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

JUN 2011

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OFFICE OF
AIR AND RADIATION

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

Dear Mr. Stroble:

On March 30, 2011, the Carlsbad Field Office (CBFO) requested that the U.S. Environmental Protection Agency (EPA) approve a 55-gallon drum containing remote-handled (RH) debris waste from the alpha gamma hot cell in Building JN-1 at the Battelle Columbus Laboratory (BCL) characterized by the Central Characterization Project (CCP) at the Savannah River Site (SRS) as a Tier 1 change. This RH waste drum was generated at the BCL facility from 1981-1983, as a result of experiments associated with terrorist attacks on mock transportation casks of simulated high-level waste (HLW), i.e., the Sabotage Program. CBFO's letter claimed that this drum belonged to an approved solid Waste Stream SR-BCLDP.002. However, the requested drum (Drum No. BC0148) contains debris waste and actually belongs to a new debris waste stream, SR-RL-BCLDP.002.

EPA approves Drum No. BC0148, characterized using the EPA-approved transuranic (TRU) waste characterization processes implemented by SRS-CCP. SRS-CCP may dispose of this drum at the Waste Isolation Pilot Plant (WIPP). The enclosed report (EPA Docket No. A-98-49; II-A4-149) supports EPA's decision.

The CCP at SRS characterized this waste using RH waste characterization processes that EPA approved in August 2008 (See EPA Docket No. A-98-49; II-A4-104 for details). No additional RH waste is expected to be generated at BCL. A small number of the BCL waste containers, however, are stored at the Hanford Site. When characterization of these containers is initiated for the disposal at WIPP, EPA notification will be necessary. Upon notification, EPA will determine the scope of the EPA inspection and approval process.

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

Tom Peake, Director
Center for Waste Management and Regulations

Enclosure

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DOCKET NO: A-98-49, II-A4-149

WASTE CHARACTERIZATION REPORT

EPA TIER 1 EVALUATION OF THE CENTRAL CHARACTERIZATION PROJECT REMOTE-HANDLED TRANSURANIC WASTE CHARACTERIZATION PROGRAM: ADDITION OF WASTE STREAM SR-RL-BCLDP.002 CONSISTING OF DRUM NUMBER BC0148 FROM THE BATTELLE COLUMBUS LABORATORY SABOTAGE PROGRAM

April - May 2011

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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ACRONYMS AND ABBREVIATIONS

AK	acceptable knowledge
AKSR	Acceptable Knowledge Summary Report
Am	americium
APPR	Army Package Power Reactor
Ba	barium
BCL	Battelle Columbus Laboratory
BCLDP	Battelle Columbus Laboratory Decommissioning Project
BDR	batch data report
CAA	Controlled Access Area
CBFO	Carlsbad Area Field Office
CCP	Central Characterization Project
CFR	*Code of Federal Regulations*
CH	contact-handled
Ci	curie
Cm	curium
CRR	Characterization Reconciliation Report
Cs	cesium
CSSF	Correlation and Surrogate Summary Form
D&D	decontamination and decommissioning
DF	decontamination factor
DOE	U.S. Department of Energy
DQO	data quality objective
DR	discrepancy resolution
DTC	dose-to-curie
DU	depleted uranium
EPA	U.S. Environmental Protection Agency
Eu	europium
FGE	fissile gram equivalent
g/cm^3	grams per cubic centimeter
HEC	high-energy cell
HLW	high-level waste

LOQI	List of Qualified Individuals
LWA	Land Withdrawal Act
LWR	light-water reactor
m	meter or meters
mR/hr	milliroentgen per hour
mrem/hr	millirem per hour
nCi	nanocurie
NCR	non-conformance report
NMED	New Mexico Environment Department
Np	neptunium
NWPA	*Nuclear Waste Policy Act*
ORIA	Office of Radiation and Indoor Air
ORIGEN	Oak Ridge Isotope Generation and Depletion Code
PE-Ci	plutonium equivalent curies
PNL	Pacific Northwest Laboratory
Pu	plutonium
PWR	pressurized-water reactor
QA	quality assurance
QAO	quality assurance objective
RH	remote-handled
Ru	ruthenium
SCG	Summary Category Group
SNF	spent nuclear fuel
SPM	Site Project Manager
Sr	strontium
SRS	Savannah River Site
T1	Tier 1
T2	Tier 2
TMU	total measurement uncertainty
TRU	transuranic
U	uranium
VE	visual examination
WCPIP	Waste Characterization Program Implementation Plan

WIPP	Waste Isolation Pilot Plant
WMP	waste material parameter
WSPF	Waste Stream Profile Form
WTS	Washington TRU Solutions
Y	yttrium

1.0 EXECUTIVE SUMMARY

This report supports the U.S. Environmental Protection Agency's (EPA) Tier 1 (T1) approval of Waste Stream SR-RL-BCLDP.002 containing one 55-gallon container[1] of remote-handled (RH) transuranic (TRU) debris (S5000) waste. This container was originally included in Waste Stream SR-RL-BCLDP.001 (SRS-CCP Baseline approval in August 2008, see EPA Docket No. A-98-49; II-A4-104), but was segregated due to the different radiological composition of the material. The waste container in question was generated at Battelle Columbus Laboratory (BCL) as part of an experimental activity and is currently in storage at the Savannah River Site (SRS). The Central Characterization Project (CCP) is responsible for characterizing this waste stream generated at the BCL Decommissioning Project (BCLDP) using the EPA-approved system of controls. The RH waste stream discussed in this report was generated at the BCL facility from 1981-1983, as a result of experiments associated with terrorist attacks on mock transportation casks of simulated high-level waste (HLW), i.e., the Sabotage Program. This waste was packaged or repackaged and shipped to SRS, where it is currently in storage for ultimate disposal at the Waste Isolation Pilot Plant (WIPP).

On March 30, 2011, DOE requested EPA approval of this sole debris waste container. However, the letter cites that this drum belonged to an approved solid Waste Stream (S3000), SR-BCLDP.002. In fact, the requested drum (Drum No. BC0148) contains debris waste (S5000) and belongs to a new waste stream SR-RL-BCLDP.002.

SRS-CCP is approved to characterize and dispose at WIPP the following containers of BCL RH waste:

- 87 debris waste containers in Waste Stream SR-RL-BCLDP.001 (Baseline approval);
- 11 additional debris waste containers in waste streams SR-BCLDP.001.002, SR-BCLDP.004.003, and SR-BCLDP.004.002 (T1 approval); and
- 13 solid waste containers in waste streams SR-BCLDP.001.001, SR-BCLDP.002, and SR-BCLDP.003 (T1 approval).

See Appendix A for a complete list of BCL waste streams and containers approved by EPA.

The only additional BCL waste containers eligible for WIPP disposal are the 20 liners[2] of debris waste stored at the Department of Energy's (DOE's) Hanford site. Characterization of these 20 liners must be approved by EPA as a T1 change prior to their emplacement at the WIPP facility. Characterization of these debris liners will meet the DOE requirements for characterizing RH waste that are outlined in the RH Waste Characterization Program Implementation Plan (WCPIP), Revision 2. Any other BCL waste, including additional waste containers proposed for inclusion in any of the approved waste streams listed in Appendix A, must be approved under a separate baseline inspection. Any modifications to the documents reviewed as part of this evaluation must be provided to EPA for review. As described in EPA's final baseline inspection

[1] *Container* is a generic term which applies to cans, canisters, drums, and any other types of waste packages that may be characterized individually for their radiological and physical contents.

[2] A *liner* is a 55-gallon rigid steel liner that fits within a standard 55-gallon drum and acts as an overpack.

report, Tier 2 (T2) elements were not relevant. Accordingly, this report does not address T2 elements.

2.0 PURPOSE OF TIER 1 EVALUATION

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 *Code of Federal Regulations* (CFR) 194.8 regulations and incorporated in the SRS-CCP RH 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 (Vol. 69, No. 136, pages 42571–42583, July 16, 2004). The purpose of EPA's baseline inspection is to approve the site's waste characterization program, based on the demonstration that the program's components, with applicable conditions and limitations, can adequately characterize TRU wastes and comply with the regulatory requirements imposed on TRU wastes destined for disposal at the 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 (T2) notification, are identified in the site-specific baseline inspection reports. When evaluating proposed T1 changes for approval, EPA may conduct a site inspection to observe first-hand the implementation of the change, or can opt to conduct a "desktop" review of information provided specific to a change. DOE may choose to characterize and dispose of any previously approved TRU waste using processes/procedures/equipment implemented as T2 changes at risk of subsequent EPA disapproval. EPA reviews T2 changes on a quarterly basis and EPA may conduct continued compliance inspections to evaluate implemented T2 changes to verify adequacy.

