013

Am-241 ASSAY: 2.27E+00 Ci (04/24/70)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - 3062
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0377
SERIAL NUMBER: 2Q324 CROSS REFERENCE: NA

Am-241 ASSAY: 1.00E+01 uCi (01/01/89)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~0.5" X 1.0" plastic encapsulated

********** ********** ********** **********

FACILITY: Building No. 9213 - **** is ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0166
SERIAL NUMBER: 98-057-4 CROSS REFERENCE:

Am-241 ASSAY: 1.17E+00 uCi (03/01/83)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - 3062
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0375
SERIAL NUMBER: 2Q320 CROSS REFERENCE: NA

Am-241 ASSAY: 1.00E+01 uCi (01/01/89)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~0.5" X 1.0" plastic encapsulated

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - 3062
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0376
SERIAL NUMBER: 2Q322 CROSS REFERENCE: NA

Am-241 ASSAY: 1.00E+01 uCi (01/01/89)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~0.5" X 1.0" plastic encapsulated

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0711
SERIAL NUMBER: 7Q482 CROSS REFERENCE:

Am-241 ASSAY: 1.13E+00 uCi (09/01/86)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~1"x0.5" plastic encapsulation (rectangular)

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0712
SERIAL NUMBER: 7937-1 CROSS REFERENCE:

Am-241 ASSAY: 4.50E-02 uCi (07/01/80)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:

SOURCE DESCRIPTION: ~1" disc; mylar covered

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-B-0207
SERIAL NUMBER: CROSS REFERENCE: AM-B-014

Am-241 ASSAY: 2.27E+00 Ci (04/24/70)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-Li-0196
SERIAL NUMBER: CROSS REFERENCE: AM-241008

Am-241 ASSAY: 9.40E+00 Ci (06/12/79)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** is ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0169
SERIAL NUMBER: 205-6-5 CROSS REFERENCE:

Am-241 ASSAY: 5.54E-01 uCi (10/01/87)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: disc

********** ********** ********** **********

FACILITY: Building No. 9213 - **** is ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0389
SERIAL NUMBER: 205-7-4 CROSS REFERENCE:

Am-241 ASSAY: 1.08E+00 uCi (10/01/87)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~2" disc/evap. metallic salts/active diam=3mm/cover=0.01"mylar

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-B-0205
SERIAL NUMBER: CROSS REFERENCE: AM-B-012

Am-241 ASSAY: 2.27E+00 Ci (04/24/70)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** is ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0523
SERIAL NUMBER: 98-057-2 CROSS REFERENCE:

Am-241 ASSAY: 1.03E+00 uCi (03/01/83)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~0.75" diam. disc with mylar cover

********** ********** ********** **********

FACILITY: Building No. 9213 - **** is ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0345
SERIAL NUMBER: 98-057-5 CROSS REFERENCE:

Am-241 ASSAY: 1.17E+00 uCi (03/01/83)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: 0.75" diam. plastic disc with mylar cover

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****

SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-B-0208
SERIAL NUMBER: CROSS REFERENCE: AM-B-015

Am-241 ASSAY: 2.27E+00 Ci (04/24/70)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-Be-0081
SERIAL NUMBER: CROSS REFERENCE: Am-Be-001 O

Am-241 ASSAY: 3.00E+00 Ci (04/01/64)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-B-0200
SERIAL NUMBER: CROSS REFERENCE: AM-B-003

Am-241 ASSAY: 2.90E+00 Ci (10/15/62)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:
********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-B-0201
SERIAL NUMBER: CROSS REFERENCE: AM-B-005

Am-241 ASSAY: 2.90E+00 Ci (04/06/64)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** is ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0386
SERIAL NUMBER: 205-7-1 CROSS REFERENCE:

Am-241 ASSAY: 1.09E+00 uCi (10/01/87)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~2" disc/evap. metallic salts/active diam=3mm/cover=0.01"mylar

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-B-0203
SERIAL NUMBER: CROSS REFERENCE: AM-B-008

Am-241 ASSAY: 3.80E+00 Ci (04/11/68)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:
********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-Li-0197
SERIAL NUMBER: CROSS REFERENCE: AM-241009

Am-241 ASSAY: 9.40E+00 Ci (06/12/79)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - 3062
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0371
SERIAL NUMBER: 2Q220 CROSS REFERENCE: NA

Am-241 ASSAY: 1.00E+01 uCi (01/01/89)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~0.5" X 1.0" plastic encapsulated

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - 3062
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0373
SERIAL NUMBER: 2Q225 CROSS REFERENCE: NA

Am-241 ASSAY: 1.00E+01 uCi (01/01/89)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~0.5" X 1.0" plastic encapsulated

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-Be-0210
SERIAL NUMBER: CROSS REFERENCE: AM-BE-006

Am-241 ASSAY: 3.00E-01 Ci (03/28/79)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - 3062
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0374
SERIAL NUMBER: 2Q222 CROSS REFERENCE: NA

Am-241 ASSAY: 1.00E+01 uCi (01/01/89)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~0.5" X 1.0" plastic encapsulated

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-B-0198
SERIAL NUMBER: CROSS REFERENCE: AM-B-001

Am-241 ASSAY: 2.90E+00 Ci (10/15/62)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-Li-0193
SERIAL NUMBER: CROSS REFERENCE: AM-241005

Am-241 ASSAY: 9.87E+00 Ci (09/22/72)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM: AmO2
SOURCE DESCRIPTION: 1.25" X 4.25"; SS encapsulated; SS inside tungsten to reduce gamma.

