DOCKET NO: A-98-49, II-A4-129

WASTE CHARACTERIZATION REPORT

EPA TIER 1 EVALUATION OF THE CENTRAL CHARACTERIZATION PROJECT REMOTE-HANDLED TRANSURANIC WASTE CHARACTERIZATION PROGRAM BATTELLE COLUMBUS LABORATORIES DECOMMISSIONING PROJECT WASTES STORED AT THE SAVANNAH RIVER SITE FOR SIX WASTE STREAMS:

- **SR-BCLDP.001.001 - HOMOGENEOUS WASTE**
- **SR-BCLDP.001.002 - COMPOSITE FILTER DEBRIS**
- **SR-BCLDP.002 - CEMENTED SLUGS**
- **SR-BCLDP.003 - HYDRAULIC SLUDGE AND DEBRIS**
- **SR-BCLDP.004.002 - CARTRIDGE WATER FILTERS**
- **SR-BCLDP.004.003 - TRI-NUC VACUUM FILTERS**

November 2009 - March 2010

U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Center for Waste Management and Regulations
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ACRONYMS AND ABBREVIATIONS

AK	acceptable knowledge
AKE	acceptable knowledge expert
AKSR	Acceptable Knowledge Summary Report
Am	americium
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
Ci/Ci	curies per curie
Cm	curium
Co	cobalt
COC	Chain-of-Custody
CRR	Characterization Reconciliation Report
Cs	cesium
CSSF	Correlation and Surrogate Summary Form
CTAC	Carlsbad Technical Assistance Contractor
CTP	Confirmatory Test Plan
CTS	Commitment Tracking System
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DQO	data quality objective
DR	discrepancy resolution
DTC	dose-to-curie
EPA	U.S. Environmental Protection Agency
Eu	europium

g/cm^3	grams per cubic centimeter
HLW	high-level waste
LWR	light-water reactor
m	meter
mR/hr	milli Roentgen per hour
mR/hr/Ci	milli Roentgen per hour per curie
NCR	non-conformance report
NDA	nondestructive assay
NQA	Nuclear Quality Assurance
NWPA	*Nuclear Waste Policy Act*
ORIGEN	Oak Ridge Isotope Generation
PTS	Project Tracking System
Pu	plutonium
QA	quality assurance
RH	remote-handled
R_i	$radionuclide_i$
RTR	real-time radiography
SCG	Summary Category Group
SF	scaling factor
SNF	spent nuclear fuel
SPM	Site Project Manager
Sr	strontium
SRS	Savannah River Site
T1	Tier 1
T2	Tier 2
TMU	total measurement uncertainty
TRAMPAC	Transuranic Waste Authorized Methods for Payload Control
TRU	transuranic
U	uranium
VE	visual examination
WCPIP	Waste Characterization Program Implementation Program
WIPP	Waste Isolation Pilot Plant
WMC	waste matrix code

WMP	waste material parameter
WSPF	Waste Stream Profile Form
Y	yttrium

1.0 EXECUTIVE SUMMARY

This report supports the U.S. Environmental Protection Agency's (EPA or the Agency) approval of six retrievably stored, remote-handled (RH) transuranic (TRU) solid (S3000) and debris (S5000) waste streams that were generated at the Battelle Columbus Laboratory (BCL) facility and are currently in storage at the Savannah River Site (SRS).

- SR-BCLDP.001.001, Homogeneous Waste composed of five drums
- SR-BCLDP.001.002, Composite Filter Debris composed of four drums
- SR-BCLDP.002, Cemented Slugs composed of one drum
- SR-BCLDP.003, Hydraulic Sludge and Debris composed of seven 55-gallon drums
- SR-BCLDP.004.002, Cartridge Water Filters composed of five drums
- SR-BCLDP.004.003, Tri-Nuc Vacuum Filters composed of two drums

The Central Characterization Project (CCP) is responsible for characterizing these waste streams using the system of controls which EPA evaluated during the baseline inspection conducted from July - December 2007 and approved in May 2008 (see EPA Docket No. A-98-49, II-A4-99). The baseline approval included one retrievably stored RH TRU debris Waste Stream, SRS-RL-BCLDP.001, generated at the BCL Decommissioning Project (BCLDP).

The RH waste streams discussed in this report were generated at the BCL facility and are currently in storage at the SRS. These wastes were originally generated at BCL from 1955–1988, at which time decommissioning of the facility was initiated. These wastes were packaged or repackaged and shipped to sites including SRS, with final shipment to SRS in 2005 for ultimate disposal at the Waste Isolation Pilot Plant (WIPP).

Between July and October 2009, the Carlsbad Field Office (CBFO) provided documents for EPA review. Because there was no new equipment or processes on site at SRS to examine, EPA conducted the evaluation by desktop review from November 2009 through March 2010. Between March and May 2010, CBFO conducted a Peer Review of radiological data generated by the BCL that were used to develop scaling factors for two of the six RH waste streams (SR-BCLDP-004.002 and SR-BCLDP-004.003). EPA evaluated the technical information supporting the peer review independently and found that it was acceptable. This report presents the results of this Tier 1 (T1) evaluation. EPA determined that the procedures and processes used by SRS-CCP for the BCL RH TRU wastes were adequate.

EPA, therefore, approves this T1 change for the following six waste streams:

- SR-BCLDP.001.001, Homogeneous Waste composed of five drums
- SR-BCLDP.001.002, Composite Filter Debris composed of four drums
- SR-BCLDP.002, Cemented Slugs composed of one drum
- SR-BCLDP.003, Hydraulic Sludge and Debris composed of seven 55-gallon drums
- SR-BCLDP.004.002, Cartridge Water Filters composed of five drums
- SR-BCLDP.004.003, Tri-Nuc Vacuum Filters composed of two drums

EPA did not include a tiering table in its original baseline approval of the SRS BCLDP RH waste stream. EPA, however, will review the waste stream profile form (WSPF) for these six waste streams approved today as each WSPF is available as a Tier 2 (T2) change. EPA expects that the only additional BCL waste remaining to be evaluated for WIPP disposal are the 20 liners of debris waste stored at Hanford that are part of the waste stream approved in the baseline. Any other BCL waste must be approved under a separate baseline, including addition of any waste containers[1] to any approved waste streams. Any modifications to the documents reviewed as part of this evaluation need to be provided to EPA for review.

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. The U.S. Department of Energy (DOE) may choose to characterize and dispose of, at risk of subsequent EPA disapproval, any previously approved TRU waste using processes/procedures/equipment implemented as T2 changes. EPA reviews T2 changes on a quarterly basis and EPA may conduct continued compliance inspections to evaluate implemented T2 changes to verify adequacy.

3.0 PURPOSE OF THIS REPORT

This report presents the results of EPA's evaluation of six retrievably stored, RH TRU solid (S3000) and debris (S5000) waste streams that were generated at the BCL facility and are 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 the six BCLDP waste streams has been conveyed to DOE separately by letter. As discussed previously, EPA will also

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

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 six individual waste streams:

- Waste Stream SR-BCLDP.001.001 (homogeneous waste) is a Summary Category Group (SCG) S3000 homogeneous pressure wash and laundry sludge materials created during decontamination and decommissioning (D&D) and clean-out of the hot cells in the Building JN-1 Hot Cell Laboratory at the Battelle West Jefferson North Facility.
- Waste Stream SR-BCLDP.001.002 (composite filter debris waste) is a SCG S5000 debris and consists of filters used in the pressure wash and laundry processes, with an incidental amount of organic and inorganic absorbed materials.
- Waste Stream SR-BCLDP.002 is a single-drum waste stream that consists of about 300 cemented acid slugs generated in Alpha-Gamma Hot Cell 7 by the BCLDP program during repackaging of historic waste materials generated during Building JN-1 operations.
- Waste Stream SR-BCLDP.003 is an SCG S3000 homogeneous hydraulic sludge generated during clean-out of the hot cells in the Building JN-1 Hot Cell Laboratory at the Battelle West Jefferson North Facility. The sludge also contains debris particles.
- Waste Stream SR-BCLDP.004.002 is an SCG S5000 debris waste stream consisting of cartridge prefilters and debris generated during the change-out of resins used for filtering the Building JN-1 Transfer and Storage Pool water.
- Waste Stream SR-BCLDP.004.003 is an SCG S5000 debris waste stream consisting of Tri-Nuc filters that were used by the vacuum system used to clean the hard surfaces of the pool when the pool water was drained.

5.0 TIER 1 EVALUATION

This evaluation included two waste characterization areas: acceptable knowledge (AK) and radiological characterization. Each of the six waste streams was evaluated in the two areas. Personnel who participated in the T1 evaluation are listed in Table 1, along with each person's affiliation and function during the evaluation.

Table 1. T1 Evaluation Participants

Name	Affiliation & Function
Rajani Joglekar	EPA Headquarters, Lead Inspector
Ed Feltcorn	EPA Headquarters, Inspector
Connie Walker	SC&A, Technical Evaluator – AK
Patrick Kelly	SC&A, Technical Evaluator – Radiological Characterization
Kira Darlow	SC&A, Technical Evaluator – AK
Amir Mobasheran	SC&A, Technical Evaluator – Radiological Characterization
Jim Holderness	CCP, Technical Support – Radiological Characterization
Irene Quintana	CCP, AKE SPM
Kevin Peters	CCP, AKE
Steve Schafer	CCP, AKE
Jene Vance	CCP, Technical Support – Radiological Characterization

5.1 Report Organization

EPA examined the AK and radiological characterization processes and associated information to determine whether SRS-CCP demonstrated compliance with 40 CFR 194.8 for a T1 change to add these six BCLDP waste streams. Each of the waste streams is supported primarily by two documents, an AK Summary Report (AKSR) and a radiological characterization report, as shown in Table 2, below.

Table 2. Acceptable Knowledge Summary Reports and Radiological Reports for BCLDP RH Waste Streams

BCLDP Waste Stream	AKSR	Radiological Characterization Report
SR-BCLDP.001.001	CCP-AK-SRS-510	CCP-AK-SRS-511A
SR-BCLDP.001.002	CCP-AK-SRS-510	CCP-AK-SRS-511B
SR-BCLDP.002	CCP-AK-SRS-520	CCP-AK-SRS-521
SR-BCLDP.003	CCP-AK-SRS-530	CCP-AK-SRS-531
SR-BCLDP.004.002	CCP-AK-SRS-540	CCP-AK-SRS-541A
SR-BCLDP.004.003	CCP-AK-SRS-540	CCP-AK-SRS-541B

SRS-CCP chose to address the six waste streams in four separate AKSRs and six radiological characterization reports, as indicated above. This was done in part because some waste streams had common AK pertaining to the location of origin and waste generation procedures, even though separate waste streams with unique radiological characteristics resulted from these common elements. EPA accepted SRS-CCP's grouping and conducted this T1 evaluation by focusing on one waste stream at a time. A comprehensive listing of all the references SRS-CCP provided for each waste stream is presented in Attachment A.

5.2 Acceptable Knowledge

EPA examined the AK process and associated information to determine whether the SRS-CCP waste characterization program demonstrated compliance with the requirements of 40 CFR 194.8 for the following six RH TRU waste streams that were generated at BCL and are currently stored at SRS:

- SR-BCLDP.001.001, Homogeneous Waste composed of five drums
- SR-BCLDP.001.002, Composite Filter Debris composed of four drums
- SR-BCLDP.002, Cemented Slugs composed of one drum
- SR-BCLDP.003, Hydraulic Sludge and Debris composed of seven 55-gallon drums
- SR-BCLDP.004.002, Cartridge Water Filters composed of five drums
- SR-BCLDP.004.003, Tri-Nuc Vacuum Filters composed of two drums

Waste Characterization Element Description

As part of the T1 evaluation, EPA reviewed the following with respect to the use of AK for characterizing these six RH TRU waste streams:

- Waste stream identification and definition
- Radionuclide content of waste
- Physical composition of waste
- Sufficiency of modified AK Summary
- Drum data traceability
- Defense origin of waste and identification of TRU versus high-level waste (HLW), low-level waste or spent nuclear fuel (SNF)
- AK source document sufficiency
- The Confirmatory Test Plan (CTP)
- The Waste Stream Profile Form (WSPF) and Characterization Reconciliation Report (CRR)
- Correlation and Surrogate Summary Form (CSSF) and Contact-Handled (CH)-RH correlation
- Personnel training
- Non Conformance Reports (NCRs) and AK Discrepancy Resolutions (DRs)
- AK accuracy
- Load management
- Data Quality Objective (DQO) attainment

Documents, Waste Containers, and Batch Data Reports Provided

EPA evaluated the documentation that SRS-CCP prepared to support the approval of these six BCLDP RH TRU waste streams. The list of all documents provided to EPA is included in Attachment A. Typically, batch data reports (BDRs) containing the results of radiological (non-destructive assay or NDA and dose-to-curie or DTC) and radiographic analysis (Real-Time Radiography or RTR) are also reviewed as part of EPA's traceability examination. Also, historic data storage, transfer, and other records are reviewed. This evaluation is performed to provide an understanding of the information available for drums as they were packaged, shipped to SRS for storage, and subsequent visual examination (VE), RTR, NDA or DTC as part of the SRS-CCP waste characterization program. The BDRs that were available are described in Table 3, below, by waste stream. For those waste streams without DTC BDRs, SRS-CCP used 1-meter dose rate data obtained by BCLDP in DTC Calculations, so BDRs were not generated. Instead, radiological characterization data for drums with BCLDP 1-meter data are included in the Waste Drum DTC Conversion Records in the associated radiological characterization reports.

Table 3. BCLDP Drums and Associated BDRs Examined by EPA

Drum or Liner	VE BDR No.	DTC BDR No.
SR-BCLDP.001.001 (Homogeneous Waste)		
BC0130	RHSRVSVE80002	NA
BC0138	RHSRSVE080001	NA
BC0141	RHSRSVE080001	NA
BC0160	RHSRSVE080001	NA
BC0167	RHSRSVE080001	NA
SR-BCLDP.001.002 (Composite Filter Debris waste)		
BC0090	RHSRVSVE80002	NA
BC0091	RHSRVSVE80002	NA
BC0124	RHSRVSVE80002	NA
BC0127	RHSRSVE080001	NA
SR-BCLDP.002 (Cemented Slugs)		
BC0034	RHSRSVE800002	NA
SR-BCLDP.003 (Hydraulic Sludge and Debris)	RHSRSVE080001	NA
BC0153	RHSRSVE080001	NA
BC0154	RHSRSVE080001	NA
BC0155	RHSRSVE080001	NA
BC0156	RHSRSVE080001	NA
BC0157	RHSRSVE080001	NA
BC0158	RHSRSVE080001	NA
BC0165	RHSRSVE080001	
SR-BCLDP.004.002 (Cartridge Water Filters)		
BC0001	RHSRSVE080002	SRSRHDTC08001
BC0009	RHSRSVE080002	SRSRHDTC08001
BC0012	RHSRSVE080002	SRSRHDTC08001
BC0017	RHSRSVE080002	SRSRHDTC08001
BC0021	RHSRSVE080002	SRSRHDTC08001
SR-BCLDP.004.003 (Tri-Nuc Filters)		
BC0038	RHSRSVE080002	NA
BC0095	RHSRSVE080002	NA

5.2.1 Global Acceptable Knowledge Process Overview and Analysis

Several analyses performed resulted in common results for the six waste streams. These analyses are grouped together as "global" analyses, as the evaluations and results for each waste stream were based on common data and had the same results.

(1) Sufficiency of the Acceptable Knowledge Summary Report and implementation of Acceptable Knowledge as required in Attachment A of the Waste Characterization Program Implementation Program were evaluated and found to be adequate for all six waste streams upon revision of key documents.

Attachment A of the Waste Characterization Program Implementation Plan (WCPIP) specifies what information must be included in the AKSR for a waste stream. The Attachment mandates that the data collection and analysis process should be similar to the process used for CH wastes. Both the content of the AKSR and sufficiency of AK implementation were assessed, and EPA determined that the AKSR adequately addressed the main required elements of the WCPIP.

(2) The identification of these wastes as defense-related, transuranic versus high-level waste, low-level waste or spent nuclear fuel was examined and accepted.

The AKSR states that a variety of defense-related research was conducted in the JN-1 Hot Cell Laboratory. Most of the defense research was conducted for the U.S. Navy, although defense research and development also was performed for the U.S. Air Force and U.S. Army, as were some reactor studies. Specifically, defense work performed for the U.S. Air Force included support to the Aircraft Nuclear Propulsion Program. BCL helped develop the Army Package Power Reactor program, the mission of which was to develop a portable reactor. In addition, the Hot Cell laboratories were used for other army agent-related tests involving irradiation of chemical agents using cobalt-60 (^{60}Co) sources (References C001, C002, C014 and P501). Even though a majority of the work performed in the hot cells was not done in support of defense programs, no attempt was made to segregate the defense-related wastes. As a result, defense and non-defense radioactive contamination is present throughout the JN-1 Hot Cell, and wastes could not be physically separated into defense and non-defense components (References C501, P041 and P518). Therefore, the waste is eligible for disposal at the WIPP facility. This defense determination was previously examined and approved by EPA under the initial baseline and is applicable to these six waste streams.

