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

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OFFICE OF
AIR AND RADIATION

MAY 2011

J. R. Stroble
Manager, National TRU Program
Carlsbad Field Office
U.S. Department of Energy
P.O. Box 3090
Carlsbad, NM 88221-3090

Dear Mr. Stroble:

On January 28, 2011 the U.S. Department of Energy (DOE), Carlsbad Field Office (CBFO) requested the U.S. Environmental Protection Agency's (EPA) approval of the Super High Efficiency Neutron Counter A (SHENCA), non-destructive assay (NDA) system for contact-handled (CH) transuranic (TRU) waste used by the Central Characterization Project (CCP) at Hanford. With this letter, EPA approves the SHENCA to be used to characterize waste at Hanford subject to the limitations of its calibration and our report.

In the baseline inspection report (Docket No. A-98-49; II-A4-138), EPA identified the addition of a new NDA system as a Tier 1 change, which requires EPA approval prior to implementation. According to the requirements of 40 CFR 194.8 (b), DOE requested approval of the SHENCA for CH TRU waste as a Tier 1 change to the Hanford-CCP CH baseline approval.

EPA conducted an on-site evaluation of the Hanford-CCP SHENCA on March 22-23, 2011. EPA's inspection of the SHENCA included an examination of the procedures, a review of the calibration records, a demonstration of the SHENCA, replicate measurements run at EPA's request, and an examination of Batch Data Reports for the SHENCA. EPA's inspection report (Docket No. A-98-49; II-A4-146) for the SHENCA is enclosed and will be placed in the Agency's public docket.

EPA has determined that the SHENCA used by Hanford-CCP is adequate for the characterization of CH TRU waste in standard waste boxes at Hanford-CCP. This approval does not make any changes to the tiering table provided with the baseline approval. Changes to the approved components of the SHENCA system at Hanford-CCP must follow the tiering requirements described in the baseline inspection report issued for the Hanford-CCP CH TRU program.

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

Sincerely,

Tom Peake

Tom Peake, Director
Center for Waste Management and Regulations

Enclosure

cc: Electronic Distribution
Courtland Fesmire, CBFO
Norma Castaneda, CBFO
Martin Navarrete, CBFO
Dennis Miehls, CBFO
Allison Pangle, CTAC
Steve Zappe, NMED
Site Documents

DOCKET NO: A-98-49; II-A4-146

WASTE CHARACTERIZATION REPORT

TIER 1 CHANGE:
ADDITION OF THE SUPER HIGH EFFICIENCY NEUTRON COUNTER "A" NON DESTRUCTIVE ASSAY SYSTEM AT THE HANFORD CENTRAL CHARACTERIZATION PROJECT

U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Center for Waste Management and Regulations
1200 Pennsylvania Avenue, NW
Washington, DC 20460

May 2011

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

1.0 EXECUTIVE SUMMARY

This report supports the U.S. Environmental Protection Agency (EPA or the Agency) approval of a Tier 1 (T1) change request in the form of the addition of the Super High Efficiency Neutron Counter "A" (SHENCA) non destructive assay (NDA) system with two limitations listed in this section below. On January 28, 2011, the Carlsbad Field Office (CBFO) requested approval of this T1 change. EPA conducted a T1 evaluation of the SHENCA onsite at Hanford-CCP on March 22-23, 2011.

In accordance with 40 CFR 194.8(b), EPA conducted Baseline Inspection No. EPA-Hanford-CCP-CH-04.10-8 of the Central Characterization Project Waste Characterization Program at the Hanford Site (Hanford-CCP) in April 2010. As a result of this inspection, EPA approved the Hanford-CCP waste characterization program in December 2010 with conditions and limitations, as documented in the Hanford-CCP Inspection Report, see Docket No. A-98-49, II-A4-138. This approval specified two nondestructive assay (NDA) systems, GEA Unit A and GEA Unit B.

Based on EPA's evaluation as detailed below, EPA approves the use of the SHENCA for assaying contact-handled (CH) transuranic (TRU) wastes in standard waste boxes (SWBs), consistent with the system's operational ranges and limitations discussed in this report. Specifically, the limitations are:

- Use of the SHENCA is limited to SWBs; assaying 55-gallon drums or containers other than SWBs is a T1 change that requires prior EPA approval.
- Use of the gamma mode of the SHENCA is limited to relative measurements to support isotopic determinations; measurements in the absolute mode are not allowed. Use of the absolute mode is a T1 change that requires prior EPA approval.

This report serves as EPA's public notification of the results of the T1 change and its evaluation. This information will be provided through the EPA website and by sending e-mails to the WIPPNEWS list, in accordance with 40 CFR 194.8(b)(3). As a result of this evaluation, the Hanford-CCP tiering table required modifications and the revised Table 2 is included in Section 7.0 of this report.

2.0 PURPOSE OF INSPECTIONS AND TIER 1 EVALUATIONS

Any changes to the waste characterization activities from the date of the baseline inspection must be reported to, and, if applicable, approved by EPA, according to the tiering requirements set forth in the Hanford-CCP Baseline Final Report cited above.

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. The purpose of the 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 WIPP. An EPA

inspection team conducts an on-site inspection to verify that the site's system of controls is technically adequate and properly implemented.