3.0 PURPOSE OF THIS REPORT

This report presents the results of EPA's evaluation of one drum of retrievably-stored, RH TRU debris (S5000) waste that was generated by the Sabotage Program at the BCL facility and is currently in storage at SRS. This report presents the technical basis and results of EPA's approval decision. EPA's approval decision regarding the addition of this one BCLDP waste drum has been conveyed to DOE separately by letter. As discussed previously, EPA will also announce the decision on its website at www.epa.gov/radiation/WIPP, in accordance with 40 CFR 194.8(b)(3). Any of the DOE documents provided to EPA in support of this T1 evaluation can be requested from the following address:

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

4.0 SCOPE OF THE TIER 1 EVALUATION

The T1 evaluation includes a single drum of TRU Summary Category Group (SCG) S5000 waste generated by BCL in Building JN-1 Hot Cell Laboratory as a result of tests performed to determine the effects of a terrorist attack on nuclear material within shipping casks using vitrified mock HLW. A detailed waste description is given in Section 6.1, (1).

5.0 EVALUATION PERSONNEL

EPA and its support personnel conducted interviews with SRS-CCP personnel in several disciplines by telephone. The EPA evaluation team members and the personnel contacted are listed in Table 1 with their affiliations and technical areas of expertise. This listing includes all personnel present at meetings conducted as part of this evaluation.

Table 1. T1 Evaluation Personnel

Personnel Name	Affiliation	Area of Expertise, Function
Rajani Joglekar	EPA ORIA	Tier 1 Evaluation Lead
Amir Mobasheran	SC&A	Radiological Characterization
Connie Walker	SC&A	Acceptable Knowledge
Patrick Kelly	SC&A	Radiological Characterization
Kevin Peters	CCP-TechSpecs	Acceptable Knowledge Expert
Jene Vance	WTS-CCP	Radiological Characterization, Technical Expert
Steve Schafer	CCP-TechSpecs	Acceptable Knowledge Expert
Jim Holderness	WTS-CCP	Radiological Characterization, Technical Expert
Irene Quintana	WTS-CCP	Site Project Manager

6.0 TECHNICAL EVALUATION

Sections 6.1 and 6.2 of this report detail the two technical areas assessed during this evaluation:

- Programmatic Requirements and Acceptable Knowledge (AK), including Visual Examination (VE)
- Radiological Characterization

6.1 Programmatic Requirements and Acceptable Knowledge

EPA examined the programmatic requirements and AK process and associated information to determine whether SRS-CCP demonstrated compliance with 40 CFR 194.8 requirements for Waste Stream SR-RL-BCLDP.002.

Waste Characterization Element Description

As part of the inspection, EPA reviewed the following with respect to programmatic requirements and the use of AK for RH waste characterization:

- Inspection scope and waste stream identification
- Identification of the WCPIP waste characterization process
- Adequacy of the Certification Plan and other WCPIP documentation
- Adequacy of WCPIP waste qualification pathway
- Adequacy of data management reviews, validation activities, data reporting and records retention
- Adequacy of training
- Adequacy of waste stream profile form (WSPF) and related attachments
- Adequacy of Nonconformance and Discrepancy Resolution (DR) documentation
- Waste stream definition including radiological and physical characteristics
- Verification that the subject waste is of defense origin and is not HLW, low-level waste, or spent nuclear fuel (SNF)
- Role of AK in the characterization methodology, including scaling factors
- Adequacy of AK procedure and procedure implementation, including Attachments - AK Accuracy Reports, Characterization Reconciliation Reports (CRRs), and Correlation and Surrogate Summary Forms (CSSFs)
- Adequacy of the AK Summary Report (AKSR) and associated source documents
- AK data traceability
- Attainment of Data Quality Objectives (DQOs)

Documents and Batch Data Reports Reviewed

EPA reviewed source documents and other data as part of this T1 evaluation, all of which are listed in Attachment B. The waste stream consists of a single drum, No. BC0148, with one associated VE batch data report (BDR) that was evaluated in (7), below. A radiological characterization BDR was not prepared and the results of radiological characterization were included in CCP-AK-SRS-501, Revision 8, Appendix A. Radiological characterization is evaluated in Section 6.2.

Technical Evaluation

EPA evaluated the adequacy of AK information specific to Waste Stream SR-RL-BCLDP.002 as described in CCP-AK-SRS-500 (AKSR), Revision 5 and CCP-AK-SRS-501, Revision 8. EPA also evaluated the records relative to the WCPIP programmatic requirements. Because this is the first T1 evaluation performed under WCPIP, Revision 2, the specific WCPIP citation that addresses EPA requirements for AK is included parenthetically at the end of each component heading[3].

[3] In some cases, a requirement occurs in multiple places in Revision 2 of the WCPIP and the citations may provide one of several sections.

(1) The scope of the T1 request and the waste stream determination were examined for Waste Stream SR-RL-BCLDP.002 and found to be adequate (WCPIP, Revision 2, Section 3.0, p. 13).

The T1 requests approval of a single RH debris waste stream that originated from a set of tests conducted at BCLL from 1981-1983[4]. SRS-CCP representatives stated that the waste stream is limited to a single container (No. BC0148) and no additional wastes will be generated. The scope of the T1 request is well-defined and confined to this waste stream containing a single drum.

The WCPIP, Revision 2 defines a waste stream as "waste material that is (1) generated from a single process/activity and (2) similar in material, physical form, and radiological properties." The Sabotage Program was conducted in the Controlled Access Area (CAA) of the Battelle Columbus JN-1 Hot Cell. The program was performed to determine the effects of a terrorist attack on nuclear material within shipping casks. During 1981, two sets of experiments were conducted; the first dealt with SNF in shipping casks, but material from this activity is not in Waste Stream SR-RL-BCLDP.002 (Reference DR1001). The second experiment involved shooting a shrapnel charge into small model casts containing mock vitrified HLW canisters and evaluating the resulting gases and solids. Waste materials generated by this test were placed in a Cask Sabotage waste vessel, and were stored in the CAA until 2002, at which time the waste was brought into the high-energy cell (HEC) where it was packaged in container BC0148 (References P012, P071, P726, P072, P501, P1000, P1001, and P1005).

The experiments were conducted using mock HLW generated at Pacific Northwest Laboratory (PNL) for a waste vitrification study. Six pressurized water reactor (PWR) fuel assemblies containing uranium (U) from the Point Beach reactor were processed to create mock HLW using a conventional Purex-type process. This produced a material typical of a nitric-acid/fission product waste stream generated by the first extraction cycles from a commercial power plant. Uranium and non-radioactive chemicals were then added to the waste to mimic back-cycling of waste from second and third extraction cycles to produce a mock HLW compositionally typical of a commercial plant. The waste was concentrated ten-times and fed to the PNL-developed spray calciner/in-can melting process. The waste was then vitrified, and the resulting glass was placed in a shipping cask (References P1003, and P726).

Based on this information, the processes used to generate the source material within the waste and the waste itself are well understood and represent a single process or waste stream. The radiological and physical compositions of the waste stream are addressed in (12).

(2) The Certification Plan, including description of the waste characterization process, was examined and found to be complete and technically adequate (WCPIP, Revision 2, Section 3, pp. 14-15).

CCP-AK-SRS-502, Revision 3 (Certification Plan) states that a combination of characterization methods was employed to characterize Waste Stream SR-RL-BCLDP.002. These methods include AK, VE, and radiological characterization. AK was used to determine and describe the

[4] See footnote 2 for specifics regarding CBFO's T1 request.

waste stream, and was used to define Land Withdrawal Act (LWA) DQOs such as the defense status of the waste [Item (4)] and absence of HLW and SNF [Item (13)]. VE was used to verify the physical composition of the waste stream [Item (12)], and AK in combination with Dose-to-Curie (DTC) and scaling factors were used to determine the radiological composition (Section 6.2). The characterization process is adequately described in the Certification Plan.

