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

OCT 21 2014

OFFICE OF
AIR AND RADIATION

Mr. J. R. Stroble
Manager, TRU Sites and Transportation Division
Carlsbad Field Office
U.S. Department of Energy
P.O. Box 3090
Carlsbad, NM 88221-3090

Dear Mr. Stroble:

On May 30, 2014 the U.S. Department of Energy (DOE), Carlsbad Field Office (CBFO) requested the U.S. Environmental Protection Agency's (EPA) approval of the Mobile *In Situ* Object Counting System (ISOCS) Large Container Counter-2 (MILCC2) unit. This is a non-destructive assay (NDA) system for quantifying radiological contents of contact-handled (CH) transuranic (TRU) waste containers used by the Central Characterization Program (CCP) at the Oak Ridge National Laboratory (ORNL). With this letter, EPA approves the MILCC2 to characterize waste at ORNL-CCP, subject to the limitations of its calibration and our report.

In the ORNL-CCP baseline inspection report (Docket No. A-98-49; II-A4-103), 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 MILCC2 for CH TRU waste as a Tier 1 change to the ORNL-CCP CH baseline approval.

EPA conducted an on-site evaluation of the ORNL-CCP MILCC2 on August 5-6, 2014. EPA's inspection of the MILCC2 included an examination of the procedures, a review of the calibration records, a demonstration of the MILCC2, replicate measurements run at EPA's request, and an examination of Batch Data Reports generated by the MILCC2. EPA's inspection report (Docket No. A-98-49; II-A4-192) for the MILCC2 is enclosed and will be placed in the Agency's public docket.

EPA has determined that the MILCC2 used by ORNL-CCP is adequate for the characterization of CH TRU waste in 55-gallon drums at ORNL-CCP. This approval makes two changes to the Tier 1 requirements and one change to the Tier 2 requirements for ORNL-CCP NDA systems. This change is noted in bold in Table 1 of the enclosed report. Changes to the approved components of the MILCC2 system at ORNL-CCP must follow the tiering requirements described in the updated tiering table contained in this report.

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

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EPA DOCKET NO. A-98-49; II-A4-192

WASTE CHARACTERIZATION REPORT

TIER 1 CHANGE EVALUATION: ADDITION OF THE MOBILE ISOCS LARGE CONTAINER COUNTER 2 FOR THE CENTRAL CHARACTERIZATION PROGRAM AT THE OAK RIDGE NATIONAL LABORATORY

August 5–6, 2014

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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ACRONYMS AND ABBREVIATIONS

AK	acceptable knowledge
AKE	acceptable knowledge expert
AKSR	AK summary report
Am	americium
ASTM	American Society for Testing and Materials
BDR	batch data report
BEGe	Broad Energy Germanium
CBFO	Carlsbad Field Office
CCP	Central Characterization Program
CFR	*Code of Federal Regulations*
CH	contact-handled
Ci	curie
CIS	characterization information summary
CMB	corrugated metal boxes
Cs	cesium
CTAC	CBFO Technical Assistance Contractor
DOE	U.S. Department of Energy
DWAS	Digital Waste Assay System
EA	Expert Analyst
EPA	U.S. Environmental Protection Agency
FRAM	Fixed-Energy Response-Function Analysis with Multiple Efficiencies
g	gram
g/cc	grams per cubic centimeter
in.	inch
IPAN	imaging passive active neutron
ISOCS	In Situ Object Counting System
ITR	Independent Technical Reviewer
IUE	ISOCS Uncertainty Estimator
keV	kilo-electron volt
ORNL	Los Alamos National Laboratory
LLD	lower limit of detection

LOQI	list of qualified individuals
MCNP	Monte Carlo N-Particle Transport Code
MCS	Mobile Characterization Services
MDA	minimum detectable activity
MDC	minimum detectable concentration
MeV	mega-electron volt
MGA	Multi-Group Analysis
MILCC2	Mobile ISOCS Large Container Counter-2
nCi/g	nanocuries per gram
NCR	nonconformance report
NDA	nondestructive assay
NDE	nondestructive evaluation
NFS	Nuclear Fuel Services
NIST	National Institute of Standards and Technology
Np	neptunium
NWP	Nuclear Waste Partnership, LLC
OA	operator aid
ORNL	Oak Ridge National Laboratory
PDP	Performance Demonstration Program
Pu	plutonium
QA	quality assurance
RDS	Radioassay Data Sheet
RTR	real-time radiography
SCG	Summary Category Group
SGS	segmented gamma scanner
SLB2	Standard Large Box-2
SNM	special nuclear material
SPM	Site Project Manager
Sr	strontium
SWB	Standard Waste Boxes
T1	Tier 1
T2	Tier 2
TMU	total measurement uncertainty

TRU	transuranic
TWPC	Transuranic Waste Processing Center
U	uranium
VE	visual examination
WG Pu	weapons grade plutonium
WIPP	Waste Isolation Pilot Plant
WSPF	waste stream profile form

1.0 INTRODUCTION

This report supports the U.S. Environmental Protection Agency's (EPA's) approval of a Tier 1 (T1) change to add a Mobile *In Situ* Object Counting System (ISOCS) Large Container Counter-2 (MILCC2) unit to the Central Characterization Program's (CCP's) approved waste characterization program at Oak Ridge National Laboratory (ORNL). In accordance with Title 40 of the Code of Federal Regulations (40 CFR) 194.8(b), EPA conducted a baseline inspection of CCP's waste characterization program for contact-handled (CH) transuranic (TRU) wastes at the U.S. Department of Energy's (DOE's) ORNL in Oak Ridge, TN, in 2008. As a result, EPA approved the ORNL-CCP CH TRU waste characterization program (see EPA Docket No. A-98-49, II-A4-103). On February 4–6, 2014, EPA conducted a continued compliance inspection of the ORNL-CCP waste characterization program and evaluated two T1 changes: modification of the MCS IQ3 NDA system and the addition of summary category group (SCG) S3000 (homogenous solid) waste to ORNL-CCP's approval (see EPA Docket Nos. A-98-49, II-A4-186 and A-98-49, II-A4-189). EPA's reviews and approvals of ORNL-CCP's CH waste characterization program are listed in Attachment A.

On May 30, 2014, the Carlsbad Field Office (CBFO) requested EPA approval of a T1 change to add the MILCC2 as a new nondestructive assay (NDA) system at ORNL. The MILCC2 will assay SCGs S3000 (homogenous solids), S4000 (soil and gravel) and S5000 (debris) waste in 55-gallon drums. On August 5–6, 2014, EPA conducted an on-site inspection to evaluate the MILCC2 NDA system. EPA also evaluated Visual Examination (VE) of CH TRU waste at that time, the results of the VE evaluation will be presented in a separate report.

EPA evaluated the proposed T1 change by reviewing ORNL-CCP documents and conducting an onsite evaluation of the MILCC2 at ORNL on August 5–6, 2014. During the evaluation, EPA and ORNL-CCP agreed that ORNL may relocate the MILCC2 on site or make other system changes (e.g., changing system components in a like-for-like replacement). Following such changes to the MILCC2, ORNL-CCP must verify that the EPA-approved calibration remains valid. If the EPA-approved calibration is successfully verified, ORNL-CCP may continue to operate the MILCC2 and notify EPA as a Tier 2 (T2) change. However, if the EPA-approved calibration cannot be verified, ORNL-CCP must recalibrate the MILCC2. EPA must approve the new calibration as a T1 change prior to shipment to WIPP of any containers that were characterized using the new calibration.

The MILCC2 may not be used to formally assay any containers other than 55-gallon drums [i.e., Standard Waste Boxes (SWBs) or Standard Large Box-2s (SLB2s)] at any distance or 55-gallon drums at distances other than the three measurement configurations discussed in this report. The addition of other container types or measurement configurations to the MILCC2 approval is a new T1 change.

EPA modified the ORNL-CCP CH tiering table (Table 1) to reflect the requirements described in the previous paragraph. Table 1 shows the substantive T1 and T2 changes in **bold** text. T1 and T2 changes that were initiated during the baseline and subsequent continued compliance inspections and T1 approvals remain in effect. The language in Table 1 regarding AK documentation applies to all ORNL-CCP waste streams.

