EA Operational Awareness Record	Report Number: EA-LLNL-2016-03-14	
Site: Lawrence Livermore National Laboratory	**Subject:**	Transuranic Waste Inventory Tracking System
Dates of Activity: March 14-18, 2016	**Report Preparer:** Ron Bostic	

Activity Description/Purpose:

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted an operational awareness visit to the Lawrence Livermore National Laboratory (LLNL) on March 14-18, 2016, to evaluate the effectiveness of the transuranic (TRU) waste management and inventory tracking processes in maintaining the TRU waste inventory bounded by the analytical assumptions of the applicable safety basis documents. EA reviewed the Waste Storage Facilities (WSF) Documented Safety Analysis (DSA), the Building 332 (B332) Plutonium Facility DSA, and their supporting calculations to understand the underlying analytical assumptions – e.g., material at risk (MAR), damage ratios (DRs), airborne release fractions, respirable fractions, and dose conversion factors (DCFs) – that were used to develop the hazards and accident analyses to bound the risk associated with TRU waste handling and storage operations. EA held discussions with site personnel to gain an understanding of the current and projected TRU waste inventory and the strategies to ensure adequate TRU waste storage capacity until LLNL can resume TRU waste shipments to the Waste Isolation Pilot Plant (WIPP). EA also completed walkdowns of B332 and the WSFs and observed a demonstration of the information included in and the calculations and functions performed by the HazTrack inventory tracking system.

Attachments:

Attachment 1 – Key Documents, Interviews, and Observations

Result:

Lawrence Livermore National Security, LLC (LLNS), the LLNL operating contractor, developed the WSF DSA using the methodologies prescribed in DOE-STD-5506-2007, *Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities*. LLNS made conservative assumptions for waste characteristics, such as physical form, combustibility, chemical form, and packaging configuration. The close proximity of the WSFs to the LLNL site boundary resulted in relatively restrictive MAR limits for individual waste containers – e.g., all containers must be $\leq$50 plutonium-239 equivalent curies (PE-Ci), and waste >30 PE-Ci must be packaged in a pipe overpack component (POC) – as one of the primary controls to mitigate the potential public dose consequences. These inventory controls were set as initial conditions for the safety analyses and protected via specific administrative controls in the WSF technical safety requirements (TSRs). For the vehicle impact/pool fire scenario, the DOE-STD-5506-2007 statistical MAR approach was appropriately used, as documented in calculation WSF-StatMAR-1418, *Statistical Analysis of TRU Waste PE-Ci Data*, to establish a reasonably conservative, bounding MAR. WSF-StatMAR-1418 assumed a DR of zero for POCs involved in a vehicle impact and resultant fuel pool fire (consistent with DOE-STD-5506-2007 guidance) and therefore excluded the relatively higher MAR POCs from the MAR statistics calculations. However, the DOE complex-wide issue (see reference 6) that questions the experimental justification for a DR of zero for POCs during pool fires, as recommended by DOE-STD-5506-2007, could invalidate LLNL's exclusion of POCs from the statistical MAR calculations. LLNS has identified an unreviewed safety question for the WSF and has implemented a compensatory measure to prohibit receipt of additional POCs at the WSF until the complex-wide issue is addressed. (Note: The B332 DSA was not impacted by the complex-wide POC issue because the robustness of the POCs was not credited in the accident analysis.)

Both the WSF and the B332 DSAs assume that all TRU waste is 100% combustible, ensuring that conservative airborne respirable release fraction values are used in the accident scenarios. This conservative assumption alleviates one of the main issues that Los Alamos National Laboratory (LANL) has had at Area G, where the

safety analyses made less conservative (but more realistic) assumptions about the percent of TRU waste that is combustible. The LANL analyses and controls use a "combustible equivalent" concept, resulting in the need for a more sophisticated inventory tracking system to ensure that for waste streams and containers, the percent combustibility assumptions of the safety analyses remain bounding. The B332 DSA includes one bounding TRU waste scenario carried forward into the accident analysis. This bounding fire is an exposure fire resulting from the burning of nearby combustibles, not an engulfing fuel pool fire (commonly the bounding scenario for TRU waste staging/storage). Therefore, this B332 scenario assumes only confined burning of the waste in the containers and no ejection of combustible waste burning unconfined (with a significantly higher airborne respirable release fraction component) that can occur in a fuel pool fire. The B332 DSA determined that an engulfing fuel pool fire is not a credible event due to the location and configuration of the outside waste accumulation area.

One assumption in both the WSF and B332 DSAs that could be challenged by certain B332 waste streams is the solubility class for plutonium (Pu) compounds. The DSAs both use a composite DCF that is based on 99% Pu oxides (Type S solubility class) and 1% Pu in a non-oxide form (Type M solubility class). This is a conservative assumption for most LLNL TRU waste streams but could be challenged for waste streams higher in Pu chloride compounds, such as those from pyrochemical processing operations. Both DSAs explicitly discuss this potential non-conservative assumption. During EA interviews and walkdowns, waste generators, first line supervisors, managers, waste operators, and safety analysts demonstrated a good understanding of this potential concern about non-Pu oxide waste streams. In addition, for TRU waste, HazTrack defaults to using the Type M solubility class DCF for Pu to calculate the PE-Ci content of waste containers unless the waste generator selects the option that the Pu in the waste stream is confirmed to be at least 99% Pu oxides. Overall, the Pu solubility class assumptions are well protected by effective personnel training and the PE-Ci calculation algorithm used in HazTrack.