According to the *Nuclear Waste Policy Act* (NWPA), SNF is fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing. DOE's M 435.1-1, *DOE Radioactive Waste Management Manual* expands on this definition to clarify that test specimens of fissionable material irradiated for research and development only may be classified as waste. SRS-CCP determined that the wastes generated from JN-1 Hot Cell clean-up consist of debris and sludge that are contaminated with residual radiological contamination from various operations, and do not contain irradiated fuel elements withdrawn from a reactor. Additionally, SRS-CCP believes that the waste materials managed in the JN-1 hot cells were test specimens, and could be considered "waste" per the above Waste Management Manual. As a result, the waste material is not considered SNF. HLW is defined by the NWPA as the highly radioactive material resulting from the reprocessing of SNF, 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. SRS-CCP determined that the BCLDP waste streams do not contain SNF, so by definition the waste could not contain HLW. Also, Hot Cell operations did not involve separation or reprocessing of constituent elements from reactor fuel, so no HLW was generated. SRS-CCP concluded that the waste is not SNF or HLW, and EPA believes the arguments presented are reasonable (References C033, C034, C035, C501, C518, P041, P510 and U514).

(3) Sufficiency of Acceptable Knowledge support documents and related document tracking was evaluated for all six waste streams and was found to be adequate.

A list of AK source document references was prepared for each waste stream using unique identifiers for the different document types following the format used by SRS-CCP for CH wastes. The listing is based on CCP-TP-005 Revision 18, Attachment 4. The listings are complete and easy to understand because they follow the same format used for CH waste streams. EPA only examines support documentation specific to the technical element referenced in the AKSR that caused that support reference to be selected for examination.

(4) A Waste Stream Profile Form and related Characterization Reconciliation Report for each of the six waste streams were assessed and found to be adequate.

Draft WSPFs were provided for all six BCLDP waste streams. These had been prepared in accordance with the WCPIP, and the forms themselves were adequate, although the CRR and AKSR, which are normally attached, were provided separately. The EPA evaluation team evaluated the CRRs against requirements in CCP-TP-506, Revision 1, for the six waste streams to determine if these reports reflected all applicable requirements, and to ensure that the CRR addressed all required elements as specified in the WCPIP. Example CRRs examined by the EPA inspection team included all WCPIP requirements. Provision of the final approved WSPFs for any of these six waste streams is a T2 change.

(5) Interpretation of Waste Characterization Program Implementation Plan was evaluated with respect to contents of the Certification Plan and Confirmatory Test Plan (content and technical adequacy), as well as the proposed characterization process, and was found to be adequate.

EPA's RH WCPIP framework approval letter dated March 26, 2004, indicated that sites must generate a Certification Plan that explains how RH waste characterization will take place at each site, as well as a CTP. Based on the previous RH inspection experience, EPA determined that combining the Certification Plan and CTP in a single document that described the proposed characterization process would satisfy the EPA requirements. Each AKSR and associated Certification Plan/CTP was evaluated to determine whether the DQOs were adequately described and to determine whether mandatory contents of the CTP were addressed. For these waste streams, the required information is included or can be derived from the CTP. The CTP did not consistently and clearly state the radiological characterization approach used for each waste stream. To ensure that the appropriate approach was applied to each DQO, EPA examined the explanation for each DQO and determined that the defense determination was based on AK only; TRU waste determination was based on AK qualified by the DTC process; RH determination was determined by surface dose rate measurement qualified AK; activity was determined through the DTC method; and residual liquids were determined by AK qualified by waste packaging information. Content and technical adequacy of the CTPs were evaluated and found to be adequate.

(6) Use of a Correlation and Surrogate Summary Form was evaluated for all six waste streams and was found to be adequate.

Completion of a CSSF is required when AK from a related CH waste stream is used for RH waste characterization. The SRS-CCP AK Expert (AKE) stated that, to date, no CH surrogate container has been identified pertinent to these waste streams.

(7) Non-Conformance Reports and Discrepancy Resolution Forms were examined and were found to be adequate.

Several DR Forms applicable to one or more of the six waste streams were provided, including DR002-DR010, and DR016, DR017, DR018 and DR019. These documents were examined and EPA verified continued preparation of these key documents as part of the AK process. The DRs reviewed demonstrated SRS-CCP's ability to identify and develop required discrepancy resolution reports. SRS-CCP did not provide any NCRs that were pertinent to one or more of the six waste streams.

(8) Acceptable Knowledge accuracy was assessed for all six waste streams and was found to be adequate.

Draft AK accuracy reports for all six waste streams were provided to EPA for review. AK accuracy was assessed with respect to the required contents as presented in the WCPIP. The draft AK accuracy reports for each waste stream indicated no discrepancies were noted and listed verification of AK-based DQOs. Although not explicitly stated, presentation of the DQOs in this manner shows that the SCG assignments were appropriate, the drums were not placed in different waste streams, and the general radiological parameters (i.e., TRU and RH determination) were met through implementation of the WCPIP and comparison to the AK Record.

(9) Load Management was evaluated and was found to not apply to these six waste streams at this time.

SRS-CCP representatives indicated that they will not load manage any of the six waste streams described in this report.

(10) Personnel training was evaluated for all six waste streams and found to be adequate.

Kevin Peters and Steve Schafer were the SRS-CCP AKEs who prepared the reports. The AKE Qualification Cards were examined to determine whether both individuals' training was up-to-date. Neither document indicated that the AKEs had read required materials pertinent to SRS-CCP. Apparently, the process has changed so that the Qualification Cards are not kept up-to-date; instead, an e-mail verification method is used to ensure each individual receives and completes site-specific reading. Documentation that both individuals have read the required AK Source Documents was sent to EPA via e-mail. It should be noted that the documentation examined did not indicate that SRS-CCP individuals are trained to EPA requirements, nor are they trained with respect to radiological characterization aspects, both of which are required in the WCPIP. Since the WCPIP is currently under revision, EPA will examine future training against the modified WCPIP.

5.2.2 Waste Stream-Specific Acceptable Knowledge Overview and Analysis

EPA's analysis also included results specific to the individual waste streams included in the T1 review. Waste stream-specific analyses are presented below by the technical areas that were examined and the results pertinent to each of the six waste streams are summarized.

(1) Waste stream definitions for all six BCLDP waste streams were examined and found to be adequate.

The WCPIP defines *waste stream* as "waste material generated from a single process or activity, or as waste with similar physical, chemical, and radiological properties." Each waste stream was examined to determine whether the unique processes that created the waste stream, as well as the physical, chemical and radiological composition, supported the waste stream definition. Correct identification of the waste streams is important because unique radiological scaling factors were applied on a waste stream basis.

SR-BCLDP.001.001: Waste Stream SR-BCLDP.001.001 is an S3000 solid waste stream composed of five pressure wash and laundry sludge drums that has been absorbed with Radsorb and/or Floor Dry. The material was generated during clean-out and D&D of hot cells in the JN-1 Hot Cell Laboratory at the Battelle West Jefferson North facility. Waste materials originating from throughout Building JN-1 (Mechanical Test Cell, High Energy Cell, Low-level Cell) were decontaminated using the SCS-300 Decontamination System and high pressure steam cleaners. The pressure wash system included a pressure washer, wash cabinet or 85-gallon drum enclosures, and the wash water recovery system. High-pressure steam cleaners were also used to decontaminate larger areas inside the hot cells, like the cell walls, floors, and larger equipment. This wash water was collected from the cell floors and transferred to collection drums. The drums containing predominantly absorbed water and/or sludge including laundry sludge are included in Waste Stream SR-BCLDP.001.001. This waste stream contains lesser amounts of debris waste materials not exceeding 50 percent by volume in any liner, and may include portions of filter and other material that is present in greater percentages in the companion SR-BCLDP-001 waste stream. Based on this process information, the waste stream appears to be adequately defined, but the radiological and physical composition of the waste stream is also important to the waste stream definition. Physical and radiological composition of the waste stream is discussed in detail in Items 2 and 3, below.

SR-BCLDP.001.002: Waste Stream SR-BCLDP.001.002 consists of four 55-gallon drums containing 0.105-inch thick steel 55-gallon drum liners (0.8 cubic meters total volume). The steel liners were packaged between February 2001 and May 2002. The waste is composed mostly of filters used in the pressure wash and laundry processes, but includes a small amount of incidental organic and inorganic absorbed materials (by addition of Radsorb and/or Floor Dry). The waste was generated by D&D waste collected from throughout Building JN-1, including the Mechanical Test Cell, High Energy Cell, and Low-level Cell. Wastes were pressure washed in a wash cabinet or 85-gallon drum enclosure, which generated filter waste as well as sludges. The drums containing predominantly filter debris from D&D and the laundry system are included in Waste Stream SR-BCLDP.001.002. Based on this process information, the waste stream appears to be adequately defined but the radiological and physical compositions of the waste stream are also important to the waste stream definition and these are discussed in detail in Items 2 and 3, below.

SR-BCLDP.002: Waste Stream SR-BCLDP.002 consists of cemented acid slugs generated during the repackaging of historic operations waste in Building JN-1. EPA examined the waste stream generation process description and verified, among other elements, that the waste stream was generated by the dissolution of fuel samples prepared in Alpha-Gamma Cell 7, and material may have been co-contaminated with materials managed in other hot cells due to waste movement and management activities. Data suggest that the slugs managed in Cell 7 are composed of fuel material that was handled in the High-Level Cell from 1964 to 1972 and the High Energy Cell from 1972 to the time of the cell's decommissioning/shut down. Based on this description and assuming that only cemented slugs generated through acid dissolution of fuel specimens are present in the waste, the slugs appear to have been generated by a definable process, but the waste stream is defined by the physical and radiological composition of the waste material. Physical and radiological compositions of the waste stream are discussed in detail in Items 2 and 3, below.

SR-BCLDP.003: Waste Stream SR-BCLDP.003 is composed of SCG S3000 homogeneous hydraulic sludge generated during clean-out of the hot cells in the Building JN-1 Hot Cell Laboratory at the Battelle West Jefferson North Facility. The sludge also contains debris particles. The sludge was generated in the Hydraulic Room that was below large shielded doors used to access the High-Level and Low-Level Cells from the Controlled Access Area (CAA); the doors were controlled by a hydraulic system located beneath the hot cells. The Hydraulic Room contained the rams and upper portions of the hydraulic cylinders for both doors and was located beneath the CAA. While in operation, hundreds of gallons of hydraulic oil from the door's hydraulic system leaked into the Hydraulic Room. Also, the waste stream contains debris, water, radioactive contamination and other waste that fell through the gaps in the Hydraulic Room floor into the waste hydraulic fluid that leaked from the system. The waste stream was created during clean-up of the leaked fluid and the oil and sludge material was absorbed onto Radsorb, Nochar Petrobond, or Floor Dry. Also, organic and inorganic absorbents (e.g., Radsorb and Floor Dry) were added to the waste in the containers as a "precautionary measure" to preclude free water development by condensation. Based on this process information, the waste stream appears to be adequately defined, but the radiological and physical compositions of the waste streams are also important to the waste stream definition. Physical and radiological composition of the waste stream is discussed in detail in Items 2 and 3, below.

SR-BCLDP.004.002: Waste Stream SR-BCLDP.004.002 is a debris waste stream (SCG S5000) composed of cartridge prefilters and debris generated during the change-out of resins used for filtering the Building JN-1 Transfer and Storage Pool water. The filter matrix is composed of glass and cellulose fibers combined with melamine resin and the filter end caps are polypropylene with rubber gaskets (butyl/nitrile). The waste may also include Floor Dry and Radsorb added during repackaging to absorb any water from condensation or dewatering. The High Bay was constructed by 1972 and housed the Transfer and Storage Pool that received, stored, and transferred entire fuel assemblies. Fuel assemblies were also stored in the pool for an extended period of time. While in operation, the pool contained nearly 150,000 gallons of water that was filtered by an ion-exchange system that included 12 ion-exchange columns and two cartridge pre-filters. These filters comprise Waste Stream SR-BCLDP.004.002 generated during the change-out of the Transfer and Storage Pool prefilters and resins; these containers were repackaged in the Mechanical Test Cell between May and August 1999. Based on this process information, the waste stream appears to be adequately defined, but the radiological and physical compositions of the waste stream are also important to the waste stream definition. Physical and radiological compositions of the waste stream are discussed in detail in Items 2 and 3, below.

SR-BCLDP.004.003: Waste Stream SR-BCLDP.004.003 consists of the Tri-Nuc filters generated by the BCLDP program during the D&D of the Building JN-1 Transfer and Storage Pool. This waste stream consists of SCG S5000 composite filter debris generated by the vacuum system used to clean the surfaces of the pool during draining of the water in the Transfer Pool. BCLDP drained and decontaminated the Transfer and Storage Pool between 1995 and 1997, which involved the draining/evaporation of pool water, cleaning (vacuuming) the surfaces of the pool during draining, and painting the pool floor and walls. Underwater vacuuming of the pool surfaces began in August 1995 with removal of various metal debris (e.g., fuel pieces, wire, nuts and bolts) from the pool floor. A Tri-Nuc filter system was used for vacuuming and filtration, so this waste stream consists of SCG S5000 Tri-Nuc filter debris generated by the vacuuming of Transfer Pool surfaces while the pool waters were removed. As indicated previously, two drums of waste were generated. Based on this process description, the waste was generated from a single process (vacuuming of pool surfaces), but the physical and radiological composition of the waste stream is also important to the waste stream definition, and this was evaluated to determine whether these characteristics were appropriately identified and support the waste stream definition. Physical and radiological compositions of the waste stream are discussed in detail in Items 2 and 3, below.

Data evaluated indicated that the waste streams were adequately defined, based on process information; physical and radiological composition of the waste stream with respect to waste stream definition and technical adequacy were also evaluated as presented in Items 2 and 3, below.

(2) Radionuclide characteristics of the Battelle Columbus Laboratory Decommissioning Project waste as presented in the Acceptable Knowledge Summary Report and associated documents were assessed and found to be adequate.

AK was used by SRS-CCP to derive the radiological composition of each waste stream either through use of a standard isotopic distribution or unique waste stream-specific isotopic distributions and subsequent DTC conversions. BCL developed the JN-1 Standard Isotope Mix to represent the wastes contaminated by routine operations. This mix was developed by collecting 69 swipe samples throughout JN-1, to get a broad and representative sampling of all radiological contamination that might be present throughout the JN-1 facility. These data were then used in ORIGEN 2.1 runs to develop a standard mix (single isotopic distribution), i.e., the JN-1 Standard Isotope Mix, that BCL believed could be applied to all waste generated through routine operations. Additionally, BCL collected swipe samples from some waste streams. SRS-CCP used the different radiological data in the AK record (i.e., JN-1 isotopic mix and waste stream-specific sampling) to develop waste stream-specific isotopic distributions.

Isotopic distributions and subsequent radiological composition are AK-dependent, so the radiological data that serve as the basis for the SRS-CCP characterization process were evaluated by EPA. The waste stream definition is dependent upon common radiological composition of the waste stream, so EPA also examined the radiological data to determine whether each waste stream was appropriately identified.

SR-BCLDP.001.001: The AKSR and associated references state that BCLDP determined that the waste originating from the laundry and pressure waste operations, including containers in SRS-CCP waste streams SR-BCLDP.001.001, should be characterized using the JN-1 Standard Isotopic Mix and DTC. EPA evaluated and approved the development of the JN-1 Standard Isotope Mix in its baseline approval for SRS-BC RH waste (See Docket No. A-98-49, II-A4-99). However, the AKSR did not include any summary information of the BCLDP characterization results to verify the waste stream definition, and did not adequately link the radiological characterization approach used by SRS-CCP—which is entirely AK based—with the BCL approach. As a result, SRS-CCP revised the AKSR through freeze file[2] changes to draw a better correlation between historic BCL data and ongoing SRS-CCP characterization of the same drums.

SRS-CCP provided a freeze file change as Reference C522. SRS-CCP concluded that based on a review of the AK documentation relating to historic BCLDP waste management practices and review of laundry and pressure wash processes, it is reasonable to expect that the radiological distribution established for debris waste stream SR-RL-BCLDP.001 would be applicable to wastes generated during the decontamination of the materials and surfaces in the JN-1 hot cells. This assumption was based on the fact that the debris waste materials would have been exposed to the same contaminants that were removed from surfaces and materials decontaminated during the laundry and pressure wash operations. EPA agrees with this conclusion. The freeze file and related references explain that SRS-CCP used the same basic approach as BCLDP to characterize these drums, and SRS-CCP also used existing BCL data in their DTC calculations (no SRS-CCP-derived measurements were obtained). However, SRS-CCP recalculated the Standard Isotope Mix using the same 69 swipe samples and ORIGEN 2.2 rather than 2.1, which was used in the original scaling factor development. As a result, new scaling factors were developed. EPA examined this information and determined that the radiological composition of the waste stream was appropriately defined, and that AK information supported SRS-CCP's use of the JN-1 isotopic mix-based scaling factors for this waste stream.

[2] Freeze File: As a result of EPA inspections, if CCP must revise documents to address EPA issues, CCP makes those changes and provides a copy to EPA as objective evidence for the changes made. These revisions are then processed by CCP's document control process to generate an official version as the most current revision.