Table 1. Tiering of Contact-Handled Transuranic Waste Characterization Processes Implemented by ORNL-CCP (Based on November 2007 Baseline Inspection and Subsequent Tier 1 Evaluation, Updated October 2014)

Process Elements	ORNL-CCP CH Waste Characterization Process – T1 Changes	ORNL-CCP CH Waste Characterization Process – T2 Changes*
Acceptable Knowledge, including Load Management	Any new waste category other than retrievably stored debris, soils/gravel and solids (i.e., any type of newly generated waste) Load management	Submission of a list of active ORNL-CCP CH AKEs and SPMs Notification to EPA upon completion of or substantive modification** to: • AK accuracy reports (annually, at a minimum) • AK-AK and AK-NDA/NDE Discrepancy Resolution Reports • WSPFs and related attachments (e.g., CIS) for all new or modified waste streams, including change notices • AKSRs (new and updated versions) • CCP-TP-005, Attachments 4, 6, 7 and 8 and/or associated memoranda, including "Add Container" memoranda • Site AK procedures requiring CBFO approval
Nondestructive Assay	New equipment or substantive physical modifications** to approved equipment Extension of or changes to approved calibration range for approved equipment **Activities that require system recalibration** **Addition of new measurement configurations or container types**	Submission of a list of ORNL-CCP NDA operators, EAs and ITRs that performed work during the previous quarter Notification to EPA upon substantive modification** to: • Software for approved equipment • Operating ranges upon CBFO approval • Site NDA procedures requiring CBFO approval **Notification to EPA upon successful calibration verification of MILCC2 following on-site relocation or other equipment changes**
Real-Time Radiography	None	Submission of a list of ORNL-CCP RTR operators and ITRs that performed work during the previous quarter Notification to EPA upon: • New equipment or substantive physical modifications** to approved equipment • Substantive modification** to site RTR procedures requiring CBFO approval
Visual Examination and Visual Examination Technique	Any use of visual examination	Submission of a list of ORNL-CCP VE operators, VE Experts and ITRs that performed work during the previous quarter
WIPP Waste Data System	Load management	Notification to EPA upon substantive modification** to site WDS procedures requiring CBFO approval

* ORNL-CCP will report all T2 changes to EPA every three months.

** "Substantive modification" refers to a change with the potential to affect ORNL-CCP's CH waste characterization processes or documentation of them, excluding changes that are solely related to the environment, safety and health; nuclear safety; or the Resource Conservation and Recovery Act, or that are editorial in nature or are required to address administrative concerns. EPA may request copies of new references that DOE adds during a document revision.

2.0 PURPOSE OF TIER 1 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 into the SRS-CCP baseline final report (see EPA Docket No. A-98-49, II-A4-103).

Under the changes to 40 CFR 194.8 promulgated in the July 16, 2004, Federal Register notice (Vol. 69, No. 136, pages 42571–42583), EPA must perform a single baseline inspection of a TRU waste generator site's waste characterization program. 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 WIPP.

Following EPA's baseline approval, EPA is 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 notification (T2) are identified in the site-specific baseline inspection reports and subsequent T1 evaluation reports. When evaluating proposed T1 changes for approval, EPA may conduct a site inspection to observe 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 any previously approved TRU waste using processes, procedures or equipment implemented as T2 changes at risk of subsequent EPA disapproval.

3.0 PURPOSE OF THIS REPORT

This report presents the results of EPA's evaluation of a T1 change to allow the use of the MILCC2 for assaying 55-gallon drums. This report documents the basis for EPA's approval decision and explains the results of the technical evaluation of the system, including any limitations. EPA's approval decision regarding the MILCC2 has been conveyed to DOE separately by letter. EPA will also announce the decision on its website at www.epa.gov/radiation/wipp, in accordance with 40 CFR 194.8(b)(3).

Documents provided by CBFO for this evaluation and listed in Section 6.2 of this report can be requested from CBFO at the following address:

U.S. Department of Energy
Carlsbad Field Office
TRU Sites and Transportation Division
P.O. Box 3090
Carlsbad, NM 88221-3090

4.0 SCOPE OF REVIEW

The scope of this review is limited to the addition of a new ORNL-CCP NDA system, the MILCC2. Use of the MILCC2 is limited to assaying 55-gallon drums containing SCG S3000,

S4000 and S5000 wastes. EPA evaluated this proposed change request in accordance with 40 CFR 194.8(b) to assess the technical adequacy, implementation and effectiveness of the technical processes implemented by ORNL-CCP for the MILCC2. As part of this review, EPA evaluated personnel qualifications and training, operating procedures, the physical configuration of the measurement system and replicate testing of the MILCC2 to assess the system's adequacy.

5.0 EVALUATION PERSONNEL

Table 2 lists all personnel involved in this T1 evaluation, along with their professional affiliations and T1 evaluation functions.

Table 2. Evaluation Personnel

Personnel Name	Affiliation	T1 Evaluation Function
Ed Feltcorn	EPA	EPA Evaluation Lead
Rose Gogliotti	SC&A/EPA	Technical Evaluator
Dorothy Gill	SC&A/EPA	Technical Evaluator
Tom Morgan	DOE/CBFO	CBFO Observer
Ed Gulbransen	NWP/CCP	CCP Management
Ron Reeves	NWP/CCP	Project Manager
Andrew Stallings	NWP/CCP	Vendor Project Manager
Berry Pace	CBFO/CTAC	CTAC Observer
Beverly Schrock	NWP/CCP	ORNL SPM
Ron Whitson	MCS/CCP	NDA Technical Lead
Kevin Meyer	Canberra Industries	NDA EA

6.0 TECHNICAL EVALUATION

EPA evaluated the MILCC2 NDA system on-site at ORNL on August 5–6, 2014. As part of the evaluation, EPA reviewed the following elements of the MILCC2 process:

- Capability of the measurement hardware and software to perform the required analyses.
- Technical adequacy of the NDA documents and procedures.
- Knowledge and understanding of the personnel involved in the NDA program.

Section 6.2 identifies the objective evidence that was examined for EPA's evaluation. During the evaluation, the EPA team members assessed technical elements of the MILCC2 system that are detailed in the checklist in Attachment B and discussed below. Upon evaluation, EPA concluded that Items 6.4 – 6.10 discussed below are implemented in a technically adequate manner.

6.1 System Description

The MILCC2 is operated by ORNL-CCP and is currently located in Building (trailer) 7880AC at the Transuranic Waste Processing Center (TWPC) at ORNL. This is a new NDA system and it consists of two ISOCS Broad Energy Germanium (BEGe) gamma detectors that are affixed to wheeled mobile carts and placed at fixed distances equidistant and on opposite sides of the container to be measured. During measurement, the container sits on a turntable that allows

continual rotation during measurement. The detectors are connected wirelessly to computers with the ISOCS user interface software.

The BEGe detectors are appropriate for the direct quantification of plutonium-238 (^{238}Pu), ^{239}Pu, ^{240}Pu, americium-241 (^{241}Am), uranium-233 (^{233}U), ^{235}U, ^{238}U, cesium-137 (^{137}Cs), neptunium-237 (^{237}Np) and other gamma-emitting radionuclides. The MILCC2 is capable of assaying materials with densities from 0 to 2.5 grams per cubic centimeter (g/cc), which includes debris, soils, gravel and homogeneous solids matrices. There are three acceptable assay configurations for 55-gallon drums on the MILCC2, the Near-, Mid- and Far-Field positions, discussed in Section 6.4, below. The actual drum-to-detector distance is measured for each item assayed as described below, as shown in Figure 1, below.

Unlike most other CH NDA systems used around the DOE complex, the MILCC2 system is designed to be a mobile system. ORNL-CCP conveyed to EPA that they intend to use the system only in its current location in the near term; however, it is possible the system may be relocated in the future. Currently the turntable used on the instrument is bolted to the floor of Building 7880AC.

6.2 Documents Reviewed

EPA evaluated the following documents to support the approval of the addition of the MILCC2:

- CI-MILCC2-NDA-1001, "Mobile ISOCS Large Container Counter Calibration Report," Revision 0, March 10, 2014
- CI-MILCC2-NDA-1002, Canberra Factory Document, "Oak Ridge MILC Counter Total Measurement Uncertainty Report," Revision 0, March 13, 2014
- Canberra Factory Document, "Canberra Services Group ISOCS Measurement and Analysis Procedure," Revision A, August 13, 2009
- ISOCS Detector QA Measurement Check and Detector Specification and Performance Data, detector BE8879, December 6, 2013
- ISOCS Detector QA Measurement Check and Detector Specification and Performance Data, detector BE8903, December 6, 2013
- MILCC2 BDR Nos. OR-MILCC2-0002, OR-MILCC2-0028, OR-MILCC2-0029, OR-MILCC2-0034, OR-MILCC2-0002 and OR-MILCC2-0011 (55-gallon drums)
- CI-MILCC2-NDA-1004, " Calibration Verification Report for the MCS MILCC2," April 15, 2014
- CCP-Oak Ridge National Laboratories List of Qualified Individuals, July 9, 2014 and July 24, 2014
- ORNL MILCC2 NDA Qualification Cards for Susan Anderson, Bob Ceo, Dan Crosby, Chad Gerlock, Kevin Meyen, Maria Steade, and Ron Whitson
- Operator Aids: OA-ORNL-0135, Revision 0, OA-ORNL-0134-14 Revision 0 and OA-ORNL-0123-11, Revision 1

- Standing Orders: CCP-SO-ORNL-014, Revision 7; and CCP-SO-112, Revision 0
- Logbooks CCP-ORNL-NDA-MILCC-001 (entries dated April 7- 18, 2014) and CCP-ORNL-NDA-MILCC-002 (August 5, 2014)
- CCP-TP-076, CCP Operating the Mobile ISOCS Large Container Counter Using NDA 2000, Revision 1, March 25, 2014
- CCP-TP-077, CCP Calibrating the Mobile ISOCS Large Container Counter Using NDA 2000, Revision 1, April 1, 2014
- CCP-TP-048, CCP ORNL NDA System Data Reviewing, Validating, and Reporting Procedure, Revision 16, November 1, 2013

6.3 Evaluation Checklist

Based on EPA's review of the ORNL-CCP documents listed above, EPA prepared a revised checklist for this evaluation that addressed the relevant aspects of the proposed change to the measurement configuration. The checklist is included as Attachment B to this report.

