

INEL-94/0226  
Revision 5  
Effective: October 20, 2000

# **Radioactive Waste Management Complex Safety Analysis Report**

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**Idaho National Engineering and Environmental Laboratory  
Mechanical, Civil, and Industrial Engineering Department  
Idaho Falls, Idaho 83415**

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**INEL-94/0226, Revision 5**  
**Effective: October 20, 2000**

Approved by:

N. K. Rogers

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Nuclear Facility Manager  
Radioactive Waste Management Complex

09/28/00

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Date

Reviewed by:

See DAR EO-RS-5639 for signatures  
RWMC Operations Safety Board Committee

09/20/00

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Date

See R. M. Stallman, DOE Operations Office, letter to  
J. A. Van Vliet, Acting Site Area Director, Qualified  
Approval of Recommended Additions to the RWMC  
Safety Analysis Report (SAR) and Associated  
Technical Safety Requirements (TSR) to Support  
OU 7-10 Project (Probing into the Pit 9)  
(OPE-RWMC-99-072)

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DOE-ID Approval Letter

11/17/99\*

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Date

NOTE: *Review and approval signatures appear on DAR EO-RS-5639.*

\* USQ was completed for Revision 4.



## CHANGE PAGE

Revision Number	Change Number	Date Issued	Affected Page Number(s)	Justification
5	1	03/06/01	iii, xii, 2-44, 3-15, 3-23, 3-49	Adds system description and accident scenarios for heated operation of the GGTS. DAR: EO-RS-6237
5	2	04/17/01	See revision bars in Front Matter, Sections 2, 3, 5, and 6.	Change adds safety analysis for RTR units in accordance with DOE Order 5480.23 and DOE-STD-3009-94. See DAR: EO-RS-6298. Approved by DOE-ID R. M. Stallman letter to D. M. Bright, "Approval of changes to the Radioactive Waste Management Complex Safety Analysis Report and Technical Safety Requirements." EM-WM-01-027, March 23, 2001  Change also adds description of Type B probing and sampling activity to support TSR change approved by DOE-ID R. M. Stallman letter to D. M. Bright, "Approval of Changes to the Radioactive Waste Management Complex Technical Safety Requirements." EM-WM-01-033. See DAR: EO-RS-6067.
5	3	05/30/01	Front Matter, 2-37, 2-38, 2-40, 2-41, 3-20, and 3-15	Adds two new Addendums for Gas Generation Systems and Waste Assay Gamma Spectrometer Absolute Assay System. See DAR No. 32125.
5	4	06/14/01	Front Matter, and Section 2	Adds New Addendum D and makes appropriate changes to the body of the SAR to reference PAN Assay System. See DAR No. 32254
5	5	11/26/01	Front Matter, Table 3-8 and Section 3.4.2.3	Adds new Addendum E and makes appropriate changes to the body of the SAR to include new Accident Scenarios. See DAR No. 32253.
5	6	03/13/02	See new Addendum G	Add new Addendum G to address overpacked drum recovery project. See DAR No. 33018
5	7	05/04/02	See new Addendum F	Add new Addendum F to address Absorbent Addition project. See DAR No. 33234
5	8	05/13/02	See revision bars for changes throughout document.	Changes reflect new Addendum F. See DAR No. 33620
5	9	08/13/02	See new Addendum H	Changes reflect new Addendum H. See DAR No. 93692.
5	10	02/26/03	See new Addendum I	Changes address BNFL turn-over issues. See DAR No. 34472
5	11	5/5/03	See New Addendum J	Changes address new Addendum J for OU 7-10 Operations at Pit 9. See DAR No. 96059

## EXECUTIVE SUMMARY

### Facility Background and Mission

This Safety Analysis Report (SAR) has been prepared for the Radioactive Waste Management Complex (RWMC), located at the Idaho National Engineering and Environmental Laboratory (INEEL). The mission of the RWMC is to safely dispose of low-level radioactive waste (LLW) and to temporarily store mixed transuranic (TRU) waste, which will be retrieved, nondestructively examined, treated in the Advanced Mixed Waste Treatment Facility (AMWTF), and shipped to a permanent disposal facility such as the Waste Isolation Pilot Plant (WIPP) at Carlsbad, New Mexico.

