



# **Independent Assessment of the Transuranic Waste All-Hazards Planning Basis at the Oak Ridge National Laboratory**

**February 2024**

Office of Enterprise Assessments  
U.S. Department of Energy

## Table of Contents

Acronyms.....	ii
Executive Summary .....	iii
1.0 Introduction.....	1
2.0 Methodology .....	1
3.0 Results.....	2
3.1 Procedures.....	2
3.2 All-Hazards Survey.....	3
3.3 Emergency Planning Hazards Assessment .....	4
4.0 Best Practices.....	5
5.0 Findings .....	5
6.0 Deficiencies .....	6
7.0 Opportunities for Improvement .....	6
Appendix A - Supplemental Information.....	A-1

## Acronyms

AHS	All-Hazards Survey
CRAD	Criteria and Review Approach Document
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
EAL	Emergency Action Level
EPHA	Emergency Planning Hazards Assessment
EPZ	Emergency Planning Zone
OFI	Opportunity for Improvement
OREM	Oak Ridge Office of Environmental Management
ORNL	Oak Ridge National Laboratory
PA	Protective Action
PAC	Protective Action Criteria
TRU	Transuranic
TWPC	Transuranic Waste Processing Center
UCOR	United Cleanup Oak Ridge, LLC
UT-Battelle	UT-Battelle, LLC

# **INDEPENDENT ASSESSMENT OF THE TRANSURANIC WASTE ALL-HAZARDS PLANNING BASIS AT THE OAK RIDGE NATIONAL LABORATORY**

## **Executive Summary**

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted an independent assessment of the all-hazards planning basis for transuranic waste operations at the Oak Ridge National Laboratory from November to December 2023. This assessment evaluated the effectiveness of both the DOE Oak Ridge Office of Environmental Management and its management and operating contractor, United Cleanup Oak Ridge, LLC (UCOR), in developing and maintaining the all-hazards planning basis for transuranic waste operations at the Transuranic Waste Processing Center (TWPC).

The all-hazards planning basis includes development and maintenance of all-hazards surveys (AHS) and emergency planning hazards assessments (EPHAs). DOE Order 151.1D, *Comprehensive Emergency Management System*, identifies requirements for the all-hazards planning basis, and the associated emergency management guide provides guidance for implementing the requirements.

EA focused primarily on hazards identification and screening, and the documented analysis for supporting the development of response plans, emergency action levels (EALs), predetermined protective actions (PAs), and sizing of the emergency planning zone (EPZ). EA also evaluated the utility of the EPHA as a reference for a consequence assessment team when conducting dispersion modeling of analyzed release scenarios.

EA identified the following strengths, including one best practice:

- UCOR procedure CMP-EN-003-R-13, *Chemical Management*, requires approval by the emergency management lead for any chemical acquisitions. This process ensures that the emergency management organization evaluates any new chemicals or additional chemical quantities being procured for inclusion in the TWPC AHS and determines whether the chemical needs to be analyzed in the EPHA prior to being purchased or brought on site by a subcontractor. This proactive process supports maintaining compliance with DOE Order 151.1D requirements and protecting workers, the public, and the environment from accidental releases of hazardous material. (Best Practice)
- UCOR has developed an integrated approach to the development of safety basis and safety documentation, including emergency management technical planning basis documents. UCOR guide UCOR-4387, *Emergency Management Technical Planning Basis Application Guide*, presents the structure behind the development of the AHS, the EPHA, and the EALs in accordance with DOE Order 151.1D. This document standardizes the UCOR emergency management technical basis document development process.
- The AHS and EPHA for the TWPC are technically accurate and provide information to support the development of response plans, EALs, predetermined PAs, and PA recommendations. In addition, the EPHA provides the data, methods, and assumptions needed for a consequence assessment team to replicate the analysis in response to an incident.

While the all-hazards planning basis complies with DOE Order 151.1D requirements, the EPZ developed for the TWPC may not adequately support local authorities in planning and preparedness activities to protect offsite populations.