6.4 Measurement Geometries

ORNL-CCP will use the MILCC2 to characterize TRU waste in 55-gallon drums with the detectors placed in three fixed distances. These positions include:

- Near-Field position with 180° collimator, detectors located approximately 17 inches (in.) from drum
- Mid-Field position with 180° collimator, detectors located approximately 69 in. from drum
- Far-Field position with 90° collimator, detectors located approximately 115 in. from drum

The placement of the detectors is illustrated in Figure 1, below. The Near-Field position is intended to maximize gamma detection efficiency for low-activity containers. The Mid-Field and Far-Field positions accommodate the measurement of higher activity drums to reduce system dead-time[1]. An operator aide (OA-ORNL-0134-14, Revision 0) is posted in the Control Room of the instrument indicating the allowed detector distances and their collimation. There are lines on the floor of Building 7880AC to guide operators regarding approximate locations of detectors; however, laser distance measurements are taken to confirm the distance and assign detectors for every measurement, as described below.

Containers are moved from storage to the instrument by forklift. The forklift operator places the drum to be measured on a turntable that is bolted to the floor of Building 7880AC. The operator then positions the detectors for assay. All drum-to-detector distances are measured prior to assay using a tape measure or a laser, both of which are stored in the operational area. The laser is held

[1]"Dead time" is the time during which a detector cannot record a new photon because it is busy recording a previous photon, i.e., the detector is idle or dead. The number of photons that are not counted are called "dead-time losses" and can be considerable for drums with high concentrations of photon emitting radionuclides.

in-line with the detector face to ensure the detector is aligned correctly with the midline of the drum's height. The detector height on the cart is fixed and is subject to minor height fluctuations caused from the extent of inflation of the cart's tires. The detector aligns with the center height of the 55-gallon drum. The detector height and fluctuations are incorporated in the modeling of the ISOCS geometry and calibration uncertainty.

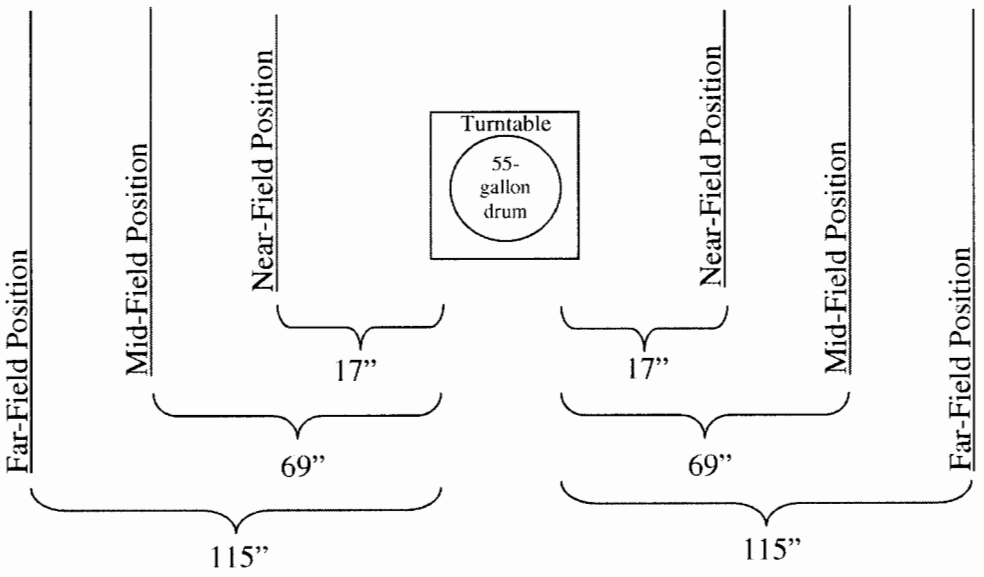

Figure 1. 55-Gallon Drum Measurement Configurations

ORNL-CCP indicated that 55-gallon drums would initially be informally assayed with one detector at the Near-Field position and one at the Far-Field position to determine if the dead time was too great at either location. If the dead-time is appropriate at the Near-Field position, the other detector will be moved to the Near-Field position and the assay will be performed at that position. If the dead-time is excessive at the Near-Field position but appropriate at the Mid-Field position, both detectors will be moved to the Mid-Field position and the assay will be performed at that position. If the dead-time is excessive at both the Near- and Mid-Field positions, both detectors will be moved to the Far-Field position and the assay will be performed at that position. If an acceptable assay cannot be obtained at any one of the three positions using routine counting times, NDA personnel may elect to increase the counting time. There were no concerns regarding the technical adequacy and determination of the measurement configurations for the MILCC2.

The MILCC2 may not be used to formally assay any containers other than 55-gallon drums (i.e., SWBs or SLB2s) at any distance or 55-gallon drums at distances other than the three measurement configurations discussed above and shown in Figure 1, above. The addition of other container types or measurement configurations to the MILCC2 approval is a T1 change requiring prior EPA approval.

6.5 Calibration, Calibration Validation and Confirmation

The MILCC2's calibration of record is documented in CI-MILCC2-NDA-1001, Revision 0. The calibration of record does not contain all relevant information because the two BEGe detectors were ISOCS characterized at Canberra in Meriden, CT, as discussed in detail in section 6.5.3, below.

6.5.1 Gamma Ray Peak Shape and Energy Calibrations

In January 2014, the gamma ray peak shape and energy calibrations for both detectors were performed. The spectral gain was set at approximately 0.90 kilo-electron volt (keV)/channel with an offset of approximately 0.0 keV. The results of the gamma energy and peak shape calibrations are shown in Appendix 3 of the Calibration Report. EPA reviewed this documentation and found it to be technically adequate. There were no concerns regarding the technical adequacy and documentation of these calibrations for the MILCC2.

6.5.2 Reference Peak Calibration

No reference peak calibration was needed for the calibration of the MILCC2 because this system does not use a pulser. Instead, a digital amplifier has an algorithm that serves the same function of the reference peak calibration. EPA reviewed and found it to be technically adequate.

6.5.3 Efficiency Calibration/Detector Characterization

The MILCC2 uses two ISOCS model BE5030 planar BEGe detectors, each with an area of 5,000 square millimeters. Canberra performed an ISOCS-generated multi-curve efficiency calibration of each detector at their Meriden, CT, location. Appendix 9.0 of the Calibration Report documents the parameters used to generate the multi-curve efficiency calibrations. Calibration efficiency charts spanning nine densities are depicted in Figures 1–3 of the Calibration Report.

Both detectors were ISOCS characterized by their manufacturer Canberra. EPA has previously evaluated the technical aspects of this process through technical discussions with Canberra personnel at the Meriden, CT, facility. Although the exact method Canberra uses to characterize detectors is proprietary, it was described to EPA with sufficient detail to support its use in characterizing gamma detectors for assaying WIPP-bound waste. It involves the development and validation of an MCNP model for each detector, which includes generating efficiency data sets to predict a detector's response to point-like sources at many locations. A detector characterization file that contains the relationship of the detector to the point-efficiency data and the validation of the resulting characterization file is generated, and this file is then used by the ISOCS user interface software. EPA reviewed both Canberra detector characterization reports and found them to adequately document the characterization of the detectors.[2]

Detector No. 01 is currently located on the south side of the instrument trailer and has serial number (SN) 8903. It was originally characterized by Canberra in Meriden, CT, in November 2013, as listed on the detector. Detector No. 02 is currently located on the north side of the

[2] As a result of this characterization, the BEGe detectors are described as "ISOCS-characterized detectors."

instrument trailer and has a SN 8879. It was originally characterized by Canberra in Meriden, CT, in July 2013, as listed on the detector. Upon receipt of each detector from Canberra, ORNL-CCP performed a calibration validation to confirm that the calibration was still technically adequate. There were no concerns regarding the efficiency calibration and detector characterization for the MILCC2.

6.5.4 Calibration Verification

ORNL-CCP performed a calibration verification of the MILCC2 using PDP drums containing combustibles, sludge and metals matrices and an ORNL foam matrix 55-gallon drum. Three assays were done on each container using National Institute of Standards and Technology (NIST) traceable mixed-gamma line sources to verify the calibration. These sources and their placement in the 55-gallon drum are discussed in the Calibration Report. Using the four matrix drums with varying different densities, the multi-curve efficiency calibration was verified, as detailed in the Calibration Report. The accuracy and precision of the calibration verification data were in compliance with the limits in DOE/WIPP-02-3122[3], Appendix A, Table A-2, and EPA determined that the results of the calibration verification indicated that the MILCC2 is operating within the acceptable limits. There were no concerns regarding the calibration verification for the MILCC2.