SR-BCLDP.001.002: BCLDP determined that the filter samples originating from the laundry and pressure waste operations should be characterized using the JN-1 Standard Isotopic Mix and the DTC method. However, the AKSR does not include any information regarding the results of the BCLDP characterization effort for this waste stream to justify the waste stream determination, and did not adequately link the radiological characterization approach used by SRS-CCP—which is entirely AK based—with the BCL approach. The approach used by SRS-CCP to characterize the composite filter debris waste stream employed a different scaling factor development process than that used by BCLDP. Because the AKSR did not adequately explain available AK information and subsequent use of that information by BCL and SRS-CCP, a freeze file modification was submitted (C522) that modified the AKSR radiological discussion. This modification explained that eight samples of pool filter media were collected during the packaging of waste stream SR-BCLDP.004.002, which is also a filter media waste stream. Sampling was performed because the concentration of the key gamma isotope cesium-137 (^{137}Cs) could be depleted in the filters compared to the debris waste materials due to its solubility. SRS-CCP determined that similar to Waste Stream SR-BCLDP.004.002, ^{137}Cs in Waste Stream SR-BCLDP.001.002 may also be depleted, so SRS-CCP assumed that the scaling factors derived for the SR-BCLDP.004.002 (transfer and storage pool filter cartridges) would also apply to the distributions in Waste Stream SR-BCLDP.001.002 (the laundry and pressure wash filters). SRS-CCP believed that this assumption was reasonable: "due to the exposure to similar aqueous environments and the fact that the vast majority of the contamination in the hot cell originated from the ongoing examination of primarily light water reactor fuel. These assumptions were further verified by the comparison of the ratios for insoluble radionuclides from the sampling data to the ratios for the same isotopes for the debris waste determined using the ORIGEN2.2 modeling described above for the pressure wash and laundry sludge." SRS-CCP applied the DTC method for this waste stream using the BCLDP dose measurements and the scaling factors that originated from the eight SR-BCLDP.004.002 filter samples. The SRS-CCP-derived scaling factors were applied in lieu of the scaling factors developed for the JN-1 Standard Isotopic Mix to account for the depletion of soluble ^{137}Cs in water filter media. EPA examined this explanation and determined that the radiological composition of the waste stream was appropriately defined and that AK supported SRS-CCP's use of alternative AK-based scaling factors for this waste stream.

SR-BCLDP.002: Waste Stream SR-BCLDP.002 was generated in the Alpha-Gamma hot cells, and specifically within Cell 7 which received materials from the High-Level and High Energy cells, and that material was composed of various light-water reactor (LWR) Fuels. SRS-CCP representatives indicated that there are no data assigning specific slugs to specific campaigns or activities, so the isotopic composition of the slugs generated from these cells are, as a whole, represented by the overall isotopic distribution of the material that went through the cells. SRS-CCP elected to use the JN-1 standard isotopic mix for this waste stream and modeling using ORIGEN 2.2. EPA previously approved the representativeness of these samples, as well as the modeling approach, (see Docket No. A-98-49, II-A4-99). SRS-CCP also identified historic sampling and analytical results collected from a past sampling event on the slugs, and used these data (which could not be qualified) to show general comparability between these samples and the modeled results.

However, the AKSR did not include this information that was obtained through file review and interviews of SRS-CCP representatives, so SRS-CCP submitted a freeze file change (C523) that explained the historic data available in the AK record, development of the JN-1 isotopic mix, applicability of this mix to the SR-BCLDP.002 waste stream, and comparison of the JN-1 mix with non-qualified sampling results. SRS-CCP's freeze file stated that, based on a review of the AK documentation relating to historic BCLDP waste management practices and information relating to the fuel dissolution operation, it is reasonable to expect that the radiological distribution established for debris Waste Stream SR-RL-BCLDP.001 would be applicable to the cemented slugs containing the cemented fuel slugs. This assumption was based on the fact that the debris waste materials in the hot cell operations would have been exposed to the same fuel materials during the cutting and grinding prior to the dissolution and cementing of the fuel slugs, in addition to the fact that the vast majority of the contamination in the hot cell originated from the ongoing examination of primarily light water reactor fuel specimens. EPA reviewed the AKSR, freeze file changes and other source documents and agrees that the radiological composition of the waste stream is appropriately defined, and application of the assigned scaling factors is supported by the AK record.

SR-BCLDP.003: Waste Stream SR-BCLDP.003 was generated from clean-up of the Hydraulic Room below the CAA and the shield doors for the High-Level Cell and Low-Level Cell research labs in the JN-1 Building. This waste included oil, sludge and debris that originated from various locations in the JN-1 Building, and would therefore exhibit radionuclide contamination from throughout the JN-1 cells and rooms. BCLDP determined that the hydraulic sludge waste should be characterized by the JN-1 Standard Isotopic Mix and the dose-to-curie method described in this section. While samples of the hydraulic sludge were collected and analyzed, results were not used by BCLDP. SRS-CCP agreed that the DTC approach should be used, and SRS-CCP also identified the presence of two sludge samples that had been taken, although outside of the D&D program and thus unusable as measurement-based AK under an equivalent quality assurance (QA) argument. SRS-CCP chose to use their ORIGEN 2.2 scaling factors in DTC calculations, and used the BCLDP one-meter dose measurements in their calculations. SRS-CCP determined that the AKSR did not include much of the AK information presented in the radiological characterization report, and additional information was required to present a complete discussion in the AKSR.

SRS-CCP addressed these shortcomings through a freeze file change (C524) that addressed the use of the JN-1 standard isotopic mix and DTC method application. The freeze file change also stated that based on a review of the AK documentation relating to historic BCLDP waste management practices and information relating to the operations conducted above the Hydraulic Room, it is reasonable to expect that the radiological distribution established for debris waste stream SR-RL-BCLDP.001 would be applicable to the hydraulic sludge, because debris waste materials generated in the hot cell operations above the Hydraulic Room would have been exposed to the same fuel materials that fell into the Hydraulic Room below. The assumption was verified by the comparison of these ratios to the results of the analysis of two samples of hydraulic sludge by the BCLDP program taken in 2002. EPA reviewed the AKSR, freeze file changes, and other source documents and agrees that the radiological composition of the waste stream is appropriately defined, and application of the assigned scaling factors is supported by the AK record.

SR-BCLDP.004.002: BCLDP determined that the JN-1 Standard Isotope Mix is not applicable to the Cartridge Water Filter waste stream because the pool water changes the ratio of the radionuclides to ^{137}Cs, so direct sampling for most of the isotopes was performed. BCLDP collected eight composite samples from the cartridge water filters as they were being packaged for the purpose of radiological characterization, with "snip" or grab samples collected from every fifth cartridge filter as it was placed in the waste drum. Samples were eventually composited on a per-drum basis, resulting in one composite sample/drum. A total of eight waste drums were packaged and although only five of the drums were TRU, the analyses for all eight drums were available in the AK Record. SRS-CCP asserted, and EPA agrees, that the complete sampling process is representative of the waste stream as presented in a memorandum prepared by SRS-CCP dated March 4, 2010. However, because the analytical suite did not include all of the EPA-required radionuclides, SRS-CCP indicated that the values for the strontium-90 (^{90}Sr) and uranium (U) isotopes were determined by ratio from other BCLDP data (C701). SRS-CCP determined the radiological composition of this waste stream based on the AK data obtained by BCLDP through sampling, as well as ORIGEN 2.2 modeling results to develop waste stream-specific scaling factors.

SRS-CCP recognized that the AKSR did not include all AK-related elements and provided a freeze file (C525) change that described scaling factor development and measurement data (i.e., one-meter survey measurements were obtained by SRS-CCP). SRS-CCP concluded that use of ORIGEN 2.2 to develop scaling factors for radionuclides missing from the sampling results is justified based on the common origin of radionuclide material in JN-1 (LWR fuel). The BCLDP container weights and the cartridge filter sample data used for the scaling factors were qualified as Nuclear Quality Assurance (NQA)-1. EPA reviewed the AKSR, freeze file changes, and other source documents and agrees that the radiological composition of the waste stream is appropriately defined, and application of the assigned scaling factors is supported by the AK record.

SR-BCLDP.004.003: Waste Stream SR-BCLDP.004.003 consists of the Tri-Nuc filters generated by the BCLDP program during the D&D of the Building JN-1 Transfer and Storage Pool. Because BCLDP anticipated changes to the ratio of isotopes due to the high solubility of the principal gamma emitting isotope, ^{137}Cs, BCLDP did not apply the JN-1 Standard Isotope Mix and collected/analyzed samples of the Tri-Nuc vacuum filters. Samples were collected from six different Tri-Nuc filters, and these were analyzed for a small subset of radionuclides required for WIPP characterization. However, BCLDP did not use these sample data and, instead, used the standard JN-1 isotopic mix in their characterization processes. SRS-CCP elected to use the Tri-Nuc filter samples in scaling factor development, and provided a memorandum dated March 4, 2010, that addressed representativeness of the Tri-Nuc filters. In this memorandum, SRS-CCP concluded that: "even though the documentation describing the method BCLDP selected to collect representative samples of the Tri-Nuc filters was not available, it was determined that the use of the data to calculate the radionuclide distributions for the two containers in Waste Stream SR-BCLDP.004.003 as described in CCP-AK-SRS-541B is reasonable." This conclusion was drawn because the filters selected for sampling bounded the Tri-Nuc operational period; the origin of contamination was LWR fuels throughout the operational period; and the contamination within the filters did not exhibit temporal or spatial variability due to the presence of the filters in the closed pool system. As with Waste Stream SR-BCLDP.004.002, analysis did not include the full suite of EPA-required radionuclides, so SRS-CCP used the sampling data and modeling to determine a unique isotopic mix specific to the Tri-Nuc filters.

SRS-CCP recognized that the AKSR did not include all AK-related elements and provided a freeze file (C525) change that addressed sample collection and determination of sample representativeness, as well as the analytical suites and use of modeling to determine the applied scaling factors. The dose measurements, in addition to the container weight measurements and sample data used for the scaling factors were qualified based on an equivalency to NQA-1. EPA reviewed the AKSR, freeze file changes, and other source documents and agrees that the radiological composition of the waste stream is appropriately defined, and application of the assigned scaling factors is supported by the AK record.

EPA concluded that the radiological composition of each waste stream was adequately defined and supported the waste stream designation, and the AKSR, radiological characterization report, supporting references, and recently generated memoranda support SRS-CCP's use of various AK data as the basis for scaling factor development.

(3) Physical characteristics of the BCLDP waste were evaluated with regard to the waste stream definition and adequacy of information, and were found to be adequately presented.

SR-BCLDP.001.001: Waste Stream SR-BCLDP.001.001 consists predominantly of "organic and inorganic homogenous solids generated during laundry and pressure washing activities. In addition, Waste Stream SR-BCLDP.001.001 contains lesser amounts of debris waste materials not exceeding 50 percent by volume in any liner." AK data suggest that the waste stream is composed of approximately 86.9 percent organic materials and 13.1 percent inorganic materials by weight. The waste is composed predominantly of Radsorb, Floor Dry, and other sorbants, as well as debris particles like fiberglass filter components, gaskets, pieces of metal, etc. SRS-CCP applies waste matrix code (WMC) S3212, Organic Absorbents, to this waste stream. Examination of VE BDRs associated with this waste stream, including those for drums BC0130, BC0138, BC0141, BC0160 and BC0167, verify that the waste stream is composed predominantly of homogeneous solids. SRS-CCP has indicated that no additional containers are expected for this waste stream, and the limited waste stream size, AK documentation, and VE BDRs support the physical waste stream discussion. Note that SRS-CCP did not identify any prohibited items during review of the VE tapes; also, some filter material was present in drums (e.g., drum BC0130).

SR-BCLDP.001.002: Waste Stream SR-BCLDP.001.002 consists predominantly of cartridge and sock filters used in the pressure wash water recovery system, with lesser amounts of organic and inorganic homogenous solids generated during laundry and pressure washing activities. SRS-CCP calculated the waste material parameter (WMP) percentages based on the description of the items in the BCLDP container documentation, and found that the relative waste weight percentages for organic waste materials and inorganic waste materials for Waste Stream SR-BCLDP.001.002 are 69.0 percent and 31.0 percent, respectively. AK documents indicated that the waste stream was composed primarily of sock filters, lint, Radsorb and "cuno" filters. The filters in this waste stream include those generated through D&D activities, including filters used in pressure wash water recovery, media cartridges, resin cartridges and polypropylene sock filters. WMC S5410, Composite Filter Debris, is assigned to Waste Stream SR-BCLDP.001.002. No prohibited items were identified in this waste stream.

SR-BCLDP.002: Waste Stream SR-BCLDP.002 is a single drum composed of over 300 individual cemented slugs. The AKSR states that this waste stream consists of greater than 50 percent solidified inorganic homogeneous solids and WMC S3150, Solidified Homogeneous Solids, is the appropriate WMC assignment for this waste stream, since it includes waste that is primarily immobilized with cement and cured into a solidified form. SRS-CCP evaluated the WMPs for the cemented slugs by examining inventory records for container BC0034. These records indicated that the waste stream consists "solely of cemented acid slugs and Floor Dry with trace amounts of Styrofoam, representing 100 percent inorganic matrix and less than 0.1 percent plastic by weight." This was verified by examining historic drum records in Reference U514, which states that the original drum contained 100 percent inorganic solids, i.e., cemented sludges. SRS-CCP's reexamination of packaging tapes (Reference U517) agreed with this conclusion, with over 300 individual slugs from various casks identified as being present in the drum. No data suggest that the drum contains any material other than the cemented slugs (and related Styrofoam).

SR-BCLDP.003: Waste Stream SR-BCLDP.003 consists of the absorbed hydraulic sludge and debris generated by the BCLDP program during the D&D of the Building JN-1 Hydraulic Room. Waste Stream SR-BCLDP.003 consists predominantly of organic and inorganic homogenous solids. The AKSR also indicates that the waste stream contains small amounts of debris waste "not exceeding 50 percent by volume in any liner". AK documentation indicates that the waste is composed of: organic matrix (Radsorb absorbent added to the bottom of the liner and to immobilize the hydraulic sludge during D&D); inorganic matrix like particles of concrete and dust; other inorganic material like glass, rags, gloves and muslin bags; plastic wastes such as duct tape and bottles, rubber gloves, and various metal items and shavings. SRS-CCP indicated that based on the evaluation of the materials contained in this waste stream, assignment of WMC S3212, Organic Absorbents, is appropriate. SRS-CCP also calculated the WMP percentages within the waste stream by weight, and determined that the waste contained predominantly organic and inorganic solidified matrices.

SR-BCLDP.004.002: Waste Stream SR-BCLDP.004.002 consists of the cartridge prefilters and debris generated during the change-out of resin used for filtering the Building JN-1 Transfer and Storage Pool water. The filter matrix is composed of glass and cellulose fibers combined with melamine resin. The end caps are polypropylene and the filters are rubber gaskets (butyl/nitrile). The AKSR indicates that other debris are packaged with the filters, including items such as rubber gaskets, rubber gloves, muslin resin bags, paper, cloth (wipes), tape, metal cans, plastic bags, sheeting, and gloves, as well as Floor Dry and Radsorb added during packaging to absorb any water in the containers. WMC S5410, Composite Filter Debris, is assigned to this waste stream. WMPs were determined by examining inventory records for the waste stream. The relative waste weight percentages for organic waste materials and inorganic waste materials for Waste Stream SR-BCLDP.004.002 were calculated to be 54.5 percent and 45.5 percent, respectively.

SR-BCLDP.004.003: Waste Stream SR-BCLDP.004.003 consists of, “the Tri-Nuc filters generated by the BCLDP program during the D&D of the Building JN-1 Transfer and Storage Pool. These filters were used by the vacuum system used to clean the surfaces of the pool during draining of the pool water. These filters are 30 inches long and 6 inches in diameter and consist of media enclosed within a stainless steel screen shroud, and aluminum screen reinforced with plastisol end caps. The filter media is composed of polypropylene and melt brown reinforced typar. Weighted stainless steel strips run the length of the filter and are bonded to the end caps. The Tri-Nuc filters were air dried, cut, size reduced, and compacted for packaging efficiency.” Floor Dry and Radsorb were also added to the waste to absorb liquids. (References C515, U511, U514 and U517) Waste Stream SR-BCLDP.004.003 is assigned WMC S5410, Composite Filter Debris. WMPs were determined by examining inventory records for the waste stream. The WMPs for Tri-Nuc filters from the Transfer and Storage Pool underwater vacuum system (SR-BCLDP.004.003) were estimated to be, based on records and calculations, 41.0 percent organic waste and 59.0 percent inorganic waste.

EPA determined that the physical characteristics of each waste stream were adequately defined and confirmed the waste stream determinations.

(4) Data traceability was examined and found to be adequate.

SR-BCLDP.001.001 and SR-BCLDP.001.002: EPA examined traceability of AK data for this waste stream to understand the BCL waste generation, packaging, processing and transport, and characterization processes up to what was performed by SRS-CCP. Data management in the Commitment Tracking System (CTS)/Project Tracking System (PTS) data system used by SRS-CCP was also assessed. Original data packaging sheets were examined for each of the drums in the SR BCLDP.001.001 and -.002 waste streams. Fluor Hanford Container Data Sheets, TRU waste packaging loading records, material inventory calculations, Radioactive Waste Container Summary Sheets, liner dose rate illustrations, and Health Physics survey reports were examined. Additionally, drum characterization data, including BDRs and the AK Tracking Spreadsheet, as well as CCP-TP-005 Attachment 8, were examined. EPA also examined the VE BDRs associated with each container, as well as the full DTC Conversion Records developed through modeling and application of AK for all 9 drums as presented in CCP-AK-SRS-511A and CCP-AK-SRS-511B. EPA also examined representative PTS screen shots for drums BC0124 and BC0160. EPA concluded that traceability was adequately established for both waste streams. Evaluation of data examined indicted that the drum data were traceable from origin to characterization. EPA concluded that traceability was adequately established.

