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Page 1 of 1

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				Process for Designation of				
				K Basin Debris				

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Data Quality Objectives Process for Designation of K-Basins Debris

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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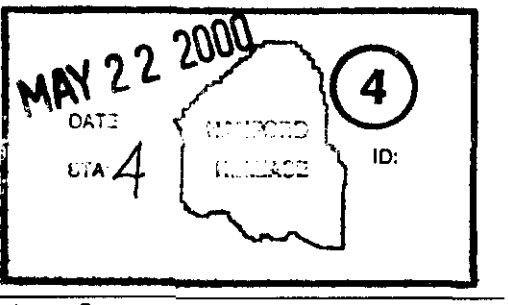

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EXECUTIVE SUMMARY

The data quality objectives process was applied to support disposition of debris to be removed from above and below water at the K East and K West Basins. The purpose of the analyses discussed in this document is to designate debris removed from the K Basins to determine whether it is suitable for disposal at the Environmental Restoration Disposal Facility.

The structures that house the basins are classified as radioactive material areas. Therefore, all materials removed from the buildings are presumed to be radioactively contaminated. Because most of the materials that will be addressed under this plan will be removed from the basins, and because of the cost associated with screening materials for release, it is anticipated that all debris will be managed as low-level waste. Materials will be surveyed, however, to estimate radionuclide content for disposal and to determine that the debris is not contaminated with levels of transuranic radionuclides that would designate the debris as transuranic waste.

Debris that is contaminated with *Resource Conservation and Recovery Act of 1976* / Washington State dangerous constituents above regulated levels will designate as mixed waste. Contamination may be present at levels that require treatment to comply with Land Disposal Restrictions. Debris >60 mm that requires treatment for compliance with the Land Disposal Restrictions will be treated through macro-encapsulation as an approved alternative treatment technology for debris under 40 *Code of Federal Regulations* 268.45. Debris $\leq$60 mm will be treated as appropriate, based on *Resource Conservation and Recovery Act of 1976* constituents. This approach is anticipated for only a small volume of debris and is more cost-effective than sampling this waste.

The sampling design for the debris incorporates two stages. In Stage 1, facility or historical radiological sample data will be used to establish the radionuclide/isotopic distribution of radiological constituents of concern. The radionuclide distributions will be established for each waste stream and subsequently used to estimate the content of constituents of potential concern, indexed to cesium-137. The cesium-137 content of

the waste will be estimated using a variety of instruments, including portable radiation detectors and nondestructive analysis (gamma spectroscopy, neutron counting) equipment. During Stage 2, K-Basin staff will use the correlation when evaluating data from radiological nondestructive analysis, dose rate, or gamma surveys to estimate isotopic inventories for waste shipments.

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ACRONYMS

ACM	asbestos-containing material
BHI	Bechtel Hanford, Inc.
CERCLA	*Comprehensive Environmental Response, Compensation and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COCs	contaminants of concern
COPCs	contaminants of potential concern
CWC	Central Waste Complex
DOE	U.S. Department of Energy
DQO	data quality objective
DR	decision rule
DS	decision statement
EHW	extremely hazardous waste
EPA	U.S. Environmental Protection Agency
EQM	Environmental Quality Management
ERDF	Environmental Restoration Disposal Facility
GEA	gamma energy analysis
HEPA	high-efficiency particulate air
HIC	high integrity container
ICP	inductively coupled plasma
IWTS	integrated water treatment system
IX	ion exchange
IXM	ion-exchange module
KE	K East
KW	K West
LDR	Land Disposal Restrictions
LLBG	low-level burial ground
LLW	low-level waste
MDL	minimum detection limit
NDA	nondestructive assay
PCB	polychlorinated biphenyl
PPE	personal protective equipment
PQL	practical quantitation limit
PSQ	principal study question
RCRA	*Resource Conservation and Recovery Act of 1976*
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SNF	spent nuclear fuel
TBD	to be decided
TC	toxicity characteristic
TCLP	Toxicity Characteristic Leachate Procedure
TRU	transuranic
TSCA	*Toxic Substances Control Act of 1976*
WAC	waste acceptance criteria
WS	waste stream

METRIC CONVERSION CHART

The following conversion chart is provided to aid the reader in conversion.

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	.0836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerel	millibecquerel	0.027	picocuries

1.0 STEP 1 – STATE THE PROBLEM

1.1 PROJECT OBJECTIVES

The U.S. Department of Energy has developed a schedule and approach for the removal of spent fuels, sludge, and debris from the K East (KE) and K West (KW) Basins, located in the 100 Area at the Hanford Site. The project that is the subject of this data quality objective (DQO) process is focussed on the removal of debris from the K Basins and onsite disposal of the debris at the Environmental Restoration Disposal Facility (ERDF). This material previously has been dispositioned at the Hanford Low-Level Burial Grounds (LLBGs) or Central Waste Complex (CWC).

The goal of this DQO process and the resulting Sampling and Analysis Plan (SAP) is to provide the strategy for characterizing and designating the K-Basin debris to determine if it meets the *Environmental Restoration Disposal Facility Waste Acceptance Criteria* (WAC), Revision 3 (BHI 1998). A critical part of the DQO process is to agree on regulatory and WAC interpretation(s) to support preparation of the DQO workbook and SAP.

1.2 PROJECT ASSUMPTIONS

The KE and KW Basins contain spent nuclear fuel (SNF) and contaminated sludge, water, and debris. Previous studies have shown that sludge is present in significant volumes in the KE Basin, which results in potentially higher surface contamination concerns for debris from this basin due to contact with the sludge. The scope of this DQO includes only the characterization of the debris from the K Basins and immediately adjacent areas, to allow the SNF Project to assign the appropriate waste designation. The scope includes characterization for disposal of the ion-exchange modules (IXMs) from the integrated water treatment system (IWTS). Waste designation will allow a determination of the appropriate method for treatment, packaging, and transportation of the waste for disposal at ERDF. If the debris cannot meet ERDF WAC (BHI 1998), it will be transferred to a 200 Area waste management facility, including one or more of the following: CWC, Mixed Waste Trench (W-025), LLBG, Waste Receiving and Processing facility, or T Plant. In this event, the waste must meet the requirements of the *Hanford Site Solid Waste Acceptance Criteria* (HNF 1998).