6.5.5 Calibration Confirmation

The gamma calibration was confirmed by measuring Pu sources in a 55-gallon drum. The drum was measured six times at the Near-Field, Mid-Field and Far-Field detector positions with total Pu mass loadings of approximately 0.975 grams (g), 31.5 g, and 175 g. Sources in each mass loading are summarized in the Calibration Report. Measured isotopic fractions were used if they were available; otherwise, declared or certificate isotopics are used. The confirmation measurements listed in the Calibration Report show that the percent recovery and precision of each of the six replicate measurements met the criteria in DOE/WIPP-02-3122, Appendix A, Table A-2. There were no concerns regarding the calibration confirmation for the MILCC2.

6.6 Operating Range

The operating range for the MILCC2 is limited by density, spectral parameters, dead time and lower limit of detection (LLD). The MILCC2 may assay wastes with densities ranging from 0.001–2.50 g/cc. This includes and exceeds the density ranges ORNL-CCP expects to encounter in the population of S3000, S4000 and S5000 waste containers the MILCC2 will assay. Although not a formal operating range, ORNL-CCP stated that the expected operating range of the MILCC2 is a total Pu mass from the LLD to 325 g. There were no concerns regarding the determination and documentation of the operating range for the MILCC2.

6.7 Lower Limit of Detection Determination

Instruments performing TRU/Non-TRU waste discrimination must have a minimum detectable concentration (MDC) of less than 100 nanocuries per gram (nCi/g) of TRU radionuclides.

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[3] U.S. DOE CBFO, "Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant," DOE/WIPP-02-3122, Revision 7.4, Carlsbad, New Mexico, April 22, 2013.

Minimum detectable activities (MDAs) are variable and depend on measurement conditions such as background rate and matrix. To establish an MDA typical of a MILCC2 assay, ORNL-CCP performed three replicate measurements on a surrogate matrix 55-gallon drum with no radioactive sources at the Near-, Mid- and Far-Field positions. The NDA 2000 software calculated MDAs from these measurements by applying weapons-grade Pu (WG Pu) isotopic, and the calculated MDAs were used to derive MDCs, as shown in Tables 8a-8cd of the Calibration Report. All WIPP-tracked radionuclides were found to have an MDA below 100 nCi/g in a typical waste assay in the Near-Field position. At the Mid- and Far-Field positions, the total MDCs were found to be above 100 nCi/g in a typical waste assay. This was discussed with ORNL-CCP NDA personnel who stated that this is unlikely to be a problem because the default assay position for a drum is the Near-Field position, for which the MDA was acceptable. Only if the dead-time is excessive for the Near-Field position is a drum assayed with detectors in the Mid- or Far-Field positions. The drum would only be assayed at the Mid- and Far-Field positions if the dead-time was excessive at the Near-Field position, a condition that indicates the container's activity would exceed the MDC. EPA agreed with ORNL-CCP's explanation.

Because the LLD is a measurement-based parameter, ORNL-CCP personnel stated that it is not technically feasible to calculate for radionuclides that are not directly measured, i.e., ^{242}Pu, ^{234}U and strontium-90 (^{90}Sr). There were no concerns regarding the determination and documentation of the LLD for the MILCC2.

6.8 Total Measurement Uncertainty

Total measurement uncertainty (TMU) for the MILCC2 is documented in "Oak Ridge MILC Counter Total Measurement Uncertainty Report," Revision 0, dated February 3, 2014. The TMU determination was performed with the ISOCS Uncertainty Estimator (IUE), a software tool that generates models associated with errors caused by the evaluation of these parameters. The primary components of uncertainty include:

- Calibration source.
- ISOCS model.
- Detector positioning.
- Matrix in homogeneity.
- Non-uniform source distribution.
- Fill-height.
- Self-attenuation of special nuclear material (SNM) "lumps."
- Counting statistics.
- Background fluctuations.
- Radionuclide interferences.
- Isotopic measurement uncertainty.

Other potential sources of uncertainty are expected to be small. The uncertainty for each of the quantifiable uncertainty sources is assumed to be statistically independent and is added in quadrature to derive the TMU, as documented in the TMU report. EPA discussed the evaluation of TMU with ORNL-CCP and found it to be technically appropriate. There were no concerns regarding the determination and documentation of TMU for the MILCC2.

6.9 Batch Data Reports

At the time of EPA's evaluation, 574 drums (excluding 24 PDP drums) had been assayed on the MILCC2 since the instrument became operational on April 16, 2014. The assays were documented in 63 batch data reports (BDRs). ORNL-CCP indicated that as many as 20 drums can be assayed on a given day; however, the system averages between 9 and 10 assays per day. ORNL-CCP provided EPA with MILCC2 BDRs Nos. OR-MILCC2-0001 through OR-MILCC2-0035. The EPA reviewed BDR Nos. OR-MILCC2-0002, OR-MILCC2-0028, OR-MILCC2-0029, OR-MILCC2-0034, OR-MILCC2-0002 and OR-MILCC2-0011. EPA verified that each BDR included the following:

- Site Project Manager (SPM) Checklist, CCP-TP-001, Revision 21, Attachment 3.
- BDR Cover Sheet, CCP-TP-048, Revision 16, Attachment 4.
- BDR Table of Contents, CCP-TP-048, Revision 16, Attachment 2.
- NDA Batch Report Narrative Summary, CCP-TP-048, Revision 16, Attachment 5.
- Independent Technical Reviewer (ITR) Review Checklist, CCP-TP-048 Revision 16, Attachment 3.
- Assay Report for each container listed on Attachment 1.
- Radioassay Data Sheet (RDS) for each container listed on Attachment 1.
- Automated ITR for each container listed on Attachment 1.
- Genie Quality Assurance Reports.
- CCP Records Transmittal/Receiving Form, CCP-QP-008 Rev. 22, Attachment 2.
- Evidence of signatures by the ITR on Attachment 1, an SPM on Attachment 3 and an EA on the Automated ITR report for each container listed on Attachment 1.
- Correct revisions of CCP-TP-001[4] and CCP-TP-048.

The MILCC2 reports direct quantitative values and uncertainties for ^{238}Pu, ^{239}Pu, ^{241}Am, ^{233}U, ^{235}U, ^{238}U, ^{137}Cs, and ^{237}Np. Values for ^{90}Sr, ^{234}U, and ^{242}Pu are obtained through the application of scaling factors. The Pu isotopic ratios are determined using the Multi-Group Analysis (MGA) or Fixed-Energy Response-Function Analysis with Multiple-Efficiencies (FRAM) Software, or are based on site-approved acceptable knowledge (AK). Each assayed container contained TRU radionuclides at concentrations greater than 100 nCi/g. There were no concerns regarding the technical adequacy of the radionuclide documentation in NDA BDRs for the MILCC.

6.10 Replicate Assays

The purpose of replicate testing is to provide EPA with an independent means to verify that the MILCC2 can provide reproducible results for determination of the 10 WIPP-tracked radionuclides (^{241}Am, ^{137}Cs, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{90}Sr, ^{233}U, ^{234}U and ^{238}U) and the TRU

[4] CCP-TP-001, CCP Project Level Data Validation and Verification, Revision 20, September 27, 2012.

alpha concentration.[5] This is accomplished by the MILCC2 reassaying containers it previously measured to demonstrate the system's ability to:

- 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.
- Provide reproducible results over longer periods of time by comparing the results of the replicate measurements to the original reported values.

As part of this evaluation, EPA requested that ORNL-CCP reassay three 55-gallon drums. EPA randomly selected these containers from a list of all containers previously assayed on the MILCC2 that were accessible. EPA selected Drum No. X10CSATN02626B for the Near-Field position, Drum No. X10CSATN02023P for the Mid-Field position and Drum No. X10CSATN01937AG for the Far-Field position. All three drums were reassayed five times and the results were compared to the original assay data. EPA Inspectors witnessed the assay of Drum No. X10CSATN02023P on the first of five assays.

Two statistical tests, a chi-squared (χ^2) test and a *t-test*, were performed. Data and results of the statistical analyses are included in Attachments C.1 and C.2 of this report. The χ^2 test (also known as the goodness-of-fit test or the chi-squared test for independence) is used to show how observed data compare with what we would expect to obtain according to a specific hypothesis. It is applied in this instance to assess the difference between the replicate and original measurements. The *t-test* is used to tell if two sets of data are statistically different. It is applied in this instance to determine if there is a statistically significant difference between the original assay values and the average of the five replicate measurements.

For Container Nos. X10CSATN02626B and X10CSATN02023P, the χ^2 test 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 Drum Nos. X10CSATN02626B, X10CSATN02023P, and X10CSATN01937AG showed no statistically significant differences between the original assay values and the average of the five replicate measurements.

For Drum No. X10CSATN01937AG , the *t-test* showed *Highly Significant* statistical differences between the original assay values and the average of the five replicate measurements for ^{237}Np. It is important to keep this in mind when evaluating replicate data and to realize that *Significant* or *Highly Significant* results are not always representative of true measurement issues.