The WCPIP, Revision 2 requires that the Certification Plan describe the process for certification of the waste stream, including a description of the following:

- AK qualification and/or characterization methods selected to meet the DQOs, including the justification for the selection of the methods
- Quality Assurance Objectives (QAOs) for the selected methods
- Characterization and testing methods not included in the WCPIP in sufficient detail to allow for CBFO approval prior to implementation
- Summary of the program documents to be prepared during the characterization and/or qualification methods

EPA examined the Certification Plan and found that while the document contained much of the fundamental information cited above, it had not been revised to reflect requirements presented in the WCPIP, Revision 2. SRS-CCP provided freeze file[5] modifications (Reference U834) that adequately addressed the deficiencies. As revised through the freeze file modifications, the Certification Plan is adequate, noting that future certification plans may be modified and streamlined to more clearly address WCPIP requirements.

(3) The waste qualification pathway was identified and documentation of the approach was adequate (WCPIP, Revision 2, Figure 2, p.15, Sections 5.0-5.4).

SRS-CCP employed several different qualification methods. VE was not performed under CCP's approved VE program, so the VE records were considered AK. SRS-CCP received EPA approval of an equivalent quality assurance (QA) program demonstration for VE as part of the baseline approval of Waste Stream BCLDP.001, which extends to the use of VE for Waste Stream SR-RL-BCLDP.002.

The radiological composition was determined using both AK and measurements; AK data were used to determine the basic isotopic composition of the vitrified waste that was subsequently used in modeling and other characterization activities. The AK data were qualified by the use of corroborating data, the details of which were included in CCP-AK-SRS-501, Revision 9, Appendix A [see Section 6.2, (2)]. The WCPIP, Revision 2 states: "The use of corroborating data will be described in a report (e.g., Radiological Technical Report) that will describe the source of the data, define the AK information that the data are intended to qualify, present or summarize

[5] As a result of a T1 evaluation-related EPA issue, SRS-CCP may have to revise a document. SRS-CCP makes the change(s) and provides the revised document to EPA as a *freeze file* to serve as objective evidence for the evaluation. SRS-CCP's document control process then generates an official version of the revised document.

the data, justify the use of the data, describe the reasons why the data are considered reliable, and explain any limitations associated with the data." EPA determined that CCP-AK-SRS-501, Revision 8, did not initially include this information, and SRS-CCP submitted CCP-AK-SRS 501, Revision 9 on May 12, 2011, that more fully explained the use of corroborating data. The revised text provided the information required by the WCPIP.

The Certification Plan states that because ORIGEN2.2 was confirmed as a result of a comparison with qualified smear samples, the same modeling can be used to qualify the isotopic composition of the simulated waste. Specifically, ORIGEN2.2 has been shown to adequately model decay and in-growth of light-water reactor (LWR) fuel and was approved by EPA in the SRS BCL RH baseline. SRS-CCP used ORIGEN2.2 to determine the isotopic composition of this waste based on burnup and enrichment data presented in a PNL report (Reference P1003). PNL used the same fuel pins for which the burnup and enrichment data were available were to create the mock HLW with the Purex-like process. The original fuel pin data are not available, only the summary report is available (Reference P1003), so SRS-CCP compared the PNL HLW analytical results and modeling to determine if they were sufficiently comparable to qualify the original fuel pin data. The modeling results and analytical results compared well, thus achieving this qualification.

Confirmation through modeling was included in EPA's original SRS BCL RH baseline approval and is described in CCP-AK-SRS-501, Revision 8. The WCPIP, Revision 2 includes an explicit requirement about this type of qualification and states that the use of modeling as "confirmatory" testing is considered a method outside what is described in the WCPIP, thus requiring preparation of a confirmation testing approach to be included in the Certification Plan and approved by CBFO. However, because this T1 evaluation is similar to what EPA approved in its baseline inspection, EPA does not require additional information for the qualification pathway. Any future submission that includes this approach must follow the technical requirements presented in Section 5.3 of the WCPIP, Revision 2. Based on the above, the qualification process was adequately described in the Certification Plan. Table 2 summarizes the elements requiring qualification and the qualification methodology employed.

Table 2. AK Qualification Methods for Waste Stream SR-RL-BCLDP.002

Item	Qualification Method	Location of Method Description	Comment
Physical Parameters	Equivalent QA of BCL VE process	CCP-AK-SRS-502, Revision 3	EPA approved the equivalent QA program as part of the BCL Baseline
Radiological Parameter- PNL analytical results	Confirmatory ORIGEN2.2 Modeling	CCP-AK-SRS-502 Revision 3, CCP-AK-SRS-501, Revision 8 Attachment A	Modeling used to confirm original AK fuel pin data
Radiological Parameter- PNL process preparation	Corroborating Data	CCP-AK-SRS-502 Revision 3, CCP-AK-SRS-501, Revision 8 Attachment A	Corroborating data used to verify decontamination factors for U and Pu

(4) Example Nonconformance Documentation and Discrepancy Resolution was examined and found to be adequate (WCPIP, Revision 2, Section 3.4.2.3, p. 24).

No Non-Conformance Report (NCR) were generated during characterization of this waste stream. SRS-CCP has provided example NCRs for other waste streams and because the NCR process remains the same under WCPIP, Revision 2, demonstration of continued adequacy of the NCR process is not required for this T1 request. SRS-CCP provided DR1001 that described initial documentation suggesting Waste Stream SR-RL-BCLDP.002 was HLW and may contain prohibited items, a determination that was subsequently resolved by a more thorough review of VE and AK information [see (7) and (12), below]. SRS-CCP demonstrated adequate implementation of the discrepancy resolution process.

(5) The Acceptable Knowledge procedure was examined and found to be adequate and appropriately implemented (WCPIP, Revision 2, Section 4.1, pp. 32-33).

During the WCPIP revision process, AK procedural requirements were removed from WCPIP, Revision 0d, Appendix A, and placed into procedure CCP-TP-005, Revision 22. Data were assembled for this T1 change while this transition was occurring, i.e., EPA determined this T1 request to be complete April 4, 2011, and CCP-TP-005, Revision 22 and related attachments (Nos. 1, 4, 6, and 8) were approved on April 29, 2011. Because this is the only waste stream to be processed during this transition and because CCP-TP-005, Revision 23 must contain all relevant AK procedures from WCPIP, Revision 0d, EPA reviewed the AK process for this T1 change against Appendix A. EPA also reviewed CCP-TP-005, Revision 22 to ensure that all pertinent requirements from WCPIP, Revision 0d were adequately transferred. EPA identified discrepancies in the new AK procedures in the areas of: EPA regulatory requirement citations and waste stream definition; documentation of required auditable record maintenance; container-specific data acquisition; waste correlation; and prohibited item. EPA found that procedure CCP-TP-005, Revision 22 reflected all applicable WCPIP requirements, and that there was adequate implementation of the AK process based on WCPIP, Revision 0d, Appendix A.

(6) The Acceptable Knowledge Summary Report was examined, along with associated source documents and reference list, and found to be adequate (WCPIP, Revision 2, Section 4.1, p. 31).

The AKSR included information about the BCL decontamination and decommissioning (D&D) debris Waste Stream SR-RL-BCLDP.001 and Waste Stream SR-RL-BCLDP.002. The AKSR contained numerous incorrect references and did not adequately address AK pertaining to generation of the waste used in the Sabotage Program, including: the general radiological composition of the original fuel pins; the processes used to generate the mock HLW; and, characteristics of the waste from the vitrification program. The AKSR did not explain the SRS-CCP radiological characterization approach used for SR-RL-BCLDP.002 and did not present the complete qualification process as required in WCPIP, Revision 2. SRS-CCP revised the AKSR and the revision adequately addressed these concerns.

SRS-CCP provided the source document list pertinent to this waste stream, but it was incomplete because it did not include all source documents associated with CCP-AK-SRS-501 as well as new source documents that were identified during the course of EPA's review. SRS-CCP provided a final revised list that included all missing references, and the revised list is adequate.

(7) The radiological and physical properties of the waste stream were examined and found to be adequately described based on AK (WCPIP, Revision 2, Section 3.0, p. 13).

CCP-AK-SRS-500, Revision 5 and CCP-AK-SRS-501, Revision 9 contain AK information pertinent to the the waste stream's physical and radiological composition. Waste Stream SR-RL-BCLDP.002 is composed of a single drum containing a drum liner of debris from the Sabotage Program. SRS-CCP originally segregated this drum for additional examination because it was discovered upon review of drum loading tapes (U517) that small sealed cylinders or casks were placed in the liner, but the contents of these containers were not examined by BCLDP during VE (DR1001). SRS-CCP representatives assembled AK information such as drawings and pictures of items in the sealed cylinders and casks that provided information about the physical form of the material tested and the resulting waste, and compared that information against every item loaded into the drum evidenced on the drum loading tapes. SRS-CCP determined that the sealed mock casts and canisters contained vitrified waste from PNL, based on extensive comparison of original experimental and photographic documentation of the "unshot" casks/canisters and the video record, which shows the same casks/canisters with "shot holes" from the Sabotage experiment. Drum loading tapes also showed that Drum No. BC0148 contains two empty model casks from an earlier unrelated experiment involving simulated terrorist attacks on a cask containing mock SNF.