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-Li-0194
SERIAL NUMBER: CROSS REFERENCE: AM-241006

Am-241 ASSAY: 1.06E+01 Ci (06/12/79)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-Li-0124

SERIAL NUMBER: CROSS REFERENCE:
Am-241-011

Am-241 ASSAY: 1.00E+00 Ci (03/05/83)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION:
********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION:
66

IDENTIFICATION NUMBER: Am-Li-0195
SERIAL NUMBER: CROSS REFERENCE:
AM-241007

Am-241 ASSAY: 9.40E+00 Ci (06/12/79)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION:
66

IDENTIFICATION NUMBER: Am-Be-0212
SERIAL NUMBER: CROSS REFERENCE:
AM-BE-008

Am-241 ASSAY: 3.00E-01 Ci (03/28/79)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** is ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION:
66

IDENTIFICATION NUMBER: Am-241-0170
SERIAL NUMBER: 205-6-3 CROSS REFERENCE:

Am-241 ASSAY: 5.51E-01 uCi (10/01/87)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: disc
********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - 3062
CUSTODIAN: D . A . Jones (008279) DIVISION:
66

IDENTIFICATION NUMBER: Am-241-0372
SERIAL NUMBER: 2Q223 CROSS REFERENCE: NA

Am-241 ASSAY: 1.00E+01 uCi (01/01/89)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~0.5" X 1.0" plastic encapsulated

********** ********** ********** **********

FACILITY: Building No. 9213 - **** is ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION:
66

IDENTIFICATION NUMBER: Am-241-0522
SERIAL NUMBER: 1Q285 CROSS REFERENCE:

Am-241 ASSAY: 1.11E+00 uCi (03/01/83)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~0.5" plastic disc

********** ********** ********** **********

FACILITY: Building No. 9213 - **** is ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION:
66

IDENTIFICATION NUMBER: Am-241-0168
SERIAL NUMBER: 205-6-4 CROSS REFERENCE:

Am-241 ASSAY: 5.61E-01 uCi (10/01/87)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: disc
********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION:
66

IDENTIFICATION NUMBER: Am-Li-0192
SERIAL NUMBER: CROSS REFERENCE:
AM-241004

Am-241 ASSAY: 1.01E+01 Ci (09/22/72)
MASS (g): 3.11E+00 [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM: AmO2

SOURCE DESCRIPTION: 1.25" X 4.25"; SS encapsulated; SS inside tungsten to reduce gamma

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-B-0209
SERIAL NUMBER: CROSS REFERENCE: AM-B-016

Am-241 ASSAY: 2.27E+00 Ci (04/24/70)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-B-0204
SERIAL NUMBER: CROSS REFERENCE: AM-B-009

Am-241 ASSAY: 3.80E+00 Ci (04/11/68)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:
********** ********** ********** **********

FACILITY: Building No. 9213 - **** is ****
SOURCE LOCATION: BLDG. No. 9213 -
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0521
SERIAL NUMBER: 205-6-2 CROSS REFERENCE:

Am-241 ASSAY: 5.45E-01 uCi (10/01/87)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-B-0199
SERIAL NUMBER: CROSS REFERENCE: Am-B-002

Am-241 ASSAY: 2.90E+00 Ci (10/15/62)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-B-0202
SERIAL NUMBER: CROSS REFERENCE: AM-B-006

Am-241 ASSAY: 2.30E+00 Ci (03/04/65)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:
********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - 3062
CUSTODIAN: D . A . Jones (008279) DIVISION: 66

IDENTIFICATION NUMBER: Am-241-0370
SERIAL NUMBER: 2Q219 CROSS REFERENCE: NA

Am-241 ASSAY: 1.00E+01 uCi (01/01/89)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas): s
CHEMICAL FORM:
SOURCE DESCRIPTION: ~0.5" X 1.0" plastic encapsulated

********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION: 66

IDENTIFICATION NUMBER: Am-Be-0211
SERIAL NUMBER: CROSS REFERENCE: AM-BE-007

Am-241 ASSAY: 3.00E-01 Ci (03/28/79)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:
********** ********** ********** **********

FACILITY: Building No. 9213 - **** ad ****
SOURCE LOCATION: BLDG. No. 9213 - mode
CUSTODIAN: D . A . Jones (8279) DIVISION:
66

IDENTIFICATION NUMBER: Am-Be-0213
SERIAL NUMBER: CROSS REFERENCE:
AM-BE-009

Am-241 ASSAY: 3.00E-01 Ci (03/28/79)
MASS (g): [NOT DECAY CORRECTED]
PHYSICAL STATE (solid, liquid, gas):
CHEMICAL FORM:
SOURCE DESCRIPTION:

Appendix C: ES&H Vulnerability Assessment Forms (VAFs)

Executive Summary of ES&H Vulnerability Assessment Forms (VAFs)

VAF Index	Executive Summary	Appendix B Site and Facility Question Set Identification
X-10/3027/1	Packaging materials were not historically specified and recorded. No records were consistently maintained on the intermediate packaging details. Incompatible packaging might lead to a chemical reaction or radiolysis which could cause container breach.	Site: X-10 Facility: Building 3027 FUNCTION: S.N.M. Storage Vault
X-10/3038/1	Packaging materials were not historically specified and recorded. Discontinuation of programs within the facility has resulted in surplus materials. The materials were packaged with the expectation of reuse within a reasonable period of time without the knowledge or belief that it would be stored in this condition for extended periods of time.	SITE:X-10 FACILITY: 3038 FUNCTION: Shutdown, and interim storage
X-10/4501/1	Material is in double-bagged plastic bottles within a glove box approved for alpha radioactivity handling. Deterioration of plastic bottle after several years of storage. Possible low-level protective clothing (work-issued) contamination from glove box work.	SITE: X-10 FACILITY: 4501 FUNCTION: High level radiochemical Laboratory
X-10/7920/1	Under particularly adverse conditions (elevated temperature and HNO_3 concentrations, etc.), the resin in a small glass anion exchange column inside a glove box or hood might destablize to the point that it could pressurize the ion column or become an explosive hazard. In the event of extreme pressurization (or explosion), radioactive materials from the column or from other breached containers in the glove box (or hood) could be released into the immediate vicinity. Exposure, contamination, and possible injury to workers in the room is likely.	SITE: X-10 FACILITY: REDC Bldg. 7920 FUNCTION: Separation of Transuranium Elements
X-10/7920/2	A compressed gas cylinder could fall, break its regulator valve or end-stem, and become a missile in the room where radioactive materials are used and stored in glove boxes and hoods. In the event that a glove box or hood were struck and breached, material could be released into the room. There is potential for exposure, contamination, and injury to workers in the room.	SITE: X-10 FACILITY: REDC Bldg. 7920 FUNCTION: Separation of Transuranium Elements
X-10/7920/3	An earthquake, or high wind (though judged to be far less frequent than the expected life of this type facility, e.g., ~ 75 years) could cause a breach of the secondary containment from falling walls or collapsing roof of areas containing glove boxes or hoods. In the event that a glove box or hood were struck and breached, material could be released into the room. There is potential for exposure, contamination, injury to workers in the room, release of material to the environment, and contamination of public areas.	SITE: X-10 FACILITY: 7920 FUNCTION: Separation of Transuranium Elements
X-10/7920/4	Concrete casks containing RH-TRU waste are filled in the Limited Access Area of Bldg. 7920 and transferred through the air lock to a transport vehicle located outside. If the cask were dropped in the LAA a failure of the cask is likely and a portion of the contents may be released into the immediate area. There would be some contamination and exposure of the workers. If the cask were dropped when being transferred from the loading dock to the transport vehicle, the same release would likely occur, but now the contamination might extend to areas where there is public access.	SITE: X-10 FACILITY: 7920 FUNCTION: Separation of Transuranium Elements