Following the EPA's approval of waste characterization processes evaluated during the baseline inspection, EPA is authorized to evaluate and approve, if necessary, changes to the site's approved waste characterization program by conducting additional inspections under the authority of 40 CFR 194.24(h). Under 40 CFR 194.24, 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. Based on the adequacies of the waste characterization processes demonstrated during the baseline inspection, including all conditions and limitations, EPA specified which subsequent waste characterization program changes or modifications must undergo further EPA evaluation or approval under 40 CFR 194.24. This was accomplished by assigning a tier level to each aspect of the Hanford-CCP's characterization program. T1 activities have more stringent reporting requirements and require that DOE notify EPA and that EPA provide approval prior to implementation of the proposed change. The rule under which baseline inspections are conducted can be found in the *Federal Register* (Vol. 69, No. 136, pages 42571–42583 of July 16, 2004).

3.0 PURPOSE OF THIS REPORT

This report presents the results of the EPA's evaluation of a T1 change to add the Hanford-CCP SHENCA system for assaying CH TRU wastes in SWBs. This report documents the basis for EPA's approval decision and explains the technical evaluation of the SHENCA system.

EPA's approval decision regarding the Hanford-CCP SHENCA has been conveyed to DOE separately by letter. As discussed previously, EPA will also announce the decision on its website at www.epa.gov/radiation/WIPP, in accordance with 40 CFR 194.8(b)(3).

The DOE documents that EPA reviewed for this evaluation are cited in section 6.0 of this report. Any of these documents can be requested from the following address:

Manager, National TRU Program
Carlsbad Field Office
U.S. Department of Energy
P O Box 3090
Carlsbad, NM 88221-3090

4.0 SCOPE OF EVALUATION

The scope of the evaluation was the use of the Hanford-CCP SHENCA system to assay CH TRU waste in SWB containers, as requested by CBFO. EPA conducted a T1 evaluation in accordance with 40 CFR 194.8(b) to evaluate the adequacy of the technical processes implemented by Hanford-CCP for the SHENCA NDA system for characterizing CH TRU debris waste in SWBs. EPA had inspected the SHENCA in 2007 under Hanford's pre-CCP TRU waste characterization program and subsequently approved it in 2008. Since Hanford-CCP stated that some aspects of

the SHENCA were unchanged, EPA compared the current operation against what had been approved in 2008 (EPA Docket No. A-98-49; II-A4-106). Upon confirming that specific components of the SHENCA were unchanged, these components were not assessed directly during this T1 evaluation. The aspects that were changed by the proposed T1 change were evaluated in detail and these are discussed in this report.

5.0 EVALUATION TEAM

All personnel involved in the SHENCA evaluation are listed in Table 1, along with each person's affiliation and function for the purpose of this evaluation.

Table 1. Tier 1 Evaluation Personnel

Personnel	Affiliation	Inspection Function - Area of Expertise
Edward Feltcorn	U.S. EPA ORIA	EPA Inspection Team Leader
Patrick Kelly	SC&A/EPA Contractor	EPA Inspector, Technical Lead
Dorothy Gill	SC&A/ EPA Contractor	EPA Inspector, RTR
Rose Gogliotti	SC&A/ EPA Contractor	EPA Inspector, NDA
Stephanie McElhaney	PSC	SHENCA Expert Analyst
Alan Slumaker	PSC/ITR/OP	SHENCA Operator
Charlie Riggs	CTAC	CBFO Observer
Joe Harvill	WTS/CCP/NDA	Technical Support, SHENCA
Howard Budweg	DOE, CBFO/NTP	Hanford/INL Facility Representative
Michael Sensibaugh	WTS/CCP	CCP Project Manager
Larry Porter	WTS/CCP	Site Program Manager
Ron Reeves	WTS/CCP	Hanford-CCP Program Manager
Eric Greager	CHPRC/STR	Hanford Site Technical Representative
David Haar	WTS/CCP	Retrieval, Characterization and Storage Manager

6.0 EVALUATION OF THE HANFORD-CCP SUPER HIGH EFFICIENCY NEUTRON COUNTER "A"

EPA performed an on-site evaluation of the SHENCA system and related documentation that Hanford-CCP had prepared to support the use of the SHENCA for assaying CH TRU waste. As part of this evaluation, EPA assessed the adequacy of the SHENCA and its supporting documentation relative to the following:

- Identification and quantification of the 10 WIPP-tracked radionuclides and their uncertainty, i.e., plutonium-238 (^{238}Pu), ^{239}Pu, ^{241}Pu, ^{242}Pu, americium-241 (^{241}Am), uranium-233 (^{233}U), ^{234}U, ^{238}U, cesium-137 (^{137}Cs), and strontium-90 (^{90}Sr)
- Determination of a technically appropriate lower limit of detection (LLD)
- Providing technical support for the changes to the system's Total Measurement Uncertainty (TMU)
- Assaying the waste stream of interest with respect to nuclear material content and matrix with the system's hardware and software

- Technical adequacy of the documents and procedures to support the use of the SHENCA to characterize TRU waste
- Knowledge and understanding of the personnel involved in the Hanford-CCP NDA program.