Disposal of solid radioactive waste began at the RWMC in 1952. In 1953, the Atomic Energy Commission (AEC) decided that solid radioactive waste from its Rocky Flats Plant (RFP) near Golden, Colorado, would be sent to the RWMC. Therefore, starting in 1954, RFP wastes containing TRU nuclides (principally plutonium) were buried in pits and trenches at the RWMC.

In 1960, the INEEL was designated as one of two national interim burial grounds for disposal of radioactive waste from any source. Although waste was received from many sources, most of the TRU waste received at the INEEL was from the RFP. The national designation of the operations was discontinued in 1963 when commercial disposal facilities for radioactive waste became available.

In 1970, the AEC directed that all waste contaminated with TRU isotopes be segregated from other types of radioactive waste because of the radiotoxicity and long half-lives of the TRU material. The TRU waste was to be stored in a readily retrievable manner during an interim storage period of 20 years. When a Federal repository became available, this waste was to be retrieved and sent to the repository for long-term isolation. The U.S. Department of Energy (DOE) adopted an aboveground storage method at the Transuranic Storage Area (TSA) of the RWMC to meet the interim storage requirement. Although newly generated TRU mixed waste may still be accepted for storage, very little has been accepted since 1990; LLW continues to be accepted for permanent disposal.

Management of the INEEL stored TRU waste will be performed per requirements negotiated by DOE and the United States Navy with the State of Idaho. These requirements are delineated in the Spent Nuclear Fuel Settlement Agreement (SA) negotiated to resolve legal issues concerning continued receipt of Naval and DOE spent nuclear fuel for management at INEEL facilities and the Consent Order (CO) to resolve Resource Conservation and Recovery Act (RCRA) compliance issues for storage of mixed TRU wastes. The conditions of the SA include initiating removal of TRU waste from Idaho no later than April 30, 1999 and completing the removal of 3,100 m<sup>3</sup> no later than December 31, 2002. The SA also establishes conditions for the treatment and removal of all INEEL stored TRU waste by December 31, 2018 and is addressed by the AMWTF project.

Revision 0 of the RWMC SAR, based on DOE Order 5480.23, *Nuclear Safety Analysis Report*, requirements, was approved February 8, 1995. Per Paragraph 1.5 of that version, the baseline was established in April 1993; several construction projects were not addressed in that SAR. Those projects, the Waste Storage Facilities (WSF), TSA-Retrieval Enclosure (RE), and Waste Characterization Facility (WCF), were addressed in separate SARs that would be incorporated into the RWMC SAR as part of the annual update.

Construction of the WSF modules is now complete. Waste from the Certified and Segregated (C&S) Building and the Air Support Building-II (ASB-II) has been transferred into the WSF modules. The SAR developed for the operation of the WSF was approved in May 1994. The design lifetime of the WSF is 25 years.

Construction of the TSA-RE is complete, the project has been put on standby maintenance. The TSA-RE SAR has been developed and has been approved by the Department of Energy Idaho Operations Office (DOE-ID). Since the facility is not operational at this time, no radioactive release mechanisms have been identified. Therefore, no accident (causing a radioactive release) prevention or mitigative controls for this facility are in place. Retrieval operations are scheduled to begin in 2002.

Revision 1 combined the WSF SAR with the RWMC SAR.

Revision 2 includes several facility upgrades. Each of these upgrades was processed through the Unreviewed Safety Question (USQ) evaluation process as part of the design activity. Where applicable, this revised SAR reflects the completion of these facility upgrades. This revision has a baseline date of January 1997.

Revision 3 of the RWMC SAR includes the following: elimination of the Limiting Conditions for Operation from the Technical Safety Requirements, the RWMC management organizational structure, the work schedule for operations, the update of the LLW source term, a new bounding fire scenario, the relocation and reconfiguration of the suspect overloaded drums to the WSF, and the U-233 waste relocated from the Intermediate-Level Transuranic Storage Facility (ILTSF) to the WSF.