In summary, the Oak Ridge Office of Environmental Management and UCOR have developed a technically sound all-hazards planning basis that meets DOE requirements to support the development of response

plans, EALs, predetermined PAs, and sizing of the EPZ. Additionally, the TWPC EPHA is established using standardized modeling input parameters that can be applied consistently across the site, and the EPHA provides pertinent information to support incident analysis by a consequence assessment team. The size of the EPZ, however, may not adequately support local authorities in planning and preparedness activities to protect offsite populations

# **INDEPENDENT ASSESSMENT OF THE TRANSURANIC WASTE ALL-HAZARDS PLANNING BASIS AT THE OAK RIDGE NATIONAL LABORATORY**

## **1.0 INTRODUCTION**

The U.S. Department of Energy (DOE) Office of Emergency Management Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of the all-hazards planning basis for transuranic (TRU) waste operations at the Oak Ridge National Laboratory (ORNL). The all-hazards planning basis includes the development and maintenance of all-hazards surveys (AHSs) and emergency planning hazards assessments (EPHAs). EA conducted this assessment as part of a series of assessments of the TRU waste all-hazards planning basis for sites that make shipments to DOE's Waste Isolation Pilot Plant. The assessment was conducted from November to December 2023 in accordance with the *Plan for the Independent Assessment of Emergency Management Evaluation of the TRU Waste All-Hazards Planning Basis at the Oak Ridge National Laboratory, December 2023*.

The DOE Oak Ridge Office of Environmental Management (OREM) and its management and operating contractor, United Cleanup Oak Ridge, LLC (UCOR), are responsible for the development of the all-hazards planning basis for TRU waste operations at ORNL. The all-hazards planning basis supports UT-Battelle, LLC (UT-Battelle) in its emergency planning and response. UT-Battelle uses a "lead and event contractor" concept of operations for emergency planning and response. UT-Battelle is the lead contractor, while other onsite contractors, including UCOR, are event contractors. As an event contractor, UCOR provides the results of its EPHAs to UT-Battelle for use in preparing ORNL for a potential emergency response. The significant elements for UT-Battelle to develop include response plans, emergency action levels (EALs), predetermined protective actions (PAs) or PA recommendations, and the emergency planning zone (EPZ). The assessment evaluated the effectiveness of both OREM and UCOR in developing and maintaining the all-hazards planning basis for TRU waste operations at the Transuranic Waste Processing Center (TWPC) facilities, where the operations for the storage, characterization, processing, and preparation for offsite shipment of TRU waste occur.

## **2.0 METHODOLOGY**

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which EA implements through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. This report uses the terms "best practices, deficiencies, findings, and opportunities for improvement (OFIs)" as defined in the order.

As identified in the assessment plan, this assessment considered requirements specified in DOE Order 151.1D, *Comprehensive Emergency Management System*. EA also used section 4.2, *All-Hazards Planning Basis*, of EA CRAD 33-09, Revision 0, *DOE O 151.1D Emergency Management Program*, and considered the guidance provided in DOE Guide 151.1-1B, *Comprehensive Emergency Management System Guide*.

EA examined key documents, such as UCOR's procedures for developing and maintaining AHSs and EPHAs; the TWPC AHS and EPHA; the documented safety analysis (DSA) for TWPC; and other relevant programmatic documentation supporting the preparation of the all-hazards planning basis. EA toured the TWPC facilities and interviewed key personnel responsible for the development of all-hazards

planning basis documents. The members of the assessment team, the Quality Review Board, and the management responsible for this assessment are listed in appendix A.

There were no previous findings for follow-up addressed during this assessment.

### 3.0 RESULTS

#### 3.1 Procedures

This portion of the assessment determined whether UCOR procedures provide clear and appropriate guidance for developing, documenting, and maintaining AHSs and EPHAs, including identifying roles and responsibilities for review and approval.

UCOR has developed and implemented an adequate set of program documents for developing and maintaining a technically based emergency management program that meet all DOE requirements. Together, UCOR procedure PROC-EP-3022, *Preparation/Maintenance of Emergency Management Technical Planning Basis Documents*, and guide UCOR-4387, *Emergency Management Technical Planning Basis Application Guide, Oak Ridge, Tennessee*, implement the technical and administrative requirements for the development and maintenance of AHSs, EPHAs, EALs, and predetermined PAs. The procedure and guide are compliant with DOE Order 151.1D and provide clear guidance for developing, documenting, and maintaining AHSs and EPHAs, including identifying roles and responsibilities for review and approval. The AHS and EPHA procedures are applicable to all hazards at the site, including TRU waste. Additionally, UCOR has a proactive chemical management program described in procedure CMP-EN-003-R-13, *Chemical Management*. The procedure describes the process for approving and tracking chemicals from procurement through receipt, storage, and disposal, and the management of excess and empty hazardous chemical containers used at the TWPC. Notably, the procedure requires that any new chemicals or additional chemical quantities being procured are evaluated and approved by the UCOR emergency management lead for inclusion in the TWPC AHS and EPHA prior to being purchased by UCOR personnel or brought on site by a subcontractor. This proactive process is cited as a **Best Practice** because it ensures that the introduction of hazardous material is appropriately evaluated for impacts on the emergency management program and that compliance with requirements in DOE Order 151.1D is maintained.

