



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

SEP 14 2010

OFFICE OF
AIR AND RADIATION



Donald C. Gadbury
Manager, National TRU Program
U.S. Department of Energy
P.O. Box 3090
Carlsbad, NM 88221-3090

Dear Mr. Gadbury:

On July 8, 2010 the U.S. Department of Energy (DOE), Carlsbad Field Office (CBFO) requested the U.S. Environmental Protection Agency's (EPA) approval of a modification of a non-destructive assay process implemented by the Central Characterization Project (CCP) at the Savannah River Site (SRS) for contact-handled (CH) waste. This letter approves the requested T1 change which allows SRS-CCP to extend the calibration range of the Box Segmented Gamma System aspect of the Nondestructive Assay Box Counter to 7.18 grams of ^{238}Pu utilizing a reduced 20-minute assay time.

In the tiering table provided in the report accompanying EPA's Tier 1 approval of S3000 (solid) waste (Docket no. A-98-49; II-A4-123) dated March 2010, EPA identified the "extension or changes to approved calibration range for approved equipment" as a T1 change, which requires EPA approval prior to implementation. CBFO proposed this Tier 1 (T1) change to the baseline approval as required by 40 CFR 194.8(b).

EPA conducted a desk-top evaluation of the documentation provided for the requested change. EPA's evaluation did not identify any issues related to the processes implemented to characterize the subject waste. EPA's inspection report (A-98-49, II-A4-133) is enclosed and will be placed in the Agency's public docket.



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

Sincerely,



Tom Peake, Director
Center for Waste Management and Regulations

01/15

Enclosure

cc: Electronic Distribution
David Moody, CBFO
Ava Holland, CBFO
Courtland Fesmire, CBFO
Norma Castaneda, CBFO
Martin Navarrete, CBFO
Dennis Miehl, CBFO
Bert Crapse, DOE-SR
Steve Zappe, NMED
Mike Sensibaugh, WTS-CCP
Allison Pangle, CTAC
Porf Martinez, CTAC
Site Documents

DOCKET NO: A-98-49; II-A4-133

WASTE CHARACTERIZATION REPORT

TIER 1 CHANGE:

**EVALUATION OF THE EXTENSION OF THE CALIBRATION RANGE FOR THE
BOX GAMMA SEGMENTED SYSTEM (BSGS) OF THE NONDESTRUCTIVE ASSAY
BOX COUNTER (NABC) AT THE CENTRAL CHARACTERIZATION PROJECT
(CCP) AT SAVANNAH RIVER SITE (SRS)**

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

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1.0 EXECUTIVE SUMMARY

In accordance with 40 CFR 194.8(b), the U.S. Environmental Protection Agency (EPA or the Agency) conducted Baseline Inspection No. EPA-SRS-10.05-8 of the Central Characterization Project (CCP) waste characterization program for contact-handled (CH) transuranic (TRU) wastes at the U.S. Department of Energy (DOE) Savannah River Site (SRS) in Aiken, South Carolina, from October 31 through November 3, 2005. As a result of this baseline inspection, EPA approved the SRS-CCP CH TRU waste characterization program with conditions and limitations, as discussed in the SRS Baseline Final Inspection Report (see EPA Docket No. A-98-49, II-A4-64). This approval included two nondestructive assay (NDA) systems: the IQ3 gamma system and the Imaging Passive Active Neutron (IPAN) system.

On March 9, 2009, the Carlsbad Field Office (CBFO) requested EPA approval of a Tier 1 (T1) change to add the Nondestructive Assay Box Counter (NABC) at SRS. The NABC is a bimodal system consisting of a gamma detection mode referred to as the Box Segmented Gamma System (BSGS) and a neutron detection mode referred to as the Box Neutron Assay System (BNAS). On March 24–26, 2009, EPA conducted an onsite evaluation of the NABC at SRS and approved the NABC. A summary of all EPA approvals of SRS-CCP's CH TRU waste characterization program is provided in Table 1, below. On July 8, 2009, the CBFO requested EPA approval of a T1 change to extend the calibration range of the BSGS aspect of the NABC to 7.18 grams of ²³⁸Pu utilizing a reduced 20-minute assay time and that change is the subject of this evaluation.

This report serves as EPA's public notification of the results of the proposed T1 change and its evaluation. This information will be provided through the EPA web site and by sending e-mails to the WIPPNEWS list, in accordance with 40 CFR 194.8(b)(3). As a result of this approval no changes were made to the modified tiering table provided with the approval of S3000 (solid) waste in March 2010.