SR-BCLDP.002: EPA examined traceability of AK data for this waste stream to understand the BCL waste generation, packaging, processing and transport, and characterization processes up to what was performed by CCP. Data management in the CTS/PTS data system used by SRS-CCP was also assessed. Original data packaging sheets were examined for drum No. BC0034 that is included in BDR No. RHSRSVE80002. EPA also examined Fluor Hanford Container Data Sheets, TRU waste packaging loading records that identify the original cask location associated with the slug, material inventory calculations, Radioactive Waste Container Summary Sheets, liner dose rate illustrations, and Health Physics Survey Reports. These data indicate that drum

No. BC00034 was filled with slugs originally placed in at least five different locations/containers. None of the source documents referenced in the AKSR directly indicated whether the individual slugs contained any kind of markings on the remnant Styrofoam, or whether this outer material was removed during original packaging and hence removed the possibility of tracing individual slugs to activities that occurred in Cell 7. Regardless, EPA concluded that traceability was adequately established.

SR-BCLDP.003: EPA examined traceability of AK data for this waste stream to understand the BCL waste generation, packaging, processing and transport, and characterization processes up to what was performed by SRS-CCP. Data management in the CTS/PTS data system used by SRS-CCP was also assessed. Original data packaging sheets were examined for drum Nos. BC0153, BC0154, BC0155, BC0156, BC0157, BC0158 and BC0165. EPA also examined the VE BDRs associated with the containers, as well as the full DTC Conversion Record developed through modeling and application of AK for the drum as presented in CCP-AK-SRS-531. Historic data examined included Fluor Hanford Container Data Sheets, TRU waste packaging loading records, Container Data Sheets, Waste Container Issuance Requests, Hazardous Material/Waste Sampling Checklists, material inventory calculations, Radioactive Waste Container Summaries, Liner Dose Rates, Health Physics Survey Reports, Marking and Labeling Instructions for Radioactive Waste (Tri-Nucs), and Waste Container Issuance Requests. EPA concluded that traceability was adequately established.

SR-BCLDP.004.002 and SR-BCLDP.004.003: EPA examined traceability of AK data for these two waste streams to understand the BCL waste generation, packaging, processing and transport, and characterization processes up to what was performed by SRS-CCP. Data management in the CTS/PTS data system used by SRS-CCP was also assessed. Original data packaging sheets and BDRs for VE were examined, as well as DTC BDRs for the cartridge water filter wastes. Various historic container documents were examined, including the Fluor Hanford Container Data Sheet, TRU waste packaging loading records, Report of JN-1 Resin and Pool Samples, including Chain-of-Custody (COC) forms, Radioanalytical laboratory requests and laboratory reports for each cartridge filter sample, Sampling Checklists and Determination of Need for Sampling Plan (Cartridge filters), Summary/Special Report Form, Waste Container Issuance Requests, Hazardous Material/Waste Sampling Checklists, material inventory calculations (Tri-Nucs), Radioactive Waste Container Summaries (Tri-Nucs), Liner Dose Rates (Tri-Nucs), Health Physics Survey Reports (Tri-Nucs), Marking and Labeling Instructions for Radioactive Waste (Tri-Nucs), and Waste Container Issuance Requests. EPA also examined the VE BDRs associated with the container, as well as the full DTC Conversion Record developed through modeling and application of AK. EPA concluded that traceability was adequately established.

(5) Attainment of Data Quality Objectives was evaluated and found to be adequate.

As a result of the analysis presented in Sections 5.2.1 and 5.2.2, EPA was able to assess how WCPIP DQOs were met for all six of the BCLDP RH TRU waste streams. Further, EPA determined that the EPA-required qualification pathways were met for any AK data used to quantify data; i.e., confirmatory testing, data acquisition under an NQA equivalent QA program, or peer review. For the most part, all sampling data were qualified by the equivalent QA methodology, noting that an equivalent QA pathway could not be established for the

SR-BCLDP.002 (cemented slug) and SR-BCLDP.003 (hydraulic sludge and debris) samples, which consequently were not used to develop scaling factors. When evaluated as a whole, the AKSRs and the associated freeze file changes/additional references prepared by SRS-CCP in March 2010 radiological characterization reports, Certification Plans/CTPs, and the supporting source documents presented in Attachment A of this report indicate that the DQOs, as specified in the WCPIP, have been met.

<u>Summary of Acceptable Knowledge Findings and Concerns</u>

Findings or Concerns

There were no findings or concerns in the area of AK for any of these six waste streams.

5.3 Radiological Characterization

Considering the majority of contamination at the West Jefferson North site is residual material from decades of research on irradiated fuel, predominantly from commercial fuel development programs and LWRs, the BCLDP RH TRU radiological waste characterization is based on materials contaminated with uranium, actinides, and fission/activation products. The characterization methods used for these BCLDP RH TRU wastes were evaluated in terms of the technical adequacy of this approach as supported by the program's documents, procedures and controls, and the knowledge and understanding of the personnel involved in the RH waste characterization program. During this T1 evaluation, EPA examined the following elements of the SRS-CCP radiological characterization program:

- Development of DTC relationships as a function of waste density using MicroShield® based on each drum's measured external exposure (dose) rate, assuming the main contributors to the external exposure were ^{137}Cs and ^{60}Co
- Derivation of radionuclide scaling factors for quantification of the 10 WIPP-tracked radionuclides as supported by the radiological characterization report for each waste stream, i.e., the radiological characterization report for each waste stream and the supporting calculation packages

EPA evaluated the following aspects for all six BCLDP RH TRU waste streams:

- Activity values derived from modeling and statistical metrics, namely mean and standard deviation values for each measured radionuclide
- The appropriateness of the choice of physical constants and radionuclide-specific attributes (specific activity, physical half-life, decay heat, neutron cross-sections, photon transition probabilities, etc.) and the technical correctness of the values assigned to each attribute
- Isotopic activity values correlated to the radionuclides whose physical half-lives are such that they could be responsible for the measured external dose rate, i.e., ^{137}Cs and ^{60}Co
- Contributions of the short-lived radionuclides to the total measured dose rate

- Appropriate decay correction according to procedure CCP-TP-504 of all radionuclide values for purposes of model development and routine assays performed via DTC
- The calculated results used to develop the scaling factors and convert the measured external dose rates obtained via DTC to radionuclide activity levels
- Activity and uncertainty values determined for the ten WIPP-Tracked radionuclides [^{233}U, ^{234}U, ^{238}U, plutonium-238 (^{238}Pu), ^{239}Pu, ^{240}Pu, ^{242}Pu, americium-241 (^{241}Am), ^{137}Cs and ^{90}Sr]
- The determination of the contribution of all radionuclides to the radiological hazard[3]
- Shielding and other calculations supporting the scaling factors performed using MicroShield® to derive the appropriate DTC relationships as a function of waste density for the geometry appropriate to each waste stream

Based on a thorough review of these aspects, it was noted that the source for certain values (e.g., specific activity and decay heat) was the CH-TRU Waste Authorized Methods for Payload Control (TRAMPAC), as appropriate. The sources for the physical half-life of the radionuclides that are used for calculations were not always documented. The half-life values used were generally consistent with values published in typical sources (e.g., Brown & Firestone, Chart of the Nuclides and the DOE TRAMPAC). There is no concern regarding the accuracy of the values that were used or the data that were generated through their use with respect to supporting the characterization of these six BCLDP RH waste streams. However, this issue was raised at a previous EPA RH inspection (General Electric Vallecitos Nuclear Center in December 2008) and EPA suggests that SRS-CCP address this issue comprehensively for future RH T1 evaluations.

Radiological Characterization Overview

The nature of RH TRU wastes presents difficulties with respect to obtaining meaningful measurement data. As has been the case at the six RH TRU waste characterization sites that EPA has previously approved, RH radiological characterization relies on the development of scaling factors that correlate an easily measured parameter like a waste container's external exposure (dose) rate with isotopic distributions for specific TRU radionuclides. The development of radionuclide scaling factors for these BCLDP RH TRU wastes is essentially the same as what EPA evaluated and approved during the SRS-CCP baseline inspection. ^{137}Cs was considered as the key gamma radionuclide in the development of scaling factors. The development of the ^{137}Cs scaling factors was supported by comparisons between the radionuclide distribution in the 69 swipe samples and the 1,000 ORIGEN2.2 computer runs representing LWR fuel that led to the reasonable expectation that the average radionuclide distributions in these wastes would be similar to the average distribution in the debris waste. The comparison demonstrated that LWR fuel material was the dominant fuel material examined in the hot cells. Two of the six waste streams, SR-BCLDP-004.002 and SR-BCLDP-004.003, used radionuclide-specific scaling factors that had been developed based on radiometric and mass spectrometry analyses of samples collected from these waste streams. CBFO chose to approve these data based on a peer review

[3] Although the determination of a waste container's radiological hazard is not an EPA requirement, this information may be useful in understanding other aspects of a container's radiological characterization.

process. EPA's evaluation of the technical data supporting the peer review for these two waste streams is presented in the section for SR-BCLDP-004.002 below.

Documents Reviewed

EPA evaluated the documentation that SRS-CCP prepared to support the approval of these six RH TRU waste streams. The list of all documents provided to EPA is included in Attachment A.

5.3.1 Overview of Waste Stream SR-BCLDP.001.001

Waste Stream SR-BCLDP.001.001 consists of homogeneous solids and has been assigned WMC S3212. It predominantly consists of organic and inorganic homogeneous solids generated during laundry and pressure washing activities and also contains debris. Review of the AK for the waste stream identified the following materials:

- **Organic** matrix waste: precautionary Radsorb absorbent, added to the bottom of the liner, in addition to liquids and sludges immobilized with Radsorb
- **Inorganic** matrix waste: precautionary Floor Dry absorbent, added to the bottom of the liner, in addition to liquids and sludges immobilized with Floor Dry
- **Other inorganic material** waste: fiberglass filter component
- **Cellulosic** waste: filter media, lint, rags, towels
- **Plastic** waste: filter components
- **Rubber** waste: filter components (gaskets) and rubber gloves
- **Metal** items: filter components (metal rings in sock filters) and drum lifting slings

This waste stream consists of five drums of sludge that were generated from laundry and pressure wash activities that are currently stored at SRS. Based on the results of comparing the above comparison and the nature of the laundry and pressure washing activities (being conducted on some of the same surfaces involved in the swipe samples), the scaling factors used for the characterization of the five sludge drums are similar to the scaling factors used in the characterization of the RH TRU debris waste.

Radiological Characterization Overview

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

- Development of DTC relationships as a function of waste density using MicroShield® based on each drum's measured external exposure (dose) rate, assuming the main contributors to the external exposure were ^{137}Cs and ^{60}Co

- Derivation of radionuclide scaling factors for quantification of the 10 WIPP-tracked radionuclides as supported by CCP-AK-SRS-501 and its calculation packages

5.3.2 Overview of Waste Stream SR-BCLDP.001.002

Waste Stream SR-BCLDP.001.002 is debris waste (WMC S5410) containing composite filter debris waste and cartridge and sock filters used in the pressure wash water recovery system. The cartridge filter matrix is composed of glass and cellulose fibers combined with melamine resin. The end caps are polypropylene and the gaskets are butyl/nitrile rubber. This waste also includes sock filters generated during the laundering of mop heads and rags. Review of the AK for this waste stream identified the following materials:

- **Organic** waste: filter resins and precautionary Radsorb absorbent, added to the bottom of the liner, in addition to liquids and sludges immobilized with Radsorb
- **Inorganic** waste: liquids and sludges immobilized with Floor Dry
- **Other inorganic material** waste: fiberglass filter component
- **Cellulosic** waste: filter media and lint
- **Plastic** waste: filter components
- **Rubber** waste: filter components (gaskets)
- **Metal** items: filter components (metal rings in sock filters) and drum lifting slings

This waste stream consists of four drums that are currently stored at SRS.

Radiological Characterization Overview

A comparison of the radionuclide distribution in the 69 swipe samples and the 1,000 ORIGEN2.2 computer runs representing LWR fuel (as described in CCP-AK-SRS-501) supports the premise that the radionuclide distributions in the laundry and pressure wash filters would be the same with one exception. The concentration of ^{137}Cs might be depleted in the filters because of its solubility relative to the other reportable radionuclides. To account for the depletion of ^{137}Cs, it was assumed that the scaling factors derived for the transfer and storage pool filter cartridges would reflect the distributions in the laundry and pressure wash filters, as both are in an aqueous environment. EPA concurred with this approach.

Eight grab samples of the cartridge filter materials from the transfer and storage pool cleanup system were collected during the decommissioning activities of the JN-1 Building. The radionuclides measured were: ^{60}Co, ^{134}Cs, ^{137}Cs, europium-154 (^{154}Eu), ^{241}Am, curium-244 (^{244}Cm), ^{238}Pu, and ^{239}Pu/^{240}Pu. ORIGEN2.2 was used to develop scaling factors for the non-measured radionuclides, specifically the uranium isotopes, ^{90}Sr, ^{241}Pu and ^{242}Pu.

5.3.3 Overview of Waste Stream SR-RL-BCLDP.002

Waste Stream SR-RL-BCLDP.002 is homogeneous solids (WMC S3150) consisting of a single drum containing 340 cemented acid slugs of dissolved fuel solution generated during the operation of Building JN-1. This one drum is currently stored at SRS.

Radiological Characterization Overview

Based on a comparison of the nature of the material comprising the cemented slugs (solidified fuel solutions), the scaling factors used for the characterization of the single drum under evaluation are similar to the scaling factors used in the characterization of the RH TRU debris waste.

5.3.4 Overview of Waste Stream SR-BCLDP.003

Waste Stream SR-BCLDP.003 is homogeneous solids (WMC S3212) consisting of the absorbed hydraulic sludge and debris generated by the BCLDP program during D&D of the Building JN-1 Hydraulic Room. The waste is the result of solidifying oil/sludge with a solidifying agent specifically developed to solidify oil-based materials. Review of the AK supporting this waste stream identified the following materials:

- **Organic** matrix waste: precautionary Radsorb absorbent, added to the bottom of the liner; Radabsorb and Nochar Petrobond to immobilize the hydraulic sludge during D&D
- **Inorganic** matrix waste: concrete pieces and dust, Precautionary Floor Dry absorbent, added to the bottom of the liner. Floor Dry was also added to immobilize the hydraulic sludge during D&D.
- **Other inorganic material** waste: glass pieces
- **Cellulosic** waste: rags, gloves, and muslin bags
- **Plastic** waste: as low as reasonably achievable paint, epoxy paint, bags, ties, duct tape, and bottles
- **Rubber** waste: rubber gloves
- **Metal** items: shavings, pieces, shims, and tools (C-clamp, wrenches, and a screw driver)

Seven drums of BCL RH TRU hydraulic sludge and debris were generated during the operation of JN-1 Building, and these drums are currently stored at SRS.

Radiological Characterization Overview

Based on the results of the above comparison and the consideration of the nature of the material comprising the hydraulic sludge and debris, the scaling factors used for the characterization of the single drum under evaluation are similar to the scaling factors used in the characterization of the RH TRU debris waste. Also, the reported results, based on two samples collected in 2002, presumably for radiological characterization of the hydraulic sludge (CCP-AK-SRS-531), provided a secondary confirmation of the assumption that the radionuclide distribution in the hydraulic sludge was similar to what was developed for debris waste (CCP-AK-SRS-501).

5.3.5 Overview of Waste Stream SR-BCLDP.004.002

Waste Stream SR-BCLDP.004.002 is debris waste (WMC S5410) consisting of cartridge water filter waste and other debris repackaged with the filters that were contaminated during JN-1 fuel transfer and storage pool clean. Review of the AK for this waste stream identified the following materials:

- **Cartridge Filters**: glass and cellulose filter matrix, polypropylen end caps and core supports.
- **Debris** (repackaged with filters): rubber gaskets, rubber gloves, muslin resin bags, paper, cloth (wipes), tape, metal cans, and plastic bags, sheeting, and gloves.
- **Absorbent Materials**: Floor Dry and Radsorb.

This waste stream consists of five drums that are currently in storage at SRS.

Radiological Characterization Overview

The development of radionuclide scaling factors for BCLDP RH TRU cartridge water filters is essentially the same as what EPA evaluated and approved during the SRS-CCP baseline inspection. Cobalt-60 was considered as the key gamma radionuclide in the development of scaling factors because it is reasonably insoluble and would therefore deposit on the filter media along with other TRU radionuclides to a greater extent than ^{137}Cs, which is expected to be soluble. The development of the ^{60}Co-based scaling factors was supported by the following sources of information:

- The comparisons between the radionuclide distribution in the 69 swipe samples and the 1,000 ORIGEN2.2 computer runs representing LWR fuel (as described in CCP-AK-SRS-501), which lead to the expectation that the radionuclide distributions in the cartridge water filters would generally be the same with the exception that the concentration of ^{137}Cs might be depleted in the filters because of the solubility of ^{137}Cs, as compared to the other reportable radionuclides.
- Eight grab samples of the cartridge filter materials from the transfer and storage pool cleanup system, collected during the decommissioning activities of the JN-1 Building. The radionuclides measured were: ^{60}Co, ^{134}Cs, ^{137}Cs, ^{154}Eu, ^{241}Am, ^{244}Cm, ^{238}Pu, and ^{239}Pu/^{240}Pu.
- ORIGEN2.2 computer code, used to develop scaling factors for the non-measured radionuclides, specifically the uranium isotopes, ^{90}Sr, ^{241}Pu and ^{242}Pu.

5.3.6 Overview of Waste Stream SR-BCLDP.004.003

Waste Stream SR-BCLDP.004.003 is debris waste (WMC S5401) consisting of Tri-Nuc filters from the vacuum system that was used to clean the surfaces of the pool during draining of the pool water. Review of the AK for this waste stream identified Floor Dry and Radsorb that were added to the drums to absorb any free liquid to prevent accumulation of residual liquids from condensation or dewatering. The two drums of this waste stream are currently stored at SRS.