SRS-CCP performed VE in 2010 by examining the video and paper waste loading records and documented their examination in VE BDR No. RHSRSVE100006, which EPA evaluated. There were minor inconsistencies with the VE BDR, specifically:

- Question No. 5 on the Site Project Manager's (SPM) checklist was answered incorrectly, but a correction was added to the comments section and it is unclear why the SPM did not make and document the correction at the time of his/her review
- The BDR contains a spreadsheet listing recording start and stop times which the EPA VE technical lead had not seen before and in the future the VE tape would be reviewed to ensure that the camera resumes at the exact place it had stopped to ensure nothing had been missed during the recording down time
- The List of Qualified Individuals (LOQI) in effect when VE was performed was not available to EPA and the training of the VE Operators could not be independently verified

EPA's review confirmed that neither prohibited items nor liquids were observed, and the VE BDR was adequate.

SRS-CCP representatives discovered that none of the mock fuel pins were in the model casks, so this waste did not contribute to the radiological composition of the waste but did affect the

overall Waste Material Parameters (WMP) content. SRS-CCP concluded that Drum No. BC0148 contains material generated from the Sabotage Program on mock HLW and metal from other experiments that did not impact the radiological composition of the waste, and is composed primarily of metal debris from the waste canisters and casks with small quantities of (vitrified) mock HLW (C1000, P1002, P1003, and P1005). The liner in Drum No. BC0148 contains a pipe component holding the Sabotage Program that is secured by three dunnage rings composed of cellulosic material. Based on this information, the waste stream is composed of approximately 98% metal by weight including program shot blocks, model cases and canisters, and sweepings; a small amount of floor-dry was added to the drum as a precautionary measure to absorb any liquids. No liquids were observed by SRS-CCP representatives reviewing the VE tapes (References C1001, U515, and U517). The physical composition of the waste is adequately described.

Table 3. Augmented Radionuclide Concentrations in Simulated High-Level Radioactive Waste (Reference P726)

Radionuclide	Concentration (g/L)
U-238	1.1×10^{-1}
U-235	6.4×10^{-4}
U-234[a]	2.1×10^{-5}
U-236[a]	4.6 x 10-^{4}
Np-237[b]	1.8 x 10-^{1}
Pu-238	1.8 x 10-^{5}
Pu-239	5.5×10^{-4}
Pu-240	2.8×10^{-4}
Pu-241[c]	1.4×10^{-4}
Pu-242	7.0×10^{-5}
Am-241	4.3×10^{-2}
Am-242[d]	1.4×10^{-4}
Am-243[d]	1.0×10^{-2}
Cm-243[e]	3.7×10^{-5}
Cm-244	3.0×10^{-3}
Cm-245[e]	1.3×10^{-4}
Cm-246[e]	1.5×10^{-5}
Ru-106	5.1×10^{-4}
Cs-134	4.1×10^{-3}
Cs-137	3.9×10^{-1}
Ce-144	3.1×10^{-4}
Eu-154	4.9×10^{-3}

Concentrations are as of 10/08/1980, about 6.75 years after the fuel was discharged from the reactor.
Source: Walters and Ebersole (1983) (Reference P1001)
[a]Based on the measured ^{238}U concentration
[b]Based on the measured ^{137}Cs concentration
[c]Based on the measured ^{242}Pu concentration
[d]Based on the measured ^{241}Am concentration
[e]Based on the measured ^{244}Cm concentration

The radiological composition of the waste stream and its generation are described in several source documents (References P1001, P1002, P1003, and P726), as well as the AKSR and CCP-

AK-SRS-501, Revision 8. The nuclear material used in the Sabotage Program originated in the Nuclear Waste Vitrification Project at PNL. PNL conducted laboratory analysis of the HLW generated, so the isotopic composition of the HLW prior to vitrification is documented (References P1003, and P726). Table 3 above was taken from Reference P726, and shows the augmented radionuclide concentrations in simulated HLW waste. This information was used to develop the radionuclide mass and activity percentages presented in Table 9 of the AKSR. Based on this information, the radiological composition of the HLW is adequately documented in the AK record.

(8) The waste stream information was examined and indicates the waste stream does not contain spent nuclear fuel or high level waste. (WCPIP, Revision 2, Section 2.2.7, p. 12).

The LWA prohibits the WIPP disposal of SNF fuel and HLW waste, as defined by the Nuclear Waste Policy Act (NWPA). The NWPA states SNF is "fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing." The *DOE Radioactive Waste Management Manual* expands on this definition and states that, "test specimens of fissionable material irradiated for research and development only, and not production of power or plutonium, may be classified as waste, and managed in accordance with the requirements of this Order when it is technically infeasible, cost prohibitive, or would increase worker exposure to separate the remaining test specimens from other contaminated material." HLW is defined by the NWPA as "the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations, and other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation."

AK records initially indicated that Drum No. BC0148 contained HLW, so it was segregated from the BCL debris drum population for further analysis. Subsequent evaluation by SRS-CCP showed that the drum contained simulated HLW in a vitrified form that originated from the Sabotage Program in which a small amount of test liquid was generated (References C1000, DR013, DR017, DR1001, and P1005). SRS-CCP concluded that this waste does not meet the definition of SNF because it does not contain any spent fuel material. Similarly, because the waste came from testing of a shipping cask with vitrified mock HLW from PNL and not from processing/reprocessing of nuclear material, SRS-CCP concluded that the waste does not meet the definition of HLW.

(9) The waste stream information was examined and indicates the waste stream is defense in origin (WCPIP, Revision 2, Section 2.2.7, p. 12).

The AKSR states that numerous activities were performed in the CAA and HEC, many of which were defense related including research and development work performed for the U.S. Air Force in support of the Aircraft Nuclear Propulsion Program and related reactor studies (References C501 and P501). Battelle also supported the development of the Army Package Power Reactor (APPR) Program and the destruction of defense chemical agents (References C001, C002, C014, and P501). In June 2005, SRS-CCP submitted a formal defense determination to the DOE CBFO for RH waste generated by the Building JN-1 Hot Cell Laboratory D&D activities that CBFO

approved it July 2005 (References C501, P041, P501, and P518). EPA also notes that the Sabotage Program was conducted to evaluate the effects of terrorist attacks on nuclear material in the interest of national defense. The defense determination is justified based on cross contamination with defense activities, the CBFO-approved defense determination, and the general intent of the Sabotage Program.

(10) The Waste Stream Profile Form and Attached Characterization Reconciliation Report were examined and found to be adequate (WCPIP, Revision 2, Section 3.4.2.1, p. 22).

Prior to implementation of WCPIP, Revision 2, SRS-CCP prepared two WSPFs, one that addressed WCPIP requirements and another that addressed requirements of the New Mexico Environment Department (NMED) Permit. With implementation of the WCPIP, Revision 2, SRS-CCP elected to generate a single WSPF that satisfied both the WCPIP and the NMED Permit. The WCPIP states that the WSPF must contain the following:

- WSPF Number
- Generator Site
- Technical Contact/Phone Number
- Generator Site EPA ID
- Summary Category Group
- Waste Stream Name and Description
- Number of Containers
- BDR numbers supporting waste stream characterization
- AKSR Number
- Site Project Manager (SPM) signature/date

The Characterization Reconciliation Report (CRR) is attached to the WSPF and must contain the following, at a minimum:

- Specification of applicable site and waste stream
- Listing of each DQO
- Data from the AK record that addresses each DQO
- AK source document references that support/provide the data
- Listing of AK record discrepancy resolutions, if any, that are relevant to each DQO
- Documentation, including specific references, of how the AK data for each DQO were qualified, such as BDRs, corroborative data, proceedings of a peer review
- Radiography and/or VE summary to document that prohibited liquids are absent from the waste and to confirm the physical properties of the waste
- Summary presentation of radiological data used to meet the DQOs and to confirm AK
- Complete AK summary (unless previously submitted)

- Complete listing of all container identification numbers used to generate the WSPF, cross-referenced to each BDR
- Signature of the Site Project Manager (SPM)

The WSPF did not specify the BDR or provide a detailed waste stream description, but it referenced and attached a Characterization Information Summary and AK Summation of Aspects. Both of these attachments are required to demonstrate WCPIP compliance. The draft CRR did not: adequately identify or reference the QA qualification methods; include HLW or SNF exclusions as a DQO; and indicate that DTC was used to quantify drum contents. A revised CRR was submitted that corrected these omissions. The original CRR was considered *Draft* and did not include the SPM's signature, and SRS-CCP's final WSPF and CRR included the required signatures. The Draft WSPF and revised CRR are adequate.