UCOR AHSs and EPHAs are developed in accordance with UCOR-4387, a technical planning basis guide that provides accurate and comprehensive guidance for developing the technical planning basis of the emergency management hazardous materials program, as required by DOE Order 151.1D. UCOR-4387 requires a quantitative analysis of all hazardous materials identified for further analysis in the AHS; provides correct criteria for excluding hazardous materials from further analysis in the EPHA; identifies receptors of interest for consequence projections; and provides source term determination instructions that effectively establish conservative material-at-risk quantities. In addition, UCOR-4387 appropriately defines conservative and average meteorological conditions and includes PA guides for both radioactive and chemical hazardous materials. Finally, UCOR-4387 effectively describes the establishment of a spectrum of potential emergency incident scenarios for analysis in the EPHA.

UCOR procedure PROC-EP-3022 appropriately requires facility management and suitable technical expert involvement in developing, reviewing, and approving AHSs and EPHAs. Specifically, the procedures appropriately require review and approval of the AHS and EPHA by the applicable facility manager, nuclear safety lead, nuclear safety manager, emergency services manager, project manager, technical planning basis engineering lead, and others as deemed necessary (e.g., fire protection lead) prior to being submitted to OREM for review and approval. Furthermore, both the procedure PROC-EP-3022

and guide UCOR-4387 have adequate maintenance provisions that require AHSs and EPHAs to be reviewed after any update to the facility's safety basis documents and updated prior to significant changes to the facility/site operations or to hazardous material inventories, but not less than every three years as required by DOE Order 151.1D, attachment 4, section 2, paragraph o.

UCOR-4387 also effectively documents modeling input parameters for use in EPHAs. When performing dispersion modeling, analysts need many modeling input parameters, such as deposition velocity (terminal velocity of the contaminant toward earth), terrain roughness settings (contaminant removal by surface structures and dilution by air turbulence mixing), fuel pool surface areas in fire scenarios (affecting the rate of contaminant rise), and effective release height and release duration. Determining the values for these attributes requires the application of professional judgment using scientific and engineering principles, such as guidance found in DOE Guide 151.1-1B, the associated dispersion-modeling program user's guides, and published information from technical studies (internal and external to DOE). All analytical assumptions are required to be stated in an EPHA to support replication during a response. UCOR has established the appropriate parameters in UCOR-4387 to ensure consistent and effective application across all OREM EPHA facilities. Use of this technical basis guide enhances the effectiveness of the UCOR technical basis planning process.

## **Procedures Conclusions**

UCOR has prepared procedures that are compliant with DOE Order 151.1D and provide clear direction for developing, documenting, and maintaining the all-hazards planning basis. UCOR's process for approving and tracking chemicals, which requires that any new chemicals or additional chemical quantities being procured are evaluated and approved by the UCOR emergency management lead for inclusion in the TWPC AHS and EPHA prior to being purchased by UCOR personnel or brought on site, was cited as a best practice.

### **3.2 All-Hazards Survey**

This portion of the assessment determined whether the TWPC AHS identifies all the hazards applicable to TRU waste operations and establishes the appropriate input for the all-hazards planning basis of the emergency management program.

The AHS for the TWPC facilities (CM-R-EM-001-R6, *TRU Waste Processing Center All-Hazards Survey*) was prepared by the previous contractor, North Wind Solutions, LLC prior to the TWPC contract transitioning to UCOR in October 2022. The AHS was adopted for use by UCOR under a blue-sheeting process. The AHS is compliant with the UCOR technical basis procedure PROC-EP-3022 and guide UCOR-4387 and was reviewed by UCOR prior to approval by OREM. The AHS accurately describes the TRU waste operations and hazards at the TWPC. The results of the AHS are informative and technically sound, consistent with DOE guidance.