The Declaration of the Record of Decision for DOE Hanford 100 Area (EPA et al. 1999) for the K Basin defines debris qualitatively as all solid waste from the removal of materials from KE and KW Basins excluding SNF, sludge, and water. The Focused Feasibility Study for the K Basins Interim Remedial Action (DOE-RL 1998) provides a working definition of debris as any solid with a size greater than 0.64 cm (.25 in.). The purpose of this size specification for debris is to provide criteria to segregate fuel fragments from basin sludge. The project working definition of debris, as used in both the ROD and the FSS, is not to be confused with the RCRA definition of debris provided in 40 CFR 268.2 (g). For purposes of establishing disposal requirements, RCRA defines debris as a solid material exceeding a 60 mm (2.34 in.) particle size. Thus,

debris from the K Basins is subdivided into two categories, small debris (60 mm or less) that is subject to standard RCRA waste disposal requirements, and large debris (greater than 60 mm) that is eligible for disposal under the RCRA debris requirements. All project debris will be managed as required by the RCRA Land Disposal Restrictions. Project debris includes items located both above and below the water in the basins, wastes generated from operation of the water and sludge treatment systems, and wastes generated during basin deactivation. Equipment that is not an integral part of the basin structures will be decontaminated as appropriate, removed from the basin, drained, packaged, and disposed of as debris. Decontamination of debris from within the basins will take place primarily through a high-pressure wash system before the material is removed from the basin water. The pressure wash is expected to remove the majority of sludge from the surface of the debris, thus eliminating the majority of surface contamination from radionuclides, polychlorinated biphenyls (PCBs), and regulated metals.

Equipment could include components of the SNF retrieval system and washing station, the IWTS, and the sludge retrieval system. The IWTS equipment and the structure in which it is installed will be removed, decontaminated as appropriate, packaged, and disposed as debris. Debris also includes the aluminum and stainless steel fuel canisters in the basins, fuel racks, and miscellaneous piping, tools, hose, scrap, and other materials. There are approximately 1,800 empty and 7,400 full canisters in the two basins with an estimated waste volume of 27,600 ft^3. Full canisters will be managed for disposal according to this DQO and resulting SAP only after the fuel has been removed. Fuel racks will make up approximately 1,546 ft^3 of waste, and miscellaneous debris from the two basins will result in approximately 1,289 ft^3 of waste (*Remedial Design Report and Remedial Action Work Plan for the K Basins Interim Remedial Action* (DOE-RL 1999a), Section 1.3.3 "Contaminated Debris").

Debris management will depend on the waste designation. Because the K-Basin structures are designated as a radioactive material area, all materials are anticipated to be low-level waste (LLW), unless they can be released through survey and analysis or contamination is detected that causes the material to be designated transuranic (TRU) waste. Debris might designate as LLW, mixed waste, TRU waste, or TRU mixed waste, depending on contaminant concentrations associated with the specific items.

Limited analysis of samples from the basins indicates the presence of PCBs in sludge from some locations. All debris will be pressure-washed and drained of free-flowing liquid as it is removed from the basins; after washing, the debris will not subsequently be regulated under the *Toxic Substances Control Act of 1976* (TSCA)[1]. Although the paint on some debris items may contain PCBs, the concentrations are assumed to be below levels of concern for disposal at ERDF (concentrations are based on the total

1 The K-Basin ROD (EPA et al. 1999) states that debris is regulated as PCB remediation waste where it has contacted sludge. After it is drained of free-flowing liquids and rinsed with water to remove the sludge, the debris will no longer be managed as TSCA-regulated waste. The risk-based disposal approval under 40 CFR 761.61(c) is based on the expectation that minimal quantities and concentrations of PCBs will be left on the debris and that management of this waste in accordance with applicable radioactive waste and dangerous waste requirements will be protective of residual PCBs present in the waste.

mass for the item, not merely the paint itself). Some items, such as fluorescent light ballasts, are assumed to have regulated PCBs and are managed appropriately. For all these reasons, this DQO and resulting SAP do not include a sampling strategy for PCBs.

Before disposal at the ERDF, LLW from the K Basins might be crushed, sized, sorted, etc., to minimize volumes for disposal. Lead bricks and lead shielding will undergo macro-encapsulation before disposal at ERDF. Other debris that does not meet Land Disposal Restriction (LDR) criteria after decontamination also will be encapsulated for disposal at ERDF. Based on the debris inventory (*K Basins Debris Inventory* [Knox 1997]), a relatively small volume of painted debris is anticipated as part of the waste stream (WS). The SNF Project will establish a toxicity characteristic (TC) contaminant of concern (COC) to mass ratio for painted objects as part of the SAP. Painted debris will be assigned a TC designation for metals, based on the total mass of the object(s). The project believes that designation of this waste based on an agreed-upon ratio is a more efficient approach than sampling the painted debris for characterization. The same approach may be used for other small-volume suspect WSs, such as light bulbs. The overall quantity of hazardous constituents from these wastes is considered to be minimal. This approach is considered appropriate due to the low volume of waste, coupled with the expense of sampling and analysis, as compared to encapsulation. Macro-encapsulation is a designated alternative treatment standard for debris with no contaminant restrictions under 40 *Code of Federal Regulations* (CFR) 268.45.

Transuranic waste is not eligible for disposal at ERDF and will be directed to an alternate waste management pathway. All debris will be field surveyed for radionuclide contamination after pressure washing and removal from the basins. A small fraction of the debris might designate as either contact-handled or remote-handled TRU waste, or TRU mixed waste (waste that designates as both dangerous waste and TRU waste). This might happen if sludge or fuel particles are trapped inside debris. Debris with entrained sludge or fuel particles will be placed into a basket at the K Basins, agitated to dislodge the sludge and particles, and washed with water. Any debris that is still TRU-designated after this washing will be stored temporarily at the CWC until it can be packaged and certified at the Waste Receiving and Packaging facility for eventual disposal at Waste Isolation Project Plant. Debris that is not designated as TRU waste will be treated and packaged as appropriate and transferred to the 200 Area for disposal at ERDF. Actual treatment (e.g., macro-encapsulation) may take place at ERDF.

Six individual categories of waste have been identified by K-Basin project personnel for inclusion in ERDF waste profiles. The purpose of this document is to generate sufficient data to allow for the establishment of waste profiles. Although project personnel may wish to retain these categories for inventory control purposes, ERDF personnel will likely consolidate the waste categories into fewer profiles that correspond to the facility's waste management needs. The WSs identified by project personnel are described as follows:

Mixed Waste - consists of radiologically-contaminated materials that are also regulated as hazardous waste under the *Resource Conservation and Recovery Act of 1976* (RCRA) or dangerous wastes under the Washington State Dangerous Waste Regulations.