There are several possible reasons for the *Highly Significant* differences in ^{237}Np replicate values versus original values: actual changes in the physical configuration of the drum's contents due to movement or settling; fluctuations in the measurement system's background; temporal factors such as radioactive growth or decay; or, actual changes in the measurement system, the aspect that these tests are designed to query. Although the software identified these variances as *Highly Significant*, this does not necessarily indicate a measurement issue that warrants additional

[5] Revision 2 of the EPA Replicate Testing Protocol provides the details of the replicate testing assay protocol and data evaluation.

attention at this time. Further investigation into the results showed that the statistical flag was caused by the original measurement reporting a very small value for ^{237}Np of 1.52E-05 Ci. In comparison, two of the replicate values were reported as less than the LLD and entered into the replicate worksheet as zeroes. The two zero values drove the average of the five replicates to be calculated at a much lower value (9.86E-06 Ci) and resulted in the subsequent calculation of a relatively large standard deviation for the population of the five replicate measurements. This caused a failure of the statistical test and resulted in a *Highly Significant* flag. The three positive replicate results showed an average activity of 1.64E-05 Ci, which is in good agreement with the original result, differing by only 8% from the original measurement.

7.0 FINDINGS AND CONCERNS

There were no findings or concerns regarding the use of the MILCC2 by ORNL-CCP.

8.0 CONCLUSIONS

Changes to Tiering

During the evaluation, EPA and ORNL-CCP agreed that ORNL may relocate the MILCC2 on site or make other system changes (e.g., changing system components in a like-for-like replacement). Following such changes to the MILCC2, ORNL-CCP must verify that the EPA-approved calibration remains valid. If the EPA-approved calibration is successfully verified, ORNL-CCP may continue to operate the MILCC2 and notify EPA as a T2 change. However, if the EPA-approved calibration cannot be verified, ORNL-CCP must recalibrate the MILCC2. EPA must approve the new calibration as a T1 change prior to shipment to WIPP of any containers that were characterized using the new calibration.

The MILCC2 may not be used to formally assay any containers other than 55-gallon drums (i.e., SWBs or SLB2s) at any distance or 55-gallon drums at distances other than the three measurement configurations discussed in this report. The addition of other container types or measurement configurations to the MILCC2 approval is a new T1 change.

Table 1 shows the T1 and T2 changes based on this evaluation in bold text. T1 and T2 changes that were initiated during the baseline and subsequent continued compliance inspections and T1 approvals remain in effect. The language in Table 1 regarding AK documentation applies to all ORNL-CCP waste streams.

Approval

During this T1 evaluation, EPA evaluated the ORNL-CCP MILCC2. EPA did not identify any concerns or findings and based on the results of this evaluation, EPA is approving the ORNL-CCP MILCC2 NDA system for assaying 55-gallon drums in the three configurations described in this report.

ORNL-CCP may make changes to the MILCC2 (e.g., changing system components in a like-for-like replacement, or relocating the system to another area at ORNL) followed by verification of the EPA-approved calibration. The tiering requirements for these changes are described above and in Table 1.

ATTACHMENT A

APPROVAL SUMMARY FOR ORNL-CCP CONTACT-HANDLED WASTE CHARACTERIZATION PROGRAM

Approved Activity	EPA Inspection Number, Approval Dates	EPA Docket Number
ORNL-CCP CH Baseline Approval	EPA-ORNL-CCP-CH-11.07-8, August 21, 2008	A-98-49, II-A4-103
T1 Change – Extension of the Calibration and Density Ranges for the SGS NDA System	October 8, 2008	A-98-49; II-A4-108
T1 Change – Extension of the Passive Mode Calibration Range for the DWAS/IPAN SGS	January 8, 2009	A-98-49, II-A4-109
T1 Change – Addition of SCG S4000	October 7, 2009	A-98-49, II-A4-117
Unannounced Continued Compliance Inspection	November 23, 2009	A-98-49, II-A4-121
T1 Change – Addition of the MCS IQ3 NDA System and Visual Examination	March 30, 2010	A-98-49, II-A4-125
T1 Change – Addition of NFS Trench B Soils to Waste Stream OR-NFS-CH-SOIL	March 23, 2011	A-98-49; II-A4-144
Continued Compliance Inspection and T1 Change for Modifications to the IQ3 NDA System	June 18, 2014	A-98-49, II-A4-186
T1 Change – Addition of SCG S3000	July 9, 2014	A-98-49, II-A4-189

ATTACHMENT B

MOBILE ISOCS LARGE CONTAINER COUNTER-2 EVALUATION CHECKLIST

Technical Elements	Objective Evidence	Additional Comments
General		
Confirm the NDA system is the MILCC2, its location and number.	The instrument is located in Building (trailer) 7880AC at the Transuranic Waste Processing Center in Oak Ridge. MILCC2 stands for Mobile ISOCS Large Container Counter-2, and is also referred to as the Oak Ridge MILC Counter in the TMU documentation.	This was confirmed with NDA personnel during evaluation. EPA inspectors visually confirmed the instrument's location.
Describe the MILCC2.	The detectors are BEGe detectors, i.e., planar detectors that provide excellent response and energy resolution from 45 keV to 3 MeV. The detectors are identified as Nos. 8903 (detector 1) and 8879 (detector 2), and were ISOCS characterized in 2013. Both detectors are chilled by liquid nitrogen to protect the germanium crystals. The two MILCC2 detectors are placed equidistant from and on opposite sides of the container to be assayed. Three distances are fixed for a 55-gallon drum, the selection of which is determined by the dead time of the detector. The closest position (Near-Field, 17 in. drum-to-detector) accommodates containers with low dead times, uses a 180° collimator with typical assay time of 15 minutes The middle position (Mid-Field, 69 in. drum-to-detector) accommodates containers with midrange dead times, uses 180° collimator with typical assay time of 15 minutes The farther position (Far-Field, 115 in. drum-to-detector), accommodates containers with high dead times, uses a 90° collimator with typical assay time of 30 minutes.	This was confirmed with NDA personnel during evaluation.
Identify the consensus standards that were used for the system calibration.	ORNL-CCP used consensus standards ASTM C-1030, C-1133, C-1207 and C-1500 for the MILCC2 calibration.	CI-MILCC2-NDA-1001, confirmed with NDA personnel during evaluation.
Identify the container and wastes types assayed on the MILC'C2.	The MILCC2 is capable of assaying debris, soils and gravel, and homogeneous solid wastes in 55-gallon drums.	The MILCC2 is limited by waste density and dead time, calibrated to assay wastes with densities of 0-2.50 g/cc. All ORNL TRU waste is expected to fall in this range.

Technical Elements	Objective Evidence	Additional Comments
Identify the period of performance relevant to the MILCC2 and the number of BDRs and waste containers this system assayed during the period.	The MILCC2 is a new system with a limited performance history. The system became operational on April 16, 2014, and ORNL-CCP has been assaying drums at risk.	Including the containers initially assayed at risk, the MILCC2 has assayed ~ 574 containers (excluding 24 PDP drums) which are contained in 64 BDRs. Not all BDRs have been finalized at the time of inspection
Confirm that the MILCC2 is able to report quantitative values for the WIPP-tracked radionuclides.	Direct Measurements: ^{238}Pu, ^{239}Pu, ^{241}Am, ^{233}U, ^{235}U, ^{238}U, ^{137}Cs and ^{237}Np. Radionuclides by Scaling: ^{90}Sr, ^{234}U and ^{242}Pu. Pu and other TRU isotopic ratios are determined using the MGA or FRAM software, or AK.	This was confirmed with NDA personnel during evaluation.
Confirm the MILCC2's calibration of record.	The calibration is documented in CI-MILCC2-NDA-1001, Revision 0. Each detector factory characterization report was provided to EPA reviewers.	This was confirmed with NDA personnel during evaluation.
Identify the procedures that govern this function and where the results of these calculations are documented.	CCP-TP-076, Operating Procedure (Revision 1, 3/2014) CCP-TP-077, Calibration Procedure (Revision 1, 4/2014) CCP-TP-048, Data Review Procedure (Revision 16, 11/2013)	These were confirmed with NDA personnel. Copies of the current operating and calibration procedures were available in the control room to operators.
Confirm the methods used to derive the isotopic contribution for unmeasured radionuclides.	^{241}Am and Pu isotopics determined by MGA or FRAM software when enough mass exists.	This was confirmed with NDA personnel during evaluation.
Calibration Verification and Confirmation		
Confirm the pedigree of all radionuclide standards that were used for calibration confirmation and/or verifications. List or reference all standards used.	Sources are summarized in Table 6.1 of CI-MILCC2-NDA-1001, Revision 0, with source certificates in Attachment 1.	EPA reviewed all source certificates found in Appendix 2; All standards are independently certified and acceptable for the MILCC2 calibration.
Confirm the MILCC2 operational range with respect to matrix (density) and activity.	Acceptable density range for gamma is approximately 0.001–2.50 g/cc; activity is limited by spectral parameters (peak shape and resolution) and system dead time.	This was confirmed with NDA personnel during evaluation.