Radiological Characterization Overview

The development of radionuclide scaling factors for BCLDP RH TRU Tri-Nuc Vacuum Filter Waste is essentially the same as what EPA evaluated and approved during the SRS-CCP baseline inspection. Cobalt-60 was considered as the key gamma radionuclide in the development of scaling factors because it is reasonably insoluble and would therefore deposit on the filter media along with the transuranic radionuclides to a greater extent than ^{137}Cs, which is expected to be soluble. The development of the ^{60}Co-based scaling factors was supported by the following sources of information:

- The comparisons between the radionuclide distribution in the 69 swipe samples and the 1,000 ORIGEN2.2 computer runs representing LWR fuel (as described in CCP-AK-SRS-501), which lead to the expectation that the radionuclide distributions in the Tri-Nuc vacuum filter waste would generally be the same with the exception that the concentration of ^{137}Cs might be depleted in the filters because of the solubility of ^{137}Cs, as compared to the other reportable radionuclides.
- Six grab samples of the filter materials from the transfer and storage pool cleanup system that were collected during the decommissioning of the JN-1 Building. The radionuclides measured in the samples were: ^{241}Am, ^{60}Co, ^{154}Eu, ^{134}Cs and ^{137}Cs.
- ORIGEN2.2 was used to develop scaling factors for the non-measured radionuclides, specifically the uranium isotopes, ^{90}Sr, and the plutonium isotopes.

5.3.7 Radiological Characterization Technical Evaluation

The EPA inspection team evaluated the following aspects of the technical report for technical adequacy and proper documentation:

(1) The extensive computer modeling and swipe sampling and analysis for LWR fuel, as referred to in the radiological characterization reports and supporting calculation packages for all six waste streams, were found to be technically adequate and properly documented.

The modeling (ORIGEN2.2 computer runs) and the 69 swipe debris samples collected from a wide range of surfaces and materials in the hot cells at the JN facilities had been evaluated and found to be adequate during the baseline inspection and this aspect had not changed for any of these six waste streams examined during this T1 evaluation. Additionally, there were no concerns regarding the technical adequacy and documentation of the eight grab samples collected for Waste Streams SR-BCLDP.001.002, SR-BCLDP.004.002, and SR-BCLDP.004.003.

(2) The development of radionuclide scaling factors for all six waste streams was found to be technically adequate and appropriately documented.

SR-BCLDP.001.001: The results of the ORIGEN2.2 runs documented in CCP-AK-SRS-501, were used to develop ^{137}Cs-based scaling factors and their associated uncertainties for all radionuclides except ^{233}U. Because alpha spectrometry is unable to definitively separate ^{233}U and ^{234}U, the scaling factor for ^{233}U was determined when its activity would be reported all as ^{234}U from the smear sample data.

A ^{60}Co/^{137}Cs scaling factor is needed to determine the contribution of these two radionuclides to the average gamma dose rate measured for each waste drum. The ^{137}Cs and ^{60}Co dose contributions in conjunction with the waste density and the DTC correlation determine the concentrations of ^{137}Cs and ^{60}Co and allow the determination of the activities of the WIPP-tracked radionuclides using the ^{137}Cs-based scaling factors. The scaling factors are shown in Table 4, below.

Table 4. Scaling Factors for the BCLDP RH TRU Laundry and Pressure Wash Sludge in Units of Curies of Specific Radionuclide/Curies ^{137}Cs (Ci/Ci ^{137}Cs)

Radionuclide	Cs-137 Scaling Factor
U-233	5.12E-05
U-234	2.59E-05
U-235	3.58E-07
U-238	5.89E-06
Pu-238	3.41E-02
Pu-239	5.83E-03
Pu-240	9.48E-03
Pu-241	6.87E-01
Pu-242	3.01E-05
Am-241	5.00E-02
Cm-244	1.76E-02
Co-60	2.27E-02
Sr-90	6.77E-01
Y-90	6.77E-01
Cs-137	1.00E+00
Ba-137m	9.46E-01

A summary of the steps involved in the radiological characterization of Waste Stream SR-BCLDP.001.001 is provided in Figure 1, below.

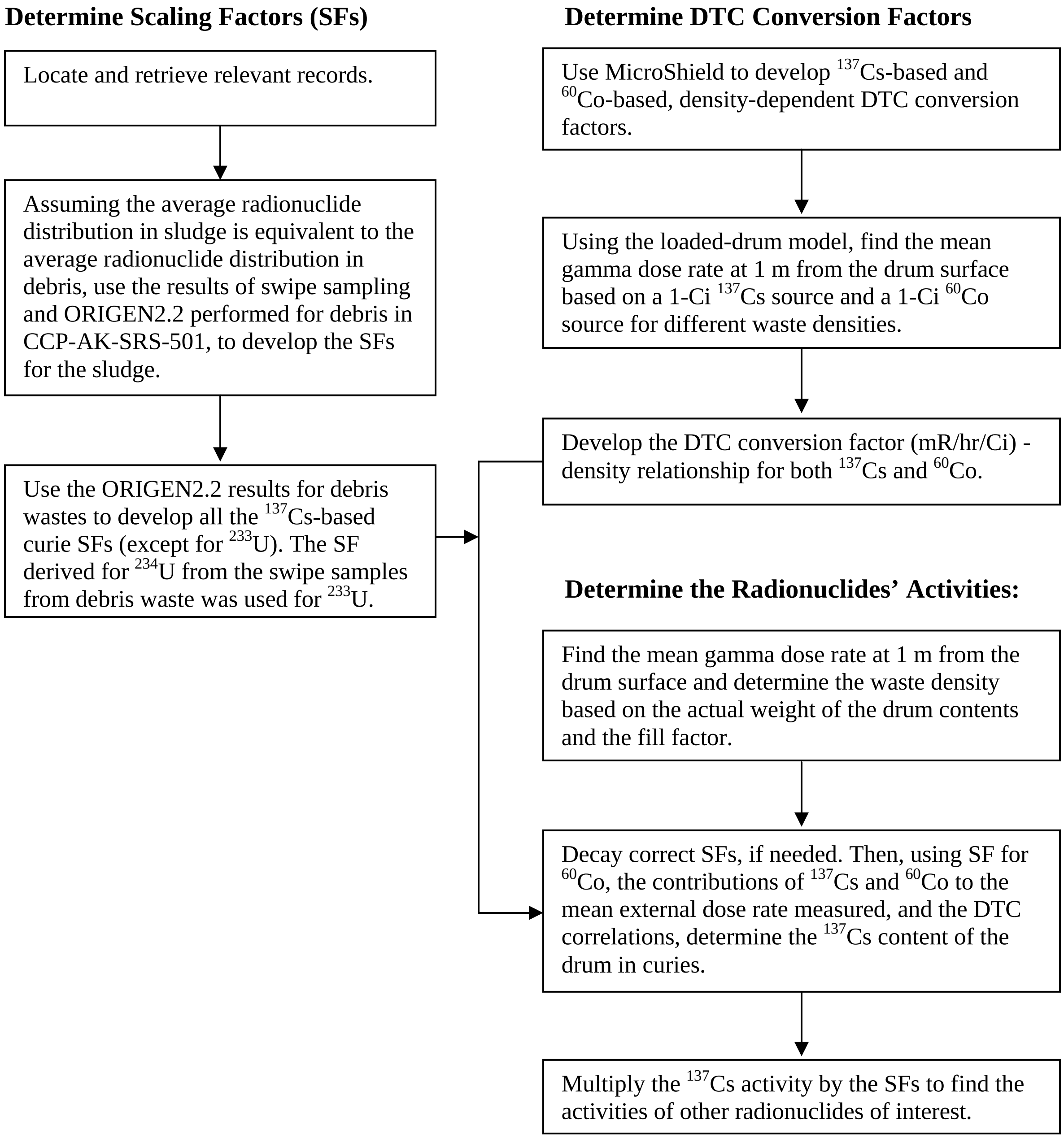

Figure 1. Flow Diagram for the Radiological Characterization of Waste Stream SR-BCLDP.001.001

There are no issues related to the technical adequacy or documentation of radionuclide scaling factors for Waste Stream SR-BCLDP.001.001.

SR-BCLDP.001.002: The ^{60}Co scaling factors for the measured radionuclides were derived as geometric means from the eight grab samples collected. For non-measured radionuclides, expected to be largely insoluble, the ^{241}Am/^{60}Co scaling factor, derived from the sample data for two insoluble radionuclides, was multiplied by the ratios of radionuclides R_i/^{241}Am from the

ORIGEN2.2 results. It was assumed that $^{234}U/^{241}Am$ ratio, derived from the 69 swipe sample data mentioned above, instead of using the ORIGEN2.2 results mentioned above, would better represent $^{233}U/^{241}Am$.

The scaling factor $^{137}Cs/^{60}Co$ is needed to determine the contribution of each of the two radionuclides to the average gamma dose rate measured at a distance of one meter from the mid-section of the waste drum. The ^{137}Cs and ^{60}Co dose contributions, when used in conjunction with the waste density and the DTC correlation, would lead to the determination of the concentrations of ^{137}Cs and ^{60}Co, and finally to the determination of the activities of the reportable radionuclides, using their ^{60}Co-based scaling factors.

The scaling factors are shown in Table 5, below.

Table 5. Scaling Factors for the Waste Stream SR-BCLDP.001.002 in Units of Curies of Specific Radionuclide/Curies ^{60}Co (Ci/Ci ^{60}Co)

Radionuclide	Co-60 Scaling Factor
U-233	1.32E-03
U-234	3.37E-04
U-235	4.66E-06
U-238	7.67E-05
Pu-241	6.77E+00
Pu-242	3.92E-04
Sr-90	7.66E+00
Co-60	1.00E+00
Cs-134	8.58E-04
Cs-137	9.39E-01
Eu-154	2.32E-01
Am-241	7.24E-01
Cm-244	4.86E-01
Pu-238	2.79E-01
Pu-239	3.42E-02
Pu-240	5.57E-02

A summary of the steps involved in the radiological characterization of Waste Stream SR-BCLDP.001.002) is provided in Figure 2, below.

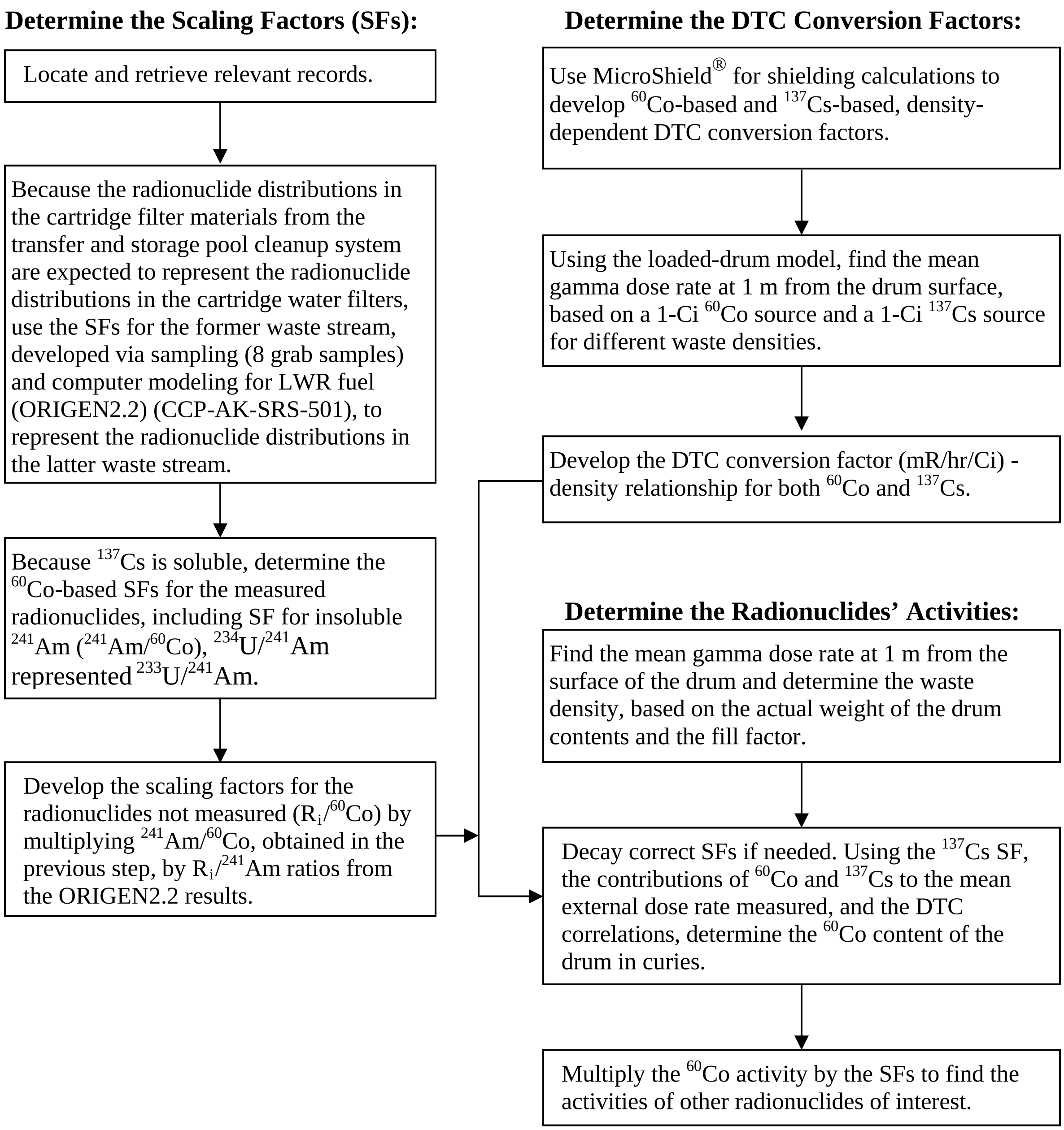

Figure 2. Flow Diagram for the Radiological Characterization of Waste Stream SR-BCLDP.001.002

There are no issues related to the technical adequacy or documentation of radionuclide scaling factors for Waste Stream SR-BCLDP.001.002.

SR-BCLDP.002: The results of ORIGEN2.2 runs were used to develop a consistent set of ^{137}Cs-based scaling factors and their uncertainties for all radionuclides except for ^{233}U. Because alpha spectrometry is unable to definitively separate ^{233}U and ^{234}U, the scaling factor for ^{233}U was determined when its activity would be reported all as ^{234}U from the smear sample data.

The ^{60}Co/^{137}Cs scaling factor is needed to determine the contribution of each of the two radionuclides to the average gamma dose rate for each waste drum. The ^{137}Cs and ^{60}Co dose contributions in conjunction with the waste density and the DTC correlation allow the determination of the concentrations of ^{137}Cs and ^{60}Co, and finally to the determination of the activities of the reportable radionuclides, using their ^{137}Cs-based scaling factors. The scaling factors are shown in Table 6, below.

Table 6. Scaling Factors for the Waste Stream SR-BCLDP.002 in Units of Curies of Specific Radionuclide/Curies ^{137}Cs (Ci/Ci ^{137}Cs)

Radionuclide	Cs-137 Scaling Factor
U-233	5.12E-05
U-234	2.59E-05
U-235	3.58E-07
U-238	5.89E-06
Pu-238	3.41E-02
Pu-239	5.83E-03
Pu-240	9.48E-03
Pu-241	6.87E-01
Pu-242	3.01E-05
Am-241	5.00E-02
Cm-244	1.76E-02
Co-60	2.27E-02
Sr-90	6.77E-01
Y-90	6.77E-01
Cs-137	1.00E+00
Ba-137m	9.46E-01

A summary of the steps involved in the radiological characterization of Waste Stream SR-BCLDP.002 is provided in Figure 3, below.