Above Water Waste - consists of radioactive, nonhazardous consumables such as disposable personal protective equipment (PPE) and other miscellaneous trash (e.g., paper, plastic, cloth, rubber, insulation, and light metal), as well as demolition debris such as structural steel and other fabricated components.

Underwater Debris - consists of radiologically-contaminated materials that are removed from beneath the water of the KE and KW Basins. These materials consist primarily of metals, plastic, and rubber components associated with tools, equipment, and structures used for handling, moving, and managing the submerged SNF. In the course of fuel handling activities, some of these items may have come into direct contact with the fuel elements (in the KW Basin) and with the exposed fuel and contaminated sludge in the KE Basin.

Ion-exchange Modules - consists of the intact spent IXM assemblies from the K-Basin water treatment system. Ion-exchange modules are used to maintain the quality of the demineralized water in the basins. The IXMs remove dissolved radionuclides from the storage basin water. Each IXM consists of a block of concrete, with six steel columns cast into the concrete to contain the ion-exchange (IX) media. The Project and U.S. Environmental Protection Agency (EPA) staff are reevaluating the suitability of the IXMs, when properly drained, as being compliant with the 40 CFR 265.45 standard for macro-encapsulation and therefore being suitable for disposal at ERDF without additional treatment. This evaluation must be completed prior to disposal of the IXMs to ERDF; if compliance with the macro encapsulation requirement cannot be demonstrated, then alternative disposition of the IXMs will be pursued. An alternative disposition colud be revising the CERCLA ROD to provide a treatment variance for the LDR requirement. (See Appendix A)

Canisters – The SNF presently stored in the K Basins is contained in cylindrical metal canisters. The SNF is not subject to the discussions in this DQO. The fuel will be removed from the canisters as part of the fuel retrieval process and the empty canisters will become waste debris. This WS consists of the empty aluminum and stainless steel canisters.

Asbestos Debris - consists of construction materials with varying content of asbestos and asbestos-containing materials (ACMs). The age of the KE and KW Basin facilities indicates that asbestos is likely to be present in numerous materials. Asbestos debris may also be radiologically-contaminated, regulated as hazardous waste, or be mixed waste.

1.3 PROJECT ISSUES

1.3.1 Global Issues

The following Global Issues, identified in interviews with project staff and decision-makers, were discussed in a meeting with decision-makers.

1. Is the project decontaminating surfaces with anything other than "Citristrip" paint stripper and rags?

2. What are the physical boundaries of the debris removal? What is the volume of debris to be removed? How much PPE is forecast for disposal?

3. Polychlorinated biphenyls can be held on the IX column. The concentration of PCBs in the IX column and entire module has been calculated. Does the project want to calculate the concentration based on the column or the entire module? Does a vented but filtered, IXM comply with the requirement for macro-encapsulation?

4. Pressure washing has been designated as the primary method of removing sludge contamination from below-water-level debris. How will the project verify that porous surfaces meet the ERDF WAC (BHI 1998)?

5. Nonradioactive metals will also be trapped on the IX column. The concentration of RCRA metals on the IX column has been calculated based on the water data and other information provided by the project. If these levels exceed the TC levels calculated based on total metals, how will LDR concentrations be addressed?

6. Previously, some mixed waste was designated as dangerous waste with a state code under the dangerous waste criteria per *Washington Administrative Code* 173-303-100. Will ERDF apply this code and is there any prohibition to accepting this code? Do all parties agree that dried paint should not include volatile organic constituents of wet paint when calculating this code?

7. For painted debris, do all parties agree to calculate the lead and other RCRA metals content based on the entire volume of debris disposed? Explain the weight percent that may cause the RCRA TC limits to be exceeded.

8. How will ballasts from fluorescent lights be disposed? (These may contain PCBs.)

9. Are the IXMs or any other waste TRU?

10. Do all parties agree that with respect to PCBs on painted debris, the waste is not TSCA based on the Record of Decision (ROD) (EPA et al. 1999)? The ROD appears to apply only to debris from below water level. How will debris above the water level be dealt with?

11. Environmental Restoration Disposal Facility packaging specified in the ERDF WAC Supplement (*Supplemental Waste Acceptance Criteria for Bulk Shipments to the Environmental Restoration Disposal Facility* [BHI 1997]) has been accepted to meet the U.S. Department of Transportation requirements. Environmental Quality Management (EQM) has been told by ERDF that this is not necessarily the case. There is also a Safety Analysis Report for Packaging for the IX module. Will any packaging be used that does not fall into either of these categories?

12. Is the water filtered before the IX column? If so, how will filters be disposed?

13. Does the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA) ROD cover maintenance debris?

1.3.2 Project-specific Technical Issues and Resolutions

Global Issues were resolved in the following manner:

1. If a product other than Citristrip is used in the future, the constituents of those materials will be characterized and included in a waste profile at that time.

2. The EPA's perspective is that anything resulting from the CERCLA remedial action that is not sludge, water, or SNF is debris per the K-Basin ROD (EPA et al. 1999) and can be addressed by this plan. Some demolition debris, generated to allow equipment access to the basins, will be included. If necessary, the DQO and SAP will be amended to address additional concerns, such as sand from filters.

   Profiles of waste going to ERDF will generally be bounded by waste type (hazardous and nonhazardous). Similar WSs will be allowed within each ERDF profile; however, hazardous and nonhazardous materials must be disposed under separate profiles. For example, painted concrete could be either hazardous or nonhazardous depending on lead concentration and mass of material disposed. Although the project may need to categorize by waste source for process control needs, this information is not required by ERDF.

   Forecasts of waste volume have been made, but are by waste type, not the sources as listed above. There are approximately 30,000-40,000 pounds of lead shielding bricks–four to five boxes worth. The ERDF macro-encapsulates the bricks/shielding at the disposal site before disposal.

3. All documents need to clearly define the IX column versus the IXM. The IXM includes the columns and the concrete and any valving, while the IX columns are simply the metal columns and the resins.

The EPA's perspective on the IXM is that the unit, which includes the columns and concrete shell, is a high-integrity container (HIC). From the agency perspective, this waste is encapsulated and meets the 40 CFR treatment standards for metals and PCBs. From the Agency's perspective, as long as the contents are not TRU, the unit can be sent to ERDF. The EPA interpretation letter supporting this position is included as Appendix A. The ERDF representatives will review this interpretation before committing to acceptance of the IXMs in this configuration. The project will proceed on the assumption that this approach will be used.

