



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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U.S. Department of Energy
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OFFICE OF
AIR AND RADIATION

Dear Mr. Mackie:

On April 28, 2010, the Carlsbad Field Office (CBFO) requested approval by the U.S. Environmental Protection Agency (EPA) of a T1 change to extend the calibration range of the HENC No. 2 NDA system at the Los Alamos National Laboratory (LANL), an action that was identified as a T1 change in the LANL baseline inspection report. EPA conducted a T1 evaluation of the requested change at LANL on May 25-26, 2010. DOE plans to use the HENC No. 2 NDA system to assay lead-lined drums. These lead-lined drums with cemented monoliths have significant amounts of ²⁴¹Am requiring shielding to address worker exposure concerns. These drums are significantly different from the lead-lined shielded containers which the U.S. Department of Energy is considering to use for emplacing remote-handled waste as they would CH waste at the Waste Isolation Pilot Plant.

Based on EPA's evaluation as detailed below, EPA has determined that the range extension for the HENC No. 2 to accommodate assaying CH TRU wastes in lead-lined 55-gallon (208-liter) drums appears to be technically adequate and it appears that the system can be implemented satisfactorily. However, before we can approve the Tier 1 request, CBFO must provide completed NDA batch data reports (BDRs) to serve as objective evidence of the HENC No. 2's performance. This needs to be done before CBFO provides to EPA for concurrence a draft LANL certification letter that includes the current change request. The enclosed report (EPA Docket No. A-98-49; II-A4-139) supports EPA's decision based on the information reviewed. No changes were made to the LANL tiering table as presented in the baseline inspection report (see EPA Docket No. A-98-49; II-A4-88, June 2007).

If you have any questions regarding this approval, please contact Rajani Joglekar at (202) 343-9462 or Ed Felcorn at (202) 343-9422.

Sincerely,

Tom Peake, Director
Center for Waste Management and Regulations

Enclosure



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DOCKET NO: A-98-49; II-A4-139

WASTE CHARACTERIZATION INSPECTION REPORT
EPA TIER 1 EVALUATION
OF THE CENTRAL CHARACTERIZATION PROJECT
CONTACT-HANDLED TRANSURANIC WASTE CHARACTERIZATION PROGRAM
FOR LOS ALAMOS NATIONAL LABORATORY:
CALIBRATION OF THE HIGH EFFICIENCY NEUTRON COUNTER No. 2
FOR LEAD-LINED DRUMS

May 25-26, 2010

U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Center for Waste Management and Regulations
1200 Pennsylvania Avenue, NW
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ATTACHMENTS

Attachment A: Approval Summary for LANL-CCP CH Waste Characterization Program

Acronym List

Am	americium
BDR	batch data report
CBFO	Carlsbad Field Office
CCP	Central Characterization Project
Cs	cesium
CH	contact-handled
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
HENC	High Efficiency Neutron Counter
HS	Heat Source
LANL	Los Alamos National Laboratory
LLD	lower limit of detection
MDA	minimum detectable activity
NDA	non destructive assay
Pu	plutonium
T1	tier 1
T2	tier 2
U	uranium
TRU	transuranic
WG	Weapons-Grade
WIPP	Waste Isolation Pilot Plant

1.0 EXECUTIVE SUMMARY

This report documents the U.S. Environmental Protection Agency's (EPA's) evaluation of a Tier 1 (T1) change to expand the calibration range of the High Efficiency Neutron Counter (HENC) No. 2 to accommodate characterization of lead-lined drums¹ for radiological contents. The HENC No. 2 is a nondestructive assay (NDA) system in use at the U.S. Department of Energy's (DOE's) Los Alamos National Laboratory (LANL) for characterizing contact-handled (CH) transuranic (TRU) wastes.

On April 28, 2010, the Carlsbad Field Office (CBFO) requested EPA approval of a T1 change to extend the calibration range of the HENC No. 2 NDA system, an action that was identified as a T1 change in the LANL baseline inspection report. EPA conducted a T1 evaluation of the requested change at LANL on May 25-26, 2010. Based on EPA's evaluation as detailed below, EPA has determined that the range extension for the HENC No. 2 to accommodate assaying CH TRU wastes in lead-lined 55-gallon (208-liter) drums is technically adequate and the system can be implemented satisfactorily. However, before EPA can fully approve the Tier 1 change, CBFO must provide completed NDA batch data reports (BDRs) to serve as objective evidence of the HENC No. 2's performance. This needs to occur before CBFO provides to EPA for concurrence a draft LANL certification letter including this change for concurrence.