(11) The AK Accuracy Report was examined and found to be adequate; a Correlation or Surrogate Summary Form was not required (WCPIP, Revision 2, Section 3.2.2 pp. 17-19, and Section 4.1, p. 30).

SRS-CCP representative stated that there is no analogous contact-handled (CH) waste stream to SR-RL-BCLDP.002, so a Correlation or Surrogate Summary Form (CSSF) was not prepared. According to the AKSR and CCP-AK-SRS-501, the single drum in Waste Stream SR-RL-BCLDP.002 was characterized primarily using AK to develop scaling factors. The AK Accuracy Report correctly points out that the results of modeling (using AK as input) and historic sampling and analysis are in good agreement, and AK data were qualified by both the modeling comparison and corroborating data. The AK Accuracy Report is adequate.

(12) Drum data are traceable and are in the Acceptable Knowledge record (WCPIP, Revision 2, Section 3.4.4.1, p. 20; Section 3.4.2.2, p. 23, and Section 4.1, pp. 29-34).

SRS-CCP representatives indicated that there is no documentation regarding acceptance of the mock HLW at Battelle Columbus, and detailed records on the removal, staging, and testing of the material are not available other than what is in published reports (References P1000 and P1001). The Sabotage Program was conducted in the CAA and generated wastes including casks, sabotage shot blocks, cylinders, and metal debris; following testing, these were retained in the Cask Sabotage vessel in the CAA until 2002, when it was taken to the HEC for packaging (U514). Waste packaging removing the waste from the vessel and placing it into a central pipe component with a steel "liner," which was then placed into a larger liner that was inserted into a drum. The waste was described in detail on a TRU Waste Package Loading Record and each item was itemized as the waste was packaged; the packaging activity was also videotaped (Reference U517). Wastes described include liner dunnage (inert), the inner pipe component, inner steel liner, and two "Sabotage" casks. As indicated previously, one of these casks contained vitrified mock HLW, and the other cask was empty. A note on the November 2002 Loading Record indicates that the videotapes were reviewed in 2003, which clarified the lack of prohibited items [see (7)]. A Container Data Sheet was developed in 2005 that described the waste composition and expected radionuclide content in anticipation of shipment to SRS. The drum was shipped to SRS in 2005 where it is currently stored pending shipment to WIPP (References U517 and U514). Prior to shipment, external dose rate measurements were taken

and used in DTC calculations using radionuclide-specific scaling factors (see Section 6.2). Based on this information, the drum data are traceable and available in the AK record.

(13) AK Training was examined and found to be non compliant with a new WCPIP as discussed below (WCPIP, Revision 2, Section 4.1, p. 32).

The WCPIP indicates that characterization program personnel responsible for compiling AK, characterizing RH TRU waste streams using the AK process, and assessing the AK characterization shall be qualified and trained in the following:

- The WCPIP
- Characterization program NCR and corrective action processes
- Site-specific training relative to the site's waste streams, e.g., current AKSRs
- Determination of radiological contents of individual containers

The WCPIP, Revision 2 also states, in bold type on page 33, that the **"RH TRU characterization program is responsible for maintaining records of the training provided to personnel responsible for compiling AK."** The documentation for this one drum was prepared during transition from the old to the new WCPIP. Training documentation showing compliance with the WCPIP, Revision 2 was not provided. EPA interviews of the SRS-CCP AK personnel involved in characterizing this drum indicated that their training is adequate, but the objective evidence documenting this training is lacking. For future baseline inspections and T1 evaluations, EPA expects that CCP AK personnel are fully compliant with all applicable training requirements and that a written record of this training will be maintained by the RH TRU characterization program and be made available to EPA for use as objective evidence.

(14) Data Quality Objectives were evaluated and found to be adequately met (WCPIP, Revision 2, Section 3.4.2, p. 22).

The WCPIP, Revision 2 identifies the following DQOs that must be addressed:

Defense Waste, High-Level Waste, and Spent Nuclear Fuel Determination (Regulatory Basis: LWA): This is required to ensure that the waste stream was generated by atomic energy defense activities, is not HLW, and is not SNF. These are addressed in CCP-AK-SRS-500, Revision 5, and CCP-AK-SRS-502, Revision 3, as discussed in (9) and (8), above, respectively.

Radioactive Properties (Regulatory Basis: LWA, EPA Certification of the WIPP):

- *TRU Waste Determination:* Waste must contain more than 100 nanocuries (nCi) of TRU isotopes per gram of waste
- *RH Waste Determination:* Surface dose rate must be equal to or greater than 200 millirem per hour (mrem/hr) and less than 1,000 rem/hr
- *Activity Determination:* The total waste inventory can be no more than 5.1 million curies of RH TRU; activity limit per canister is 23 Ci per liter; and all radionuclides important to release calculations must be tracked

These three DQOs are addressed in CCP-AK-SRS-501, Revision 8, as discussed in Section 6.2, below.

Physical Properties (Regulatory Basis: EPA Certification of the WIPP):

- *Liquids:* The absence of liquids in excess of one percent must be confirmed
- *Physical Form:* The physical form of the waste to delineate the waste stream as required by the final certification rule must be determined

These two DQOs are addressed in VE BDR No. RHSRSVE100006, as discussed in (7) and (12), above.

EPA determined that the documents cited above including their freeze file changes supported that all DQOs were achieved and that AK data used to quantify parameters were adequately qualified.

Summary of Acceptable Knowledge Findings and Concerns

The EPA evaluation team did not identify any AK-related findings or concerns relative to the addition of Waste Stream SR-RL-BCLDP.002 during this T1 change evaluation.

Acceptable Knowledge Approval

Based on the results of this evaluation, EPA is approving the T1 request to add Waste Stream SR-RL-BCLDP.002.

6.2 Radiological Characterization

Radiological Characterization Overview

The nature of RH TRU wastes requires radiological characterization techniques based on the development of scaling factors that correlate an easily measured parameter like external dose rate[6] for specific radionuclides. The development of radionuclide scaling factors for Drum No. BC0148 is comparable to what EPA inspected and approved during the SRS-CCP RH baseline in August 2008 (see EPA Docket No. A-98-49; II-A4-104), and one subsequent T1 evaluation in September 2010 (see EPA Docket No. A-98-49; II-A4-129). The development of the cesium-137 (^{137}Cs)-based scaling factors was supported by the following two major sources of information:

- AK on the generation of Waste Stream SR-RL-BCLDP.002 and the contents of Waste Drum No. BC0148, as documented in CCP-AK-SRS-500, Revision 5

[6] The criterion for RH determination is expressed in terms of a *dose rate* in Rem, which, while technically incorrect, is widely used. The term *dose rate* as used in this report represents the measured gamma radiation and can be thought of as equivalent to the more correct unit to express Rem, i.e., a dose equivalent rate.

- Radiological Characterization report CCP-AK-SRS-501, Revisions 8 and 9, Appendix A that discussed, among other details: Point Beach Nuclear Station fuel characteristics; Purex process, decontamination factors for U and plutonium (Pu); adjustment of the simulated HLW uranium composition by addition of depleted uranium (DU) (Reference P1003); and ORIGEN2.2 computer runs to determine radionuclide activity distributions

The radiological characterization methods used for the BCLDP-CCP RH TRU wastes were evaluated in terms of adequacy, procedures, and controls as supported by the program's documents, along with the knowledge and understanding of the personnel involved in RH waste characterization. During this T1 evaluation, EPA evaluated the following elements of the SRS-CCP radiological characterization program:

- Measurement of the container's external gamma dose rate and determination of the drum's ^{137}Cs concentration
- Development of a DTC relationship based on ^{137}Cs for container No. BC0148 at a calculated waste density using MicroShield® to model the one-meter gamma dose rate based on a one-curie (Ci) source of ^{137}Cs, assuming this was the main contributor to the measured dose rate
- Derivation of radionuclide scaling factors for the WIPP-tracked radionuclides using the ORIGEN2.2 computer code
- Determination of the activities of the WIPP-tracked radionuclides based on the drum's measured dose rate, DTC correlation, and scaling factors

Documents Reviewed

All SRS-CCP RH radiological characterization documents that were reviewed to support this evaluation are listed in Attachment B. There are no DTC BDRs for this evaluation and the radionuclide results are documented in CCP-AK-SRS-501, Revision 9, Appendix A, Attachment A2.