VAF Index	Executive Summary	Appendix B Site and Facility Question Set Identification
X-10/7930/1	A heavy object being moved by crane on the Third Floor operating area could strike the Cell G sampling glove box. In the event that the glove box was breached, a small amount of radioactive material (^{252}Cf) could be released into the immediate vicinity. There is potential for exposure and contamination to workers in the room.	SITE: X-10 FACILITY: REDC Bldg. 7930 FUNCTION: Californium Purification and Distribution
Y-12/9213/1	Corrosion and aging of the source containment and packaging could result in a breach of source storage container leading to contamination of material/equipment and personnel radiation exposure.	SITE: Y-12 FACILITY: 9213 FUNCTION: Long-term and interim source storage
WGAT/OR-1	Incomplete Authorization Basis There are incomplete authorization basis and analysis (seismic, tornado, materials loading, etc.). A conscious decision has been made to continue normal operations without Basis for Interim Operations (BIOs).	SITE: General FACILITY: Operating and storage FUNCTION: Operating and storage
WGAT/OR-2	Unneeded Plutonium Stored On-Site at Oak Ridge Some of the plutonium stored on the Oak Ridge site facilities has no identified mission, and thus in unneeded. The issue is that there is no central Oak Ridge storage facility to monitor and store this material.	SITE: DOE-ORO and X-10 and Y-12 FACILITY: General Operating and Storage FUNCTION: General Operating and Storaged
WGAT/OR-3	Storage of Plutonium in Rooms Without Air Monitoring Capability It was observed in the vault areas of building 5505, Transuranium Research Facility, and building 9213, Criticality Laboratory, that there was plutonium oxide and other transuranics stored in a sealed room without a constant air monitoring system present.	SITE: X-10 and Y-12 FACILITY: 5505 and 9213 FUNCTION: Operating and Storage
WGAT/OR-4	Uncertainty About Packaging Material in Security Sealed Storage Containers Security sealed storage containers have been placed in the building 3027 vault since approximately 1982 acceptance criteria for the quantity and quality of nuclear material, and the allowable storage containers were in effect. Packaging materials were not specified.	SITE: X-10 FACILITY: 3027 FUNCTION: SNM Storage
WGAT/OR-5	Plutonium Stored in Contact with Plastic It was observed that plutonium is stored in packages containing plastic (building 5505, 9204-3, 4501) which makes the material vulnerable to package degradation via radiolysis.	SITE: X-10 and Y-12 FACILITY: 4501, 5505 and 9204-3 FUNCTION: Interim storage of Pu

VAF Index	Executive Summary	Appendix B Site and Facility Question Set Identification
WGAT/OR-6	Loss of Institutional Memory Loss of experienced personnel and their knowledge of processes and facilities (i.e., their institutional memory) increases the potential for errors with potential safety consequences.	SITE: X-10 and Y-12 FACILITY: General FUNCTION: Operating and Storage
WGAT/OR-7	Lack of Technical Limits for Building 7920 Hot Cell Fire Scenarios There are presently no technical limits to ensure that the amount of combustibles or the operating parameters of the building, 7920, hot cells are within the grounds of the fire loading established in the facility fire hazards analysis documentation.	SITE: X-10 FACILITY: 7920 FUNCTION: Purification of transuranium elements
WGAT/OR-8	Lack of Standards for the Interim Storage of Plutonium There is a general lack of standards for the interim storage of plutonium. Plutonium is stored in a variety of configuration at the Oak Ridge sites.	SITE: X-10 and Y-12 FACILITY: General FUNCTION: Long-term and interim storage of Pu
WGAT/OR-9	No Operational Safety Requirements (OSRs) Limiting Condition Documentation (LCD) for building 9204-3 There does not exist OSRs or LCDs for the plutonium operations conducted in building 9204-3. Although hazard screening has been conducted for this Hazard Category III facility, the current safety basis is incomplete.	SITE: Y-12 FACILITY: 9204-3 FUNCTION: Isotope enrichment
WGAT/OR-10	No Planned Safety Analysis Report (SAR) Upgrades (Phases II and III) for building 9213 Building 9213 is a transuranic source storage vault, is currently not scheduled to participate in Phases II and III of the Oak Ridge SAR Upgrade Program. In other words, although this facility will be used for the foreseeable future for the storage of transuranic material, or has exempted this facility from thorough safety analysis activities.	SITE: Y-12 FACILITY: 9213 FUNCTION: Long-term and interim source storage
WGAT/OR-11	Breach of Source Storage Container in Building 9213 Leading to the Contamination of Material/Equipment and Personnel Radiation Exposure Event is related to corrosion and aging of the source containment and packaging in which the source is located.	SITE: Y-12 FACILITY: 9213 FUNCTION: Long-term and interim source storage
WGAT/OR-12	Breach of Glovebox (or Hood) Containment (Due to External/Energy Source) A compressed gas cylinder could fall, break its regulator valve or end-stem, and become a missile in the room where radioactive materials are used and stored in gloveboxes and hoods. In the event that a glovebox or hood were struck and breached, material could be released into the room. There is potential for exposure, contamination, and injury to workers in the room.	SITE: X-10 FACILITY: 7920, 4501 FUNCTION: Research