This report presents the results of EPA's T1 evaluation. No findings or concerns were identified during the T1 evaluation, and no changes were made to the LANL tiering table as presented in the baseline inspection report (see EPA Docket No. A-98-49; II-A4-88, June 2007). A summary of EPA's approval of the LANL CH TRU Waste Characterization program is included as Attachment A.

2.0 PURPOSE OF EVALUATIONS

Certain changes to the waste characterization activities from the date of the site's baseline inspection must be reported to and, if applicable, approved by EPA according to the tiering requirements set forth in 40 CFR 194.8 regulations and incorporated in the LANL-Central Characterization Project (CCP) CH Baseline Final Report cited in Attachment A.

Under the changes to 40 CFR 194.8 promulgated in the July 16, 2004 *Federal Register* notice, EPA must perform a single baseline inspection of a TRU waste generator site's Waste Characterization program (Vol. 69, No. 136, pages 42571-42583, July 16, 2004). The purpose of EPA's baseline inspection is to approve the site's waste characterization program, based on the demonstration that the program's components, with applicable conditions and limitations, can adequately characterize TRU wastes and comply with the regulatory requirements imposed on TRU wastes destined for disposal at the Waste Isolation Pilot Plant (WIPP).

¹ These lead-lined drums should not be confused with the shielded containers that are lead lined. The lead lined drums of this action refer to 55-gallon containers with a lead liner. The waste in these containers is CH waste in the form of cemented monoliths with potential for high gamma dose requiring shielding to minimize workers' exposure to gamma radiation. For additional information, see Section 5.0 of this report.

Following EPA's baseline approval, EPA has the authority to conduct continued compliance inspections to verify that the site continues to use only the approved waste characterization processes to characterize the waste and remains in compliance with all the regulatory requirements. EPA is also authorized to evaluate and approve changes, if necessary, to the site's approved waste characterization program by conducting additional inspections under the authority of 40 CFR 194.24(h).

Changes requiring EPA notification and approval prior to implementation (T1), and those requiring post-implementation [Tier 2 (T2)] notification, are identified in the site-specific baseline inspection reports. When evaluating proposed T1 changes for approval, EPA may conduct a site inspection to observe first-hand the implementation of the change, or can opt to conduct a "desktop" review of information provided specific to a change. DOE may choose to characterize and dispose of, at risk of subsequent EPA disapproval, any previously approved TRU waste using processes/procedures/equipment implemented as T2 changes. EPA reviews T2 changes on a quarterly basis and EPA may conduct continued compliance inspections to evaluate implemented T2 changes to verify adequacy.

3.0 PURPOSE OF THIS REPORT

This report documents the basis for EPA's technical evaluation of this T1 change to expand the HENC No. 2's operational range to include lead-lined drums. Specifically, this report does the following:

- Describes the LANL waste characterization system(s) evaluated
- Provides objective evidence of outstanding findings or concerns, as applicable
- Describes any tests or demonstrations completed during the course of the inspection and their relevance to EPA's approval decision
- Confirms the pedigree of radionuclide sources used for calibration and performance testing
- Assesses the calibrated range/operational range in terms of radionuclide type and activity, and sample matrix
- Evaluates specific technical aspects of the HENC No. 2 NDA system
- Documents the basis for EPA's T1 decision and explains the results of the technical evaluation of the HENC No. 2 system's range extension
- Ability of the HENC No. 2 to identify and quantify the ten EPA-tracked radionuclides (^{238}Pu , ^{239}Pu , ^{240}Pu , ^{242}Pu , ^{233}U , ^{234}U , ^{238}U , ^{241}Am , ^{90}Sr and ^{137}Cs) and assign an uncertainty to each measured value

EPA's evaluation of the technical aspects of extending the calibration range of the LANL-CCP HENC No. 2 NDA system will be conveyed to DOE separately by letter. More information is also on EPA's Web site at <http://www.epa.gov/radiation/WIPP/index.html> in accordance with 40 CFR 194.8(b)(3).