Table 1. Approval Summary for SRS-CCP CH Waste Characterization Program

Specific SRS-CCP CH Approval	Date	EPA Docket Number
SRS CH Baseline Approval	July 2006	A-98-49; II-A4-64
Tier 1 Change – Approval of Segmented Gamma Scanner, Nondestructive Assay System	August 2007	A-98-49; II-A4-90
Tier 1 Change – Approval of Nondestructive Assay Box Counter, Nondestructive Assay System	August 2009	A-98-49; II-A4-114
Tier 1 Change – Addition of S3000 Solids	March 2010	A-98-49; II-A4-123

2.0 PURPOSE OF INSPECTIONS

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 SRS 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 onsite 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 inspection or approval under 40 CFR 194.24. This was accomplished by assigning a tier level to each aspect of the SRS-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. 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 EPA's evaluation of a T1 change approving the extension of the BSGS aspect of the NABC calibration range for use in assaying CH TRU wastes at SRS. 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 SRS-CCP NABC calibration range extension has been conveyed to DOE separately by letter. As discussed previously, EPA will also announce the decision on its web site 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 several places in the report. Any of these documents can be requested from:

Carlsbad Field Office
Manager, National TRU Program
US Department of Energy
PO Box 3090
Carlsbad NM 88221-3090

4.0 SCOPE OF REVIEW

The NABC is located at SRS, E Area, Building 643-43E, and is operated by SRS-CCP. It is a bimodal system consisting of the BSGS gamma detection mode and the BNAS neutron detection mode. The NABC is configured for CH TRU wastes in three container types (geometries): 55-gallon (208-liter) drums; standard waste boxes (SWBs); and standard large boxes (SLB-2s). During this T1 evaluation, EPA assessed the BSGS aspect of the NABC with respect to extending the calibration range to 7.18 grams of ²³⁸Pu utilizing 20-minute assay time. This calibration range extension is only applicable to 55-gallon drums and SWBs.

5.0 T1 EVALUATION PERSONNEL

All personnel involved in this T1 evaluation are shown in Table 1, listed with their professional affiliation and function during the evaluation.

Table 2. T1 Evaluation Personnel

Personnel Name	Affiliation	T1 Evaluation Function
Ed Feltcorn	US EPA	EPA Lead Inspector
Patrick Kelly	SC&A/EPA	EPA Technical Evaluator
Rose Gogliotti	SC&A/EPA	EPA Technical Evaluator

6.0 EVALUATION OF THE NABC

EPA evaluated the documentation that had been prepared to support the approval of the calibration range change to the BSGS aspect of the NABC system that will be used to characterize CH TRU wastes at SRS-CCP. As part of the review, EPA assessed the technical adequacy of SRS-CCP documents to support the BSGS aspect of the NABC's operation for the 55-gallon drum and SWB container configurations with the extended calibration range.

The following documents were examined to assess the BSGS aspect of the NABC:

- Nondestructive Assay Box Counter: Calibration Confirmation Report for the Gamma Modality Utilizing 20-Minute Count Assay Time, CCP-SRS-SRBC003, Revision 2, May 4, 2010
- Waste Characterization Report: Tier 1 Change: Evaluation of the Gamma and Passive Neutron Operational modes of the Non Destructive Assay Box Counter for the Nondestructive Assay Box Counter (NABC) at the Central Characterization Project (CCP) at Savannah River Site (SRS), March 24–26, 2009

The NABC integrates two detection modes, gamma and neutron, the BSGS and the BNAS, respectively. It has a moving trolley, which travels on rails past two gamma counting stations, one for passive counting and one for transmission counting. The passive aspect is accomplished with a high-resolution gamma-ray counter that incorporates both density (multi-curve) and transmission-based matrix corrections, and uses Multi Group Analysis (MGA), Multi Group Analysis-Uranium (MGA-U), and FRAM¹ software for plutonium (Pu) and uranium (U) isotopic determination. The BSGS consists of four high purity germanium (HPGe) detectors mounted on two opposite towers, with two detectors per tower each at the same vertical distance (height) from the floor. The BNAS consists of a high efficiency passive neutron counter with both coincidence and multiplicity analysis capabilities, including an Add-A-Source (AAS) option for matrix corrections. The separate gamma and passive neutron operational components of the NABC are equivalent to several NDA systems that EPA has evaluated and approved for CH TRU assays at other CCP sites, e.g., Idaho National Laboratory and Los Alamos National Laboratory. Radionuclide data for waste containers are derived in one of three ways: quantitative values from the BSGS alone; isotopic gamma values from the BSGS that are applied to BNAS neutron values; or acceptable knowledge (AK)-based isotopics applied to BNAS neutron values. The NABC quantifies specific radionuclides in all three container types. By design, the NABC quantifies Pu and other WIPP-tracked and TRU radionuclides, such as ²³⁸Pu, ²³⁹Pu, ²⁴⁰Pu, ²³³U, ²³⁵U, ²³⁸U, ²³⁷Np, ²⁴¹Am, ²⁴³Am, and ¹³⁷Cs, using a combination of gamma and neutron data. Other radionuclides that cannot be quantified directly (²³⁴U, ⁹⁰Sr, and ²⁴²Pu) are determined using AK, scaling factors, and/or correlation techniques. The design and operational range of the gamma and neutron modes are evaluated separately below.