ES&H VULNERABILITY ASSESSMENT FORM
Vulnerability ID: X-10/3027/1
Block #1: Title of Vulnerability. (<20 words) Uncertainty about packaging material in security sealed storage containers.
Block #2: Executive Summary. (<50 words) Concise description of the sequence of events leading to the vulnerability. Security sealed storage containers have been placed in the 3027 Vault since approximately 1982. Acceptance criteria for the quantity and quality of nuclear material, and the allowable storage containers were in effect. Packaging materials were not specified.
Block #3: Describe the material, packaging, barrier and facility combinations that contribute to the vulnerability. Only security sealed storage containers are received at the vault for storage. The containers are accepted from many other Material Balance Area Representatives (MBAR). Plant personnel has changed over the years, and institutional memory is lost. As personnel changed, each MBAR assumed responsibility for the accountability of the nuclear material, but details on packaging became lost.
Block #4: Describe adverse conditions, events, and related concerns that contribute to the vulnerability. Each package was assessed for nuclear material accountability, and for nuclear criticality safety, but no records were consistently maintained on the intermediate packaging details. Incompatible packaging might lead to a chemical reaction or radiolysis which could cause container breach.
Block #5: Describe the compensatory measures that reduce the severity of the vulnerability. The relatively small amount of nuclear material in each package, the relatively small inventory in each storage cell, the multi-layers of containment, and the fire suppression system should keep any material dispersion to the cell and/or vault interior.

ES&H VULNERABILITY ASSESSMENT FORM
Vulnerability ID: X-10/3027/1
Block #6: Describe the likelihood of the event which causes this vulnerability and consequences which could result. The likelihood of a container breach cannot be estimated, but the consequences should be limited to the vault interior.
Block #7: Describe the timing of corrective actions (if any). Use the terms immediate (imminent ES&H issue), near-term (ES&H issue that may become an imminent hazard with further degradation), or longer term (ES&H issues which are being mitigated by barriers/compensatory measures). A letter was distributed September 9, 1993, detailing acceptance criteria for security sealed containers for storage in the 3027 Vault, which included the requirement for DOT-approved containers. This letter will be re-issued by the end of May, 1994, with the additional requirement for a detailed packaging description, certified by the MBAR involved. Because of the quantity of nuclear material involved, and the barrier levels in the vault, there are no imminent or near-term ES&H issues. The additional acceptance criteria should mitigate any long-term ES&H concerns connected with any possible changes in the usage of the 3027 Vault.
Block #8: Additional comments, views, or plans by the site operations office and M&O Contractor to mitigate or minimize any potential vulnerability.

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/3027/1

Block #9: Database Criteria. (Use identifiers from question set tables.)

This is the ES&H vulnerability assessment for the 3027 Vault.

List adverse conditions:

-
-
-
-

List potential events/concerns:

-
-
-
-

Potential Consequences.

Environment	Worker Safety and Health	Public Safety and Health
_ Ground	X Contamination	_ Contamination
_ Water	X Exposure	_ Exposure
_ Air	X Physical Injury	_ Physical Injury

E. C. Crume Jr.
Signature, Team Member

Calvin M. Hopper
Signature, Team Leader

ES&H VULNERABILITY ASSESSMENT FORM
Vulnerability ID: X-10/3038/1
Block #1: Title of Vulnerability. (<20 words) INTERNAL PACKAGING UNCERTAINTY
Block #2: Discontinuation of programs within the facility has resulted in surplus materials. The materials were packaged with the expectation of reuse within a reasonable period of time without the knowledge or belief that it would be stored in this condition for extended periods of time.
Block #3: Plant personnel have changed through the years, and institutional memory has been lost. Exact dates of packaging is generally unknown and documentation of internal packaging is either non-existent or would involve an exhaustive search of records.
Block #4: The main concerns associated with these materials were nuclear material accountability and criticality. No known records were maintained on the internal packaging details. The chemists and engineers associated with this program were highly knowledgeable and competent individuals and it is unlikely that chemically incompatible packaging materials were used which might lead to chemical reactions or radiolysis which would cause breach of a container.

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/3038/1

Block #5:

The relatively small amounts of material in most packages, the multilayers of containment, and the fire-suppression system in the facility should limit material dispersion to the immediate area of the package.

Block #6:

The likelihood of a container breach is unknown; however, the consequence of a breach of one of these containers is expected to be limited to the building interior.

Block #7:

This facility is part of the Isotopes Facility Deactivation Project and all materials have been placed on Scrap Declarations.

Block #8:

Work is currently under way to remove these materials from the facility. They will be repackaged as required for storage in another facility or for shipment.

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/3038/1

Block #9: Database Criteria. (Use identifiers from question set tables.)

List adverse conditions:

- Possible Radiolysis
- Possible Chemical Reactivity
- Possible Pressurization

List potential events/concerns:

- Worker Exposure
- Breach of Container/Barrier
- Contamination

Potential Consequences.

Environment	Worker Safety and Health	Public Safety and Health
_ Ground	X Contamination	_ Contamination
_ Water	X Exposure	_ Exposure
_ Air	_ Physical Injury	_ Physical Injury

E. C. Crume Jr.
Signature, Team Member

C M Hopper
Signature, Team Leader

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/4501/1

Block #1: Title of Vulnerability. (<20 words)

Building 4501, Alpha Laboratory, Room 127

Block #2: Executive Summary. (<50 words) Concise description of the sequence of events leading to the vulnerability.

Possible low-level protective clothing (work-issued) contamination from glove box work.

Block #3: Describe the material, packaging, barrier and facility combinations that contribute to the vulnerability.

Material is in double-bagged plastic bottles within a glove box approved for alpha radioactivity handling.

Block #4: Describe adverse conditions, events, and related concerns that contribute to the vulnerability.

Deterioration of plastic bottle after several years of storage.

Block #5: Describe the compensatory measures that reduce the severity of the vulnerability.

Approved glove box facility within a laboratory secured against inadvertent intrusion. Laboratory is located in a facility generally restricted from the public.