Technical Elements	Objective Evidence	Additional Comments
Identify the date of the last calibration verification. Have any others been completed in the last year?	One calibration verification was performed on the system other than the initial verifications performed on site when detectors were received, documented in CI-MILCC2-NDA-1004. Following the initial calibration confirmation, ORNL-CCP observed intermittent instabilities in the 1274.5 keV peak for Detector 1. To stabilize the detector, the preamp, pre-amp cables and electrical power strip were replaced, Additionally, cables for Detector 2 were replaced and a calibration verification found the changes in improvements had no adverse impacts on the operation of the instrument.	This was confirmed and discussed with NDA personnel during evaluation.
Requirements for accuracy and precision must be met, as specified in DOE/WIPP-02-3122, Appendix A, Table A-2 for calibration verifications.	The calibration confirmation documented in the MILCC2 report indicate that the %R was between 70-130 % and % RSD was less than 14% for six replicates, as required.	This was confirmed with NDA personnel during the EPA evaluation.
LLD		
Confirm that the LLD for the MILCC2 has been determined.	Typical MDAs are determined by performing three replicate assays of each container type and detector position with matrix containers without radioactive sources. MDAs are averaged and converted to MDCs using matrix weight. The MDAs documented in CI-MILCC2-NDA-1001 indicate that the instrument meets the TRU discrimination criterion of 100 nCi/g only for the Near-Field configuration. It is expected that all low-activity containers will be run at the Near-Field position. TRU determinations at the Mid- and Far-Field positions may not be possible for drums with low activity.	MDAs are variable and depend on measurement conditions such as background rate and matrix type. ORNL-CCP provided example MDAs and MDCs for a metals, combustibles and sludge on 55-gallon drum in all three positions.
Confirm if the MILCC2 is used to discriminate TRU/Non-TRU wastes at the 100 nCi/g criterion and that it has the required sensitivity.	See previous entry.	This was confirmed with NDA personnel during the EPA evaluation.
Identify any/all instances where an LLD value for a *non-measured* radionuclide is not provided based on a lack of technical feasibility.	Reporting thresholds are not discussed in the Calibration Report. This information is now reported in NDA memoranda.	This was discussed with NDA personnel during the EPA evaluation. Because the LLD is a measurement-based parameter, ORNL-CCP personnel stated that it is not technically feasible to calculate for radionuclides that are not directly measured, i.e., ^{242}Pu, ^{234}U and ^{90}Sr.

Technical Elements	Objective Evidence	Additional Comments
Quality Control		
All Operators have current CCP training as verified on LOQI.	A July 9, 2014 and July 24, 2014, LOQI was provided to EPA reviewers. Five NDA operators were listed on the LOQI, all with current training requirements met. The LOQI lists two; typically, EAs are not NDA-approved operators.	EPA confirmed the qualifications of each operator on their respective qualification cards.
Confirm the MILCC2's status with respect to the CBFO NDA PDP and last cycle.	The MILCC2 successfully participated in the PDP Drum Cycle 21A.This cycle tested 4 drum matrices and three alpha activity ranges.	ORNL-CCP provided EPA with a copy of the approval letter dated June 25, 2014.
All MILCC2 data must be reviewed and approved by qualified personnel. Identify the name and function of the individuals performing technical review and approval of MILCC2 BDRs.	Data review in the BDRs obtained by EPA was performed by: Ron Whitson, ITR Daniel Wade, SPM Susan Anderson, NDA Operator Chad Gerlock, QA Engineer, ITR Beverly Schrock, SPM	EPA reviewed Qualification Cards for all personnel listed.
Identify any NCRs within the last year.	There were no systems NCRs. There have been several assay NCRs; however, this is expected on the MILCC2 because all MILCC2 assays are first done in the Near-Field position and any container that requires reassay at the Mid-Field or Far-Field positions requires an NCR prior to reassay.	This was discussed with ORNL-CCP NDA personnel. If a sufficient assay cannot be obtained using a 30-minute count time, ORNL-CCP may consider a longer assay.

Technical Elements	Objective Evidence	Additional Comments
TMU		
Evaluate the magnitude of the TMU values observed in the MILCC2 BDRs that were examined during this evaluation.	This system is effectively equivalent to the MILC counter at LANL. Therefore the TMU document borrows heavily from the LANL TMU document. TMU for the MILCC is documented in "Total Measurement Uncertainty for the MCS/LANL ISOCS 'Box Counter'," Revision 2, March 27, 2013. The TMU for the MILCC2 is documented in "Oak Ridge MILC Counter Total Measurement Uncertainty Report'," Revision 2, March 13, 2014. The components of uncertainty included in the TMU determination consist of calibration source uncertainties, ISOCS Model uncertainties, detector positioning, matrix in homogeneity, non-uniform source distribution, fill-height uncertainty, self-attenuation of SNM "lumps", counting statistics, background fluctuations, radionuclide interferences and isotopic measurement uncertainty. The ISOCS Uncertainty estimator is used to calculate TMU. This is a companion program to the MILCC2 system.	EPA evaluated the BDRs provided. TMU was within the expected range in all instances.
Background and Performance Checks		
Confirm that MILCC2 background measurements have been taken daily.	Background measurements are required in CCP-TP-076, Operating Procedure (Revision 1, 3/2014). Evidence of daily background measurements was seen in the logbook pages reviewed.	EPA reviewed logbook entries including detailed reviews of entries from August 5, 2014 and April 7-18, 2014. All entries showed that background measurements were made and acceptable.
Assess how often background radiation was problematic to the extent that measurement personnel had to make adjustments.	This has not been an issue for the MILCC2.	This was discussed with ORNL-CCP NDA personnel who indicated background is low relative to surrounding ORNL areas.
Confirm that system performance checks have been performed at least once per operational day. Confirm that performance checks include gamma matrix correction checks, and gamma peak position and resolution checks.	Performance measurements are required in CCP-TP-076, Operating Procedure (Revision 0, 5/2013). Evidence of daily performance checks was seen in the logbook pages reviewed.	EPA reviewed logbook entries including detailed reviews of entries from August 5, 2014 and April 7-18, 2014. All entries showed that performance check measurements were made and acceptable.

Technical Elements	Objective Evidence	Additional Comments
MILCC2 BDRs contain • Testing facility name, testing batch number, container numbers, and signature of the SPM or designee. • Table of Contents. • Background and performance check data or control charts for the relevant time period. • Separate testing report sheets for each container.	EPA reviewed MILCC2 BDR Nos. OR-MILCC2-0002, OR-MILCC2-0028, OR-MILCC2-0029, OR-MILCC2-0034, OR-MILCC2-0002, OR-MILCC2-0011. The BDRs contained all required information.	NA
MILCC2 RDSs must include: • Title "Radioassay Data Sheet." • Method/procedure used. • Date of radioassay. • Activities and associated TMU for individual radionuclides. • TRU alpha concentration and its associated TMU. • Operator and reviewer signatures.	EPA reviewed MILCC2 BDR Nos. OR-MILCC2-0002, OR-MILCC2-0028, OR-MILCC2-0029, OR-MILCC2-0034, OR-MILCC2-0002, OR-MILCC2-0011. The RDSs contained all required information.	NA

ATTACHMENT C.1. MILCC2 REPLICATE TESTING RESULTS FOR CONTAINER No. X10CSATN02626B, Near-Field Position

Instrument: MILCC2
Drum: X10CSATN02626B

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
^{90}Sr Activity (Ci)	2.43E-02	1.52E-04	0.6%	2.40E-02	1.51E-04	0.6%	2.40E-02	1.51E-04	0.6%
^{137}Cs Activity (Ci)	1.41E-03	8.83E-06	0.6%	1.39E-03	8.74E-06	0.6%	1.39E-03	8.73E-06	0.6%
^{233}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{234}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{235}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{237}Np Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{238}Pu Activity (Ci)	1.90E-03	2.94E-04	15.5%	1.96E-03	4.98E-04	25.4%	1.75E-03	2.73E-04	15.6%
^{238}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{239}Pu Activity (Ci)	1.95E-02	1.23E-03	6.3%	2.02E-02	4.27E-03	21.1%	1.80E-02	1.17E-03	6.5%
^{240}Pu Activity (Ci)	7.92E-03	1.23E-03	15.5%	8.18E-03	2.08E-03	25.4%	7.31E-03	1.14E-03	15.6%
^{241}Am Activity (Ci)	1.73E-02	6.55E-04	3.8%	1.59E-02	6.50E-04	4.1%	1.65E-02	6.55E-04	4.0%
^{241}Pu Activity (Ci)	5.78E-02	8.95E-03	15.5%	5.92E-02	1.51E-02	25.5%	5.29E-02	8.24E-03	15.6%
^{242}Pu Activity (Ci)	2.05E-06	3.18E-07	15.5%	2.12E-06	5.39E-07	25.4%	1.89E-06	2.95E-07	15.6%
TRU Alpha Conc. (nCi/g)	3,050	123	4.0%	3,020	315	10.4%	2.850	117	4.1%