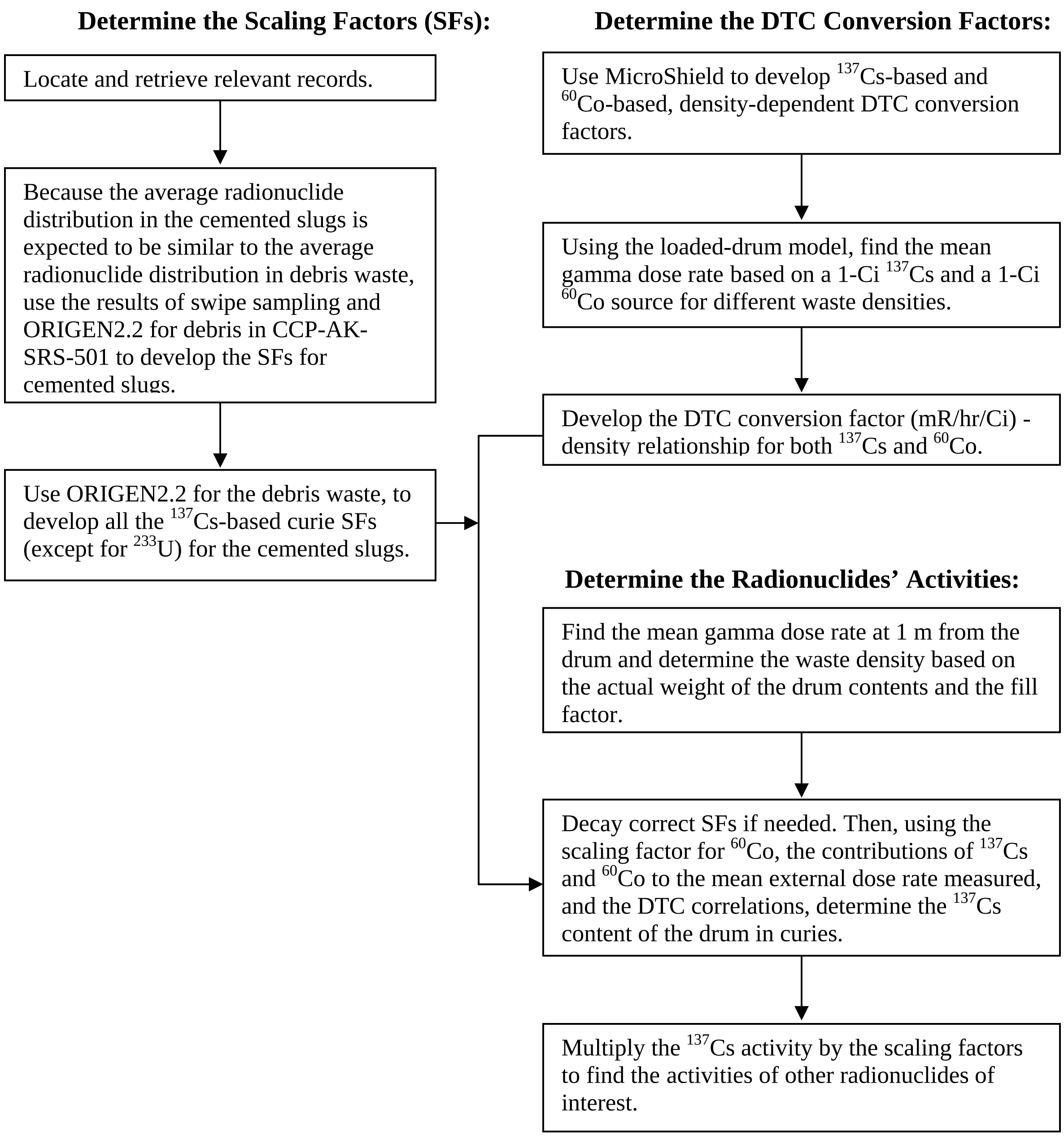

Figure 3. Flow Diagram for Waste Stream SR-RL-BCLDP.002

There are no issues related to the technical adequacy or documentation of radionuclide scaling factors for Waste Stream SR-RL-BCLDP.002.

SR-BCLDP.003: The results of the ORIGEN2.2 runs (CCP-AK-SRS-501), except for ^{233}U, were used to develop a consistent set of ^{137}Cs-based scaling factors and to estimate the uncertainties in all scaling factors. Because alpha spectrometry is unable to separate ^{233}U from ^{234}U, the scaling factor for ^{233}U was determined when its activity would be reported all as ^{234}U from the smear sample data.

The $^{60}Co/^{137}Cs$ scaling factor is needed to determine the contribution of each of these two radionuclides to the average gamma dose rate measured at the waste drum. The ^{137}Cs and ^{60}Co dose contributions, when used in conjunction with the waste density and the DTC correlation, would lead to the determination of the concentrations of ^{137}Cs and ^{60}Co, and finally to the determination of the activities of the reportable radionuclides, using their ^{137}Cs -based scaling factors. The scaling factors are shown in Table 7, below.

Table 7. Scaling Factors for Waste Stream SR-BCLDP.003 in Units of Curies of Specific Radionuclide/Curies ^{137}Cs (Ci/Ci ^{137}Cs)

Radionuclide	Cs-137 Scaling Factor
U-233	5.12E-05
U-234	2.59E-05
U-235	3.58E-07
U-238	5.89E-06
Pu-238	3.41E-02
Pu-239	5.83E-03
Pu-240	9.48E-03
Pu-241	6.87E-01
Pu-242	3.01E-05
Am-241	5.00E-02
Cm-244	1.76E-02
Co-60	2.27E-02
Sr-90	6.77E-01
Y-90	6.77E-01
Cs-137	1.00E+00
Ba-137m	9.46E-01

A summary of the steps involved in the radiological characterization of Waste Stream SR-BCLDP.003 is provided in Figure 4, below.

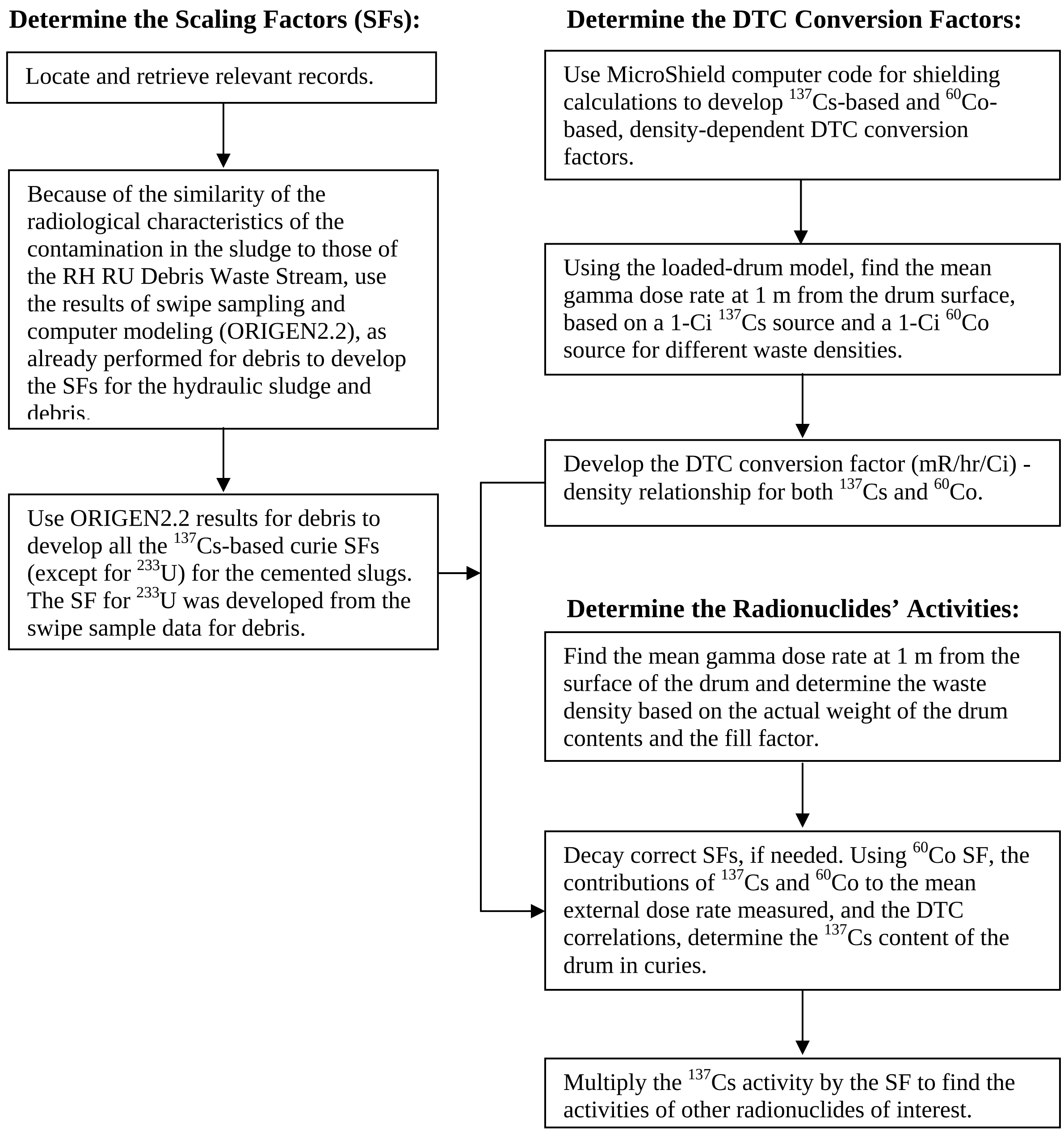

Figure 4. Flow Diagram for the Radiological Characterization of Waste Stream SR-BCLDP.003

There are no issues related to the technical adequacy or documentation of radionuclide scaling factors for Waste Stream SR-BCLDP.003.

SR-BCLDP.004.002: The ^{60}Co scaling factors for the measured radionuclides were derived as geometric means from the eight filter grab samples collected. For non-measured radionuclides, expected to be largely insoluble, the scaling factor ^{241}Am/^{60}Co, derived from the sample data for two insoluble radionuclides, was multiplied by the ratios of radionuclides R_i/^{241}Am from the ORIGEN2.2 results. It was assumed that ^{234}U/^{241}Am ratio, derived from the 69 swipe sample data mentioned above, instead of using the ORIGEN2.2 results mentioned above, would better represent ^{233}U/^{241}Am.

The scaling factor ^{137}Cs/^{60}Co is needed to determine the contribution of each of the two radionuclides to the average gamma dose rate measured at a distance of one meter from the mid section of the waste drum. The ^{137}Cs and ^{60}Co dose contributions, when used in conjunction with the waste density and the DTC correlation, would lead to the determination of the concentrations of ^{137}Cs and ^{60}Co, and finally to the determination of the activities of the reportable radionuclides, using their ^{60}Co-based scaling factors.

The scaling factors are shown in Table 8, below.

Table 8. Scaling Factors for the Waste Stream SR-BCLDP.004.002 in Units of Curies of Specific Radionuclide/Curies ^{60}Co (Ci/Ci ^{60}Co)

Radionuclide	Co-60 Scaling Factor
U-233	1.32E-03
U-234	3.37E-04
U-235	4.66E-06
U-238	7.67E-05
Pu-241	6.77E+00
Pu-242	3.92E-04
Sr-90	7.66E+00
Co-60	1.00E+00
Cs-134	8.58E-04
Cs-137	9.39E-01
Eu-154	2.32E-01
Am-241	7.24E-01
Cm-244	4.86E-01
Pu-238	2.79E-01
Pu-239	3.42E-02
Pu-240	5.57E-02

A summary of the steps involved in the radiological characterization of RH TRU Cartridge Water Filters (Waste Stream SR-BCLDP.004.002) is provided in Figure 5, below.

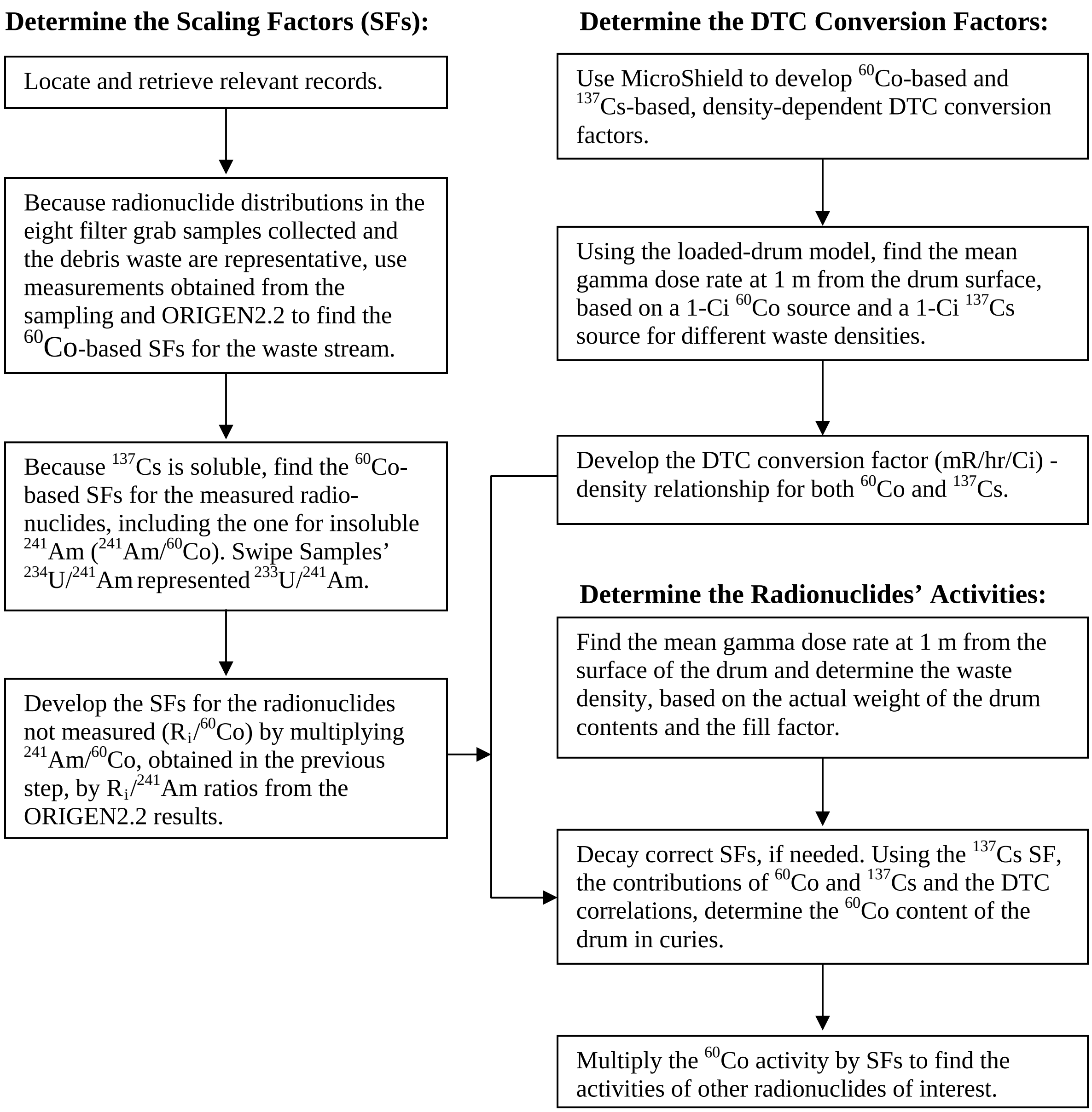

Figure 5. Flow Diagram for the Radiological Characterization of Waste Stream SR-BCLDP.004.002

Evaluation of CBFO Peer Review:

The data used to develop the scaling factors for this waste stream and SR-BCLDP-004.003 were the subject of a CBFO-sponsored Peer Review. EPA technical personnel evaluated the information supporting the peer review that had been provided to the Peer Review Panel members with respect to its ability to technically support accepting the laboratory analyses upon which the radionuclide-specific scaling factors were based.

The information that EPA reviewed consisted of the following:

- Battelle Columbus health physics procedures
- Battelle Columbus procedures for instrument calibration and operation
- Battelle Columbus procedures for specific radiometric analyses
- Independent assessments of the BCLDP laboratory that were performed by EPA and DOE, including the results of laboratory inter-comparison programs

In some cases, information was less than complete or there were gaps for specific records. However, upon reviewing the information as a whole, EPA determined that the records were adequate to support the development of radionuclide scaling factors for Waste Streams SR-BCLDP-004.002 and SR-BCLDP-004.003

There are no issues related to the technical adequacy or documentation of radionuclide scaling factors for Waste Stream SR-BCLDP.004.002.

SR-BCLDP.004.003: Radionuclide scaling factors provide a technically sound method for quantifying the difficult-to-measure radionuclide constituents of the waste on the basis of an easily measurable waste attribute like external dose rate, i.e., DTC. The DTC method assumes that the measured dose rate can be correlated to known constituents, i.e., the fission product ^{137}Cs and the activation product ^{60}Co, considered as the dominant contributors to the gamma dose rate, in the case of RH Tri-Nuc vacuum filter waste.

The ^{60}Co scaling factors for the measured radionuclides were derived as geometric means from the six grab samples of the filter materials collected. For non-measured radionuclides that were expected to be largely insoluble, the scaling factor ^{241}Am/^{60}Co was derived from the sample data for two insoluble radionuclides. This was multiplied by the ratios of radionuclides R_i/^{241}Am from the ORIGEN2.2 results. It was assumed that ^{234}U/^{241}Am ratio, derived from the 69 swipe sample data mentioned above would better represent the ^{233}U/^{241}Am ratio than the ORIGEN2.2 results.

The scaling factor ^{137}Cs/^{60}Co is needed to determine the contribution of each of the two radionuclides to the average gamma dose rate measured at a distance of one meter from the mid section of the waste drum. The ^{137}Cs and ^{60}Co dose contributions, when used in conjunction with the waste density and the DTC correlation, would lead to the determination of the concentrations of ^{137}Cs and ^{60}Co, and finally to the determination of the activities of the reportable radionuclides, using their ^{60}Co-based scaling factors.

The scaling factors are shown in

Table 9, below.

Table 9. Scaling Factors for the BCLDP RH TRU Tri-Nuc Vacuum Filter Waste in Units of Curies of Specific Radionuclide/Curies ^{60}Co (Ci/Ci ^{60}Co)

Radionuclide	Co-60 Scaling Factor
U-233	2.19E-04
U-234	6.29E-05
U-235	8,69E-07
U-238	1.43E-05
Pu-241	1.67E+00
Pu-242	7.31E-05
Sr-90	1.64E+00
Co-60	1.00E+00
Cs-134	1.22E-03
Cs-137	7.14E-01
Eu-154	5.46E-02
Am-241	1.22E-01
Cm-244	4.28E-02
Pu-238	8.29E-02
Pu-239	1.42E-02
Pu-240	230E-02

A summary of the steps involved in the radiological characterization of RH TRU Tri-Nuc vacuum filter waste (Waste Stream SR-BCLDP.004.003) is provided in Figure 6, below.