Radiological Characterization Technical Evaluation

(1) The overall radiological characterization process was technically adequate and appropriately documented.

The components of the process to characterize Drum No. BC0148 are presented in Figure 1, below. This radiological characterization process was comparable to what EPA inspected and approved during the SRS-CCP RH baseline in August 2008 and one subsequent T1 evaluation in September 2010 cited earlier. The radiological characterization was found to be technically adequate and appropriately documented.

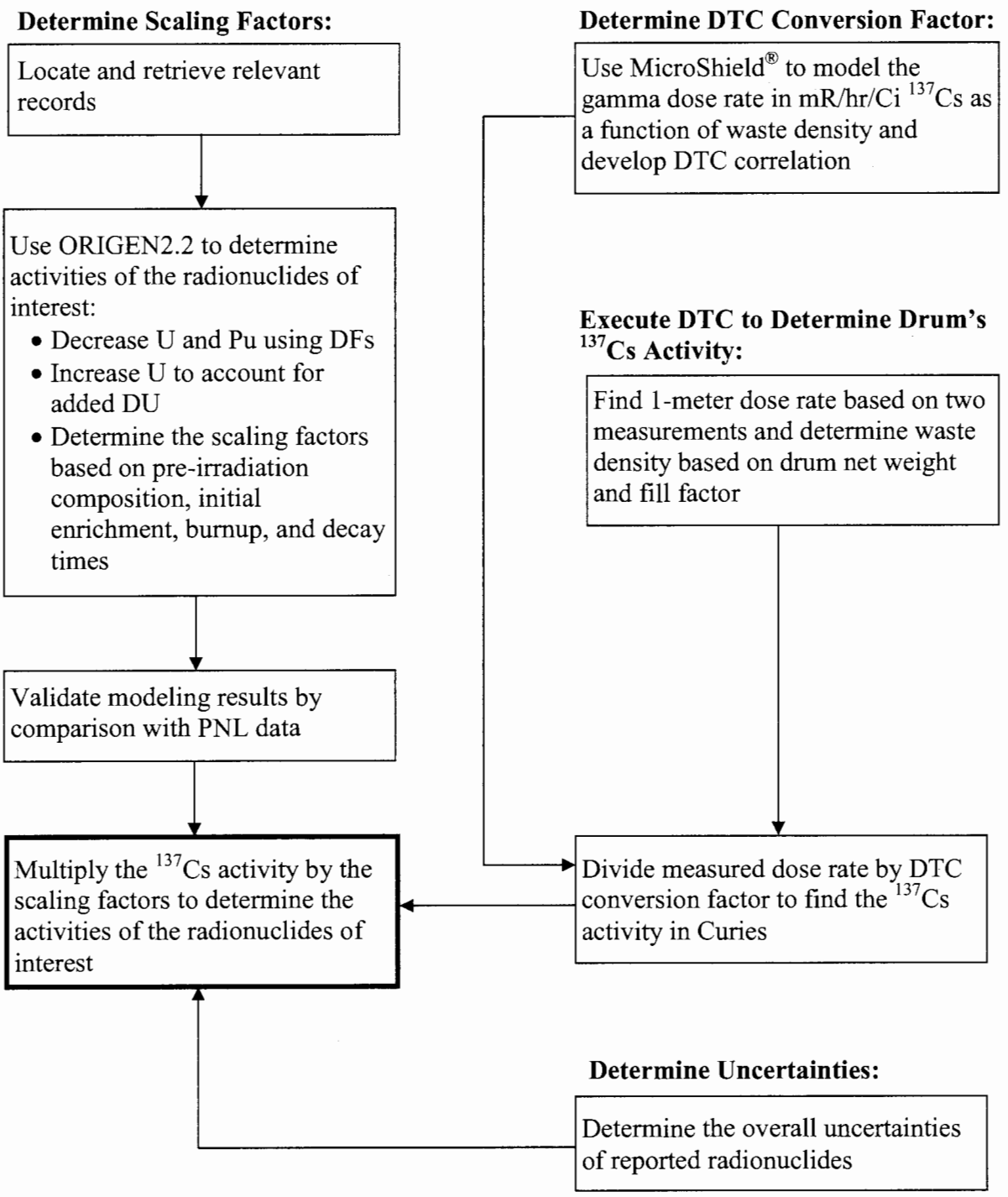

Figure 1. Flow Diagram of the Characterization Process for SR-RL-BCLDP.002

(2) The development of scaling factors based on cesium-137 was found to be technically adequate and correctly documented.

The elemental compositions of the feed material for the Purex process and the simulated HLW from the vitrification process were provided in units of the mass of the fission product and actinide elements (Reference P1003), and was identified as corroborating data. Initially, CCP-AK-SRS-501, Revision 8 did not include sufficient information regarding this aspect and Revision 9 was provided on May 12, 2011. The revised document provided more detail, specifically citations of eight technical references from Reference P1003, shown as Table A3-4 in CCP-AK-SRS-501, Revision 9. These data were used to calculate the decontamination factors (DFs) for the Purex process. A DF is defined as the ratio of the mass of constituent X in vitrified HLW to the mass of constituent X in the feed material. DFs were calculated for U and Pu, and were determined to be 8.94×10^2 and 3.42×10^2, which correspond to recovery efficiencies of 99.88% and 99.71%, for U and Pu, respectively. These values are well within the range of the literature values from Table A3-4 cited above. This use of corroborating data was adequate.

This information and the ORIGEN2.2 results for the Point Beach Fuel led to the derivation of activity distributions in the simulated HLW glass and determination of the scaling factors. Two ORIGEN2.2 computer analyses were performed. Six fuel assemblies from the Point Beach Nuclear Station were used to feed the two vitrification runs in two batches—a low-burnup batch and a high-burnup batch—and each batch comprised three assemblies. The pre-irradiation fuel composition data (initial enrichments), burnup information, and decay times were used as input data to ORIGEN2.2. One set of runs considered October 8, 1980 to compare the calculated elemental masses with those reported in the PNL report. The ORGEN2.2 results were in good agreement with the PNL-reported values with a ratio of approximately 1, with the exception of a couple of elements. The differences may be attributed to the slight discrepancy between the date selected for decay correction for the ORIGEN2.2 analyses and the date reported for the vitrification analyses performed by PNL in 1979, as stated in CCP-AK-SRS-501, Revision 9.

The second set of ORIGEN2.2 analyses used a reference date of October 24, 2010 for the scaling factors. It was assumed that the radionuclide distribution in Drum No. BC0148 was represented by the distributions of both analyses statistically weighted by their contributions to the total mass, as detailed in CCP-AK-SRS-501. The results of the second set of analyses were subject to corrections for two aspects: reduction in the U and P activities (dividing by the DFs); and the increase in the U due to the addition of DU to the simulated HLW to achieve the desired concentration in the glass. After the necessary corrections, the activities from the second set of analyses were used to develop a single set of ^{137}Cs-based scaling factors for Drum No. BC0148, which are provided in Table 5 below. There were no concerns regarding the technical adequacy or documentation of the ^{137}Cs-based scaling factors developed for Drum No. BC0148.

Table 4. Drum BC0148 Scaling Factors

Radionuclide	Scaling Factor, Ci Radionuclide/Ci ^{137}Cs
U-233	1.64E-12
U-234	4.34E-08
U-235	1.06E-09
U-238	5.01E-08
Pu-238	9.80E-05
Pu-239	2.44E-05
Pu-240	3.67E-05
Pu-241	1.51E-03
Pu-242	1.02E-07
Am-241	8.33E-02
Cm-244	7.05E-03
Sr-90	6.88E-01
Cs-137	1.00E+00
Eu-154	8.64E-03
Cm-243	1.12E-04
Cm-245	2.27E-06

(3) Computer modeling for Dose-To-Curie correlation was assessed and found to be technically adequate and appropriately documented.