Block #6: Describe the likelihood of the event which causes this vulnerability and consequences which could result.

Possible leakage and contamination inside the glove box. Glove failure might contribute to low-level contamination of worker protective clothing.

Block #7: Describe the timing of corrective actions (if any). Use the terms immediate (imminent ES&H issue), near-term (ES&H issue that may become an imminent hazard with further degradation), or longer term (ES&H issues which are being mitigated by barriers/compensatory measures).

Longer-term vulnerability mitigated by planned disposal of the Pu wastes.

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/4501/1

Block #8: Additional comments, views, or plans by the site operations office and M&O Contractor to mitigate or minimize any potential vulnerability.

Disposal of the Pu as waste.

Block #9: Database Criteria. (Use identifiers from question set tables.)

List adverse conditions:

- Aging
- Change in mission
- Radioactivity
-

List potential events/concerns:

- Contamination
-
-
-

Potential Consequences.

Environment	Worker Safety and Health	Public Safety and Health
_ Ground	x Contamination	_ Contamination
_ Water	x Exposure	_ Exposure
_ Air	_ Physical Injury	_ Physical Injury

E.C. Crume Jr.
Signature, Team Member

C M Hopper
Signature, Team Leader

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/7920/1

Block #1: Title of Vulnerability. (<20 words)

Breach of Glove Box (or Hood) Containment (due to internal pressurization or explosion)

Block #2: Executive Summary. (<50 words) Concise description of the sequence of events leading to the vulnerability.

Under particularly adverse conditions (elevated temperature and HNO_3 concentrations, etc.), the resin in a small glass anion exchange column inside a glove box or hood might destablize to the point that it could pressurize the ion column or become an explosive hazard. In the event of extreme pressurization (or explosion), radioactive materials from the column or from other breached containers in the glove box (or hood) could be released into the immediate vicinity. Exposure, contamination, and possible injury to workers in the room is likely.

Block #3: *Describe the material, packaging, barrier and facility combinations that* contribute to the vulnerability.

Potential for resin to attain unstable conditions.
Light-duty equipment and containers are required for use with materials in process.
Glove boxes and hoods may not withstand explosive forces or extreme pressurizations.

Block #4: Describe adverse conditions, events, and related concerns that contribute to the vulnerability.

Potential for buildup and subsequent release of pressure or explosive force.
Potential for breach of containers and worker barriers, release of radioactive materials, contamination, and worker exposure and injury.
No other related factors or concerns.

Block #5: Describe the compensatory measures that reduce the severity of the vulnerability.

Operating procedures for ion exchange operations include safety precautions and notes aimed at prevention of unstable resin conditions (resin is not allowed to dry out, no elevated temperatures or high HNO_3 concentrations, etc.).

Training and work instructions emphasize these operational safety factors.

ES&H VULNERABILITY ASSESSMENT FORM
Vulnerability ID: X-10/7920/1
Block #6: Describe the likelihood of the event which causes this vulnerability and consequences which could result. **This is a very-low or extremely-low-probability event.**
Block #7: Describe the timing of corrective actions (if any). Use the terms immediate (imminent ES&H issue), near-term (ES&H issue that may become an imminent hazard with further degradation), or longer term (ES&H issues which are being mitigated by barriers/compensatory measures). **This is a longer term ES&H issue. Current mitigation is sufficient. No corrective action or additional mitigation is required.**
Block #8: Additional comments, views, or plans by the site operations office and M&O Contractor to mitigate or minimize any potential vulnerability. **Potential vulnerability is currently minimized.**
Block #9: Database Criteria. (Use identifiers from question set tables.) List adverse conditions: **•Other Co-Located Hazards** **•Radiolysis** **•Pressurization** **•Chemical Reactivity** List potential events/concerns: **•Explosion** **•Worker Exposure/Injury** **•Breach of Container/Barrier** **•Contamination** Potential Consequences: Environment: _ Ground; _ Water; _ Air Worker Safety and Health: X Contamination; X Exposure; X Physical Injury Public Safety and Health: _ Contamination; _ Exposure; _ Physical Injury

ES&H VULNERABILITY ASSESSMENT FORM	
Vulnerability ID: X-10/7920/1	
E. C. Crume Jr. Signature, Team Member	C M Hopper Signature, Team Leader

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/7920/2

Block #1: Title of Vulnerability. (<20 words)

Breach of Glove Box (or Hood) Containment (due to external energy source)

Block #2: Executive Summary. (<50 words) Concise description of the sequence of events leading to the vulnerability.

A compressed gas cylinder could fall, break its regulator valve or end-stem, and become a missile in the room where radioactive materials are used and stored in glove boxes and hoods. In the event that a glove box or hood were struck and breached, material could be released into the room. There is potential for exposure, contamination, and injury to workers in the room.

Block #3: Describe the material, packaging, barrier and facility combinations that contribute to the vulnerability.

Light-duty containers and barriers are used for radioactive materials in process and storage.
The glove boxes and hoods may not withstand strong impactive blows and mechanical forces.

Block #4: Describe adverse conditions, events, and related concerns that contribute to the vulnerability.

Location of gas cylinders for related processing use in areas adjacent to glove boxes and hoods containing radioactive materials.
Potential for breach of containers and worker barriers, release of radioactive materials, contamination, and worker exposure and injury.
No other related factors or concerns.

Block #5: Describe the compensatory measures that reduce the severity of the vulnerability.

Practices for use of compressed gas cylinders: Move and handle with end-caps in place. Secure cylinders while in transport and in use.
Requirements for minimizing the amount and type of co-located hazards in areas where radioactive materials are stored and processed.
Training and work instruction emphasizes operational safety factors.

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/7920/2

Block #6: Describe the likelihood of the event which causes this vulnerability and consequences which could result.

This is a very low or extremely low probability event.

Block #7: Describe the timing of corrective actions (if any). Use the terms immediate (imminent ES&H issue), near-term (ES&H issue that may become an imminent hazard with further degradation), or longer term (ES&H issues which are being mitigated by barriers/compensatory measures).

This is a longer term ES&H issue. Current mitigation is sufficient. No corrective action or additional mitigation is required.