The EPA noted that there is no need to further characterize the resins, because the unit as defined in the ROD is considered debris. This raised a concern on the part of ERDF as to whether the concrete component of the IXM is part of the "debris" that is being disposed of, or the "encapsulation." Resins, on their own, would not meet the RCRA definition for debris. The EPA noted that this is part of the reason why debris was specifically defined differently in the ROD.

In response to a question of whether there is a potential for heat generation, it was noted that the total IXM package is high-efficiency particulate air (HEPA) vented. It was noted that the venting is primarily for release of hydrogen gas, not heat. The venting of the package raised concerns on the part of ERDF as to whether the debris is truly macro-encapsulated as defined in 40 CFR 268.45. Because the vent is for gas release, not heat release, it is possible that the vent could be sealed. This concern was addressed in the EPA letter, provided in Appendix A, which indicates that this configuration is acceptable for compliance with 40 CFR 268.45. [BHI subsequently evaluated the gas-generation issue and determined that it does not present a concern for disposal (see Appendix A).]

Ion-exchange columns that are stored within the K-Basin site are generally TRU waste and would not be considered for disposal to ERDF regardless. They are not being considered under this DQO.

4. According to the ROD (EPA et al. 1999), once an item is rinsed, PCBs are not a disposal issue. Bechtel Hanford, Inc. indicated that they would need to take a look at the specific treatment standards for the various forms of debris before agreeing that rinsing will address all concerns. The EPA reiterated that if there is a question as to whether an item exceeds regulated concentrations, the item can be designated as hazardous, placed in a container, and grouted (macro-encapsulated). Based on the anticipated small volume of questionable debris and the cost and delay associated with characterization, the SNF Project believes this is an appropriate strategy. Debris will be designated based on process knowledge. Bechtel Hanford, Inc. raised a concern as to whether specific items will qualify as debris, as defined in 40 CFR 268, and whether washing is sufficient treatment. Some items may be smaller than the regulatory-defined size for debris.

5. Metals concentrations were derived based on assumptions that included maximum values at the level of detection in feed water. Metals may not be an issue if, based on recalculation of the values using newly provided data, concentrations drop below LDR limits. [Upon inspection of the new data, it was discovered that the values were provided for effluent water only, not intake water. Therefore, recalculation of concentrations was not appropriate or useful.] It was noted, however, that concentrations in feed water might increase over time. Macro-encapsulation of the IXM has been approved as treatment and may address concerns for disposal of this debris under LDR.

6. Although most parties agree that volatiles are not a concern for dried paint, BHI is looking for objective evidence that this is in fact the case. This evidence could be from analysis or from examination of other dried paints with similar volatile content. The EPA recommended consideration of the total weight of the painted item for purposes of waste designation. Stripped paint will be collected on rags and treated as part of the debris WS.

7. Metals content is based upon the mass of the debris disposed of, not just the paint layer.

8. The site has a fluorescent light recycling program. Most of the bulbs and ballasts will go to this program. Broken bulbs in contaminated areas will go into a box with other debris for grouting (macro-encapsulation) based on TC designation for lead and possibly mercury (for older bulbs).

9. Any TRU waste will not go to ERDF.

10. Polychlorinated biphenyl solids meeting the ERDF WAC (BHI 1998) can go to ERDF, so the described waste form is not a concern. [NOTE: the ERDF does not accept liquid PCBs.]

11. The Safety Analysis Report for Packaging applies only to IXMs. Environmental Restoration Disposal Facility roll-off boxes are approved as a U.S. Department of Transportation IP-1 package and are considered an IP-2 package within the Hanford Site barricades. Other containers can be approved for use inside the barricades. Characterization performed to meet disposal needs is generally considered adequate to meet transportation needs.

12. The basin water is filtered before IX column.

13. The CERCLA ROD (EPA et al. 1999) covers maintenance debris.

1.4 FACILITY BACKGROUND INFORMATION

1.4.1 Process History

The KE and KW Reactors and their associated fuel storage basins were constructed in the early 1950s. The basins are located in the Hanford 100 K Area within 420 m (1,380 ft) of the Columbia River. The fuel basins are large, open-topped concrete pools containing approximately 4.9 million liters (1.3 million gallons) of demineralized water. The basins were originally used to store SNF from the KE and KW Reactors until the early 1970s, when these reactors were removed from service and the fuel removed from the basins. The KE and KW fuel storage basins were subsequently used to store SNF from the Hanford N Reactor. The KE and KW fuel basins currently hold approximately 1,200 metric tons and 900 metric tons of N Reactor SNF, respectively. The spent fuel elements are contained in canisters placed in storage racks under 5 m (16 ft) of water for cooling and radiation shielding.

1.4.2 Study Area

The study area consists of the areas below water and above water areas adjacent to the KE and KW Basins which will be affected by debris removal activities. Debris includes all solid waste (including IXMs and canisters) generated during cleanup and deactivation activities. The total (compacted) volume of in-pool debris at the end of calendar year 1998 was estimated to be about 150 m^3 (5,305 ft^3) in KE Basin, and 125 m^3 (4,400 ft^3) in KW Basin (*105 K-Basins 1998 Debris Report* [DOE-RL 1999b]). Additional debris volumes will be generated as a result of construction, operations, and deactivation of the facilities in support of the CERCLA interim remedial action.

1.4.3 Spill/Release History

The basins contain SNF and contaminated sludge, water, and debris. A significant portion of the SNF in the KE Basin was damaged during discharge from the reactor, resulting in breaching of the fuel cladding and release of soluble radionuclides into the basin waters and sludge. Most of the shorter-lived radionuclides have deteriorated to low levels and no hazardous chemicals have been identified in the basin waters. The SNF in both basins is deteriorating under the current storage conditions. In addition, there have been at least two documented leaks of contaminated water from the KE Basin into the underlying soil and groundwater.

The present condition of the basins and the SNF lead to the implementation of a CERCLA interim remedial action on the K-Basins cleanout project and development of a CERCLA proposed plan and ROD for the cleanout.

1.4.4 General Housekeeping Practices

Materials collected during general housekeeping and work area clean up, such as floor sweepings (soil, sawdust), vegetation debris, glass, plastic, and PPE and related material from personnel egress and decontamination areas, are included as K-Basin Debris for disposal at the ERDF. Paint and Citristrip waste, generated from the limited practice of paint stripping of debris to allow for welding activities, will be collected on rags. Based on the low concentration of paint waste on individual rags, rags will be collected and managed for disposal as debris at ERDF.