BSGS Design

This T1 change has no impact on the design of the BSGS. Further information on its design can be found in the initial EPA approval of the NABC, see EPA Docket No. A-98-49; II-A4-114.

BSGS Range

The operational range of the BSGS is stated as the system's lower limit of detection (LLD) to 305 grams for ²³⁹Pu and the LLD to 7.18 grams for ²³⁸Pu in terms of (mass) activity using a 20-minute assay time. This is a change to the previously approved range of the LLD to 204 grams for ²³⁹Pu and the LLD to 0.44 grams for ²³⁸Pu. For density-based efficiency, an operational range of 0.02 g/cm³ to 1.62 g/cm³ was established, as summarized in CCP-SRS-SRBC003, which was unchanged by the proposed range extension. Canberra Report No. 40945 describes the details of the BSGS calibration that was performed using mixed gamma sources and the system's operational range was determined by measurements of weapons grade (WG) and heat source (HS) Pu standards, as described in CCP-SRS-SRBC003. For WG Pu, ²³⁹Pu sources were assayed over a range of approximately 1 gram to 305 grams ²³⁹Pu to produce the stated operational range. For HS Pu, the operational range is the system LLD to 40 grams ²³⁸Pu. Note that operational or calibrated ranges may be stated in a variety of terms, i.e., WG Pu, ²³⁹Pu,

¹ FRAM is an initialization for a gamma identification and quantification program that is called Fixed-Energy Response Function Analysis with Multiple Efficiencies. Both MGA and FRAM are available to the SRS-CCP personnel who perform data review and approval.

HS Pu, ^{238}Pu or total Pu, all of which are interchangeable with the appropriate numerical adjustment for isotopics.

BNAS Design and Operational Range

The BNAS consists of 320 ^3He proportional tubes in a polyethylene liner of the assay enclosure (inner chamber dimensions are 81 inches wide by 120 inches long by 79 inches tall). The operational range of the BNAS is stated as the system's LLD to 305 g of ^{239}Pu for WG Pu and the LLD to 40 g for ^{238}Pu , as summarized in MCS-SRS-NDA-0810, Revision 2. The BNAS component of the NABC is unaffected by the T1 change and further information on its design and operating range can be found in CCP-SRS-SRBC003.

BSGS Calibration

The gamma calibrations were performed at Canberra's facility in Meriden, Connecticut, for all three geometries. The NABC was also calibrated for the Ten-Drum Overpack (TDOP) geometry, but that container type is not included in this T1 evaluation. After reviewing the revised calibration report, there are no changes to the initial factory calibration for the BSGS. There are no technical concerns regarding the adequacy of the calibration of the BSGS aspect of the NABC and its supporting documentation.

BNAS Calibration

Calibration of the BNAS was performed at the Canberra facility in Meriden, Connecticut, by determining Add-a-Source (AAS) calibration parameters and other system characteristics, including high-voltage, counting efficiency, die-away time, gate fractions, and dead-time parameters. This module of the NABC is unaffected by the T1 change and further information on the BNAS calibration can be found in CCP-SRS-SRBC001, see EPA Docket No. A-98-49; II-A4-114.

BSGS Calibration Confirmation

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

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

Confirmation measurements were initially performed for three WG plutonium loadings, and one HS Pu loading, in each of the two container types, 55-gallon drums and SWBs. The WG and HS Pu mass loadings for each container type used in calibration confirmation are listed in Table 2.

Table 3. Plutonium Mass Loading Contents for Container Type

	55-Gallon Drum	SWB
WG Pu	1.001 g	1.001 g
	25.375 g	25.375 g
	217.589 g	217.589 g
HS Pu	0.538 g	0.528 g

Calibration confirmation measurements were performed using different sources from those used for system's initial calibration. These sources were assayed in accordance with CCP-TP-189, Revision 1, and the resulting data were evaluated against the criteria in DOE/WIPP-02-3122, Appendix A, Table 3.2, as appropriate. The results are provided in CCP-SRS-SRBC003. The mass loadings for the initial 20-minute count time calibration confirmation measurements were determined by combining standards available through SRS to produce a range of values. Each 55-gallon drum was continuously rotated during the 1200-second confirmation measurement. The WG and HS Pu configurations were each assayed six times to provide sufficient data for statistical analysis. All assays passed the $\pm 30\%R$ criteria for accuracy and the $\%RSD$ criteria for precision (14% for six repetitions). The calibration confirmation measurement results for the 20-minute assays are documented in CCP-SRS-SRBC003. There are no concerns regarding the technical adequacy or documentation of the calibration confirmation for the BSGS aspect of the NABC.