Block #8: Additional comments, views, or plans by the site operations office and M&O Contractor to mitigate or minimize any potential vulnerability.

Potential vulnerability is presently minimized.

Block #9: Database Criteria. (Use identifiers from question set tables.)

List adverse conditions:

- **Other Co-Located Hazards**

List potential events/concerns:

- **Breach of Container/Barrier**
- **Worker Exposure/Injury**
- **Contamination**

Potential Consequences:

Environment	Worker Safety and Health	Public Safety and Health
_ Ground	X Contamination	_ Contamination
_ Water	X Exposure	_ Exposure
_ Air	X Physical Injury	_ Physical Injury

E.C. Cruse, Jr.
Signature, Team Member

C M Hopper
Signature, Team Leader

ES&H VULNERABILITY ASSESSMENT FORM
Vulnerability ID: X-10/7920/3
Block #1: Title of Vulnerability. (<20 words) **Breach of Glove Box (or Hood) Containment (due to external events and natural phenomena)**
Block #2: Executive Summary. (<50 words) Concise description of the sequence of events leading to the vulnerability. **An aircraft crash, earthquake, or high wind (though judged to be far less frequent than the expected life of this type facility, e.g., ~ 75 years) could cause a breach of the secondary containment from falling walls or collapsing roof of areas containing glove boxes or hoods. In the event that a glove box or hood were struck and breached, material could be released into the room. There is potential for exposure, contamination, injury to workers in the room, release of material to the environment, and contamination of public areas.**
Block #3: Describe the material, packaging, barrier and facility combinations that contribute to the vulnerability. **Light-duty containers and barriers are used for radioactive materials in process and storage.** **The glove boxes and hoods may not withstand strong impactive blows and mechanical forces.**
Block #4: Describe adverse conditions, events, and related concerns that contribute to the vulnerability. **Potential for breach of containers and worker barriers, release of radioactive materials, contamination, and worker exposure and injury.** **No other related factors or concerns.**
Block #5: Describe the compensatory measures that reduce the severity of the vulnerability. **Requirements for minimizing the amount and type of radioactive materials stored and processed in glove boxes or hoods.**

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/7920/3

Block #6: Describe the likelihood of the event which causes this vulnerability and consequences which could result.

This is a very-low-or extremely-low-probability event.

Block #7: Describe the timing of corrective actions (if any). Use the terms immediate (imminent ES&H issue), near-term (ES&H issue that may become an imminent hazard with further degradation), or longer term (ES&H issues which are being mitigated by barriers/compensatory measures).

This is a longer term ES&H issue. Current mitigation is sufficient. No corrective action or additional mitigation is required.

Block #8: Additional comments, views, or plans by the site operations office and M&O Contractor to mitigate or minimize any potential vulnerability.

Potential vulnerability is currently minimized.

Block #9: Database Criteria. (Use identifiers from question set tables.)

List adverse conditions:

- **Radioactivity**

List potential events/concerns:

- **Breach of Container/Barrier**
- **Worker Exposure/Injury**
- **Contamination**

Potential Consequences:

Environment	Worker Safety and Health	Public Safety and Health
X Ground	X Contamination	X Contamination
X Water	X Exposure	_ Exposure
X Air	X Physical Injury	_ Physical Injury

E. C. Crume Jr.
Signature, Team Member

C M Hopper
Signature/Team Leader

ES&H VULNERABILITY ASSESSMENT FORM
Vulnerability ID: X-10/7920/4
Block #1: Title of Vulnerability. (<20 words) **Drop of a waste cask containing RH-TRU waste.**
Block #2: Executive Summary. (<50 words) Concise description of the sequence of events leading to the vulnerability. **Concrete casks containing RH-TRU waste are filled in the Limited Access Area of Bldg. 7920 and transferred through the air lock to a transport vehicle located outside. If the cask were dropped in the LAA a failure of the cask is likely and a portion of the contents may be released into the immediate area. There would be some contamination and exposure of the workers. If the cask were dropped when being transferred from the loading dock to the transport vehicle, the same release would likely occur, but now the contamination might extend to areas where there is public access.**
Block #3: Describe the material, packaging, barrier and facility combinations that contribute to the vulnerability. **Concrete cask, light-duty inner plastic lining, and plastic waste containers may not withstand the impactive force of a cask dropping or falling from elevated heights.**
Block #4: Describe adverse conditions, events, and related concerns that contribute to the vulnerability. **Potential for breach of containers and worker barriers, release of radioactive materials, contamination, worker exposure and injury, and contamination to the environment and public access areas.** **No other related factors or concerns.**

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/7920/4

Block #5: Describe the compensatory measures that reduce the severity of the vulnerability.

Requirements for minimizing the amount and type of radioactive materials stored and processed in glove boxes or hoods.

Operating procedures for crane operations and waste cask handling.

Training and work instructions emphasize operational safety factors.

Block #6: Describe the likelihood of the event which causes this vulnerability and consequences which could result.

This is a low-probability event. Analysis of this event indicates that public exposure would be minimal.

Block #7: Describe the timing of corrective actions (if any). Use the terms immediate (imminent ES&H issue), near-term (ES&H issue that may become an imminent hazard with further degradation), or longer term (ES&H issues which are being mitigated by barriers/compensatory measures).

This is a longer-term ES&H issue. Current mitigation is sufficient.
No corrective action or additional mitigation is required.

Block #8: Additional comments, views, or plans by the site operations office and M&O Contractor to mitigate or minimize any potential vulnerability.

Potential vulnerability is currently minimized.

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/7920/4

Block #9: Database Criteria. (Use identifiers from question set tables.)

List adverse conditions:

- **Radioactivity**

List potential events/concerns:

- **Breach of Container/Barrier**
- **Worker Exposure/Injury**
- **Contamination**

Potential Consequences:

Environment	Worker Safety and Health	Public Safety and Health
X Ground	X Contamination	X Contamination
X Water	X Exposure	_ Exposure
X Air	X Physical Injury	_ Physical Injury

E. C. Crume, Jr.
Signature, Team Member

C M Hopper
Signature, Team Leader

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/7930/1

Block #1: Title of Vulnerability. (<20 words)

Breach of Glove Box (or Hood) Containment (due to external energy source)

Block #2: Executive Summary. (<50 words) Concise description of the sequence of events leading to the vulnerability.