EPA examined the following documents to assess the Hanford-CCP SHENCA:

- CCP-TP-137, CCP SuperHENC Operating of the Hanford SuperHENC Assay System, Revision 1, February 24, 2011
- CCP-TP-144, CCP SuperHENC Calibration Procedure, Revision 0, September 16, 2010
- CCP-TP-170, CCP SuperHENC Calibration Procedure, Revision 2, March 12, 2007
- CCP-TP-148, CCP SuperHENC Data Reviewing, Validating and Reporting Procedure, Revision 6, February 10, 2011
- CCP Hanford SuperHENC Calibration Procedure, Revision 0, September 2010
- BII-5169-C&VR-001, Calibration and Validation Report SuperHENC Mobile Assay System, Revision 3, November 2006
- BII-5169-MFP-001, Matrix Fill Plan, SuperHENC Mobile Assay System, Revision 0, October 2004
- CCP-SHENC-10-002, Hanford SHENCA Calibration Confirmation Report, Revision 0, December 28, 2011
- Operational Logbook CCP-RL-NDA-SHENC-002, Calendar Year 2011, issued January 3, 2011, pages 27 and 28, corresponding to Tuesday March 22, 2011
- NGI.GLB Gamma Library, Version 1.00, John West, September 2, 2010
- PC-FRAM Parameter Set: Coax_Wide_PFP_200, last modified December 22, 2010
- CCP-Hanford List of Qualified Individuals, March 10, 2011, 9:13 AM
- CCP-AK-RK-101 MPFPDD NDA Memo, September 16, 2010
- SHENCA BDR RLNDAB11001, containing SWB Nos. RL0037371and RL0037375
- SHENCA BDR RLNDAB11002, containing SWB Nos. RL0023743 (rejected as non TRU) & RL0037369
- SHENCA BDR RLNDAB11003, containing SWB Nos. RL0037140 & RL0037520

(1) The design, operation and personnel associated with the Super High Efficiency Neutron Counter "A" were assessed and found to be adequate.

The SHENCA is housed in its own trailer located in the Central Waste Complex near the Waste Receiving and Processing (WRAP) facility in the 200 West Area of the Hanford site. It is

capable of assaying two types of waste containers: SWBs[1] and 55-gallon drums. At the time of this evaluation, Hanford-CCP provided technical information to support the system's use only for SWBs. Hanford-CCP indicated that in the future, a T1 change will be submitted to extend the calibration to include 55-gallon drums. **Use of the SHENCA for any container other than an SWB is a T1 change that requires prior EPA approval, as shown in the revised Hanford-CCP tiering table (Table 2) in Section 7 where this is listed as a T1 change.**

The SHENCA consists of a passive neutron counter and an integral gamma-ray spectrometer, the SuperHENC Gamma Energy Analysis System (SGEAS). The passive neutron counter uses 240 helium-3 proportional counters in a four-pi geometry, an external californium-252 (^{252}Cf) source for the Add-a-Source (AAS) matrix correction function and an ANTEC advanced multiplicity shift register. The neutron component determines the mass of spontaneously fissioning material in waste containers, referred to as the plutonium-240 Effective (^{240}Pu$_{Eff}$). The ^{240}Pu$_{Eff}$ is defined as the amount of ^{240}Pu that would produce the observed true neutron coincidence rate, after correcting for the neutron moderation properties of the waste matrix. The system's calibration was based on measurements of a non-interfering matrix and it includes a curve that relates the measured doubles rate for each container with the ^{240}Pu$_{Eff}$, as documented in BII-5169-C&VR-001. An AAS correction factor is necessary to convert the observed doubles rate (with the sample matrix) to the equivalent calibration doubles rate (no matrix). The AAS correction curve is sufficiently robust to enable corrections over a wide range of materials or matrices. The following software supports the SHENCA's operation:

- NGI.EXE Neutron and Gamma Integration Software, Version 2.0
- SUPRHENC.EXE Neutron Counting and Analysis Software, Version 2.0
- MAESTRO Gamma Acquisition Software, Version 6.3
- PC-FRAM Gamma Analysis Software, Version 4.4

The Multiplicity Mode of the SHENCA's calibration was not evaluated at this time. Multiplicity counting is relevant at higher Pu concentrations and Hanford-CCP personnel stated that it might be helpful to enable the system to perform measurements for material control and accountability or Safeguards purposes.

The SGEAS gamma-ray spectrometer consists of a single high purity germanium (HPGe) coaxial detector. The detector is provided with a fixed 1.09 millimeter (mm) cadmium/polyethylene filter that effectively removes photons below approximately 80 kilo electron volts (keV). There is an additional 10 mm steel filter that may be used for containers where ^{241}Am concentrations are such that system dead-time exceeds 25%. Hanford-CCP personnel stated that the steel filter had not yet been used but it would be used at the discretion of the SHENCA Expert Analyst (EA). Each HPGe measurement consists of one 450-second count, following which the waste container is rotated 180 degrees, and a second 450-second count HPGe is initiated. The reported gamma

[1] A Standard Waste Box or SWB is a rectangular container with rounded corners whose measurements are approximately 54.5 inches wide by 37 inches high by 71 inches long. The cavity of the SHENCA will accept containers up to 59 inches wide by 59 inches high by 91.5 inches long.

results consist of the composite of both 450-second counts. The SGEAS is used for two types of measurements:

- Relative ratio mode: to acquire the gamma-ray spectrum to be analyzed by PC-FRAM for use in conjunction with neutron assay data
- Absolute mode: to provide direct quantification of a number of radionuclides based on analysis of the acquired gamma spectra. The uncertainty associated with the absolute mode determinations is expected to be greater than the neutron-based determinations in most instances. However, containers that display elevated neutron emission from (α, n) reactions or that contain significant quantities of U isotopes are excellent candidates for absolute mode determinations.