The TWPC AHS identifies all hazards applicable to operations at the TWPC, including chemical and radiological hazards. The AHS substantiates that no biological agents or toxins are present at TWPC. In addition, the AHS effectively identifies and documents the generic types (natural, technical, and human-caused) of serious emergency incidents or conditions to which the TWPC may be exposed. The AHS also identifies the applicable core program planning and preparedness requirements that constitute the basis for the emergency management program. The hazardous materials and emergency conditions identified in the AHS are consistent with the DSA for TWPC operations.

The TWPC AHS includes screening of hazardous materials to identify those requiring quantitative analysis in an EPHA. The screening criteria meet DOE Order 151.1D and procedural exclusion



requirements as described in the AHS development and maintenance procedure PROC-EP-3022. The AHS appropriately screened from further evaluation all chemical hazards within the TWPC. The AHS requires further analysis in an EPHA due to the maximum anticipated inventory of radioactive material, represented as a plutonium-239 equivalent, exceeding DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, category 3 threshold quantities.

### **All-Hazards Survey Conclusions**

The UCOR AHS for TRU waste operations at the TWPC was approved by OREM and is complete and accurate. The AHS identifies all applicable hazards, establishes the planning basis for the emergency management program, and complies with DOE Order 151.1D requirements.

### **3.3 Emergency Planning Hazards Assessment**

This portion of the assessment determined whether the TWPC EPHA defines the provisions of the emergency management hazardous materials program and provides the basis for establishing a graded approach that meets the hazardous material program requirements in DOE Order 151.1D, attachment 4, section 2; the assessment also evaluated the utility of the EPHA for conducting consequence assessments during a response.

Like the AHS, the EPHA for the TWPC facilities (CM-R-EM-002-R8, *TRU Waste Processing Center Emergency Planning Hazards Assessment*) was prepared by North Wind Solutions, LLC prior to the TWPC contract transitioning to UCOR in October 2022. The EPHA was adopted for use by UCOR under a blue-sheeting process. The document is compliant with the UCOR technical basis procedure PROC-EP-3022 and guide UCOR-4387 and was reviewed by UCOR prior to approval by OREM. The OREM-approved EPHA is compliant with DOE Order 151.1D and procedural requirements for ORNL facilities where TRU waste is processed, stored, and packaged for shipping. The TWPC EPHA used a comprehensive, systematic process to identify and analyze hazards associated with TRU waste operations. The EPHA contains a quantitative analysis of all hazardous materials identified for further analysis in the AHS, and the assumptions made in the EPHA are consistent with operational activities and the DSA.

The facility and process descriptions in the TWPC EPHA are consistent with the TWPC AHS and DSA, and the EPHA contains a current and accurate compilation of hazardous material maximum quantities associated with TRU waste operations at the TWPC. For each accident scenario, consequence assessment results and a corresponding incident classification are provided.

The TWPC EPHA analyzes a comprehensive spectrum of accident scenarios based on TWPC operations. The EPHA evaluated 30 scenarios ranging from low consequence and high probability to high consequence and low probability. The EPHA identifies analyzed scenarios using short descriptive names with: (1) tabulated consequences for each scenario at identified receptor locations, (2) consequences versus distance under conservative and average dispersion conditions, and (3) distances at which the protective action criteria (PAC) and thresholds of early lethality are projected to be exceeded at identified receptor locations. The source term for each scenario was appropriately converted to an equivalent isotope to facilitate dispersion modeling calculations. For all scenarios, the source terms were converted into plutonium-239 equivalent regardless of the presence of plutonium-239 in the original inventory. Calculations used the appropriate PAC of 1 rem for the radioactive material analyzed, as stated in the EPHA development procedure. Consequences were calculated for receptors of interest under two sets of atmospheric conditions: adverse (F stability, 1.5 meters per second wind speed) and average (D stability, 3.0 meters per second wind speed). Modeling parameters used in EPHA calculations are documented in the EPHA and are consistent with guidance in UCOR-4387.