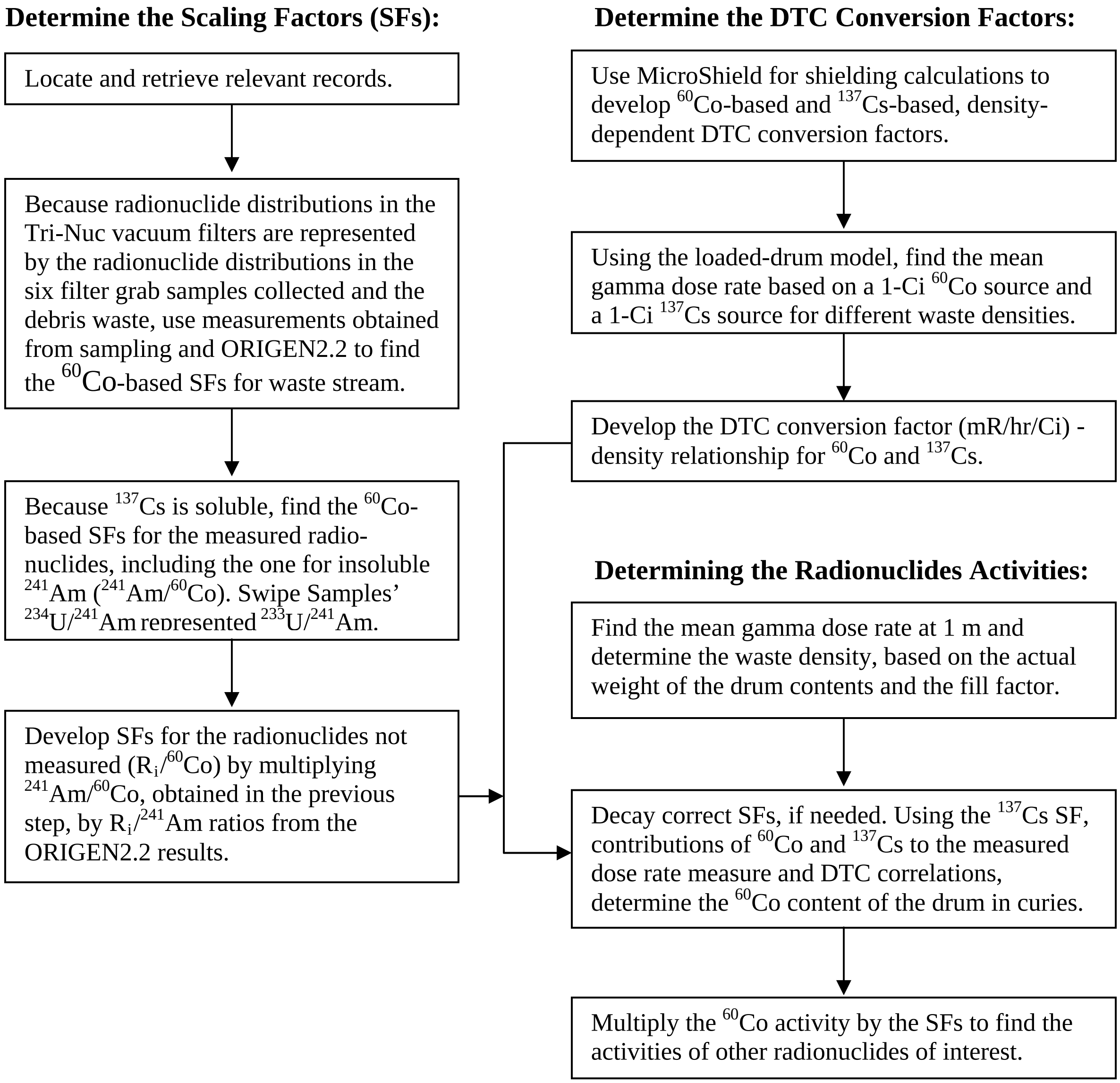

Figure 6. Flow Diagram for the Radiological Characterization of Waste Stream SR-BCLDP.004.003

Evaluation of CBFO Peer Review:

The data used to develop the scaling factors for this waste stream were the subject of a CBFO-sponsored Peer Review. EPA technical personnel evaluated the information supporting the peer review that had been provided to the Peer Review Panel members with respect to its ability to technically support accepting the laboratory analyses upon which the radionuclide-specific scaling factors were based. See the evaluation presented for Waste Stream SR-BCLDP-004.003, above.

There are no issues related to the technical adequacy or documentation of radionuclide scaling factors for Waste Stream SR-BCLDP.004.003.

(3) The technical basis of the DTC correlations and the documentation for all six waste streams were evaluated and found to be unchanged from what EPA had inspected and approved previously, and both aspects were acceptable.

The DTC correlation was based on the following assumptions:

- The waste drum is 100 percent full with waste
- The radionuclides of interest are dispersed uniformly throughout the waste
- The waste matrix was assumed to be iron, because photon attenuation is more influenced by material density, as opposed to specific composition or atomic number
- Waste densities range from 0.3 grams per cubic centimeter (g/cm^3) to 2.3 g/cm^3

Using MicroShield®[4], Version 7.0, SRS-CCP developed a DTC correlation for an SRS drum filled with RH TRU waste in terms of milli Roentgen per hour (mR/hr) for a 1-curie (Ci) source of ^{137}Cs and ^{60}Co for each of the six waste streams. The figures that illustrate this for each waste stream are shown in Table 10, below. A DTC spreadsheet similar to the DTC spreadsheet that EPA evaluated during the baseline inspection is used for laundry and pressure wash sludge as well, involving the laundry and pressure wash sludge scaling factors. The spreadsheet contained the required information, specifically: cask identification number; container gross weight; estimated fill percentage; and results of the two dose rate measurements that are obtained via the application of DTC procedure CCP-TP-504. An example Waste Drum DTC Conversion Record (spreadsheet) for each of the six waste streams was examined and they are listed in Table 10, below. There were no concerns regarding the technical basis of the DTC correlation and its documentation for any of these six waste streams.

Table 10. DTC Spreadsheets in Radiological Characterization Reports

Waste Stream	Dose Rate Versus Waste Density Reference	Example DTC Spreadsheet Reference
SR-BCLDP.001.001	Figure 6-2, CCP-AK-SRS-511B, Revision 0	Table 6-1, CCP-AK-SRS-511B, Revision 0
SR-BCLDP.001.002	Figure 6-2, CCP-AK-SRS-511A, Revision 0	Table 6-1, CCP-AK-SRS-511A, Revision 0
SR-BCLDP.002	Figure 6-2, CCP-AK-SRS-521, Revision 0	Table 6-1, CCP-AK-SRS-521 Revision 0
SR-BCLDP.003	Figure 7-2, CCP-AK-SRS-531, Revision 0	Table 7-1, CCP-AK-SRS-531, Revision 0
SR-BCLDP.004.002	Figure 6-1, CCP-AK-SRS-541B, Revision 0	Table 6-2, CCP-AK-SRS-541B, Revision 0
SR-BCLDP.004.003	Figure 6-2, CCP-AK-SRS-541B, Revision 0	Table 6-1, CCP-AK-SRS-541B, Revision 0

[4] MicroShield® is a photon/gamma ray shielding and dose assessment program developed by Grove Software, Inc.

(4) Technical aspects and documentation of the radiological characterization process were evaluated and found to be acceptable.

The radiological characterization reports for each of the six waste streams are the main documents that describe the process that SRS-CCP used for these laundry wastes. Each of these documents is extensively supported by CCP-AK-SRS-501, Revision 1, and shares its calculation packages, which were reviewed during the baseline inspection. These packages had been prepared and reviewed initially by Jene Vance, Jim Holderness, Dave Moody, and Larry Porter to support the SRS-CCP RH baseline. These packages documented the following:

- Application and verification of MicroShield®
- Evaluation of all potential contributors to a container's dose rate
- Consideration of August 22, 2002, as the data collection date, for the purpose of decay correction of the sample data (Waste Streams SR-BCLDP.001.001, SR-BCLDP.002 and SR-BCLDP-003)
- Decay correction to an assumed reference date of June 1, 2008 (Waste Streams SR-BCLDP.001.002, SR-BCLDP.004.002 and SR-BCLDP.004.003)
- Contributions of short-lived radionuclides to the measured external dose rate
- Potential sources of uncertainty for waste stream-specific aspects
- Information input checks
- Technical development of scaling factors
- Technical derivation of the DTC approach and documentation of the DTC spreadsheet

The EPA evaluation team reviewed these packages and each of the six radiological characterization reports. None of the calculation packages required serious modifications; the EPA evaluation team found that they adequately documented the radiological characterization process for the laundry and pressure wash sludge, and the calculation packages cited above adequately supported the activities upon which the radiological characterization of the laundry and pressure wash sludge was based. There were no issues related to the documentation of technical aspects of the SRS-CCP radiological characterization approach for these six waste streams.

(5) The technical basis and derivation of Total Measurement Uncertainty (TMU) were evaluated and were found to be adequate.

The development of TMU for the six evaluated waste streams is based on the propagation of uncertainties present in all aspects of the determination of the radiological constituents of RH TRU waste. These aspects are assumed to be independent, which allows them to be added in quadrature. The TMU determination included contributions of the following:

- Drum weight measurement
- Measurement uncertainty

- Scaling factor uncertainty
- MicroShield® code and modeling issues
- Contributions of other gamma emitters

SR-BCLDP.001.001: The treatment of TMU for Waste Stream SR-BCLDP.001.001 is presented in CCP-AK-SRS-511B and Calculation Package No. SRS-RH-06. The principal sources of uncertainty in the ^{137}Cs scaling factors are uncertainty in contributing fuel pins and ORIGEN2.2 benchmarking. The largest single contributor to the overall uncertainty is the scaling factor, as shown in Table 11, below.

Table 11. Overall Uncertainty Listed by Radionuclide for Waste Stream SR-BCLDP.001.001 at a Density of 1.0 g/cm^3

Radionuclide	Dose Rate Measurement Uncertainty	Other Gamma Editors	MicroShield® Code Uncertainty	MicroShield® Model Uncertainty	Scaling Factor Uncertainty	Total Uncertainty
U-233	25.0%	45.6%	10%	31.4%	155.2%	167.0%
U-234	25.0%	45.6%	10%	31.4%	66.1%	90.4%
U-235	25.0%	45.6%	10%	31.4%	85.3%	105.2%
U-238	25.0%	45.6%	10%	31.4%	36.3%	71.5%
Pu-238	25.0%	45.6%	10%	31.4%	53.7%	81.7%
Pu-239	25.0%	45.6%	10%	31.4%	34.4%	70.6%
Pu-240	25.0%	45.6%	10%	31.4%	31.6%	69.2%
Pu-241	25.0%	45.6%	10%	31.4%	58.2%	84.8%
Pu-242	25.0%	45.6%	10%	31.4%	69.4%	92.8%
Am-241	25.0%	45.6%	10%	31.4%	53.3%	81.5%
Cm-244	25.0%	45.6%	10%	31.4%	143.0%	155.7%
Sr-90	25.0%	45.6%	10%	31.4%	12.6%	62.9%
Cs-137	25.0%	45.6%	10%	31.4%	N/A	61.6%

N/A: Not applicable

There were no concerns regarding the technical derivation and documentation of TMU for Waste Stream SR-BCLDP.001.001.

SR-BCLDP.001.002: The treatment of TMU for Waste Stream SR-BCLDP.001.002 is presented in CCP-AK-SRS-511A and Calculation Package No. SRS-RH-29. The principal sources of uncertainty in the ^{60}Co scaling factors are: sampling scaling factor (uncertainty in mean); ORIGEN2.2 benchmark uncertainty; ^{241}Am benchmarking; drum loading; and contributing fuel pins. The largest single contributor to the overall uncertainty is the scaling factor, as shown in Table 12, below.

Table 12. Overall Uncertainty Listed by Radionuclide for Waste Stream SR-BCLDP.001.002 at a Density of 0.35 g/cm^3

Radionuclide	Dose Rate Measurement Uncertainty	Other Gamma Editors	MicroShield® Code Uncertainty	Scaling Factor Uncertainty	Total Uncertainty
U-233	25.0%	11.5%	10%	74.5%	80.0%
U-234	25.0%	11.5%	10%	120.7%	124.2%
U-235	25.0%	11.5%	10%	142.4%	145.3%
U-238	25.0%	11.5%	10%	98.1%	102.4%
Pu-238	25.0%	11.5%	10%	73.7%	79.3%
Pu-239	25.0%	11.5%	10%	72.0%	77.7%
Pu-240	25.0%	11.5%	10%	71.3%	77.1%
Pu-241	25.0%	11.5%	10%	101.2%	105.3%
Pu-242	25.0%	11.5%	10%	100.4%	104.6%
Am-241	25.0%	11.5%	10%	64.6%	70.9%
Cm-244	25.0%	11.5%	10%	93.4%	97.9%
Sr-90	25.0%	11.5%	10%	89.2%	93.9%
Cs-137	25.0%	11.5%	10%	131.4%	134.6%
Co-60	25.0%	11.5%	10%	N/A	29.3%

N/A: Not applicable.

There were no concerns regarding the technical derivation and documentation of TMU for the Waste Stream SR-BCLDP.001.002.

SR-BCLDP.002: The treatment of TMU is presented in CCP-AK-SRS-521 and Calculation Package No. SRS-RH-06. The principal sources of uncertainty in the ^{137}Cs scaling factors are uncertainty in contributing fuel pins and ORIGEN2.2 benchmarking. The largest single contributor to the overall uncertainty is the scaling factor, as shown in Table 13, below.

Table 13. Overall Uncertainty Listed by Radionuclide for Waste Stream SR-BCLDP.002 at a Density of 1.0 g/cm^3

Radionuclide	Dose Rate Measurement Uncertainty	Other Gamma Editors	MicroShield® Code Uncertainty	MicroShield® Model Uncertainty	Scaling Factor Uncertainty	Total Uncertainty
U-233	25.0%	45.6%	10%	31.4%	155.2%	167.0%
U-234	25.0%	45.6%	10%	31.4%	66.1%	90.4%
U-235	25.0%	45.6%	10%	31.4%	85.3%	105.2%
U-238	25.0%	45.6%	10%	31.4%	36.3%	71.5%
Pu-238	25.0%	45.6%	10%	31.4%	53.7%	81.7%
Pu-239	25.0%	45.6%	10%	31.4%	34.4%	70.6%
Pu-240	25.0%	45.6%	10%	31.4%	31.6%	69.2%
Pu-241	25.0%	45.6%	10%	31.4%	58.2%	84.8%
Pu-242	25.0%	45.6%	10%	31.4%	69.4%	92.8%
Am-241	25.0%	45.6%	10%	31.4%	53.3%	81.5%
Cm-244	25.0%	45.6%	10%	31.4%	143.0%	155.7%
Sr-90	25.0%	45.6%	10%	31.4%	12.6%	62.9%
Cs-137	25.0%	45.6%	10%	31.4%	N/A	61.6%

N/A: Not applicable

There were no concerns regarding the technical derivation and documentation of TMU for Waste Stream SR-BCLDP.002.

SR-BCLDP.003: The treatment of TMU is presented in CCP-AK-SRS-531 and Calculation Package No. SRS-RH-06. The principal sources of uncertainty in the ^{137}Cs scaling factors are uncertainty in contributing fuel pins and ORIGEN2.2 benchmarking. The largest single contributor to the overall uncertainty is the scaling factor, as shown in Table 14, below.

Table 14. Overall Uncertainty Listed by Radionuclide for Waste Stream SR-BCLDP.003 at a Density of 1.0 g/cm^3

Radionuclide	Dose Rate Measurement Uncertainty	Other Gamma Editors	MicroShield® Code Uncertainty	MicroShield® Model Uncertainty	Scaling Factor Uncertainty	Total Uncertainty
U-233	25.0%	45.6%	10%	31.4%	155.2%	167.0%
U-234	25.0%	45.6%	10%	31.4%	66.1%	90.4%
U-235	25.0%	45.6%	10%	31.4%	85.3%	105.2%
U-238	25.0%	45.6%	10%	31.4%	36.3%	71.5%
Pu-238	25.0%	45.6%	10%	31.4%	53.7%	81.7%
Pu-239	25.0%	45.6%	10%	31.4%	34.4%	70.6%
Pu-240	25.0%	45.6%	10%	31.4%	31.6%	69.2%
Pu-241	25.0%	45.6%	10%	31.4%	58.2%	84.8%
Pu-242	25.0%	45.6%	10%	31.4%	69.4%	92.8%
Am-241	25.0%	45.6%	10%	31.4%	53.3%	81.5%
Cm-244	25.0%	45.6%	10%	31.4%	143.0%	155.7%
Sr-90	25.0%	45.6%	10%	31.4%	12.6%	62.9%
Cs-137	25.0%	45.6%	10%	31.4%	N/A	61.6%

N/A: Not applicable

There were no concerns regarding the technical derivation and documentation of TMU for Waste Stream SR-BCLDP.003.

SR-BCLDP.004.002: The treatment of TMU is presented in CCP-AK-SRS-541B and Calculation Package No. SRS-RH-25. The principal sources of uncertainty in the ^{60}Co scaling factors are: uncertainty in sampling scaling factor (uncertainty in mean), ORIGEN2.2 benchmark uncertainty, ^{241}Am benchmark uncertainty, uncertainty in drum loading, and uncertainty in contributing fuel pins. The largest single contributor to the overall uncertainty is the scaling factor, as shown in Table 15, below.