Use of SHENCA in absolute mode was not evaluated during this T1 evaluation. Hanford-CCP personnel stated that the SHENCA will not be operated in absolute mode for assays of TRU wastes for the Waste Isolation Pilot Plant (WIPP) at this time. **Use of the absolute mode is a T1 change that requires prior EPA approval, as shown in the revised Hanford-CCP tiering table (Table 2) in Section 7 where this is listed as a T1 change.**

The combination of neutron and isotopic distribution information allows quantification of ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Am, ^{233}U, ^{235}U, ^{238}U, ^{137}Cs and neptunium-237 (^{237}Np). The ^{242}Pu content is determined using standard correlations techniques that EPA has evaluated previously on several systems at other TRU waste characterization facilities. Each waste container's ^{234}U content is performed by application of scaling factors that are based on observed values for ^{235}U and ^{238}U, as appropriate. The determination of ^{90}Sr is performed by application of a scaling factor based on ^{137}Cs.

SHENCA personnel include Operators/Independent Technical Reviewers and EAs. The training of all Hanford-CCP SHENCA personnel was adequate and all were current as listed on the Hanford-CCP List of Qualified Individuals. There are no technical issues with the design or operation of the SHENCA or with the personnel associated with its calibration, operation and data reduction. The Hanford-CCP approval table has been updated to reflect the two T1 changes discussed above.

(2) The calibration and calibration confirmation for the Hanford Super High Efficiency Neutron Counter "A" had been properly performed and documented in both passive neutron and gamma operational modes.

The calibration of the SHENCA is documented in *Calibration and Validation Report SuperHENC Mobile Assay System SHENCA*, BII-5169-C&VR-001, Revision 3, February 2011. The calibration of record was performed in 2005 in accordance with HNF-22923, *Calibration and Validation Plan SuperHENC Mobile Assay System*, Revision 0. This document was not reviewed during this evaluation but it was reviewed previously during EPA's initial approval of the SHENCA. Hanford-CCP did not recalibrate the SHENCA and this T1 evaluation consisted primarily of confirming that the 2005 calibration had not changed and that is was appropriate for the wastes Hanford-CCP intended to assay, i.e., Waste Stream MPFPDD. EPA expressed concern regarding CCP-SHENC-10-002, *Hanford SHENCA Calibration Confirmation Report*,

which documented the SHENCA's calibration verification. Specifically, this is the group of performance measurements that were executed to demonstrate that the system's initial calibration was appropriate. This report did not clearly present all pertinent aspects of the performance testing and the EPA technical lead identified several areas where changes were necessary. Hanford-CCP agreed to modify the document as discussed during the evaluation. EPA accepted this and requested to review a revised copy of the document when it is available.

Passive Neutron Mode

The calibration was performed using metal, plastic, and wet combustible matrices and an empty SWB and is applicable to S5400 heterogeneous debris waste packaged in SWBs. The chamber efficiency was determined using a ^{252}Cf source (~78,781 neutrons/second as of December 17, 2004) followed by a system normalization. The calibration was performed using Performance Demonstration Program (PDP)-type weapons grade plutonium (WG Pu) standards that covered the range of certified plutonium values shown:

- 0.0508 grams (g) Pu Total, 0.031 g $^{240}Pu_{Eff}$
- 5.012 g Pu Total, 0.304 g $^{240}Pu_{Ef}$
- 10.008 g Pu Total, 0.607 g $^{240}Pu_{Eff}$
- 20.009 g Pu Total, 1.214 g $^{240}Pu_{Eff}$
- 50.018 g Pu Total, 3.034 g $^{240}Pu_{Eff}$
- 75.024 g Pu Total, 4.550 g $^{240}Pu_{Eff}$

Following this, calibration confirmation was performed using a different set of the same PDP-type WG Pu standards that covered a range of 0.297 to 485.354 g Pu total, equivalent to a range of 0.018 to 30.106 g $^{240}Pu_{Eff}$. The qualified range was documented as the system's LLD to 30.1 g $^{240}Pu_{Eff}$ (LLD to 502 g WG Pu).[2] All neutron calibration and calibration confirmation assays were technically acceptable and appropriately documented.

Gamma Mode

The energy-versus-channel calibration of the SGEAS gamma-ray spectrometer was performed using six europium-152 (^{152}Eu) sources (North American Scientific Industries Source Numbers 51142 – 51147) and cadmium filters. The SHENCA's efficiency calibration was performed using six $^{152}Eu/^{137}Cs/^{241}Am$ line sources in three SWBs – dry combustibles, metals, and empty – producing an energy range of approximately 121.8 keV to 1112.1 keV. The gamma operating range is provided in BII-5169-C&VR-001, Table 61 as a *Qualified Pu Range* of LLD – 455.31 g ^{239}Pu (at 413.7 keV). However, because the absolute mode will not be used by Hanford-CCP, the *Qualified Pu Range* is not relevant. The gamma mode's range for isotopic determinations is determined by the energy-versus-channel calibration, defined as any photon line between 121.8 keV to 1112.1 keV, limited by the system's performance, i.e., dead-time and resolution or peak

[2] A complete listing of all sources used for calibration and calibration confirmation is provided in HNF-9787, *WRAP NDA Certified Radioactive Sources*.

shape considerations. Provided a gamma measurement is within this energy range and all performance-based criteria and system checks are met, the measurement would be valid irrespective of the Pu mass measured. The SHENCA system is not approved to assay TRU waste in gamma absolute mode and can only be used in relative mode, as discussed in (1), above. All gamma calibration and calibration confirmation assays were technically acceptable and appropriately documented.