EA reviewed the TWPC EPHA and determined that the results are consistent with DOE guidance and are accurate and technically sound. Conservative assumptions are used, and the calculations are accurate based on EA's replication of a sample of 10 of the 30 scenarios presented in the document using the HotSpot dispersion-modeling program. The EPHA clearly identified hazardous materials that were analyzed, how the results were formulated, and how the results relate to facility operations and configurations in a way that can be replicated and effectively used by UT-Battelle consequence assessment personnel during an Operational Emergency response. UT-Battelle has used the results of the EPHA to develop response plans, EALs, PAs, and EPZ sizing for the ORNL site.

The TWPC EPHA includes an EPZ that is compliant with DOE Order 151.1D, which only requires a determination of the size of the EPZ that is approved by DOE. However, the size of the TWPC EPZ may not adequately support local authorities in planning and preparedness activities to protect offsite populations because the EPZ does not extend beyond the site boundary. The EPHA determined an EPZ of 68 meters for the TWPC even though the EPHA consequence projections for an unmitigated bounding incident indicate a potential PAC distance of over 3,000 meters. (See **OFI-UCOR-1**.) The TWPC EPZ is bounded by the ORNL site EPZ of 5 miles, which is based on a fission product release from the High Flux Isotope Reactor. However, a release of TRU contamination from the TWPC would present different concerns for offsite authorities, including the use of different survey instruments.

### **Emergency Planning Hazards Assessment Conclusions**

UCOR has an EPHA for TRU waste operations at the TWPC that is approved by OREM and that is technically accurate; effectively implements the EPHA requirements in DOE Order 151.1D; provides sufficient information to support EALs, PAs, and EPZ development; and provides necessary information for a consequence assessment team to replicate the analysis. UT-Battelle has used the results of the EPHA in developing response plans, EALs, PAs, and EPZ sizing; however, the TWPC EPZ size may not adequately support planning and preparedness activities of local offsite authorities.

## **4.0 BEST PRACTICES**

Best practices are safety-related practices, techniques, processes, or program attributes observed during an assessment that may merit consideration by other DOE and contractor organizations for implementation. The following best practice was identified as part of this assessment:

- UCOR procedure CMP-EN-003-R-13 requires approval by the emergency management lead for any chemical acquisitions, which ensures that emergency management evaluates any new chemicals or additional chemical quantities being procured for inclusion in the TWPC AHS. The emergency management lead determines whether the chemical needs to be analyzed in the EPHA prior to being purchased or brought on site. This is a proactive process for ensuring that compliance with the requirements in DOE Order 151.1D is maintained before the introduction of a hazardous material.

## **5.0 FINDINGS**

No findings were identified during this assessment.

## **6.0 DEFICIENCIES**

No deficiencies were identified during this assessment.

## **7.0 OPPORTUNITIES FOR IMPROVEMENT**

EA identified the OFI shown below to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in assessment reports, they may also address other conditions observed during the assessment process. This OFI is offered only as a recommendation for line management consideration; it does not require formal resolution by management through a corrective action process and is not intended to be prescriptive or mandatory. Rather, it is a suggestion that may assist site management in implementing best practices or provide potential solutions to issues identified during the assessment.

### **United Cleanup Oak Ridge, LLC**

**OFI-UCOR-1:** Consider reevaluating the TWPC EPZ against the test of reasonableness questions in DOE Guide 151.1-1B to ensure that appropriate planning and preparedness measures are in place based on EPA consequence projections to support local and state authorities in executing PA recommendations that protect the public.

## **Appendix A Supplemental Information**

### **Dates of Assessment**

November 1 to December 14, 2023

### **Office of Enterprise Assessments (EA) Management**

John E. Dupuy, Director, Office of Enterprise Assessments  
William F. West, Deputy Director, Office of Enterprise Assessments  
Kevin G. Kilp, Director, Office of Environment, Safety and Health Assessments  
David A. Young, Deputy Director, Office of Environment, Safety and Health Assessments  
Thomas E. Sowinski, Director, Office of Nuclear Safety and Environmental Assessments  
Kimberly G. Nelson, Director, Office of Worker Safety and Health Assessments  
Jack E. Winston, Director, Office of Emergency Management Assessments  
Brent L. Jones, Director, Office of Nuclear Engineering and Safety Basis Assessments

### **Quality Review Board**

William F. West, Advisor  
Kevin G. Kilp, Chair  
David Olah  
Christopher E. McFearn  
William A. Eckroade

### **EA Assessment Team**

Dr. Terrance J. Jackson, Lead  
Robert F. Gee  
Jonathan L. Pack