Quantity of Interest	Original Measurement			Replicate #1			Replicate #2		
	Reported Value	Absolute Uncertainty	Relative Uncertainty	Quantity of Interest	Reported Value	Absolute Uncertainty	Relative Uncertainty	Quantity of Interest	Reported Value
^{90}Sr Activity (Ci)	2.40E-02	1.51E-04	0.6%	2.40E-02	1.64E-04	0.7%	2.40E-02	1.63E-04	0.7%
^{137}Cs Activity (Ci)	1.39E-03	8.73E-06	0.6%	1.39E-03	9.49E-06	0.7%	1.39E-03	9.47E-06	0.7%
^{233}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{234}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{235}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{237}Np Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{238}Pu Activity (Ci)	1.81E-03	2.84E-04	15.7%	1.96E-03	3.52E-04	18.0%	1.83E-03	2.92E-04	16.0%
^{238}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{239}Pu Activity (Ci)	1.87E-02	1.26E-03	6.7%	2.02E-02	2.23E-03	11.0%	1.89E-02	1.39E-03	7.4%
^{240}Pu Activity (Ci)	7.57E-03	1.19E-03	15.7%	8.19E-03	1.47E-03	17.9%	7.66E-03	1.22E-03	15.9%
^{241}Am Activity (Ci)	1.81E-02	6.67E-04	3.7%	1.74E-02	7.48E-04	4.3%	1.81E-02	6.63E-04	3.7%
^{241}Pu Activity (Ci)	5.48E-02	8.58E-03	15.7%	5.93E-02	1.06E-02	17.9%	5.55E-02	8.84E-03	15.9%
^{242}Pu Activity (Ci)	1.96E-06	3.07E-07	15.7%	2.12E-06	3.80E-07	17.9%	1.98E-06	3.16E-07	16.0%
TRU Alpha Conc. (nCi/g)	3,020	123	4.1%	3,120	183	5.9%	3,040	130	4.3%

Quantity of Interest	Original Measurement		Sample Mean	Sample Standard Deviation	Relative Standard Deviation	χ^2	Pr($x < \chi^2$)
	Reported Value	Absolute Uncertainty					
^{90}Sr Activity (Ci)	2.43E-02	1.52E-04	2.40E-02	0.00E+00	N/A	0.000	1.000
^{137}Cs Activity (Ci)	1.41E-03	8.83E-06	1.39E-03	0.00E+00	N/A	0.000	1.000
^{233}U Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	#VALUE!	#VALUE!
^{234}U Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	#VALUE!	#VALUE!
^{235}U Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	#VALUE!	#VALUE!
^{237}Np Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	#VALUE!	#VALUE!
^{238}Pu Activity (Ci)	1.90E-03	2.94E-04	1.86E-03	9.42E-05	5.1%	0.410	0.982
^{238}U Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	#VALUE!	#VALUE!
^{239}Pu Activity (Ci)	1.95E-02	1.23E-03	1.92E-02	9.72E-04	5.1%	2.499	0.645
^{240}Pu Activity (Ci)	7.92E-03	1.23E-03	7.78E-03	3.90E-04	5.0%	0.402	0.982
^{241}Am Activity (Ci)	1.73E-02	6.55E-04	1.72E-02	9.80E-04	5.7%	8.951	0.062
^{241}Pu Activity (Ci)	5.78E-02	8.95E-03	5.63E-02	2.82E-03	5.0%	0.398	0.983
^{242}Pu Activity (Ci)	2.05E-06	3.18E-07	2.01E-06	1.02E-07	5.1%	0.415	0.981
TRU Alpha Conc. (nCi/g)	3,050	123	3,010	98	3.3%	2.565	0.633

Quantity of Interest	t	Pr($x < \|t\|$)	χ^2 Test	t Test
^{90}Sr Activity (Ci)	N/A	N/A	Not Significant	Not Applicable
^{137}Cs Activity (Ci)	N/A	N/A	Not Significant	Not Applicable
^{233}U Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{234}U Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{235}U Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{237}Np Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{238}Pu Activity (Ci)	0.368	0.731	Not Significant	Not Significant
^{238}U Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{239}Pu Activity (Ci)	0.282	0.792	Not Significant	Not Significant
^{240}Pu Activity (Ci)	0.323	0.763	Not Significant	Not Significant
^{241}Am Activity (Ci)	0.093	0.930	Not Significant	Not Significant
^{241}Pu Activity (Ci)	0.472	0.661	Not Significant	Not Significant
^{242}Pu Activity (Ci)	0.321	0.764	Not Significant	Not Significant
TRU Alpha Conc. (nCi/g)	0.371	0.730	Not Significant	Not Significant

ATTACHMENT C.2. MILCC2 REPLICATE TESTING RESULTS FOR CONTAINER No. X10CSATN02023P, Mid-Field Position

Instrument: MILCC2
Drum: X10CSATN02023P

	Original Measurement			Replicate #1			Replicate #2		
Quantity of Interest	Reported Value	Absolute Uncertainty	Relative Uncertainty	Reported Value	Absolute Uncertainty	Relative Uncertainty	Reported Value	Absolute Uncertainty	Relative Uncertainty
^{90}Sr Activity (Ci)	3.09E-02	7.94E-04	2.6%	3.08E-02	7.91E-04	2.6%	3.08E-02	7.91E-04	2.6%
^{137}Cs Activity (Ci)	1.79E-03	4.60E-05	2.6%	1.79E-03	4.58E-05	2.6%	1.79E-03	4.59E-05	2.6%
^{233}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{234}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{235}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{237}Np Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{238}Pu Activity (Ci)	7.89E-04	1.85E-03	234.5%	8.15E-04	1.91E-03	234.4%	8.01E-04	1.88E-03	234.7%
^{238}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{239}Pu Activity (Ci)	7.40E-04	1.24E-03	167.6%	7.64E-04	1.28E-03	167.5%	7.52E-04	1.26E-03	167.6%
^{240}Pu Activity (Ci)	1.26E-03	2.12E-03	168.3%	1.30E-03	2.19E-03	168.5%	1.28E-03	2.15E-03	168.0%
^{241}Am Activity (Ci)	3.60E-03	1.90E-04	5.3%	3.53E-03	1.86E-04	5.3%	3.50E-03	1.85E-04	5.3%
^{241}Pu Activity (Ci)	1.25E-02	2.09E-02	167.2%	1.29E-02	2.16E-02	167.4%	1.27E-02	2.13E-02	167.7%
^{242}Pu Activity (Ci)	1.21E-06	2.04E-06	168.6%	1.25E-06	2.11E-06	168.8%	1.23E-06	2.07E-06	168.3%
TRU Alpha Conc. (nCi/g)	370	171	46.2%	372	176	47.3%	368	173	47.0%

	Original Measurement			Replicate #1			Replicate #2		
Quantity of Interest	Reported Value	Absolute Uncertainty	Relative Uncertainty	Quantity of Interest	Reported Value	Absolute Uncertainty	Relative Uncertainty	Quantity of Interest	Reported Value
^{90}Sr Activity (Ci)	3.08E-02	7.91E-04	2.6%	3.08E-02	7.90E-04	2.6%	3.07E-02	7.87E-04	2.6%
^{137}Cs Activity (Ci)	1.79E-03	4.59E-05	2.6%	1.79E-03	4.58E-05	2.6%	1.78E-03	4.56E-05	2.6%
^{233}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{234}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{235}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{237}Np Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{238}Pu Activity (Ci)	8.20E-04	1.93E-03	235.4%	8.04E-04	1.89E-03	235.1%	8.33E-04	1.96E-03	235.3%
^{238}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{239}Pu Activity (Ci)	7.70E-04	1.29E-03	167.5%	7.54E-04	1.27E-03	168.4%	7.82E-04	1.31E-03	167.5%
^{240}Pu Activity (Ci)	1.31E-03	2.20E-03	167.9%	1.29E-03	2.16E-03	167.4%	1.33E-03	2.24E-03	168.4%
^{241}Am Activity (Ci)	3.58E-03	1.88E-04	5.3%	3.56E-03	1.87E-04	5.3%	3.56E-03	1.87E-04	5.3%
^{241}Pu Activity (Ci)	1.30E-02	2.18E-02	167.7%	1.27E-02	2.13E-02	167.7%	1.32E-02	2.21E-02	167.4%
^{242}Pu Activity (Ci)	1.26E-06	2.12E-06	168.3%	1.24E-06	2.08E-06	167.7%	1.28E-06	2.15E-06	168.0%
TRU Alpha Conc. (nCi/g)	376	178	47.3%	371	174	46.9%	378	180	47.6%