A heavy object being moved by crane on the Third Floor operating area could strike the Cell G sampling glove box. In the event that the glove box was breached, a small amount of radioactive material (^{252}Cf) could be released into the immediate vicinity. There is potential for exposure and contamination to workers in the room.

Block #3: Describe the material, packaging, barrier and facility combinations that contribute to the vulnerability.

Location and use of heavy equipment items in an area adjacent to a glove box which may potentially contain radioactive materials.
Light-duty containers used for radioactive materials.
The glove box may not withstand strong impactive blows and mechanical forces.

Block #4: Describe adverse conditions, events, and related concerns that contribute to the vulnerability.

Potential for breach of containers and worker barriers, release of radioactive materials, contamination, and worker exposure.
No other related factors or concerns.

Block #5: Describe the compensatory measures that reduce the severity of the vulnerability.

Requirements for this glove box: Not to be used for storage or processing operations (only to perform transfers and some maintenance activities). Typically, limited amounts of radioactive materials are in the box only when personnel are working at the box.
Most heavy equipment/lifting operations in the Third Floor operating area (a large room) are in areas not close to the glove box.
Warning signs are posted: "Do not operate crane when glove box in use."
Crane training emphasizes operational safety factors.

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: X-10/7930/1

Block #6: Describe the likelihood of the event which causes this vulnerability and consequences which could result.

This is a very low or extremely low probability event.

Block #7: Describe the timing of corrective actions (if any). Use the terms immediate (imminent ES&H issue), near-term (ES&H issue that may become an imminent hazard with further degradation), or longer term (ES&H issues which are being mitigated by barriers/compensatory measures).

This is not an ES&H issue. Current mitigation is sufficient.
No corrective action or additional mitigation is required.

Block #8: Additional comments, views, or plans by the site operations office and M&O Contractor to mitigate or minimize any potential vulnerability.

Potential vulnerability is presently minimized.

Block #9: Database Criteria. (Use identifiers from question set tables.)

List adverse conditions:

- **Other Co-Located Hazards**

List potential events/concerns:

- **Breach of Container/Barrier**
- **Worker Exposure**
- **Contamination**

Potential Consequences:

Environment	Worker Safety and Health	Public Safety and Health
_ Ground	X Contamination	_ Contamination
_ Water	X Exposure	_ Exposure
_ Air	_ Physical Injury	_ Physical Injury

E. C. Crume, Jr.
Signature, Team Member

C M Hopper
Signature, Team Leader

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: Y-12/9213/1

Block #1: Title of Vulnerability. (<20 words)

Building 9213 Storage Vault - Breach of Container

Block #2: Executive Summary. (<50 words) Concise description of the sequence of events leading to the vulnerability.

A breach of source storage container leading to contamination of material/equipment and personnel radiation exposure. (Breach is required to permit other events.)

Block #3: Describe the material, packaging, barrier and facility combinations that contribute to the vulnerability.

Event is related to corrosion and aging of the source containment and packing in which the source is located.

Block #4: Describe adverse conditions, events, and related concerns that contribute to the vulnerability.

Environmental conditions within the storage vault, i.e. humidity.

Block #5: Describe the compensatory measures that reduce the severity of the vulnerability.

Sources are surveyed and inventoried on a scheduled basis. Containment can be re-established via repackaging and overpacking the radioactive material.

Block #6: Describe the likelihood of the event which causes this vulnerability and consequences which could result.

This event is very unlikely but could occur after many years of confinement/container aging.

ES&H VULNERABILITY ASSESSMENT FORM

Vulnerability ID: Y-12/9213/1

Block #7: Describe the timing of corrective actions (if any). Use the terms immediate (imminent ES&H issue), near-term (ES&H issue that may become an imminent hazard with further degradation), or longer term (ES&H issues which are being mitigated by barriers/compensatory measures).

If needed - immediate - repackaging or overpacking the material

Block #8: Additional comments, views, or plans by the site operations office and M&O Contractor to mitigate or minimize any potential vulnerability.

None

Block #9: Database Criteria. (Use identifiers from question set tables.)

List adverse conditions:

- Aging
- Corrosion

List potential events/concerns:

- Contamination
- Breach of Container
- Personnel Radiation Exposure

Potential Consequences.

Environment	Worker Safety and Health	Public Safety and Health
_ Ground	Y Contamination	_ Contamination
_ Water	Y Exposure	_ Exposure
_ Air	____ Physical Injury	_ Physical Injury

E. C. Crume, Jr.
Signature, Team Member

C M Hopper
Signature, Team Leader

Appendix D:
Vulnerability Evaluation Matrices

Site Assessment Team Vulnerability Matrix Evaluators	
E. C. Crume, Jr.	C. M. Hopper
C. K. Ford	G. R. Proco
W. A. Heineken	D. W. Turner

Vulnerability ID: X-10/3027/1P

Worker Health & Safety

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			

Hazard:
H Death, disability, exposure, or contamination leading to potential short-term radiological health effects.
M Lost-time injury, exposure above highest annual regulatory limits for routine operations.
L Reportable injury, exposure above annual administrative limit for routine operations.

Public Safety and Health

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			

Hazard:
H Exposure above offsite emergency response levels.
M Exposure above highest annual regulatory limits for routine operations.
L Exposure does not exceed limits but may require notification of public.

Environmental Damage

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			

Hazard:
H Event results in offsite measurable contamination above background.
M Event results in only onsite measurable contamination outside of Radiological Control Area.
L Event results in onsite measurable contamination which may not require cleanup.

Vulnerability ID: X-10/3038/1

Worker Health & Safety

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L	X		

Hazard:
H Death, disability, exposure, or contamination leading to potential short-term radiological health effects.
M Lost-time injury, exposure above highest annual regulatory limits for routine operations.
L Reportable injury, exposure above annual administrative limit for routine operations.

Public Safety and Health

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			

Hazard:
H Exposure above offsite emergency response levels.
M Exposure above highest annual regulatory limits for routine operations.
L Exposure does not exceed limits but may require notification of public.