The DOE-STD-5506-2007 statistical MAR methodology has an underlying assumption that higher MAR waste containers are not "commingled" (e.g., preferentially placed together) in storage areas. Two common operational situations can result in commingling high MAR containers in waste storage areas: 1) waste generators' campaigns to eliminate higher-MAR residues and excess materials, and 2) security requirements applicable to higher-MAR waste containers. EA conducted interviews and walkdowns to gain an understanding of the current and projected TRU waste generation profiles. Historically, LLNL has generated an average of 20 TRU waste drums per year. However, a current campaign in B332 to reduce the nuclear material inventory in the vaults is generating a relatively large number of POCs that are currently being staged in B332. As noted, the MAR in POCs is excluded from the statistical MAR calculations for the WSF DSA, so this campaign does not challenge the commingling assumption. A second B332 campaign that is under way is the repack of legacy TRU waste containers. The startup of the Consolidated Waste Packaging Line (CWPL), a new glovebox line designed for safe, expedited repackaging of 55-gallon waste containers, will increase the generation rate for this campaign. However, the CWPL process does not lend itself to "optimizing" the PE-Ci content in the new generation drums (e.g., generating one TRU drum and one low level waste drum from two legacy TRU drums by concentrating most of the MAR into the new generation TRU drum). Therefore, the TRU repack campaign is not expected to significantly alter the MAR distribution within the overall LLNL TRU waste inventory. Security upgrades are planned for one of the WSFs to accommodate some of the TRU waste being generated in B332, but the planned configuration for the secured area will not necessitate segregation of higher-MAR containers from lower-MAR containers. The DOE-STD-5506-2007 assumption of no commingling of high MAR waste containers is valid for both current and projected waste inventories and storage configurations at LLNL.

Based on currently projected TRU waste generation rates, LLNL anticipates having sufficient storage capacity in the WSFs through 2018. If LLNL shipments to WIPP have not resumed by 2018, LLNL will need to develop additional storage capacity. LLNL has looked at options for increasing TRU waste storage capacity but has not initiated specific planning.

LLNS demonstrated the HazTrack system for EA. The HazTrack system tracks waste containers through their entire lifecycle at LLNL and is used to demonstrate compliance with the WSF TSRs (based on PE-Ci). The HazTrack system is under software quality assurance (SQA) as required by its use for compliance with the WSF safety basis. Also, waste generators use HazTrack to ensure that TRU waste containers are packaged within the

WSF individual container MAR limits and thus will be acceptable for transfer to the WSFs. At the outbrief for this review, EA recommended to the Livermore Field Office management team that they consider including the HazTrack system in an upcoming SQA assessment.

Conclusion:

Overall, the TRU waste inventory is effectively managed, and the HazTrack system is sufficient to ensure that the safety basis assumptions remain bounding and the WSF TSR inventory controls are met. No findings or deficiencies were identified during this review.

EA Participants:	**References:**
Ron Bostic (Site Lead)	**1.** DOE Order 227.1A, *Independent Oversight Program* **2.** DOE-STD-5506-2007, *Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities* **3.** DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities* **4.** DOE-STD-1186-2004, *Specific Administrative Controls* **5.** *DOE-STD-3009-94, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analysis* **6.** Memorandum (D. Nichols/Distribution), *Request for Extent of Condition Assessment of Pipe Over-Pack Container Use in National Nuclear Security Administration Nuclear Facilities*, dated June 16, 2015
Were there any items for EA follow up? ☐ Yes ☒ No	
EA Follow Up Items:	None

Attachment 1 – **Key Documents, Interviews, and Observations**	**Report Number:** EA-LLNL-2016-03-14

Interviews:

- Radioactive and Hazardous Waste Management Nuclear Facility Manager
- B332 Facility Manager
- WSF DSA Safety Analyst
- Radiological Characterization Analyst
- Waste Quality Assurance Officer
- B332 TRU Waste Container Custodian
- B332 TRU Waste Generators
- TRU Waste Visual Examiner
- Waste Certification Official

Observations:

- WSF tour
- B332 tour
- HazTrack inventory tracking system demonstration

Documents:

- Procedure WCP-68, *Pack/Repackage TRU Waste*
- Building 332 Plutonium Facility Documented Safety Analysis
- Building 332 Technical Safety Requirements
- Documented Safety Analysis for the Waste Storage Facilities
- Technical Safety Requirements for the Waste Storage Facilities
- Calculation WSF-StatMar-1418, *Statistical Analysis of TRU Waste PE-Ci Data*
- Calculation WSF-VEHICLE-FUEL-1419, *Source Term of Accidents Involving Vehicle Crashes and Fuel Fires*
- Calculation WSF-DCF-1104, *Default Radioactive and Hazardous Waste Management (RHWM) Dose Conversion Factors (DCFs) and Weighting Factors and Plutonium-239 Equivalent Curie (PE-Ci) Methodology for Acceptance into the Waste Storage Facilities*