1.4.5 Summary of Historical Data

The *Listed Waste History at Hanford Facility TSD Units* (WHC 1996) will be reviewed as specific WSs are generated to verify that there are no listed waste concerns before designation. Sampling and analysis activities that have been performed to characterize waste materials from the K Basins are summarized briefly below:

Mixed Waste Debris - No waste-specific radiochemical laboratory analyses have been performed to date on this WS. For past shipments, an estimate of the cesium-137 content of the waste was performed using established dose-to-curie relationships (WHC 1996a, WHC 1996b). Once a measurement of dose or cesium-137 activity in the waste is obtained, radionuclide composition of the waste can be estimated by applying the radionuclide ratios measured and reported previously (DeVanney 1990). For radionuclides that were not analyzed in the referenced report, the radionuclide ratios in the *Hanford Site Solid Waste Acceptance Criteria*, Revision 4 (WHC 1993, Appendix K), provided estimates that were used. Radionuclides considered reportable in previous waste shipments included strontium-90, cesium-137, plutonium-239/240, americium-241, and plutonium-241. This entire WS was designated as low level radioactive mixed waste. Inductively coupled plasma total metals analysis (SW-846 Method 6010A [*Test Methods for Evaluating Solid, Waste Physical/Chemical Methods*, EPA 1997]) have been performed on nine paint chip samples as well as multiple chip samples from the overhead crane. Toxic metals (silver, arsenic, barium, cadmium, chromium, lead, and selenium) were confirmed to be present in paint chips at total concentrations greater than screening limits for the TC criteria. Toxicity Characteristic Leachate Procedure (TCLP) metals analyses were not conducted.

Above Water Waste - Radiochemical analyses for gross alpha, gross beta, cobalt-60, cesium-137, americium-241were performed on twenty 105-KE smears. A nondestructive analysis of 20 compacted drums was performed at Allied Technology Group, and nondestructive assay (NDA) of four boxes of waste was conducted on the 100K Pad. Based on these analyses, radionuclides in previous waste profiles included strontium-90, cesium-137, europium-152, plutonium-238, plutonium-239, plutonium-240, americium-241, plutonium-241, and curium-244. All of this WS was designated as low-level radioactive waste with the exception of one barrel, which was estimated to potentially contain TRU waste. Nonradiological sampling was limited to the same paint chip samples used for characterizing the mixed waste debris.

Underwater Debris – Radiochemical analyses were performed on coupons from pipes that were rinsed and removed from the basin. Analyses included total alpha, gamma energy analysis (GEA), strontium-89/90, americum-241, and total uranium. Radionuclides that were found above detection limits included cesium-137, cobalt-60, europium-154/155, strontium-90, uranium, plutonium-238, 239/240, and americium-241. In addition, 11 boxes of rinsed debris that were on the 100 K Rad Pad were evaluated by NDA for maximum cesium-137 content. The radioactive constituents of the waste were estimated from these measurements. All of the waste was determined to be low-level radioactive waste.

Polychlorinated biphenyl analysis was conducted on waters from the KE and KW Basins; PCBs were not detected using a minimum detection limit (MDL) of 0.5 ug/ml. Inductively coupled plasma (ICP) analysis for total metals was performed on water samples from both basins and on sludge from the KE Basin only. Although zinc, silicon, copper, and boron were detected in water samples, no TC metals were found using MDLs less than the TC levels. Metals have been found in KE-Basin sludge at concentrations that exceed the total concentration screening level. No TCLP analyses were performed on the sludge.

Canisters – In 1996, several empty fuel canisters were pressure washed and removed from the basin for characterization (*Characterization of Empty Fuel Canisters in 105 KE Basin* [WHC 1996f]). Smears were obtained from the canisters and submitted for GEA. The pressure-washed canisters were analyzed by NDA (gamma and neutron analysis) and an estimate was performed of the radionuclide content of the canisters. The NDA results reported in WHC (1996g) indicated that the rinsed canisters were contaminated with estimated concentrations of cesium-137, cobalt-60, amercium-241, europium-154, 155, antimony-125 and potassium-40. The conclusion of the report was that the pressure washed canisters were not TRU waste. The report estimated the TRU content of the pressure washed canisters based on the NDA gamma analytical results and results of smears.

The NDA did not report any americium-241 or plutonium-239/240. Subsequent laboratory analysis of smears taken from nine of the 11 canisters that were subjected to NDA demonstrated a significant americium-241 content (up to 41% of the measured cesium-137 activity). The smears were analyzed in the laboratory; however, they were only subjected to gamma analysis and, thus, did not detect any plutonium isotopes. The lack of apparent plutonium-239/240 was explained in the report by a hypothesis that the americium-241 reacted with the underlying canister metal while the plutonium isotopes were associated more with the sludge that was presumed to be washed off. No data were presented to substantiate that hypothesis.

Evaluation of the gross alpha data from the smears demonstrated that, in general, the reported americium-241 activity of the smears was around 20 to 40% of the gross alpha activity. This leaves 60 to 80% of the alpha activity unaccounted for. Evaluation of the radiochemistry data from pipe samples, sludge, basin water, and fuel rod radionuclide content do not support a high degree of enrichment of americium-241 relative to

cesium-137 without a concomitant presence of plutonium isotopes. An estimate of the detection limit for plutonium-239 in 1-gallon cans indicated that the method could, at best, detect approximately 0.025 g of plutonium-239. The estimated levels of plutonium-239 that would be anticipated in the canisters based on measured ratios of radionuclides in other metallic samples, sludge, and water are generally below that level. The amount of plutonium-239 that would be estimated in the canisters (based on ratios of plutonium to americium found in other below water waste samples) would range from 0.0015 to 0.049 g plutonium.

The estimate of TRU on the canisters and other below water debris did not include an estimated plutonium isotope component and is identified as a data gap.

Asbestos – No radiochemical or chemical analyses have been performed. It is anticipated that the radionuclide content of the asbestos waste will be estimated by the same approach used for the above water waste.