BNAS Calibration Confirmation

The BNAS operating range was unaffected by this T1 change. Calibration confirmation for BNAS was performed during the initial approval of the NABC at SRS, see EPA Docket No. A-98-49; II-A4-114.

BSGS TMU Determination

The determination of the gamma component of the TMU for the NABC is addressed in Savannah River Gamma Box Counter Calibration Report Alternatives for Non-Destructive Assay (NDA) of Large Containers to Allow Shipping in TRUPACT III without Resizing and/or Repackaging, Canberra Document No. 40945. The BSGS TMU is unaffected by this T1 change.

BNAS TMU Determination

The determination of the BNAS aspect of TMU for the NABC is addressed in Savannah River Box Neutron Assay System Total Measurement Uncertainty Report for Alternatives for Non-Destructive Assay (NDA) of Large Containers to Allow Shipping in TRUPACT III without Resizing and/or Repackaging, Canberra Document No. 41309. The BNAS TMU was not affected by this T1 change.

BSGS LLD Determination

The 55-gallon drum filled with the Homasote matrix and no radioactive sources was assayed three times using the new 20-minute assay time and standard operating protocols, as documented in CCP-TP-189, Revision 1. For each assay, NDA 2000 software was used to calculate the LLDs and minimum detectable activities (MDAs) for the ten WIPP tracked radionuclides plus ^{235}U . Each LLD value was corrected for the matrix (net weight) to determine the minimum detectable concentration (MDC) for each radionuclide. All results were acceptable and meet the CH-WAC TRU/non-TRU waste discrimination criterion of 100 nCi/g. Results are documented in Appendix E-1 of the calibration report. The SWB filled with a cardboard matrix and no radioactive sources was assayed three times using the standard operating protocols, as documented in CCP-TP-189, Revision 1. Each LLD value was corrected for the matrix (net weight) and MDC values were derived. All results were acceptable and meet the CH-WAC TRU/Non-TRU discrimination criterion of 100 nCi/g. Results are documented in Appendix E-1 of the calibration report.

Reporting thresholds are required for the radionuclides that are not measured directly; specifically ^{242}Pu , ^{234}U and ^{90}Sr . The ^{90}Sr reporting threshold is computed from the reported ^{137}Cs LLD using an activity ratio determined from SRS-CCP AK NDA memoranda. For SRS waste, the activity ratio is taken as 1 unless specified differently in appropriate AK documentation. ^{234}U is derived from the measured ^{235}U and ^{238}U values or lack thereof by algorithm. Since this is not a function of scaling an individual radionuclide, SRS-CCP personnel stated that it is not technically feasible to derive a reporting threshold for ^{234}U . All gamma-based LLDs and reporting thresholds are documented in CCP-SRS-SRBC001. There are no concerns regarding the determination and/or documentation of gamma-based LLDs or reporting thresholds for the BSGS aspect of the NABC.

BNAS LLD Determination

Nominal BNAS LLDs were determined from three replicate counts of three container/matrix configurations without radioactive sources, using the Performance Demonstration Program (PDP²) Combustibles 55-gallon drum and cardboard matrices for the SWB. The BNAS LLD that was determined during the initial NABC approval was not affected by this T1 change. Additional information regarding the BNAS LLD determination is documented in CCP-SRS-SRBC001, see EPA Docket No. A-98-49; II-A4-114.

7.0 SUMMARY OF RESULTS AND CONCLUSIONS

There were no findings or concerns regarding the performance and documentation of performance testing for the gamma operational modes for the NABC resulting from this T1 evaluation.

² PDP sources are constructed by Los Alamos National Laboratory for use in the CBFO-sponsored NDA Performance Demonstration Program.

8.0 APPROVAL

During this T1 evaluation, the EPA evaluated the BSGS aspect of the NABC calibration range of ^{238}Pu and reduced 20-minute count time. Based on this T1 evaluation, the NABC is approved for the extension of the calibration range of the BSGS aspect of the NABC to 7.18 grams of ^{238}Pu utilizing a reduced 20-minute assay time. The NABC is approved to assaying CH TRU wastes in the gamma and neutron detection modes for two measurement configurations—55-gallon drum and SWBs—consistent with the limitations described in this report.