(3) The total measurement uncertainty of assays performed on the Super High Efficiency Neutron Counter "A" had been adequately determined and documented.

Determination of the TMU for assays performed on the SHENCA is documented in BII-5169-C&VR-001, Revision 3, dated February 2011. The TMU determination for the passive neutron measurement included contributions from: calibration uncertainty; neutron counting statistics; matrix and source distribution effects; background effects for high-Z matrices; and uncertainties due to isotopics, chemical forms, and neutron multiplication. Contributions for the gamma TMU component included: calibration source uncertainties, counting statistics, self-absorption effects, matrix non-homogeneities, non-uniform source distributions, and isotopic measurement uncertainties. There are no technical issues with regard to the determination and documentation of TMU for the SHENCA.

(4) The lower limits of detection, including the minimum detectable concentration of the Super High Efficiency Neutron Counter "A" had been adequately determined and documented.

The LLD was defined in the Hanford-CCP Waste Certification Plan, CCP-PO-002, Revision 25 as: "that level of radioactivity which, if present, yields a measured value greater than the critical level with a 95 percent probability, where the critical level is defined as that value which measurements of the background will exceed with 5 percent probability." The LLD of any given NDA measurement depends on the type of measurement (passive neutron versus gamma), the properties of the waste matrix being assayed, and the environmental background. For this reason, the LLD will vary from drum to drum and may even vary between multiple measurements of the same drum.

The SHENCA estimates and reports the LLD of the ten WIPP-tracked radionuclides for each measurement in both gamma and neutron modalities although Hanford-CCP personnel stated that the primary LLD values for Pu are neutron-based. Gamma LLD values are provided only for the absolute mode determinations; isotopic mode assay LLDs are referred to as *LLD equivalents* because PC-FRAM uses a complex algorithm based on scaling the LLD to the measured passive neutron-derived ^{240}Pu value. Only measured values that exceed the reported LLD for that measurement will be reported and used in calculations of derived quantities, such as total TRU alpha activity and concentration. The SHENCA has the required sensitivity to make TRU/Non-TRU determinations in accordance with the 100 nanocuries per gram TRU criterion. Although the LLD determinations were done prior to the Hanford-CCP baseline inspection, EPA determined that their essential components were unchanged. There were no concerns regarding the technical adequacy or documentation of the SHENCA LLDs.

(5) The Super High Efficiency Neutron Counter "A" had participated successfully in the Carlsbad Field Office-sponsored Non-Destructive Assay Performance Demonstration Program.

The SHENCA participated most recently in March 2011 in Supplemental Cycle 10B of the CBFO-sponsored NDA PDP, by assaying three matrices, a non-interfering matrix (empty SWB), combustibles, and metals. The formal results of the SHENCA's participation are not yet available.

(6) Environmental Protection Agency replicate testing of the Super High Efficiency Neutron Counter "A" was performed and evaluated and found to be adequate.

The purpose of the replicate testing performed as part of this evaluation is to provide EPA with an independent means to verify that the SHENCA can produce reproducible results for the determination of the quantity of ten WIPP-tracked radionuclides and the TRU alpha concentration. This is accomplished by reassaying containers previously measured on the same system in order to demonstrate the system's ability to do the following:

- Produce results consistent with the reported TMU by comparing the sample standard deviation for a number of replicate measurements taken over several hours or days to the reported TMU; and
- Provide reproducible results over longer periods of time, such as weeks or months, by comparing the results of the replicate measurement(s) to the original reported values.

As part of this T1 evaluation, EPA requested that Hanford reassay two SWBs that EPA randomly selected from a list of the six items that were previously assayed on the SHENCA at risk. EPA chose SWB Nos. RL0037375 and RL0037369. Each SWB selected was reassayed five times and the data for each replicate assay were analyzed using two statistical tests, a *Chi-Squared (χ^2) Test* and a *t Test*. Data and results of the statistical analysis are included in Attachments A.1 and A.2, respectively.

The χ^2 *Test* for SWB Nos. RL0037375 and RL0037369 showed that the observed variances in the replicate measurements are less than or equal to the reported uncertainties within the statistical limits of the test. The *t Test* for SWB Nos. RL0037375 and RL0037369 did not show any statistically significant differences between the original measurement values and the average of the five replicate measurements for the activities of any of the target radionuclides or the TRU Alpha Activity Concentration. There are no technical issues with regard to replicate testing for the SHENCA.

7.0 SUMMARY

During this evaluation, the EPA did not identify any findings or concerns related to the use of the SHENCA NDA system to assay CH TRU wastes.

7.1 Conclusions

EPA evaluated the performance of the Hanford-CCP SHENCA NDA system to assay CH TRU wastes as a T1 change. Based on the results of this evaluation, EPA is approving the use of the SHENCA system for assaying CH TRU waste with the following limitations:

- Use of the SHENCA is limited to SWBs; assaying 55-gallon drums or containers other than SWBs is a T1 change that requires prior EPA approval.
- Use of the gamma mode of the SHENCA is limited to relative measurements to support isotopic determinations; measurements in the absolute mode are not allowed. Use of the absolute mode for gamma determinations is a T1 change that requires prior EPA approval.