Quantity of Interest	Original Measurement		Sample Mean	Sample Standard Deviation	Relative Standard Deviation	χ^2	Pr($x < \|c^2\|$)
	Reported Value	Absolute Uncertainty					
^{90}Sr Activity (Ci)	3.09E-02	7.94E-04	3.08E-02	4.47E-05	0.1%	0.013	1.000
^{137}Cs Activity (Ci)	1.79E-03	4.60E-05	1.79E-03	4.47E-06	0.3%	0.038	1.000
^{233}U Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	#VALUE!	#VALUE!
^{234}U Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	#VALUE!	#VALUE!
^{235}U Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	#VALUE!	#VALUE!
^{237}Np Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	#VALUE!	#VALUE!
^{238}Pu Activity (Ci)	7.89E-04	1.85E-03	8.15E-04	1.29E-05	1.6%	0.000	1.000
^{238}U Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	#VALUE!	#VALUE!
^{239}Pu Activity (Ci)	7.40E-04	1.24E-04	7.64E-04	1.23E-05	1.6%	0.039	1.000
^{240}Pu Activity (Ci)	1.26E-03	2.12E-03	1.30E-03	1.92E-05	1.5%	0.000	1.000
^{241}Am Activity (Ci)	3.60E-03	1.90E-04	3.55E-03	3.13E-05	0.9%	0.109	0.999
^{241}Pu Activity (Ci)	1.25E-02	2.09E-02	1.29E-02	2.12E-04	1.6%	0.000	1.000
^{242}Pu Activity (Ci)	1.21E-06	2.04E-06	1.25E-06	1.92E-08	1.5%	0.000	1.000
TRU Alpha Conc. (nCi/g)	370	171	373	4	1.1%	0.002	1.000

Quantity of Interest	t	Pr($x < \|t\|$)	χ^2 Test	t Test
^{90}Sr Activity (Ci)	2.449	0.070	Not Significant	Not Significant
^{137}Cs Activity (Ci)	0.408	0.704	Not Significant	Not Significant
^{233}U Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{234}U Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{235}U Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{237}Np Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{238}Pu Activity (Ci)	-1.812	0.144	Not Significant	Not Significant
^{238}U Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{239}Pu Activity (Ci)	-1.814	0.144	Not Significant	Not Significant
^{240}Pu Activity (Ci)	-1.993	0.117	Not Significant	Not Significant
^{241}Am Activity (Ci)	1.575	0.190	Not Significant	Not Significant
^{241}Pu Activity (Ci)	-1.721	0.160	Not Significant	Not Significant
^{242}Pu Activity (Ci)	-1.993	0.117	Not Significant	Not Significant
TRU Alpha Conc. (nCi/g)	-0.685	0.531	Not Significant	Not Significant

ATTACHMENT C.3. MILCC2 REPLICATE TESTING RESULTS FOR CONTAINER No. X10CSATN01937AG, Far-Field Position

Instrument: MILCC2
Drum: X10CSATN01937AG

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
^{90}Sr Activity (Ci)	1.32E-01	4.68E-03	3.5%	1.30E-01	4.63E-03	3.6%	1.34E-01	4.77E-03	3.6%
^{137}Cs Activity (Ci)	7.64E-03	2.71E-04	3.5%	7.56E-03	2.68E-04	3.5%	7.79E-03	2.76E-04	3.5%
^{233}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{234}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{235}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{237}Np Activity (Ci)	1.52E-05	1.16E-06	7.6%	1.85E-05	1.39E-06	7.5%	0.00E+00	0.00E+00	N/A
^{238}Pu Activity (Ci)	4.03E-03	9.47E-03	235.0%	3.87E-03	9.08E-03	234.6%	3.97E-03	9.32E-03	234.8%
^{238}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{239}Pu Activity (Ci)	3.78E-03	6.35E-03	168.0%	3.63E-03	6.09E-03	167.8%	3.72E-03	6.25E-03	168.0%
^{240}Pu Activity (Ci)	6.45E-03	1.08E-02	167.4%	6.19E-03	1.04E-02	168.0%	6.35E-03	1.07E-02	168.5%
^{241}Am Activity (Ci)	1.10E+00	4.49E-02	4.1%	1.10E+00	4.58E-02	4.2%	1.14E+00	4.69E-02	4.1%
^{241}Pu Activity (Ci)	6.38E-02	1.07E-01	167.7%	6.11E-02	1.03E-01	168.6%	6.28E-02	1.05E-01	167.2%
^{242}Pu Activity (Ci)	6.21E-06	1.04E-05	167.5%	5.95E-06	1.00E-05	168.1%	6.11E-06	1.03E-05	168.6%
TRU Alpha Conc. (nCi/g)	75,400	3,250	4.3%	75,600	3,290	4.4%	78,200	3,370	4.3%

Quantity of Interest	Original Measurement			Replicate #1			Replicate #2		
	Reported Value	Absolute Uncertainty	Relative Uncertainty	Quantity of Interest	Reported Value	Absolute Uncertainty	Relative Uncertainty	Quantity of Interest	Reported Value
^{90}Sr Activity (Ci)	1.30E-01	4.62E-03	3.6%	1.32E-01	4.67E-03	3.5%	1.30E-01	4.63E-03	3.6%
^{137}Cs Activity (Ci)	7.55E-03	2.68E-04	3.5%	7.63E-03	2.71E-04	3.6%	7.55E-03	2.68E-04	3.5%
^{233}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{234}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{235}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{237}Np Activity (Ci)	1.54E-05	1.36E-06	8.8%	1.54E-05	1.21E-06	7.9%	0.00E+00	0.00E+00	N/A
^{238}Pu Activity (Ci)	3.96E-03	9.29E-03	234.6%	3.74E-03	8.78E-03	234.8%	3.83E-03	8.99E-03	234.7%
^{238}U Activity (Ci)	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A	0.00E+00	N/A	N/A
^{239}Pu Activity (Ci)	3.71E-03	6.23E-03	167.9%	3.51E-03	5.89E-03	167.8%	3.59E-03	6.04E-03	168.2%
^{240}Pu Activity (Ci)	6.33E-03	1.06E-02	167.5%	5.98E-03	1.01E-02	168.9%	6.13E-03	1.03E-02	168.0%
^{241}Am Activity (Ci)	1.09E+00	4.55E-02	4.2%	1.14E+00	4.68E-02	4.1%	1.13E+00	4.69E-02	4.2%
^{241}Pu Activity (Ci)	6.26E-02	1.05E-01	167.7%	5.91E-02	9.93E-02	168.0%	6.06E-02	1.02E-01	168.3%
^{242}Pu Activity (Ci)	6.09E-06	1.02E-05	167.5%	5.76E-06	9.67E-06	167.9%	5.90E-06	9.91E-06	168.0%
TRU Alpha Conc. (nCi/g)	75,000	3,280	4.4%	78,000	3,340	4.3%	77,700	3,360	4.3%

Quantity of Interest	Original Measurement		Sample Mean	Sample Standard Deviation	Relative Standard Deviation	χ^2	Pr($x < \chi^2$)
	Reported Value	Absolute Uncertainty					
^{90}Sr Activity (Ci)	1.32E-01	4.68E-03	1.31E-01	1.79E-03	1.4%	0.408	0.704
^{137}Cs Activity (Ci)	7.64E-03	2.71E-04	7.62E-03	1.03E-04	1.4%	0.213	0.842
^{233}U Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	N/A	N/A
^{234}U Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	N/A	N/A
^{235}U Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	N/A	N/A
^{237}Np Activity (Ci)	1.52E-05	1.16E-06	9.86E-06	9.09E-06	92.2%	0.536	0.620
^{238}Pu Activity (Ci)	4.03E-03	9.47E-03	3.87E-03	9.56E-05	2.5%	1.490	0.210
^{238}U Activity (Ci)	0.00E+00	N/A	0.00E+00	0.00E+00	N/A	N/A	N/A
^{239}Pu Activity (Ci)	3.78E-03	6.35E-03	3.63E-03	8.73E-05	2.4%	1.548	0.197
^{240}Pu Activity (Ci)	6.45E-03	1.08E-02	6.20E-03	1.52E-04	2.5%	1.523	0.202
^{241}Am Activity (Ci)	1.10E+00	4.49E-02	1.12E+00	2.35E-02	2.1%	-0.778	0.480
^{241}Pu Activity (Ci)	6.38E-02	1.07E-01	6.12E-02	1.52E-03	2.5%	1.533	0.200
^{242}Pu Activity (Ci)	6.21E-06	1.04E-05	5.96E-06	1.44E-07	2.4%	1.571	0.191
TRU Alpha Conc. (nCi/g)	75,400	3,250	76,900	1,487	1.9%	-0.921	0.409

Quantity of Interest	t	Pr($x < \|t\|$)	χ^2 Test	t Test
^{90}Sr Activity (Ci)	N/A	N/A	Not Significant	Not Significant
^{137}Cs Activity (Ci)	N/A	N/A	Not Significant	Not Significant
^{233}U Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{234}U Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{235}U Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{237}Np Activity (Ci)	N/A	N/A	**Highly Significant**	Not Significant
^{238}Pu Activity (Ci)	0.368	0.731	Not Significant	Not Significant
^{238}U Activity (Ci)	N/A	N/A	#VALUE!	Not Applicable
^{239}Pu Activity (Ci)	0.282	0.792	Not Significant	Not Significant
^{240}Pu Activity (Ci)	0.323	0.763	Not Significant	Not Significant
^{241}Am Activity (Ci)	0.093	0.930	Not Significant	Not Significant
^{241}Pu Activity (Ci)	0.472	0.661	Not Significant	Not Significant
^{242}Pu Activity (Ci)	0.321	0.764	Not Significant	Not Significant
TRU Alpha Conc. (nCi/g)	0.371	0.730	Not Significant	Not Significant