Revision 4 of the RWMC SAR includes the following: incorporation of the INEEL standardized Chapter 15, "Emergency Preparedness Program," RWMC organizational structure changes, incorporation of a fire in the LLW pit with no fire department response accident, installation of cased probe holes in the Pit 9, deletion of the design basis earthquake, change in the consequences resulting from the vehicle fire, and incorporation of BLEVE scenarios from the Vapor Vacuum Extraction (VVE) units.

Revision 5 of the RWMC SAR includes the following: change the INEEL operating contractor from LMITCO to BBWI, transfer ownership of WMF-634 to the AMWTP, update of chemical ERPGs, removal of ingestion dose from exposure calculations, description of probing activities and criticality controls in the SDA pits, incorporation of the INEEL Standardized Safety Analysis Report (SAR-100), description of gas generation testing system, description of the Waste Assay Gamma Spectrometer System, description of vapor vacuum extraction and treatment units, and an update to the overloaded drum Critically Control Area (CCA) description.

The environmental restoration activities addressed in previous revisions of the SAR continue. The Pit 9 is the most significant activity. As Pit 9 remediation actions are developed, they are evaluated using the USQ process and incorporated into the SAR as appropriate.

The Drum Vent Facility (DVF) has been temporarily modified to allow for absorbent addition to sludge drums containing excess water. The safety analysis for absorbent addition operation is documented in Addendum F. The discussions, accident scenarios, and controls specified herein cover operations of venting drums in DVF. These discussions and controls are specifically identified throughout this SAR. It should be noted both operations cannot occur concurrently in DVF, thus, one set of controls or the other are applicable. The discussions herein were not deleted because the intent is to return DVF to a configuration consistent with the discussions, accident scenarios, and controls herein.

## Facility Overview

The INEEL is a large, remote, Federally-owned site located on the East Snake River Plain. The RWMC, located in the southwest corner of the INEEL, is approximately 165 acres large, has controlled access, and is completely enclosed by a chain-link fence. No ordinary industrial or military facilities are located nearer than Idaho Falls, approximately 80 km (50 mi).

The RWMC is divided into four areas:

**The Administrative Area** consists of administrative buildings that house the RWMC support staff. Each building is protected by fire detection and protection systems.

**The Operations Area** consists of buildings that provide office space for operations and maintenance personnel, maintenance activities, and general operations support activities. Each building is protected by fire detection and protection systems, alarms, communications, and heating and ventilation, as required, to ensure worker comfort and safety. The Operations Area serves as a buffer between the Administrative Area and the TSA and Subsurface Disposal Area (SDA).

**The SDA** is an 89-acre tract of land located in the western portion of the RWMC, which provides permanent disposal of LLW. The area includes trenches, soil vaults, and pits used for the disposal of LLW.

**The TSA** is a 54-acre tract of land located in the southeast portion of the RWMC. The TSA is used for examination, segregation, certification, and interim storage of solid TRU waste. The TSA consists of storage pads, the ILTSF, the Stored Waste Examination Pilot Plant (SWEPP), and support facilities.

Outside support is available in case of an accident. The INEEL Fire Department staffs, equips, and maintains three fire stations at the INEEL. The closest station to the RWMC is the Central Facilities Area (CFA) Fire Station, which has a response time of 10 to 15 minutes, depending on weather conditions. The department capabilities include equipment, manpower, and training; it is adequate to respond to and mitigate the maximum credible fire at the RWMC. The department also maintains memoranda of understanding or interface agreements with outside local fire protection organizations to provide additional support, as needed.

The INEEL Occupational Medical Program has a central clinic at CFA. The central clinic has a decontamination unit with a dedicated holding tank. This clinic is supported by several satellite dispensaries at the INEEL. If medical treatment is needed and cannot be handled at these facilities, arrangements have been made through memoranda of understanding with various area hospitals for additional medical support onsite or offsite.

## Facility Hazard Classification

The RWMC is classified as a Hazard Category 2 nuclear facility based on DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23*, *Nuclear Safety Analysis Reports*, and 10 CFR 30, Schedule C which has a criterion of a 1 Rem dose at 100 meters.