As a result of this evaluation the Hanford-CCP tiering table required modifications and the revised table is included below as Table 2.

Table 2. Tiering of TRU Waste Characterization Processes Implemented by Hanford-CCP (Revised April 2011)

Process Elements	Hanford-CCP T1 Changes Needing EPA Review and Approval	Hanford-CCP T2 Changes[a]
Acceptable Knowledge	Implementation of load management Implementation of AK for wastes other than retrievably-stored debris (i.e., retrievably-stored soil/gravel and/or solids)	Notification to EPA upon completion of new versions or updates/substantive changes[b] of the following: - Modification of CCP-TP-005, Revision 18 - Availability of modifications to the AKSR - Availability of all final WSPF with related attachments - Availability of all AK Accuracy Reports - Availability of successful training records - Availability of the AK-NDA memorandum
Non-Destructive Assay	New equipment or physical modifications to approved equipment[c] Extension or changes to approved calibration range for approved equipment **SHENCA:** - **Assay of containers other than SWBs** - **Use of absolute gamma mode**	Notification to EPA upon completion of changes to software for approved equipment, operating range(s), and site procedures that require CBFO approval
Real-Time Radiography	There are no T1 changes at this time	Notification to EPA upon the following: - Modification[c] to approved equipment, RTR Units A and B - Completion of changes to site RTR procedures requiring CBFO approval - Addition of a new SCG(s) to the RTR process that is subject to this approval - Implementation of a different type of RTR equipment
Visual Examination	Performance of VE by any method other than using two trained operators to perform actual VE at the time of packaging	Notification to EPA upon the following: - Completion of changes to site VE procedures requiring CBFO approval - Addition of new SCG to the VE processes that are subject to this approval
Waste Data System	There are no T1 changes at this time	Notification to EPA upon the following: - Completion of changes to WDS procedure(s) requiring CBFO approval - Changes to the Excel spreadsheet titled WDS Master Template.xls, Revision 2, Addendum#2, SCO #1065

[a] Upon receiving EPA approval, Hanford-CCP will report all T2 changes to EPA at the end of each fiscal year quarter. Note: EPA may request specific T2 change items before the end of a fiscal quarter.
[b] *Substantive changes* means changes with the potential to impact the site's waste characterization activities or documentation thereof, excluding changes that are solely related to ES&H, nuclear safety, RCRA or are editorial in nature.
[c] Modifications to approved equipment include all changes with the potential to affect NDA data relative to waste isolation and exclude minor changes, such as the addition of safety-related equipment.

Attachment A.1: Replicate Testing Data for Container RL0037369 – SHENCA

Instrument: SHENCA
Container: RL0037369

Quantity of Interest	Original Measurement			Replicate #1			Replicate #2		
	Reported Value	Absolute Uncertainty	Relative Uncertainty	Reported Value	Absolute Uncertainty	Relative Uncertainty	Reported Value	Absolute Uncertainty	Relative Uncertainty
^{233}U Activity (Ci)		N/A			N/A			N/A	
^{234}U Activity (Ci)		N/A			N/A			N/A	
^{238}U Activity (Ci)		N/A			N/A			N/A	
^{238}Pu Activity (Ci)	2.63E-03	6.31E-04	2.40E-01	2.97E-03	7.98E-04	2.69E-01	2.54E-03	6.95E-04	2.73E-01
^{239}Pu Activity (Ci)	2.97E-02	7.14E-03	2.41E-01	3.35E-02	9.03E-03	2.70E-01	2.87E-02	7.86E-03	2.74E-01
^{240}Pu Activity (Ci)	7.00E-03	1.37E-03	1.96E-01	7.91E-03	1.82E-03	2.30E-01	6.78E-03	1.59E-03	2.35E-01
^{242}Pu Activity (Ci)	4.02E-07	9.66E-08	2.41E-01	4.53E-07	1.22E-07	2.69E-01	3.89E-07	1.06E-07	2.74E-01
^{241}Am Activity (Ci)	5.30E-01	1.93E-01	3.63E-01	5.94E-01	2.36E-01	3.97E-01	5.09E-01	2.03E-01	3.99E-01
^{90}Sr Activity (Ci)		N/A			N/A			N/A	
^{137}Cs Activity (Ci)		N/A			N/A			N/A	
TRU Alpha Conc. (nCi/g)	2.60E+03	9.05E+02	3.48E-01	2.92E+03	1.11E+03	3.80E-01	2.50E+03	9.58E+02	3.83E-01
^{232}U Activity (Ci)		N/A			N/A			N/A	
^{237}Np Activity (Ci)		N/A			N/A			N/A	