4.0 SCOPE OF THE T1 EVALUATION

The scope of this evaluation was a review of a change to the calibration report for the HENC No. 2 to accommodate lead-lined containers, as described in this report. CBFO extended both the material mass limits and the waste density limits to allow assay of the lead-lined containers using the gamma modality. The scope of this evaluation included evaluating the following:

- That the HENC No. 2 NDA system was, in fact, the same system in the same operational configuration that EPA had inspected and approved previously at LANL-CCP
- Qualification and training for all personnel responsible for the HENC No. 2's calibration, performance testing, operation and data reporting and validation
- LANL-CCP NDA calibration, operation procedures for HENC No. 2 calibration and operation, and data reporting and validation to ensure that all aspects of the NDA process at LANL-CCP were appropriately documented
- The calibrated and operational ranges of the HENC No. 2 for lead-lined drums in terms of radionuclide type and activity, and sample matrix
- Performance tests, i.e., calibration confirmation, that LANL-CCP used to accept the HENC No. 2's operation
- Successful participation in the CBFO-sponsored NDA Performance Demonstration Program (NDA PDP)

5.0 TIER 1 EVALUATION OF EXPANDED HENC NO. 2 CALIBRATION RANGE

EPA evaluated the documentation that had been prepared to support the approval of the operating range changes to the HENC No. 2 system that will be used to assay a population of lead-lined 55-gallon (208-liter) drums containing solidified materials at LANL. Based on the AK, LANL-CCP determined that the waste (cemented monoliths) contains significant amounts of ²⁴¹Am posing a workers exposure concern and, therefore, the purpose of the lead-lining of these containers is to shield workers from gamma radiation. The presence of high amounts of ²⁴¹Am, however, does not result in a surface dose rate that requires managing the waste as a remote-handled waste (200 millirem per hour or greater). The CH waste as cemented monoliths are being assayed on the HENC No. 2 system. These lead-lined drums are significantly different from shielded containers.²

As part of the review, EPA assessed the technical adequacy of LANL-CCP documents to support the extension of both material mass limits and the waste density limits of lead-lined containers. Personnel who participated in the T1 evaluation at LANL on May 25-26, 2010, are listed in Table 1, along with each person's affiliation and function during the evaluation.

² DOE is seeking approval from EPA, the Nuclear Regulatory Commission, and the State of New Mexico to use shielded containers to package, ship, and dispose of the RH waste at the WIPP. The shielded containers are also lead-lined with different size and configuration, and different lead thickness and are expected to be used to ship and dispose of RH waste in disposal rooms and not in the walls (similar to CH waste).

Table 1. Tier 1 Evaluation Participants

Name	Affiliation
Ed Feltcorn	EPA Headquarters, Lead Inspector
Rajani Joglekar	EPA Headquarters, Inspector
Patrick Kelly	SC&A, NDA Technical Evaluator
Joe Harvill	WTS, CCP
Sean Stanfield	MCS-CCP
Richard Baumann	MCS-CCP
Joe Wachter	MCS-CCP

The following documents were examined to assess operating range changes of the HENC2.

- Lead Lined Calibration Report for the HENC #2 Including Passive Neutron and Gamma Spectrometer, LANL-NDA-1003-Lead-Lined, Revision 2, April 26, 2010
- Total Measurement Uncertainty for the HENC#2 with Integral Gamma Spectrometer, CI-HENC2-TMU-101, April 2006.

HENC No. 2 System and Design

The HENC No. 2 is located at TA-54, on Pad 10 in Area G and has not been relocated since EPA’s initial approval. It is a multi-component NDA system that LANL-CCP uses to assay CH TRU waste for shipment to the WIPP. It includes a passive neutron counter with multiplicity shift register and Add-a-Source (AaS) matrix correction option, and an integral high purity germanium (Ge) gamma spectrometer. The neutron modality of the instrument will not change because the majority of activity in the 55-gallon lead-lined drums that will be quantified originates from gamma emissions associated with the decay (transition) of americium-241 (²⁴¹Am).

The HENC No. 2 is configured to quantify plutonium (Pu) isotopes ²³⁸Pu, ²³⁹Pu, ²⁴¹Pu, neptunium-237 (²³⁷Np), uranium-233 (²³³U), ²³⁵U, ²³⁸U, ²⁴¹Am, cesium-137 (¹³⁷Cs) and other radionuclides contained in two general matrix forms. ²³⁸Pu, ²³⁹Pu, ²⁴¹Pu, ²⁴¹Am, ²³³U, ²³⁵U, ²³⁸U, ¹³⁷Cs and ²³⁷Np are quantified through direct measurement with use of multi-efficiency calibration to compensate for variations in matrix density. Isotopic ratios for Pu are determined using the Multi-Group Analysis (MGA), FRAM³ software or acceptable knowledge (AK). ⁹⁰Sr, ²³⁴U, and ²⁴²Pu are determined through correlation algorithms, site AK, and/or scaling factors defined in CCP-TP-103. A full description and technical evaluation of the HENC No. 2 can be found in the LANL Baseline Inspection Report, see A-98-49, II-A4-88. During this T1 evaluation, EPA determined that no other aspects of the HENC No. 2’s operation had changed. There were no concerns regarding the HENC No. 2’s set up or design.