Ion-exchange Modules – The radionuclide content of the IXMs was estimated from analysis of the basin water and an assumption that 100% of the radionuclides measured in the water are removed by the IXM. Radionuclides are routinely measured in the basin water and those routinely detected included americium-241, cesium-137, strontium-90, plutonium-238, plutonium-239/240, and uranium. No radiochemistry measurements have been performed on the actual IX material due to as low as reasonably achievable (ALARA) considerations. Ion-exchange modules are routinely removed from service prior to reaching a loading that could result in the IXM being declared a TRU waste (SNF Project 2000). Polychlorinated biphenyls were not detected in K-Basin water above the 0.5 ug/ml level. Toxic metals were undetected in K-Basin water (MDLs were less than TC levels); only zinc, silicon, copper, and boron were detected. The potential content of PCBs and toxic metals that may sorb onto the IX resins was conservatively estimated based on the COCs being present in basin water at reported detection limits. The calculations using the mass of the entire IXM showed that PCB and metal concentrations were less than TC screening levels with the exception of selenium, which had a calculated concentration of 41 mg/kg versus a screening level of 20 mg/kg. Calculations using the total mass of the IXM and metal and PCB concentration in water estimates indicate the IXM may designate as hazardous waste for TC metals and TSCA regulated for PCBs. Calculations are provided in Appendix C. These calculations are based on a conservative approach, the IXM if designated as hazardous waste would be subject to treatment to meet LDR. The project is working to resolve the designation of the IXM.

1.5 EXISTING REFERENCES

Table 1-1 presents a list of the references that were reviewed as part of the scoping process, as well as a summary of the pertinent information contained within each reference. These references were the primary source for the background information presented in Section 1.4.

Table 1-1. Existing References. (2 pages)

Reference	Summary
"Remove Debris from Storage Basin for Disposal," OP-07-071, 8/17/1994.	Procedure for Removal of Debris from K Basins. Describes pressure washing, draining, obtaining dose rates upon removal, and packaging for disposal.
"Facility Source Term Report," 99-SNF/CJS-024, 3/29/99.	Provides 105 KE Smear Data.
"NDA Results for 20 Super Compacted Drums at Allied Technology Group," Summary Report by Benchmark Environmental Corp. 7/20/99.	Provides NDA Results of 20 super-compacted drums from K Basins.
"Categorizing and Inventorying Waste in Standard Containers," Engineering Data Transmittal 619217, 10/11/96.	Provides dose rate to curie conversion factor of 4'x4'x8' wood box.
"Waste Certification Summary, Ion Exchange Modules," 12/20/96.	Table 1 provides "Historically Highest Low-Level IXM Radionuclide Characterization." Document describes waste generating process description, packaging, radiological characterization, chemical characterization, waste designation.
"Characterization Plan for Spent KE Basin Ion Exchange Modules," HNF-SD-SNF-TI-039, Rev 1.	Provides basis for characterization, KE Basin isotopic ratios, KE Basin Plutonium Ratios, Conversion Factors, sample data.
"Ion Exchange Module High Integrity Container Evaluation," memo from Generator Services 87610-95-033, 4/28/95.	Evaluation of IXM container found to meet the requirements for acceptance as a HIC.
"Analytical Report for K Basin Paint," FT-6112, 9/11/96.	Analytical report consisting of TC metals for 9 paint samples taken in K-Basin area.
"Analytical Report for K Basin Crane Removal," Rev. 1, FD1-7021, 8/5/97.	Analytical report consisting of ICP metals, Flashpoint, PCBs, Total Alpha/Beta, Total Halides from 11 samples taken from various points on a crane being removed from K-Basin area.
"105 K East Basin Polychlorinated Biphenyls Spill Cleanup Plan," DOE/RL-96-53, Rev.0 (WHC 1996c)	Description of KE Basin Sludge; sludge core samples obtained from 15 locations in main basin, 5 in weasel pit; 6 out of 20 samples analyzed for PCBs in solids, 2 out of 20 analyzed for PCBs in water phase.
"105 KE Basin PCB Wipe Sampling and Analysis," WHC-SD-SNF-EV-001, 3/28/96. (WHC 1996d)	PCB Analysis performed on smear samples conducted on 10 canisters cleaned using Canister Cleaning System procedure. Results indicate PCBs not detectable at 0.1 microgram level.
222-S Analytical Results for Process water from KE and KW Fuel Basin, 1/9/96.	Analyses for water in K Basins : ICP metals, GEA, Sr-90, H-3, Am-241, Alpha, Pu238/239, No PCBs detected.
"222-S Final Hanger Coupon Analysis and Rad Survey Reports," 1/30/97.	Radiological characterization analyses on 3-pipe samples taken from 3 fuel storage hangers from 105 KE.
"Analytical Report for K Basin Pipe," FT-6021, 6/5/99.	3 pipe samples analyzed for TC metals, Am-241, Cs-137, Pu-239/240, Sr-90, Total Uranium, GEA.
"Analytical Report for KE Pipes," FD1-7002, 4/4/97.	2 pipe samples analyzed for Am-241, Cs-137, Pu-239/240, Sr-90, Total Uranium, GEA.

Table 1-1. Existing References. (2 pages)

Reference	Summary
"NDA Results for Waste Boxes and Drums at 100K Rad Pad," Battelle, 7/12//99.	NDA (GEA) measurements conducted on eleven 55 gallon drums and 9 waste boxes.
"Characterization of Empty Fuel Storage Canisters in 105 KE Basin," WHC-SD-SNF-TI-019, 6/27/96.	In situ measurement of 11 canisters at KE Basin and 40 swipe samples taken from 9 canisters upon removal. Purpose of sampling to quantify isotopes contributing significantly to overall activity on the canister. Describes the cleaning process and radiological characterization of residual isotopes.
BHI Archive Number 0161426. "105-N Basin Deactivation Project Radioactive Waste Management Archive, Volumes 1 and 2". July, 1998. (BHI 1998).	Compilation of data used to characterize N-reactor fuel and fuel storage basin. Source data were applied to K-basin waste to estimate radionuclide content of the waste and provide process information.
WHC-SD-TP-SEP-028, Rev 0. "Safety Evaluation for Packaging the N Reactor/Single Pass Reactor Fuel Characterization Shipments", Oct. 1994. (WHC 1994)	A source of predicted isotopic composition of N-reactor fuel. Used to assist in estimation of the radionuclide content of the waste.
WHC-SD-NR-RPT-005, Rev 0. "Characterization of Radioactive Waste at 100 Area", Nov. 1990 (DeVanney 1990).	Report contains analyses of samples from the KE and KW Basin areas. These data provided analytical results used to assist in the determination of contaminants of potential concern (COPCs) and estimate of several radionuclides that had not been estimated from other sources.
WHC-0063-4, Rev. 4, "Hanford Site Solid Waste Acceptance Criteria," June 1998.	Appendix K, Table K-1 is a list of radionuclides that would be predicted in N-Reactor fuel. Used as one source of radionuclide ratios to estimate hard to measure radionuclides (such as H-3 and Sm-151).