Quantity of Interest	Replicate #3			Replicate #4			Replicate #5		
	Reported Value	Absolute Uncertainty	Relative Uncertainty	Reported Value	Absolute Uncertainty	Relative Uncertainty	Reported Value	Absolute Uncertainty	Relative Uncertainty
^{233}U Activity (Ci)		N/A			N/A			N/A	
^{234}U Activity (Ci)		N/A			N/A			N/A	
^{238}U Activity (Ci)		N/A			N/A			N/A	
^{238}Pu Activity (Ci)	2.71E-03	7.08E-04	2.61E-01	2.88E-03	7.21E-04	2.50E-01	2.71E-03	7.08E-04	2.61E-01
^{239}Pu Activity (Ci)	3.06E-02	8.00E-03	2.61E-01	3.25E-02	8.15E-03	2.51E-01	3.06E-02	8.00E-03	2.61E-01
^{240}Pu Activity (Ci)	7.23E-03	1.60E-03	2.21E-01	7.68E-03	1.60E-03	2.08E-01	7.23E-03	1.60E-03	2.21E-01
^{242}Pu Activity (Ci)	4.15E-07	1.08E-07	2.61E-01	4.40E-07	1.10E-07	2.51E-01	4.15E-07	1.08E-07	2.61E-01
^{241}Am Activity (Ci)	5.43E-01	2.12E-01	3.91E-01	5.77E-01	2.21E-01	3.84E-01	5.43E-01	2.12E-01	3.91E-01
^{90}Sr Activity (Ci)		N/A			N/A			N/A	
^{137}Cs Activity (Ci)		N/A			N/A			N/A	
TRU Alpha Conc. (nCi/g)	2.67E+03	9.99E+02	3.74E-01	2.83E+03	1.04E+03	3.67E-01	2.67E+03	9.99E+02	3.74E-01
		N/A			N/A			N/A	
^{232}U Activity (Ci)		N/A			N/A			N/A	
^{237}Np Activity (Ci)		N/A			N/A			N/A	

Attachment A.1: Replicate Testing Results for Container RL0037369 – SHENCA

Instrument: SHENCA
Container: RL0037369

Quantity of Interest	Original Measurement		Sample Mean	Sample Standard Deviation	Relative Standard Deviation	x^2	$Pr(x < \|x^2\|)$
	Reported Value	Absolute Uncertainty					
^{233}U Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
^{234}U Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
^{238}U Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
^{238}Pu Activity (Ci)	2.63E-03	6.31E-04	2.76E-03	1.65E-04	5.98E-02	2.75E-01	9.91E-01
^{239}Pu Activity (Ci)	2.97E-02	7.14E-03	3.12E-02	1.86E-03	5.98E-02	2.73E-01	9.91E-01
^{240}Pu Activity (Ci)	7.00E-03	1.37E-03	7.36E-03	4.40E-04	5.98E-02	4.13E-01	9.81E-01
^{242}Pu Activity (Ci)	4.02E-07	9.66E-08	4.22E-07	2.53E-08	5.98E-02	2.73E-01	9.91E-01
^{241}Am Activity (Ci)	5.30E-01	1.93E-01	5.53E-01	3.31E-02	5.98E-02	1.18E-01	9.98E-01
^{90}Sr Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
^{137}Cs Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
TRU Alpha Conc. (nCi/g)	2.60E+03	9.05E+02	2.72E+03	1.62E+02	5.97E-02	1.29E-01	9.98E-01
	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
^{232}U Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
^{237}Np Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A

Quantity of Interest	t	$Pr(x < \|t\|)$	x^2 Test	t Test
^{233}U Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable
^{234}U Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable
^{238}U Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable
^{238}Pu Activity (Ci)	-7.49E-01	4.95E-01	Not Significant	Not Significant
^{239}Pu Activity (Ci)	-7.50E-01	4.95E-01	Not Significant	Not Significant
^{240}Pu Activity (Ci)	-7.49E-01	4.95E-01	Not Significant	Not Significant
^{242}Pu Activity (Ci)	-7.49E-01	4.95E-01	Not Significant	Not Significant
^{241}Am Activity (Ci)	-6.48E-01	5.52E-01	Not Significant	Not Significant
^{90}Sr Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable
^{137}Cs Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable
TRU Alpha Conc. (nCi/g)	-6.63E-01	5.43E-01	Not Significant	Not Significant
	N/A	N/A	Not Applicable	Not Applicable
^{232}U Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable
^{237}Np Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable

Attachment A.2: Replicate Testing Data for Container RL0037375 – SHENCA

Instrument: SHENCA
Container: RL0037375

Quantity of Interest	Original Measurement			Replicate #1			Replicate #2		
	Reported Value	Absolute Uncertainty	Relative Uncertainty	Reported Value	Absolute Uncertainty	Relative Uncertainty	Reported Value	Absolute Uncertainty	Relative Uncertainty
^{233}U Activity (Ci)		N/A			N/A			N/A	
^{234}U Activity (Ci)		N/A			N/A			N/A	
^{238}U Activity (Ci)		N/A			N/A			N/A	
^{238}Pu Activity (Ci)	1.28E-02	2.73E-03	2.13E-01	1.25E-02	2.63E-03	2.11E-01	1.29E-02	2.74E-03	2.12E-01
^{239}Pu Activity (Ci)	1.44E-01	3.09E-02	2.14E-01	1.41E-01	2.98E-02	2.12E-01	1.45E-01	3.10E-02	2.13E-01
^{240}Pu Activity (Ci)	3.41E-02	5.51E-03	1.62E-01	3.32E-02	5.28E-03	1.59E-01	3.43E-02	5.51E-03	1.61E-01
^{242}Pu Activity (Ci)	1.96E-06	4.18E-07	2.14E-01	1.90E-06	4.03E-07	2.12E-01	1.97E-06	4.19E-07	2.13E-01
^{241}Am Activity (Ci)	6.87E-02	2.07E-02	3.01E-01	6.49E-02	1.67E-02	2.58E-01	6.71E-02	1.74E-02	2.59E-01
^{90}Sr Activity (Ci)		N/A			N/A			N/A	
^{137}Cs Activity (Ci)		N/A			N/A			N/A	
TRU Alpha Conc. (nCi/g)	1.20E+03	2.48E+02	2.07E-01	1.16E+03	2.33E+02	2.01E-01	1.20E+03	2.42E+02	2.02E-01
		N/A			N/A			N/A	
^{232}U Activity (Ci)		N/A			N/A			N/A	
^{237}Np Activity (Ci)	1.51E-05	4.73E-06	3.13E-01	1.52E-05	3.79E-06	2.49E-01	1.57E-05	3.93E-06	2.50E-01