## Safety Analysis Overview

RWMC operations include low-level and TRU waste shipping, receiving, disposal, storage, drum venting, nondestructive examination, overpacking, and related industrial operations. The hazards associated with these operations were identified based on previous analyses and occurrence reporting histories. These hazards fell into the following categories: (a) radiological: radiologically hazardous material, nuclear criticality, and ionizing radiation; (b) operational: material handling and mechanical and moving equipment; (c) fires/explosions: flammable gases and liquids; and (d) natural phenomena: floods, volcanic activity, earthquakes, tornadoes/high winds, and desert wild fires. The SAR process quantitatively evaluated and showed these hazards not to present unacceptable risks. Those accidents with the highest risk were considered design basis accidents (DBAs). Table E-1 shows a summary of the resulting DBAs. Table E-2 summarizes the main preventive and mitigative features relied upon in the facility safety basis.

The DVF has been temporarily modified to allow for absorbent addition to sludge drums containing excess water. The configurations, controls, and accident scenarios for the absorbent addition process are detailed in Addendum F. The controls, configuration, and accident scenarios listed herein are with respect to drum venting operations in DVF.

**Table E-1.** Design basis accident results at the site boundary.

Frequency Category	Design Basis Accident	6-km Site Boundary Public TEDE (rem)	Evaluation Guideline TEDE (rem)
Anticipated	Box spill	6.07E-03	0.50
	Drum explosion	3.79E-03	0.50
Unlikely	Vehicle Fire— Off-shift	7.76E-02	5.0
Extremely Unlikely <sup>a</sup>	Vehicle Fire— Day-Shift	7.76E-02	25.0
Beyond Extremely Unlikely <sup>a</sup>	Seismically Induced Fire	Events in this class do not require further analysis	Events in this class do not require further analysis

**NOTE:** *Nonradiological consequences—all exposures to nonradiological hazardous materials are below guidelines*

a. Included for completeness, accident risks less than 3.

**Table E-2.** Summary of major hazard protection features.

Hazard Potentially Causing Release	Major Hazard Protection Features
Earthquake	An administrative control is provided for this hazard: <ul style="list-style-type: none"><li data-bbox="521 342 938 380">• Waste container stack stability.</li></ul>
Flood	An administrative control is provided for this hazard: <ul style="list-style-type: none"><li data-bbox="521 426 1276 464">• Maintenance of drainage channels, culverts, and SDA Dike.</li></ul>
Fire	An administrative control is provided for this hazard: A fire protection program establishes the need, limitations, and requirements (that provide the safety basis established in the accident analysis) per 420.1, Facility Safety.
Container explosion/fire/breach	An administrative control is provided for this hazard: <ul style="list-style-type: none"><li data-bbox="521 653 1377 726">• Material handling, container integrity, and storage procedures, along with the appropriate training.</li></ul>
Criticality	An administrative control is provided for this hazard: <ul style="list-style-type: none"><li data-bbox="521 768 1373 831">• A criticality control program that has a waste acceptance criteria for fissile material</li><li data-bbox="521 831 1179 871">• Requirements for a Criticality Control Area. (CCA)</li></ul>

## **Organizations**

The RWMC has been in operation since 1952. Bechtel BWXT, LLC (BBWI) is the operating contractor. DOE-ID and senior management personnel from BBWI oversee operations at the RWMC. The INEEL Fire Department and BBWI organizations that provide maintenance, power distribution, and facility-related assistance are the primary external support organizations for the facility. Independent consultants provide other external support on a case-by-case basis.

## **Safety Analysis Conclusions**

The results of the safety analysis show that safety class equipment is not required to operate the facility. The results also show that the facility can be operated with insignificant risk to the public.

## **SAR Organization**

This SAR follows the guidelines of DOE-STD-3009-94, Preparation Guide for U.S. DOE Nonreactor Nuclear Facility Safety Analysis Reports.