Table 15. Overall Uncertainty Listed by Radionuclide for Waste Stream SR-BCLDP.004.002 at a Density of 0.20 g/cm^3

Radionuclide	Dose Rate Measurement Uncertainty	Other Gamma Editors	MicroShield® Code Uncertainty	Scaling Factor Uncertainty	Total Uncertainty
U-233	25.0%	18.4%	10%	104.7%	109.6%
U-234	25.0%	18.4%	10%	120.7%	125.1%
U-235	25.0%	18.4%	10%	142.4%	146.1%
U-238	25.0%	18.4%	10%	98.1%	103.4%
Pu-238	25.0%	18.4%	10%	73.7%	80.6%
Pu-239	25.0%	18.4%	10%	72.0%	79.0%
Pu-240	25.0%	18.4%	10%	71.3%	78.4%
Pu-241	25.0%	18.4%	10%	101.2%	106.3%
Pu-242	25.0%	18.4%	10%	100.4%	105.6%
Am-241	25.0%	18.4%	10%	64.6%	72.4%
Cm-244	25.0%	18.4%	10%	93.4%	98.9%
Sr-90	25.0%	18.4%	10%	89.2%	95.0%
Cs-137	25.0%	18.4%	10%	131.4%	135.4%
Co-60	25.0%	18.4%	10%	N/A	32.6%

N/A: Not applicable.

There were no concerns regarding the technical derivation and documentation of TMU for the Waste Stream SR-BCLDP.004.002.

SR-BCLDP.004.003: The treatment of TMU is presented in CCP-AK-SRS-541B and Calculation Package No. SRS-RH-19. The principal sources of uncertainty in the ^{60}Co scaling factors are: ^{241}Am benchmarking; sampling (in ^{241}Am/^{60}Co) scaling factor (uncertainty in mean); ORIGEN2.2 benchmarking; drum loading; and contributions of fuel pins. The largest single contributor to the overall uncertainty is the scaling factor, as shown in Table 16, below.

Table 16. Overall Uncertainty Listed by Radionuclide for Waste Stream SR-BCLDP.004.003 at a Density of 0.42 g/cm^3

Radionuclide	Dose Rate Measurement Uncertainty	Other Gamma Editors	MicroShield® Code Uncertainty	Scaling Factor Uncertainty	Total Uncertainty
U-233	25.0%	7.3%	10%	59.4%	65.6%
U-234	25.0%	7.3%	10%	112.0%	115.5%
U-235	25.0%	7.3%	10%	135.1%	137.9%
U-238	25.0%	7.3%	10%	87.2%	91.5%
Pu-238	25.0%	7.3%	10%	81.1%	85.8%
Pu-239	25.0%	7.3%	10%	83.0%	87.5%
Pu-240	25.0%	7.3%	10%	73.9%	79.0%
Pu-241	25.0%	7.3%	10%	90.6%	94.8%
Pu-242	25.0%	7.3%	10%	89.8%	94.0%
Am-241	25.0%	7.3%	10%	46.3%	54.1%
Cm-244	25.0%	7.3%	10%	157.8%	160.2%
Sr-90	25.0%	7.3%	10%	77.0%	81.9%
Cs-137	25.0%	7.3%	10%	66.4%	72.0%
Co-60	25.0%	7.3%	10%	N/A	27.9%

N/A: Not applicable.

There were no concerns regarding the technical derivation and documentation of TMU for Waste Stream SR-BCLDP.004.003.

(6) RH and TRU determinations for all six waste streams were assessed and found to be adequate.

The determination that the RH containers meet the definition of TRU wastes and RH waste were examined during the baseline inspection. Both of these aspects are directly involved with the DTC measurement, as was observed during the baseline inspection. These were not assessed directly during this T1 evaluation, but EPA did verify that no aspects of these two determinations had changed. There were no technical or documentation-related concerns regarding the TRU and RH determinations for any of the evaluated waste streams.

<u>Summary of Radiological Characterization Findings and Concerns</u>

The EPA inspection team did not identify any findings or concerns related to radiological characterization for these six waste streams. There are no open concerns related to radiological characterization resulting from this T1 evaluation.

6.0 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, so no formal concerns were penned. Questions or issues were resolved in a timely fashion and there are no open concerns related to AK or radiological characterization resulting from this T1 evaluation.

Tiering Changes

The original baseline report did not include a tiering table. Based on the results of this T1 evaluation, there are no T1 and T2 designations for these waste streams that are inconsistent with those for other T1 RH waste streams.

7.0 CONCLUSIONS

EPA concluded that the waste characterization processes of AK and radiological characterization proposed to characterize RH TRU wastes from the six BCLDP waste streams are adequate, as evidenced by the records produced in characterizing these waste streams. There are no open issues relative to this T1 evaluation.

Approval

The T1 change that was evaluated consisted of the waste characterization techniques of AK and radiological characterization as applied to the following six BCLDP waste streams:

- SR-BCLDP.001.001, Homogeneous Waste composed of five drums
- SR-BCLDP.001.002, Composite Filter Debris composed of four drums
- SR-BCLDP.002, Cemented Slugs
- SR-BCLDP.003, Hydraulic Sludge and Debris composed of seven 55-gallon drums
- SR-BCLDP.004.002, Cartridge Water Filters composed of five drums
- SR-BCLDP.004.003, Tri-Nuc Vacuum Filters composed of two drums

Based on the results of this evaluation, EPA approves this T1 change for these six waste streams. SRS-CCP is approved to characterize these six BCLDP RH waste streams, consistent with the limitations specified in this report.

Attachment A

ATTACHMENT A - REFERENCES

- All C, DR, M, P and U source documents referenced in the four AKSRs and six Radiological Characterization Technical Reports listed below were provided to EPA. See the AKSR and Radiological Characterization Technical Report documents for a complete listing of all source documents not specifically mentioned in this attachment.
- 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
- CCP-AK-SRS-510, Central Characterization Project Acceptable Knowledge Summary Report for Battelle Columbus Laboratories Decommissioning Project (BCLDP) Remote-Handled Transuranic Waste from Building JN-1 Hot Cell Laboratory Pressure Wash and Laundry Operations, Waste Streams: SR-BCLDP.001.001-Homogenous Waste and SR-BCLDP.001.002-Composite Filter Debris Waste, Revision 1, April 15, 2009
- CCP-AK-SRS-511A, Central Characterization Project Remote-Handled Transuranic Radiological Characterization Technical Report for Remote-Handled Transuranic Laundry and Pressure Wash Filter Waste from Battelle Columbus Laboratories Decommissioning Project at the West Jefferson North Facility, Revision 0, May 20, 2008
- CCP-AK-SRS-511B, Central Characterization Project Remote-Handled Transuranic Radiological Characterization Technical Report for Remote-Handled Transuranic Laundry and Pressure Wash Sludge from Battelle Columbus Laboratories Decommissioning Project at the West Jefferson North Facility, Revision 0, May 15, 2008
- CCP-AK-SRS-512, Central Characterization Project RH TRU Waste Certification Plan for 40 CFR 194 Compliance and Confirmation Test Plan for BCLDP RH Waste Streams: SR-BCLDP.001.001 and SR-BCLDP.001.002, Revision 0, May 23, 2008
- CCP-AK-SRS-520, Central Characterization Project Acceptable Knowledge Summary Report for Battelle Columbus Laboratories Decommissioning Project (BCLDP) Remote-Handled Homogeneous Transuranic Waste from the Building JN-1 Hot Cell Laboratory, Waste Stream: SR-BCLDP.002-Cemented Slugs, Revision 1, June 4, 2009
- CCP-AK-SRS-521, Central Characterization Project Remote-Handled Transuranic Radiological Characterization Technical Report for Remote-Handled Transuranic Laundry Cemented Slugs from Battelle Columbus Laboratories Decommissioning Project at the West Jefferson North Facility, Revision 0, June 2, 2008
- CCP-AK-SRS-522, Central Characterization Project RH TRU Waste Certification Plan for 40 CFR 194 Compliance and Confirmation Test Plan for BCLDP RH Waste Stream: SR-BCLDP.002, Revision 0, April 24, 2008
- CCP-AK-SRS-530, Central Characterization Project Acceptable Knowledge Summary Report for Battelle Columbus Laboratories Decommissioning Project (BCLDP) Remote-Handled Homogeneous Transuranic Waste from the Building JN-1 Hydraulic Room, Waste Stream: SR-BCLDP.003-Hydraulic Sludge and Debris, Revision 1, August 13, 2009

- CCP-AK-SRS-531, Central Characterization Project Remote-Handled Transuranic Radiological Characterization Technical Report for Remote-Handled Transuranic Sludge and Debris from Battelle Columbus Laboratories Decommissioning Project at the West Jefferson North Facility, Revision 0, May 6, 2008
- CCP-AK-SRS-532, Central Characterization Project RH TRU Waste Certification Plan for 40 CFR 194 Compliance and Confirmation Test Plan for BCLDP RH Waste Stream: SR-BCLDP.003, Revision 0, April 24, 2008
- CCP-AK-SRS-540, Central Characterization Project Acceptable Knowledge Summary Report for Battelle Columbus Laboratories Decommissioning Project (BCLDP) Remote-Handled Transuranic Waste from the Building JN-1 Hot Cell Laboratory Transfer and Storage Pool, Waste Streams: SR-BCLDP.004.002-Cartridge Water Filters and SR-BCLDP.004.003-Tri-Nuc Vacuum Filters, Revision 1, June 10, 2009
- CCP-AK-SRS-541A, Central Characterization Project Remote-Handled Transuranic Radiological Characterization Technical Report for Remote-Handled Transuranic Cartridge Water Filters from Battelle Columbus Laboratories Decommissioning Project at the West Jefferson North Facility, Revision 0, June 17, 2008
- CCP-AK-SRS-541B, Central Characterization Project Remote-Handled Transuranic Radiological Characterization Technical Report for Remote-Handled Transuranic Tri-Nuc Vacuum Filter Waste from Battelle Columbus Laboratories Decommissioning Project at the West Jefferson North Facility, Revision 1, October 20, 2009
- CCP-AK-SRS-542, Central Characterization Project RH TRU Waste Certification Plan for 40 CFR 194 Compliance and Confirmation Test Plan for BCLDP RH Waste Streams: SR-BCLDP.004.002 and SR-BCLDP.004.003, Revision 0, July 9, 2008
- Characterization Reconciliation Report for SR-BCLDP.001.001, Draft for inspection purposes, provided October 14, 2009
- Characterization Reconciliation Report for SR-BCLDP.001.002, Draft for inspection purposes, provided October 14, 2009
- Characterization Reconciliation Report for SR-BCLDP.002, Draft for inspection purposes, provided October 14, 2009
- Characterization Reconciliation Report for SR-BCLDP.003, Draft for inspection purposes, provided October 14, 2009
- Characterization Reconciliation Report for SR-BCLDP.004.002, Draft for inspection purposes, provided October 14, 2009
- Characterization Reconciliation Report for SR-BCLDP.004.003, Draft for inspection purposes, provided October 14, 2009
- Waste Stream Profile Form, Waste Stream SR-BCLDP.001.001, Draft for inspection purposes, provided October 14, 2009
- Waste Stream Profile Form, Waste Stream SR-BCLDP.001.002, Draft for inspection purposes, provided October 14, 2009

- Waste Stream Profile Form, Waste Stream SR-BCLDP.002, Draft for inspection purposes, provided October 14, 2009
- Waste Stream Profile Form, Waste Stream SR-BCLDP.003, Draft for inspection purposes, provided October 14, 2009
- Waste Stream Profile Form, Waste Stream SR-BCLDP.004.002, Draft for inspection purposes, provided October 14, 2009
- Waste Stream Profile Form, Waste Stream SR-BCLDP.004.003, Draft for inspection purposes, provided October 14, 2009
- C001, Interview Record: Eugene Sands, Master Research Technician; Larry Stickel, Master Technician; Harley Toy, Manager of Regulatory Compliance and Tech. Services; Max Berchtold, JN-1 Lab Technician; George Kirsch, Health Physicist, Kevin J. Peters and Jeffery Harrison, May 1, 1998
- C002, Packet of letters concerning Destruction/Immobilization of Toxic Substances by Intense Gamma Irradiation, L. M. Lowry, H. L. Toy, E. W. Ungar, R. DiSalvo, November 8, 1982, December 13, 1982, December 15, 1982, and January 27, 1983
- C014, Interview record of George Kirsch and Eugene Sands, Re: Use of Potassium Cyanide, pool water evaporation, and nerve agent research, Kevin J. Peters, October 22, 1998
- C033, Letter to Contractors, Richland, Washington; Director, Pacific Northwest Laboratory; President, Westinghouse Hanford Company, Re: Spent Nuclear Fuel Records, Elizabeth D. Sellers, 96-SFD-059, March 14, 1996
- C034, Memorandum to Elizabeth D. Sellers, Re: National Spent Nuclear Fuel Program Evaluation of Hanford Building 327 Material for Applicability of RH-TRU Waste Criteria for Disposal at WIPP, James Boyd, OPE-SFP-081, March 24, 1997
- C035, Letter to H. J. Hatch, Re: Contract No. DE-AC05-96RL13200 - Classification of Nuclear Materials in the 327 Building, Elizabeth D. Sellers, 97-SFD-074, April 21, 1997
- C501, Battelle Defense Determination Approval, R. Tormey; E. Rose, June 28, 2005
- C515, Waste Material Parameter Weight Evaluation for Transfer and Storage Pool Waste Streams, K.J. Peters, December 13, 2007
- C518, Attachment 6 of CBFO's Response to NMED's Notice of Deficiency (NOD) regarding the AK Sufficiency Request for Waste Stream SR-RL-BCLDP.001, U.S. DOE Carlsbad Field Office, December 15, 2008
- C522, Freeze File Documentation for CCP-AK-SRS-510, Revision 1, SRS-CCP
- C523, Freeze File Documentation for CCP-AK-SRS-520, Revision 1, SRS-CCP
- C524, Freeze File Documentation for CCP-AK-SRS-530, Revision 1, SRS-CCP
- C525, Freeze File Documentation for CCP-AK-SRS-510, Revision 1, SRS-CCP
- C701, Letter to James Eide, Fuel Pool Filter Waste Form Documentation, Craig Jensen, G5012-2763WJ, January 22, 2001

- DR002, Interview Record for Discrepancy Report of George Kirsch, Re: Date of the Beginning of Operations of the HEC and Pool, Kevin J. Peters, July 28, 1998
- DR003, Letter to AK Record, re: Estimates of Waste Material Parameter Weights for Packaged JN-1 Pool Filter Resins and Debris and Assigning Matrix Parameter Categories Using RadSorb During Repackaging, Kevin J. Peters, April 8, 1999
- DR004, Interview Record of Cidney Voth, Re: Evaporation of the JN-1 Transfer/Storage Pool Water, Kevin J. Peters, April 27, 1999
- DR005, Letter to AK Record, Re: Discrepancy Report Relating to Lead Detected in Sample of Pool Water, Kevin J. Peters, May 12, 1999
- DR006, Letter to AK Record, Re: Discrepancy Report Relating to RCRA Metals Detected in Samples Pool Resins and Filters, Kevin J. Peters, June 29, 1999
- DR007, Letter to AK Record, re: Discrepancy Report Regarding Generation of Pool Water Prefilters and Debris Waste, Kevin J. Peters, November 30, 2000
- DR008, Letter to AK Record, re: Discrepancy Report Regarding Pool Water Prefilters and Debris Waste, Kevin J. Peters, January 24, 2001
- DR009, Letter to AK Record, Re: Discrepancy Report Regarding Generation of Four Debris Waste Streams, 5190-01, 5190-02, 5390-01, and 5390-02, Kevin J. Peters, May 25, 2001
- DR010, Letter to AK Record, Re: Discrepancy Report Relating to RCRA Metals Detected in Pool Resins and Filters Samples, and TRU Resin Volume Estimation, Scott M. Smith, May 25, 2001
- DR016, Debris - Homogeneous Waste Discrepancy for Waste Stream SR-BCLDP.001, K. Peters, November 30, 2007
- DR017, BCLDP RH Waste Stream Delineation - Low-Level, CH, and High Level Waste Containers, K. Peters, February 12, 2008
- DR018, Radiological Characterization of Waste from Laundry and Presser Wash Operations, K. Peters, February 13, 2008
- DR019, Discrepancy Resolution re: Prohibited Liquids Observed in Waste Stream SR-RLBCLDP.001 Liners During CCP Review of Historical Packaging Documentation Follow-Up, K. Peters, March 12, 2009
- P041, Interim Guidance on Ensuring that Waste Qualifies for Disposal at the Waste Isolation Pilot Plant, US DOE Carlsbad Area Office, December 13, 1997
- P501, Building JN-1 Hot Cell Laboratory, Acceptable Knowledge Document, Kevin J. Peters, WASTREN, Inc., TCP-98-03, Revision 2, August 2001 and August 13, 2001
- P510, Acceptable Knowledge Process Description - Repackaging of JN-1 Transfer/Storage Pool Filter Change-Out Waste, K. Peters, TCP-98-03.1.1, Revision 2, July 23, 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, Revision 0, November 2006

- U511, Waste Profile Sheets, J. Eide; D. Garber; S. Schmucker, Various Dates
- U514, BCLDP RH Waste Container Documentation, BCLDP, Various Dates
- U517, BCLDP Container Packaging Video Loading Recordings, BCLDP, Various Dates
- P755, Calculation Package - Laundry and Pressure Wash Filter Uncertainty Analysis, J. Vance, SRS-RH-29, Revision 0, February 13, 2008
- P732, Calc Package for Uncertainty Analysis, J. Vance, SRS-RH-06, Revisions 0 and 1, May 16, 2007 and November 7, 2007
- P804, Calculation Package for Tri-Nuclear Filter Waste Uncertainty Analysis, J. Vance, SRS-RH-19, Revision 0, February 13, 2008
- P810, Calculation Package for Pool Filter Waste Uncertainty Analysis, J. Vance, SRS-RH-25, Revision 0, February 13, 2008