1.6 DQO TEAM MEMBERS AND KEY DECISION MAKERS

Table 1-2. DQO Team Members. (2 pages)

Name	Organization	Area of Expertise	Telephone Number
Jeff Westcott	FH-WMP	Waste Management	373-9800
Bill Klover	WMTS	Rad Waste Analysis	376-5082
Dale Splett	DOE-RL	DOE SFO K Basins	373-7827
Jim Zimmerman	FDH	Nonrad Waste Designation	373-3288
Larry Oates	EQM	Regulatory Support/ Facilitator	588-5529
Paul Gagnon	WMFS-ERDF	ERDF Waste Management	373-4379
Paul Day	SNF Project	Regulatory Support K Basin	376-4827

Table 1-2. DQO Team Members. (2 pages)

Name	Organization	Area of Expertise	Telephone Number
Wendy Thompson	BHI	BHI Sampling and Analysis	372-9597
Chuck Miller	EQM	Chemical Technical Support	946-4985
Mitzi Miller	EQM	Facilitator	946-4985

Table 1-3. DQO Key Decision Makers.

Name	Organization	Area of Expertise	Telephone Number
Oscar M. Holgado	DOE-RL	DOE SFO Decision Maker	373-0589
Dave Einan	EPA	ERDF/EPA Decision Maker	376-3883
Larry Gadbois	EPA	EPA/K-Basin Decision Maker	376-9884
Randy Jackson	BHI	BHI Waste Designation Represents BHI Decision Maker	373-5473
Chris Lucas	SNF – OPS	K-Basin Waste Generator	373-1006
David Watson	FDH	FDH/SNF Environmental Protection	373-3250

1.7 CONTAMINANTS OF POTENTIAL CONCERN

1.7.1 Master List of Contaminants of Potential Concern

Table 1-4 identifies the individual components or waste media (e.g., piping, pumps, motors, or other facility-specific equipment) that are expected to be generated. The corresponding list of COPCs is identified for each WS.

1.7.2 Excluded Contaminants of Potential Concern

Table 1-5 lists the COPCs excluded from the investigation and the rationale for the exclusion.

1.7.3 Final Contaminants of Concern List

Table 1-6 provides the final list of COCs for each WS, with the rationale for inclusion.

The logic and tables discussing the radionuclides/isotopes remaining are presented in Appendix B, Table B-2. The COCs so derived are applicable to K-Basin waste that is below the ERDF WAC limits for cesium-137. If waste containing cesium-137 at levels greater than the ERDF WAC (BHI, 1998) encountered, then the COC selection criteria should be reevaluated prior to characterization and disposal.

1.8 PRELIMINARY ACTION LEVELS

The preliminary actions levels that apply to each of the COCs are presented in Table 1-7 with the basis for the levels. The action level is defined as the threshold value that provides the criterion for choosing between alternative actions. The action levels presented in Table 1-7 are based on regulatory thresholds or standards and/or risk. The final numerical action level will be set in DQO Step 5.

1.9 STATEMENT OF THE PROBLEM

Debris has been broadly defined by the K-Basin ROD (EPA et al. 1999) as all solid waste generated from the CERCLA interim remedial action of KE and KW Basins excluding SNF, sludge, and water. The debris has been previously disposed at the Hanford LLBG or CWC. This debris must be characterized and designated to allow disposal at ERDF, as appropriate. Because the K-Basin structures have been designated as an radioactive materials area, all materials removed from this area are assumed to be radioactively-contaminated. Most debris will designate as radioactive LLW, although some may designate as radioactive mixed waste or TRU.

Table 1-4. Master List of COPCs for Each Component or Waste Stream. (4 pages)

WS#	Waste Stream or Functional Area	Waste Material Category		COPCs
		K Basin	ERDF	
1	Painted Debris	above water/mixed	mixed waste	radioactive COC list[1] Paint constituents (as listed in waste profiles and SWEA): 2-(2-methoxy)-Ethanol, Ferric Oxide, Calcium Carbonate, Aluminum Silicate, C.I. Pigment, Carbon Black, Titanium Oxide, C.I. Pigment Green 36, 2-Phthalocyanito-copper (copper phthalocyanine), Talc, 2,2,4-Trimethyl-1,3-pentanediolmonoisobutyrate, 2-Propoxyethanol, Azo Permanent Yellow, Isopropyl Alcohol, Dibutyl Phthalate, Acrylic Resins, Dye, Film Formers, Propylene Glycol Monomethyl Ether, Toluene, C.I. Pigment Green 7, Xylene (mixed isomers), 2-Propoxyethanol, C.I. Yellow 77492, C.I. Pigment Yellow 83, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag, PCBs

Table 1-4. Master List of COPCs for Each Component or Waste Stream. (4 pages)

WS#	Waste Stream or Functional Area	Waste Material Category		COPCs
		K Basin	ERDF	
2	Rags Contaminated with Stripped Paint Waste (Citristrip)	above water/mixed	mixed waste	radioactive COC list[1] TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag Paint constituents from SWEA/waste profile: Stoddard Solvent N-Butyl Acetate Naphthalene Ethyl Benzene Aluminum Phosphate monobasic Hydroxypropylmethyl-cellulose Citristrip constituents from SWEA/waste profile: N-Methyl-2-pyrrolidone D-Limonene PCBs
3	structural shielding that contains haz metals – lead bricks, lead shielding	above water/ mixed waste	mixed waste	Pb Radioactive COC list[1]
4	Broken Fluorescent and incandescent light bulbs (ballasts/fixture assumed not present in the basin)	above water/ mixed waste	mixed waste	Hg, Pb Radioactive COC list[1]
5	cartridge filters, disposable PPE, plastic, and other trash	above water/ LLW	Low-Level Rad Waste	radioactive COC list[1]
6	materials used for decon of equipment: cloth, paper, plastic	above water/ LLW	Low-Level Rad Waste	radioactive COC list[1]
7	process equipment: heat exchangers, piping	above water/ LLW	Low-Level Rad Waste	radioactive COC list[1] lead
8	Unpainted demolition debris, structural steel, rocks, gravel, metal, glass, concrete, ceramic, bricks, roofing material, wood drywall, siding	above water/ LLW	Low-Level Rad Waste	radioactive COC list[1] asbestos

Table 1-4. Master List of COPCs for Each Component or Waste Stream. (4 pages)