Quantity of Interest	Replicate #3			Replicate #4			Replicate #5		
	Reported Value	Absolute Uncertainty	Relative Uncertainty	Reported Value	Absolute Uncertainty	Relative Uncertainty	Reported Value	Absolute Uncertainty	Relative Uncertainty
^{233}U Activity (Ci)		N/A			N/A			N/A	
^{234}U Activity (Ci)		N/A			N/A			N/A	
^{238}U Activity (Ci)		N/A			N/A			N/A	
^{238}Pu Activity (Ci)	1.21E-02	2.54E-03	2.09E-01	1.20E-02	2.53E-03	2.10E-01	1.25E-02	2.63E-03	2.11E-01
^{239}Pu Activity (Ci)	1.37E-01	2.87E-02	2.10E-01	1.36E-01	2.87E-02	2.11E-01	1.41E-01	2.98E-02	2.12E-01
^{240}Pu Activity (Ci)	3.23E-02	5.06E-03	1.57E-01	3.21E-02	5.06E-03	1.58E-01	3.32E-02	5.28E-03	1.59E-01
^{242}Pu Activity (Ci)	1.85E-06	3.89E-07	2.10E-01	1.84E-06	3.88E-07	2.11E-01	1.90E-06	4.03E-07	2.12E-01
^{241}Am Activity (Ci)	6.32E-02	1.62E-02	2.56E-01	6.27E-02	1.61E-02	2.57E-01	6.49E-02	1.67E-02	2.58E-01
^{90}Sr Activity (Ci)		N/A			N/A			N/A	
^{137}Cs Activity (Ci)		N/A			N/A			N/A	
TRU Alpha Conc. (nCi/g)	1.13E+03	2.24E+02	1.99E-01	1.12E+03	2.24E+02	2.00E-01	1.16E+03	2.33E+02	2.01E-01
		N/A			N/A			N/A	
^{232}U Activity (Ci)		N/A			N/A			N/A	
^{237}Np Activity (Ci)	1.48E-05	3.66E-06	2.48E-01	1.47E-05	3.65E-06	2.48E-01	1.52E-05	3.79E-06	2.49E-01

Attachment A.2: Replicate Testing Results for Container RL0037375 – SHENCA

Instrument: SHENCA
Container: RL0037375

Quantity of Interest	Original Measurement		Sample Mean	Sample Standard Deviation	Relative Standard Deviation	x^2	$Pr(x < \lvert x^2 \rvert)$
	Reported Value	Absolute Uncertainty					
^{233}U Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
^{234}U Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
^{238}U Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
^{238}Pu Activity (Ci)	1.28E-02	2.73E-03	1.24E-02	3.36E-04	2.71E-02	6.08E-02	1.00E+00
^{239}Pu Activity (Ci)	1.44E-01	3.09E-02	1.40E-01	3.79E-03	2.71E-02	6.02E-02	1.00E+00
^{240}Pu Activity (Ci)	3.41E-02	5.51E-03	3.30E-02	8.95E-04	2.71E-02	1.06E-01	9.99E-01
^{242}Pu Activity (Ci)	1.96E-06	4.18E-07	1.89E-06	5.13E-08	2.71E-02	6.04E-02	1.00E+00
^{241}Am Activity (Ci)	6.87E-02	2.07E-02	6.46E-02	1.75E-03	2.71E-02	2.86E-02	1.00E+00
^{90}Sr Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
^{137}Cs Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
TRU Alpha Conc. (nCi/g)	1.20E+03	2.48E+02	1.15E+03	3.12E+01	2.71E-02	6.31E-02	1.00E+00
	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
^{232}U Activity (Ci)	0.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
^{237}Np Activity (Ci)	1.51E-05	4.73E-06	1.51E-05	4.10E-07	2.71E-02	3.00E-02	1.00E+00

Quantity of Interest	t	$Pr(x < \lvert t \rvert)$	x^2 Test	t Test
^{233}U Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable
^{234}U Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable
^{238}U Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable
^{238}Pu Activity (Ci)	1.11E+00	3.31E-01	Not Significant	Not Significant
^{239}Pu Activity (Ci)	1.11E+00	3.30E-01	Not Significant	Not Significant
^{240}Pu Activity (Ci)	1.11E+00	3.31E-01	Not Significant	Not Significant
^{242}Pu Activity (Ci)	1.11E+00	3.31E-01	Not Significant	Not Significant
^{241}Am Activity (Ci)	2.14E+00	9.87E-02	Not Significant	Not Significant
^{90}Sr Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable
^{137}Cs Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable
TRU Alpha Conc. (nCi/g)	1.37E+00	2.41E-01	Not Significant	Not Significant
	N/A	N/A	Not Applicable	Not Applicable
^{232}U Activity (Ci)	N/A	N/A	Not Applicable	Not Applicable
^{237}Np Activity (Ci)	5.52E-02	9.59E-01	Not Significant	Not Significant