Qualifications and Training for NDA Personnel

EPA determined that the personnel responsible for the extension of the HENC No. 2’s range to accommodate lead-lined drums were appropriately qualified and trained. EPA may revisit the

³ FRAM stands for Fixed Energy Response at Multiple Energies, a gamma identification software.

training for HENC No. 2 NDA personnel at a later date once a larger number of lead-lined drums have been assayed on this system. There were no concerns regarding the qualification and training of personnel responsible for the HENC No. 2.

Calibration

Calibration methods utilized for this instrument follow the manufacturer's recommendations. Radioactive material and matrix is assumed to be approximately uniformly distributed in homogeneous waste for the gamma measurement method. Calibration for lead-lined drums was applied to the system separate from the original calibration performed on the system. The range of the gamma system was confirmed by a series of measurements ranging from the Lower Limit of Detection (LLD) to 217 g of total Weapons-Grade (WG) Pu. These measurements support the establishment of an administrative operating range of 325.5 g of WG material. It is not expected that drums assayed will have larger total Pu mass than 250 g. The acceptable density range for HENC No. 2 gamma assay mode is 0.03 to 2.15 g/cc in lead-lined containers. Drums with less than 2 g of total Pu content will require extended review by an Expert Analyst (EA), as discussed below under Confirmation Calibration. Measurements also support the establishment of an administrative operating range up to 27 g Heat Source (HS) material using an approach that EPA has evaluated and approved previously.

Gamma ray energy and shape calibrations for the Ge gamma detector were performed using the sources listed in Table 2 of LANL-NDA-1003-Lead-Lined, Revision 2. The digital signal processor was adjusted so that the spectral gain was approximately 0.075 keV/channel, and the offset was approximately 0.0 keV. A 1150 keV pulser was used to provide dead time corrections for the gamma ray spectrometer. Reference peak calibration was performed with no drum present. Additional calibration results can be found in LANL-NDA-1003-Lead-Lined, Revision 2. There were no concerns regarding the HENC No. 2's calibration for lead-lined drums.

Calibration Confirmation

To comply with requirements established in DOE/WIPP-02-3122 Appendix A-1 Section A.3, calibration confirmation measurements must be performed after each calibration or re-calibration. The confirmation must meet the following criteria:

- Replicate measurements must be made with a non-interfering matrix.
- Containers must be of the same nominal size as waste containers to be assayed.
- Number of replicates must be documented and technically justified.
- Items used for calibration confirmation must contain nationally recognized standards, or standards derived from nationally recognized standards, whose contents span the range of use.
- Standards used to establish accuracy shall not be the same as those used for calibration.
- Accuracy (%R of the content of record) shall not exceed $\pm 30\%$.
- Precision (% RSD) must meet criteria listed in Table A 3.2, DOE/WIPP-02-3122 Appendix A.

Confirmation measurements were initially performed for the gamma modality for the lead-lined matrix and were confirmed by measuring Pu sources in a standard zero-matrix drum. Mass loadings of 0.6g, 3g, 15g, and 217.6g Pu were selected as representative of typical waste drums

for primarily ^{239}Pu (WG Pu) waste forms. Mass loadings of 0.3g, 7.234g, 10.82g and 18.0g Pu were selected as representative of typical waste drums for primarily ^{238}Pu (HS Pu) waste forms. Following established practice, if viable measured isotopic fractions are available via MGA or FRAM, they are used, otherwise, certificate isotopic fractions were used. Measurements were also performed to validate the lead-lined calibration for an interfering matrix. All drums were each assayed six times to provide sufficient data for statistical analysis. The results are presented in LANL-NDA-1003-Lead-Lined, Revision 2.