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ADDENDUM B – Gas Generation Test Systems

ADDENDUM C – Waste Assay Gamma Spectrometer Absolute Assay System

ADDENDUM D - Hazard Evaluation for SWEPP Passive Active Neutron Assay System

ADDENDUM E – Safety Evaluation of Accident Scenarios

ADDENDUM F – TRU Waste Absorbent Addition in WMF-615

ADDENDUM G – Overpacked Drum Recovery Operation

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## ACRONYMS

ACGIH	American Conference of Government Industrial Hygienist
ACGLF	adjustable center of gravity lift fixture
AEC	Atomic Energy Commission
AIGA	American Industrial Hygiene Association
AMWTP	Advanced Mixed Waste Treatment Project
ANL-W	Argonne National Laboratory-West
ANS	American Nuclear Society
ANSI	American National Standards Institute
ARF	airborne release fraction
ASB	air support building
BBWI	Bechtel BWXT, LLC
BNFL	British Nuclear Fuels Limited
BST	building source term
C&S	Certified and Segregated
CAM	constant air monitor
CCA	Criticality Control Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CH	contact-handled
CIDRA	Contamination Inventory Database for Risk Assessment
CO	Consent Order
cpm	counts per minute
CRT	cathode ray tube
CSE	criticality safety evaluation

DBA	design basis accident
DOE	Department of Energy
DOE-ID	Department of Energy Idaho Operations Office
DOT	Department of Transportation
DR	damage ratio
DVF	Drum Vent Facility
DVS	Drum Vent System
EBR-I	Experimental Breeder Reactor No. I
ECC	Emergency Command Center
EDF	Engineering Design File
EPA	Environmental Protection Agency
ER	environmental restoration
ERPG	Emergency Response Planning Guidelines
ESH&Q	Environment, safety, health, and quality
EWR	early waste retrieval
FAMS	Fire Alarm Monitoring System
HEPA	high-efficiency particulate air
HFEF	Hot Fuel Examination Facility
HVAC	heating, ventilation, and air-conditioning
INEEL	Idaho National Engineering and Environmental Laboratory
ILTSTF	Intermediate-Level Transuranic Storage Facility
LANL	Los Alamos National Laboratory
LCO	limiting condition for operation
LEL	lower explosive limit
LLW	low-level radioactive waste
MAR	material at risk

MCE	maximum credible explosion
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
OU	operable unit
P&FIM	punching and filter insertion machine
PAN	passive-active neutron
PCB	polychlorinated biphenyls
PCM	personal contamination monitor
PPE	personal protective equipment
RAM	remote area monitor
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician
RF	respirable fraction
RFP	Rocky Flats Plant
RH	remote-handled
RMA	radioactive materials area
RRWAC	Reusable Property, Recyclable Materials, and Waste Acceptance Criteria
RSAC	Radiological Safety Analysis Computer
RTR	Real-Time Radioscopy
RWMC	Radioactive Waste Management Complex
RWMIS	Radioactive Waste Management Information System
RWP	Radiological Work Permit
SA	Settlement Agreement
SAR	Safety Analysis Report
SGRS	SWEPP Gamma-Ray Spectrometer
SSC	structures, systems, and components

SDA	Subsurface Disposal Area
SWB	Standard Waste Boxes
SWEPP	Stored Waste Examination Pilot Plant
TEDE	total effective dose equivalent
TEEL	temporary emergency exposure limits
TLD	thermoluminescent dosimeter
TLF	TRUPACT-II Loading Facility
TLV	threshold limit value
TRIPS	Transuranic Reporting, Inventory, and Processing System
TRU	transuranic
TRUPACT	Transuranic Package Transportor
TSA	Transuranic Storage Area
TSA-RE	Transuranic Storage Area-Retrieval Enclosure
TSDf	treatment, storage, and disposal facility
TSR	Technical Safety Requirement
TWA	time-weighted average
UBC	Uniform Building Code
UCRL	University of California Research Laboratories
USQ	unreviewed safety question
VRS	Vapor Recovery System
VVE	vapor vacuum extraction
WAC	Waste Acceptance Criteria
WAG	Waste Area Group
WAGS	Waste Assay Gamma Spectrometer System
WCF	Waste Characterization Facility
WERF	Waste Experimental Reduction Facility

WIPP	Waste Isolation Pilot Plant
WMF	Waste Management Facility
WMIN	waste minimization
WSFs	Waste Storage Facilities (WMF-628 through -633, -635, -636)