The MicroShield® computer code was used to develop DTC correlations at the nominal density of 2.91 g/cm^3 based on container's tare and gross weights, using a 1-curie ^{137}Cs source in a 55-gallon drum. The actual drum configuration consisted of the waste in a one-inch steel shield inside of a pipe component (liner), which was inside a 55-gallon steel drum, as described in Section 6.1. This is represented in CCP-AK-SRS-501, Revision 9, Appendix A, Figure A4-1. The technical details of the modeling are provided in Reference P820, *Dose-to-Curie Derivation for Cs-137*, SRS-RH-37. There were no concerns regarding the DTC correlations based on modeling for Drum No. BC0148.

(4) Correlation of radionuclide values to the cesium-137 concentration to determine the activities of the 10 WIPP-tracked radionuclides was evaluated and found to be adequate.

The application of the DTC correlation factor to determine the ^{137}Cs concentration in the drum was derived by dividing the arithmetic mean of two one-meter dose measurements made at mid-point of the drum on opposite sides by the DTC correlation factor. The dose measurements that were used to quantify the radionuclides of interest in the drum were performed by BCL; SRS-CCP did not make any new dose rate measurements. These measurements were combined with the radionuclide-specific scaling factors to produce the list of radionuclides reported for Drum No. BC0148 in CCP-AK-SRS-501, as follows: ^{233}U, ^{234}U, ^{235}U, ^{238}U, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, americium-241 (^{241}Am), curium-244 (^{244}Cm), ^{245}Cm, ^{137}Cs, ^{137m}Ba (^{137}Cs progeny), strontium-90 (^{90}Sr), and yttrium-90 (^{90}Y) (^{90}Sr progeny). This list goes beyond the 10 WIPP-tracked radionuclides because for transportation purposes, SRS-CCP must report all radionuclides that contribute to at least 95% of the radionuclide hazard, at least 95% of the thermal loading and any radionuclide that contributes greater than one percent of the total, which

includes ^{244}Cm, ^{137m}Ba and ^{90}Y[7]. Additionally, for criticality purposes, the ^{235}U and ^{245}Cm values must be considered. The determination of the WIPP-tracked radionuclides was found to be technically adequate and correctly documented.

(5) The technical basis and derivation of total measurement uncertainty were evaluated and found to be adequate.

The development of Total Measurement Uncertainty (TMU) is based on the propagation of uncertainties present in the determination of the radiological constituents of for Drum No. BC0148. These aspects are assumed to be independent, which allows them to be added in quadrature[8]. The TMU determination included contributions of the following:

- ^{137}Cs DTC correlation – MicroShield® code, MicroShield® modeling, and waste density uncertainties
- ^{137}Cs activity measurement – dose rate measurement uncertainty and uncertainty due to the contribution of other gamma-emitting radionuclides
- Scaling factor uncertainty – including contributions of ORIGEN2.2 benchmark uncertainty and the uncertainty in the ^{137}Cs benchmark results, as the scaling factors are defined relative to ^{137}Cs; uncertainty in decontamination factor; the DFs for U and Pu; and uncertainty in the composition of the simulated HLW used in the Sabotage Program capsules

A general treatment of TMU for RH TRU Waste Stream SR-RL-BCLDP.002 is presented in CCP-AK-SRS-501 and in *Uncertainty Analysis for Sabotage Drum,* Calculation Package SRS-RH-39 (Reference P822). The overall uncertainties for Drum No. BC0148 are provided in Table 6, below. There were no concerns regarding the technical derivation and documentation of TMU for Drum No. BC0148 in SRS-CCP Waste Stream SR-RL-BCLDP.002.

[7] Transportation is not within EPA's regulatory purview; however, this information may be useful in understanding a container's radionuclide composition.

[8] Adding in quadrature is a standard statistical technique that allows one to combine the square root of the sum of each contributor to uncertainty squared, resulting in a lower value than what would be obtained by simply adding the values. For example, the total uncertainty for ^{239}Pu is derived by taking the square root of $(36.3\%)^2$ plus $(20.1\%)^2$ which equals 41.9%, which is less than 56.4%, obtained by simply adding the values if the values had simply been added, i.e., 56.4%, as shown in Table 5, below.

Table 5. Overall Uncertainty for SRS-CCP Drum No. BC0148

Radionuclide	^{137}Cs Uncertainty	Total Scaling Factor Uncertainty	Total Uncertainty
U-233	36.3%	44.5%	57.4%
U-234	36.3%	44.7%	57.6%
U-235	36.3%	19.6%	41.2%
U-238	36.3%	10.4%	37.8%
Pu-238	36.3%	34.2%	49.9%
Pu-239	36.3%	20.1%	41.5%
Pu-240	36.3%	27.4%	45.5%
Pu-241	36.3%	54.0%	65.1%
Pu-242	36.3%	46.7%	59.1%
Am-241	36.3%	45.9%	58.6%
Cm-244	36.3%	96.2%	102.8%
Cm-245	36.3%	96.8%	103.4%
Sr-90	36.3%	8.2%	37.2%
Y-90	36.3%	8.2%	37.2%
Cs-137	36.3%	0.0%	36.3%
Ba-137m	36.3%	0.0%	36.3%
TRU	36.3%	45.9%	58.5%
FGE	36.3%	22.1%	42.5%
PE-Ci	36.3%	44.0%	57.1%
Decay Heat	36.3%	12.2%	38.3%
Total Activity	36.3%	7.1%	37.0%

(6) The remote-handled determination of Drum No. BC0148 was evaluated and found to be adequate.

SRS-CCP did not make any independent dose rate measurements of Drum No. BC0148; all dose rate measurements of Drum No. BC0148 in support of the drum's status as RH waste were performed at BCL, as described in CCP-AK-SRS-501, Revision 9, and CCP-AK-SRS-503. SRS-CCP documentation states that the dose rate measurements were performed by operators who were required to use BCL radiation survey procedure HP-OP-019, specifying that dose rate measurements be recorded on BCL Form DDO-138 survey forms (Reference U514). These measurements were performed under the BCLDP measurement program and are of the same pedigree as what EPA approved during the SRS-CCP baseline inspection (see EPA Docket No. A-98-49; II-A4-104). A copy of the container data sheet for Drum (Liner) No. BC0148 is provided in CCP-AK-SRS-501, Revision 8, Attachment A2, and it shows dose rates at the drum surface (contact) and one meter, the lowest of which is 5,000 mR/hr (container top, contact). The average one-meter dose taken at the drum centerline is 14,500 mR/hr, based on the two readings of 10,000 mR/hr and 19,000 mR/hr, as shown in Attachment A2. These measurements are clearly in excess of 200 mrem/hr, as required to meet the RH criterion. There are no concerns regarding the RH determination of Drum No. BC0148.

(7) The transuranic determination of Drum No. BC0148 was evaluated and found to be adequate.

The radionuclide values of record for Drum No. BC0148 are provided in CCP-AK-SRS-501, Revision 9, Appendix A, Table A4-1 and are not in a DTC BDR, as discussed in (4), above. The data presented indicate that Drum No. BC0148 is TRU, i.e., it contains more than 100 nCi/g of TRU radionuclides with a stated TRU Alpha Activity Concentration of 3.18×10^5 nCi/g. There are no concerns regarding the TRU determination of Drum No. BC0148.

Summary of Radiological Characterization Findings and Concerns

The EPA evaluation team did not identify any radiological characterization-related findings or concerns relative to the addition of Waste Stream SR-RL-BCLDP.002 during this T1 change evaluation.

Radiological Characterization Approval

Based on the results of this evaluation, EPA is approving the T1 request to add Waste Stream SR-RL-BCLDP.002.

7.0 FINDINGS OR CONCERNS

Summary of Findings and Concerns

The EPA inspection team did not identify any findings related to AK or radiological characterization. EPA worked interactively with their SRS-CCP counterparts to answer questions, identify information needs, and acquire necessary data and references; all potential issues were resolved in a timely fashion. There are no open concerns related to AK or radiological characterization resulting from this T1 evaluation.

8.0 CONCLUSIONS

EPA concluded that the waste characterization processes of AK and radiological characterization used to characterize Drum No. BC0148 of RH TRU waste from BCLDP Waste Stream SR-RL-BCLDP.002 are adequate, as evidenced by the records evaluated. There are no open issues relative to this T1 evaluation.

Approval

This T1 change consisted of the waste characterization techniques of AK and radiological characterization as applied to Drum No. BC0148 from BCLDP Waste Stream SR-RL-BCLDP.002. Based on the results of this evaluation, EPA approves this T1 change for Waste Stream SR-RL-BCLDP.002, consistent with the limitations specified in this report.

9.0 REFERENCES

U.S. Environmental Protection Agency, "Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Certification Decision; Final Rule," *Federal Register*, Vol. 63, No. 95, May 18, 1998, pp. 27354, 27405.