Environmental Damage

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			

Hazard:
H Event results in offsite measurable contamination above background.
M Event results in only onsite measurable contamination outside of Radiological Control Area.
L Event results in onsite measurable contamination which may not require cleanup.

Vulnerability ID: X-10/4501/1/P

Worker Health & Safety

Likelihood*	Hazard: H	Hazard: M	Hazard: L
H			
M			
L			X

Hazard:
H Death, disability, exposure, or contamination leading to potential short-term radiological health effects.
M Lost-time injury, exposure above highest annual regulatory limits for routine operations.
L Reportable injury, exposure above annual administrative limit for routine operations.

Public Safety and Health

Likelihood*	Hazard: H	Hazard: M	Hazard: L
H			
M			
L			

Hazard:
H Exposure above offsite emergency response levels.
M Exposure above highest annual regulatory limits for routine operations.
L Exposure does not exceed limits but may require notification of public.

Environmental Damage

Likelihood*	Hazard: H	Hazard: M	Hazard: L
H			
M			
L			

Hazard:
H Event results in offsite measurable contamination above background.
M Event results in only onsite measurable contamination outside of Radiological Control Area.
L Event results in onsite measurable contamination which may not require cleanup.

Vulnerability ID: X-10/7920/1/P

Worker Health & Safety

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L		X	

Hazard:

H Death, disability, exposure, or contamination leading to potential short-term radiological health effects.

M Lost-time injury, exposure above highest annual regulatory limits for routine operations.

L Reportable injury, exposure above annual administrative limit for routine operations.

Public Safety and Health

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			

Hazard:

H Exposure above offsite emergency response levels.

M Exposure above highest annual regulatory limits for routine operations.

L Exposure does not exceed limits but may require notification of public.

Environmental Damage

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			

Hazard:

H Event results in offsite measurable contamination above background.

M Event results in only onsite measurable contamination outside of Radiological Control Area.

L Event results in onsite measurable contamination which may not require cleanup.

Vulnerability ID: X-10/7920/2/P

Worker Health & Safety

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L		X	

Hazard:
H Death, disability, exposure, or contamination leading to potential short-term radiological health effects.
M Lost-time injury, exposure above highest annual regulatory limits for routine operations.
L Reportable injury, exposure above annual administrative limit for routine operations.

Public Safety and Health

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			

Hazard:
H Exposure above offsite emergency response levels.
M Exposure above highest annual regulatory limits for routine operations.
L Exposure does not exceed limits but may require notification of public.

Environmental Damage

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			

Hazard:
H Event results in offsite measurable contamination above background.
M Event results in only onsite measurable contamination outside of Radiological Control Area.
L Event results in onsite measurable contamination which may not require cleanup.

Vulnerability ID: X-10/7920/3/P

Worker Health & Safety

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			X

Hazard:
H Death, disability, exposure, or contamination leading to potential short-term radiological health effects.
M Lost-time injury, exposure above highest annual regulatory limits for routine operations.
L Reportable injury, exposure above annual administrative limit for routine operations.

Public Safety and Health

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			X

Hazard:
H Exposure above offsite emergency response levels.
M Exposure above highest annual regulatory limits for routine operations.
L Exposure does not exceed limits but may require notification of public.

Environmental Damage

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			X

Hazard:
H Event results in offsite measurable contamination above background.
M Event results in only onsite measurable contamination outside of Radiological Control Area.
L Event results in onsite measurable contamination which may not require cleanup.

Vulnerability ID: X-10/7920/4/P

Worker Health & Safety

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			X

Hazard:
H Death, disability, exposure, or contamination leading to potential short-term radiological health effects.
M Lost-time injury, exposure above highest annual regulatory limits for routine operations.
L Reportable injury, exposure above annual administrative limit for routine operations.

Public Safety and Health

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			X

Hazard:
H Exposure above offsite emergency response levels.
M Exposure above highest annual regulatory limits for routine operations.
L Exposure does not exceed limits but may require notification of public.

Environmental Damage

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			X

Hazard:
H Event results in offsite measurable contamination above background.
M Event results in only onsite measurable contamination outside of Radiological Control Area.
L Event results in onsite measurable contamination which may not require cleanup.

Vulnerability ID: X-10/7930/1/P

Worker Health & Safety

	Hazard		
Likelihood*	H	M	L
H			
M			
L		X	

Hazard:
H Death, disability, exposure, or contamination leading to potential short-term radiological health effects.
M Lost-time injury, exposure above highest annual regulatory limits for routine operations.
L Reportable injury, exposure above annual administrative limit for routine operations.

Public Safety and Health

	Hazard		
Likelihood*	H	M	L
H			
M			
L			

Hazard:
H Exposure above offsite emergency response levels.
M Exposure above highest annual regulatory limits for routine operations.
L Exposure does not exceed limits but may require notification of public.

Environmental Damage

	Hazard		
Likelihood*	H	M	L
H			
M			
L			

Hazard:
H Event results in offsite measurable contamination above background.
M Event results in only onsite measurable contamination outside of Radiological Control Area.
L Event results in onsite measurable contamination which may not require cleanup.

Vulnerability ID: Y-12/9213/1/P

Worker Health & Safety

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			

Hazard:
H Death, disability, exposure, or contamination leading to potential short-term radiological health effects.
M Lost-time injury, exposure above highest annual regulatory limits for routine operations.
L Reportable injury, exposure above annual administrative limit for routine operations.

Public Safety and Health

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			

Hazard:
H Exposure above offsite emergency response levels.
M Exposure above highest annual regulatory limits for routine operations.
L Exposure does not exceed limits but may require notification of public.

Environmental Damage

Likelihood*	Hazard H	Hazard M	Hazard L
H			
M			
L			

Hazard:
H Event results in offsite measurable contamination above background.
M Event results in only onsite measurable contamination outside of Radiological Control Area.
L Event results in onsite measurable contamination which may not require cleanup.

- Likelihood:

H Condition currently exists or event is likely to occur within two years.

M Event is not likely to occur immediately but is likely to occur within a two- to five-year time frame.

L Event is not likely to occur within the next five years but is likely to occur within the expected life of the facility.

Appendix E: References

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