Calibration confirmation measurements were performed using reference sources that are certified reference materials or are working reference materials traceable to national standards database. Specifically, the mixed gamma sources were obtained from North American Scientific and the WG and HS Pu sources are diatomaceous earth triple encapsulated in stainless steel that were fabricated at the LANL CMR⁴ building, as documented in LANL-NDA-1003-Lead-Lined, Revision 2. Reference sources are different than those used in calibration and span the approximate range of expected operation of the HENC No. 2. These sources were assayed and the resulting data were evaluated against the criteria in DOE/WIPP-02-3122, Appendix A, Table 3.2, as appropriate. All assays passed the $\pm 30\%$ R criteria for accuracy and the % RSD criteria for precision ($\pm 14\%$ for six repetitions) except for the gamma modality for the 0.60 g loading. An administrative limit will therefore be set at 2 grams of total Pu, and all Pu values identified as below 2 g will require EA review. The calibration confirmation measurement results are documented in LANL-NDA-1003-Lead-Lined Revision 2. There are no concerns regarding the technical adequacy or documentation of the calibration confirmation for the HENC No. 2.

Ability to Identify and Quantify the 10 WIPP-Tracked Radionuclides

The changes to the HENC No. 2 to accommodate lead-lined drums did not significantly affect the system's ability to identify and quantify the 10 WIPP-Tracked radionuclides, as evidenced by the data in LANL-NDA-1003-Lead-Lined Revision 2. However, EPA may revisit this once a larger number of lead-lined drums have been assayed on this system. There are no concerns regarding the HENC No. 2's ability to identify and quantify the 10 WIPP-tracked radionuclides in the lead-lined mode.

Total Measurement Uncertainty (TMU)

The TMU will not change for the lead-lined drum calibration. The system was calibrated using lead-lined matrices so the uncertainty in the calibration curve will include the uncertainty in the measurements of lead-lined drums. There are no concerns regarding the determination and documentation of TMU for the HENC No. 2 in the lead-lined operational mode.

Minimum Detectable Quantities (MDA/MDC)

Minimum quantities were determined by replicate measurements of surrogate matrix materials. These measurements were performed when there were no other radioactive sources near the detector. To determine the minimum detectable activities (MDAs) for seven of the ten WIPP-tracked radionuclides that are measurable by gamma methods, measurements were performed on a lead-lined drum filled with concrete. The NDA 2000 software calculated the MDAs from these measurements and minimum detectable concentrations (MDCs) for gamma modes were

⁴ CMR is the Chemical and Metallurgical Research Facility at LANL where the majority of the WG and HS Pu sources that are used throughout the DOE complex were fabricated.

determined using the weight of the container matrix. All measurements were performed with 1800-second count times and are documented in LANL-NDA-1003-Lead-Lined, Revision 2. There are no concerns regarding the determination and documentation of the MDA/MDC for the HENC No. 2 in the lead-lined operational mode.

Successful Participation in the CBFO-Sponsored NDA PDP

The HENC No. 2 had not yet participated in the CBFO NDA PDP but participation has been scheduled for a later distribution. EPA will request the PDP results from CBFO and evaluate them at a later date.

6.0 SUMMARY OF T1 EVALUATION

Findings and Concerns

The EPA inspection team did not identify any findings or concerns related to this T1 evaluation.

Tiering Changes

Based on the results of this T1 evaluation, EPA has not revised the T1 and T2 designations assigned during the LANL-CCP baseline approval. Upon final approval, the lead-lined operational mode of the HENC No. 2 will be added to the LANL-CCP tiering summary.

Approval

Based on the results of this T1 evaluation, EPA approves the technical basis for expanding the calibration range of the HENC No. 2 to accommodate lead-lined drums, consistent with the limitations described in this report. Formal approval will be provided upon EPA's technical evaluation and acceptance of BDRs generated by the HENC No. 2's successful assays of lead-lined drums.

**ATTACHMENT A:
 APPROVAL SUMMARY FOR LANL-CCP CH
 WASTE CHARACTERIZATION PROGRAM**

Approved Activity	EPA Inspection Number, Approval Dates	Docket Number
LANL-CCP CH Baseline Approval	LANL-CCP-05.06-8 — June 21, 2007	A-98-49, II-A4-88
T1 Change – Extension of range for the High Efficiency Neutron Counter (HENC) No. 1	March 8, 2006	No report issued
T1 Change – Extension of range for the High Efficiency Neutron Counter (HENC) No. 2	October 28, 2007	A-98-49; II-A4-91
T1 Change – Extension of range for the High Efficiency Neutron Counter (HENC) No. 1	December 7, 2007	A-98-49, II-A4-95