U.S. Code of Federal Regulations, *Title 40, Protection of Environment*, Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes."

U.S. Code of Federal Regulations, *Title 40, Protection of Environment*, Part 194, "Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations."

U.S. Department of Energy, Office of Environmental Management, "Radioactive Waste Management Manual," DOE M435.1-1, July 9, 1991, Change 1: June 19, 2001.

U.S. Department of Energy, Carlsbad Field Office, "Remote Handled TRU Waste Characterization Program Implementation Plan," DOE/WIPP-02-3214, Revision 0D, Carlsbad, New Mexico, October 30, 2003.

U.S. Department of Energy, Carlsbad Field Office, "Remote Handled TRU Waste Characterization Program Implementation Plan," DOE/WIPP-02-3214, Revision 2, Carlsbad, New Mexico, April 21, 2011.

U.S. Department of Energy, Title 40 CFR Part 191, Compliance Certification Application for the Waste Isolation Pilot Plant, DOE/CAO 1996-2184, Carlsbad, New Mexico, 1996.

U.S. Department of Energy, Title 40 CFR Part 191, SUBPART D AND C, Compliance Recertification Application 2004, DOE/WIPP/2004-3231.

U.S. Department of Energy, "Remote-Handled Transuranic Waste Authorized Methods for Payload Control (RH-TRAMPAC)," Carlsbad, New Mexico.

Attachment A:

Summary of Approvals
Battelle Columbus Laboratory Waste Streams Approved for Characterization by SRS-CCP

Waste Stream	No. of Approved Containers	SCG and Brief Description of Waste	EPA Approval Date	EPA Docket No.
SR-RL-BCLDP.001[9]	87	S5000 – Debris	August 2008	A-98-49; II-A4-104
SR-BCLDP.001.001	5	S3000 – Homogeneous waste	September 2010	A-98-49; II-A4-129
SR-BCLDP.001.002	4	S5000 – Composite filter debris	September 2010	A-98-49; II-A4-129
SR-BCLDP.002	1	S3000 – Cemented slugs	September 2010	A-98-49; II-A4-129
SR-BCLDP.003	7	S3000 – Hydraulic sludge and debris	September 2010	A-98-49; II-A4-129
SR-BCLDP.004.002	5	S5000 – Cartridge water filters	September 2010	A-98-49; II-A4-129
SR-BCLDP.004.003	2	S5000 – Tri-Nuc vacuum filters	September 2010	A-98-49; II-A4-129
SR-RL-BCLDP.002	1	S5000 – Sabotage Drum	June 2011	A-98-49; II-A4-149

[9] The 20 containers of debris waste stored at the Hanford Site are part of this Waste Stream, but are not approved for characterization.

Attachment B:

SRS-CCP DOCUMENT REFERENCE LIST

CCP-AK-SRS-500, Central Characterization Project Acceptable Knowledge Summary Report for Battelle Columbus Laboratories Decommissioning Project (BCLDP) Remote-Handled Transuranic Debris Waste From the Building JN-1 Hot Cell Laboratory Waste Streams: SR-RL-BCLDP.001 and SR-RL-BCLDP.002, Revision 5, September 20, 2010

CCP-AK-SRS-501, Central Characterization Project Remote-Handled Transuranic Radiological Characterization Technical Report for Remote-Handled Transuranic Waste from Battelle Columbus Laboratories Decommissioning Project at the West Jefferson North Facility, Revision 8, March 28, 2011

CCP-AK-SRS-501, Central Characterization Project Remote-Handled Transuranic Radiological Characterization Technical Report for Remote-Handled Transuranic Waste from Battelle Columbus Laboratories Decommissioning Project at the West Jefferson North Facility, Revision 9, May 12, 2011

CCP-AK-SRS-502, Central Characterization Project RH TRU Waste Certification Plan for 40 CFR Part 194 Compliance and Confirmation Test Plan for BCLDP RH Waste Streams: SR-RL-BCLDP.001 and SR-RL-BCLDP.002, Revision 3, March 3, 2011

CCP-AK-SRS-503, Central Characterization Project Battelle Columbus Laboratory Decommissioning Project Quality Assurance Equivalency Report and Procedure Matrix for Remote-Handled Transuranic Debris Waste Revision 1, July 2, 2007

Acceptable Knowledge Accuracy Report, Waste Stream SR-RL-BCLDP.002 Lot 1, March 22, 2011

CCP-TP-005, CCP Acceptable Knowledge Documentation and Attachments 1, 4, 6, and 8, Carlsbad, New Mexico, Washington TRU Solutions, LLC, Revision 22, April 21, 2011

Characterization Reconciliation Report, Draft, CRR-SR-RL-BCLDP.002, provided May 12, 2011

C001, Interview Record E. Sands, L. Stickel, H. Toy, M. Berchtold, G. Kirsh, re: JN-1, by K. Peters and J. Harrison, May 1, 1998

C002, Packet of letters Addressing Destruction/Immobilization of Toxic Substances by Intense Gamma Irradiation, L. Lower, et al, various dates 1982 and 1983

C014, Interview Record of G. Kirsh and E. Sands, Use of Potassium Cyanide, Pool Water Evaporation, and Nerve Agent Research, K. Peters, October 22, 1988
C1000, Battelle Columbus Waste Drum (BC0148), High Level Waste Presentation, Mike Griffith, September 24, 2008

C501, Battelle defense Determination Approval, R. Tormey, June 28, 2005

C1001, Memorandum Waste Material Parameter Weight Evaluation for Waste Stream SR-RL-BCLDP.002, Kevin Peters, July 5, 2010

DR013, Discrepancy Resolution, Drum BC0148 Sabotage Waste Discrepancy, K Peters, July 27, 2007

DR017, BCLDP RH Waste Stream Delineation-Low-Level, CH, and High Level Waste Containers, K. Peters, February 12, 2008

DR1001 Discrepancy Resolution for BCL0148, Kevin Peters, August 18, 2010

P012, Controlled Access Area JN-1A, L. Myers et al., September 1, 1994

P041, Interim Guidance on Ensuring that Waste Qualifies for Disposal at the Waste Isolation Pilot Plant, Battelle Columbus Division, August 15, 1986

P071, Interim Report on Shipping Cask Sabotage Source Term Investigation to U. S. Nuclear Regulatory Commission, W. Schmidt et al., November 6, 1979

P072, Final Report on Shipping Cask Sabotage Source Term Investigation to U. S. Nuclear Regulatory Commission, E. Schmidt et al., September 1, 1982

P501, Building JN-1 Hot Cell Laboratory, Acceptable Knowledge Document TCP-98-03 Kevin J. Peters, WASTREN, Inc. August 2001

P518, Lessons Learned Report for the BCLDP Transuranic Waste Shipments to Hanford and the Savannah River Site for Interim Storage and the Final Characterization, J. Eide, November 2006

P726, Calculation Report for Radionuclide Inventory for the Sabotage Experiment Waste, S. Maheras, January 20, 2003

P819, Determination of the Scaling Factors for the Sabotage Drum, Jene Vance, SRS-RH-36, January 10, 2011

P820, Dose-to-Curie Derivation for Cs-137, Jene Vance, SRS-RH-37, January 10, 2011

P821, Determination of Reportable Radionuclides, Jene Vance, SRS-RH-38, January 10, 2011

P822, Uncertainty Analysis for Sabotage Drum, James Holderness, SRS-RH-39, January 10, 2011

P823, DTC Spreadsheet for Sabotage Drum, James Holderness, SRS-RH-40, January 10, 2011

P1000 Progress Report on High Level Waste Sabotage Source Term Investigation, Audeen Walters, September 9, 2003

P1001 Final Report on High Level Waste Sabotage Source Term Investigation, A. Walters and H. Ebersol, June 30, 1983

P1002 Engineering Scale Vitrification of High-Level Waste, PNL-3375, W.F. Bonner, April 1, 1980

P1003 Technical Summary, Nuclear Waste Vitrification Project, E.J. PNL 3038, Wheelright et al., May 1, 1979

P1005 Waste Classification for Battle Drum # BC-0148, SRNS J2000-2008-00015, no author, undated

U514 BCLDP RH Waste Container Documentation, BCLDP, various dates

U515 Waste Information Data System Report, 218-W-3AE, May 24, 2001

U517 BCLDP Container Packaging Video Loading Recordings, BCLDP, various dates

U834 Freeze File Modification of CCP-AK-SRS-502 addressing EPA comments, May 12, 2011