WS#	Waste Stream or Functional Area	Waste Material Category		COPCs
		K Basin	ERDF	
9	materials collected during general housekeeping: soil, sawdust, vegetation, debris, glass, plastic	above water/ LLW	Low-Level Rad Waste	radioactive COC list[1]
10	HEPA filters	above water/ LLW	Low-Level Rad Waste	radioactive COC list[1]
11	structural steel – fuel storage racks & bulkheads; structures used for fuel handling	underwater/ LLW or mixed[2]	Low-Level Rad Waste or mixed	radioactive COC list[1] PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag
12	process equipment – pumps, old canister washer, piping and piping components, rubber hoses	underwater/ LLW or mixed[2]	Low-Level Rad Waste or mixed	radioactive COC list[1] PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag
13	miscellaneous debris – electrical cables, light fixtures, long tools, brushes, PPE, metal, plastic	underwater/ LLW or mixed[2]	Low-Level Rad Waste or mixed	radioactive COC list[1] PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag
14	Canisters/canister lids	underwater/ LLW or mixed[2]	Low-Level Rad Waste or mixed	radioactive COC list[1] PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag
15	IXMs	above water/ LLW or mixed[2]	Low-Level Rad Waste or mixed	radioactive COC list[1] PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag
16	floor tiles/ceiling tiles; sprayed on ceiling texture or acoustic surface coatings	above water/ LLW or mixed[3]	Low-Level Rad Waste or mixed	Pb, PCBs, and organics from WS#1, if painted asbestos radioactive COC list[1]

Table 1-4. Master List of COPCs for Each Component or Waste Stream. (4 pages)

WS#	Waste Stream or Functional Area	Waste Material Category		COPCs
		K Basin	ERDF	
17	pipe and duct insulation and insulation mastic; mastic used as adhesive for plastic baseboard moldings	above water/ LLW Asbestos	Low-Level Rad Waste	asbestos radioactive COC list[1]
18	mineral based building insulation in walls and ceilings	above water/ LLW asbestos	Low-Level Rad Waste	asbestos radioactive COC list[1]
19	asbestos board (transite) used in walls, ceilings, siding	above water/ LLW asbestos	Low-Level Rad Waste	asbestos radioactive COC list[1]
20	high temp gaskets and seals	above water/ LLW PCBs asbestos	Low-Level Rad Waste	asbestos radioactive COC list[1]

[1]Radiological COPCs are numerous (80) and are provided in Appendix B, Table B-1.

[2]Radioactive/LLW could potentially designate as mixed waste if the sludge is incompletely removed, or if the underwater debris items are porous.

[3]TC Metals in paint may cause this Radioactive/LLW to be designated as mixed waste.

Table 1-5. Rationale for COPC Exclusions. (3 pages)

WS #	Waste Stream or Functional Area	Material (Component)/ Category	COPC	Rationale for Exclusion
1	Painted Debris	above water/ LLW or mixed[2]	radioactive COC list[1]	see Appendix B
			Paint Constituents:	
			2-(2-methoxy)-Ethanol	Volatile/ vp>1mm Hg at 20 degrees C [3]
			Ferric Oxide	Not Toxic
			Calcium Carbonate	Not Toxic
			Aluminum Silicate	Not Toxic

Table 1-5. Rationale for COPC Exclusions. (3 pages)

WS #	Waste Stream or Functional Area	Material (Component)/ Category	COPC	Rationale for Exclusion
			C.I. Pigment	content not identified
			Carbon Black	Not Toxic
			Titanium Oxide	Not Toxic
			C.I. Pigment Green 36	content not identified
			Talc	Not Toxic
			Azo Permanent Yellow	content not identified
			Isopropyl Alcohol	Volatile/ vp>1mmHg at 20 degrees C [3]
			acrylic resins	Not Toxic
			Dye	content not identified
			Film Formers	content not identified
			Propylene Gycol Monomethyl Ether	Volatile/ vp>1mmHg at 20 degrees C [3]
			Toluene	Volatile/ vp>1mmHg at 20 degrees C [3]
			C.I. Pigment Green 7	content not identified
			Xylene	Volatile/ vp>1mmHg at 20 degrees C [3]
			2-Propoxyethanol	Volatile/ vp>1mmHg at 20 degrees C [3]
			C.I. Yellow 77492	content not identified
			C.I. Pigment Yellow 83	content not identified
			PCBs	Excluded for paint waste disposal at ERDF
2	Rags Contaminated with Stripped Paint Waste (Citristrip)	above water/ mixed	radioactive COC list[1]	See Appendix B
			Paint constituents:	
			Stoddard Solvent	Volatile/ vp>1mmHg at 20 degrees C [3]

Table 1-5. Rationale for COPC Exclusions. (3 pages)

WS #	Waste Stream or Functional Area	Material (Component)/ Category	COPC	Rationale for Exclusion
			N-Butyl Acetate	Volatile/ vp>1mmHg at 20 degrees C [3]
			Ethyl Benzene	Volatile/ vp>1mmHg at 20 degrees C [3]
			Aluminum Phosphate monobasic	Not Toxic

[1]Radiological COPCs are numerous (80) and are provided in Appendix B, Table B-1. Rationale for Exclusion is also provided in Appendix B.

[2]TC Metals in paint may cause this Radioactive/LLW to be designated as mixed waste.

[3]Volatile constituents of paint, although unlikely to be present in dried paint, must remain as a COPC until objective evidence has been obtained through analysis or examination of other dried paint with similar volatile content. Refer to Section 1.3.2 item 6.

Table 1-6. Final List of COCs. (5 pages)

WS#	Material (Component)/ Category	COC	Rationale for Inclusion
1	Painted Debris	radioactive COC list[1]	Radioactive COC list[1]
		TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	Metals confirmed to be present in paint at concentrations above screening limits for TC.
		2-(2-methoxy)-Ethanol, 2-Phthalocyanito-copper (copper phthalocyanine), 2,2,4-Trimethyl-1,3-pentanediolmonoisobutyrate, 2-propoxyethanol, Dibutyl Phthalate, Naphthalene, Hydroxypropylmethylcellulose,	Nonvolatile paint constituents. Toxicity must be evaluated to determine the contribution to Dangerous Waste Criteria Equivalent Concentration per *Washington Administrative Code* 173-303-100 ***NOTE**: Volatile paint constituents identified in Table 1-5 for exclusion cannot be excluded without objective evidence, see Section 1.3.2 item 6.

Table 1-6. Final List of COCs. (5 pages)

WS#	Material (Component)/ Category	COC	Rationale for Inclusion
2	Rags Contaminated with Stripped Paint Waste	radioactive COC list[1]	radioactive COC list[1]
		TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	Metals confirmed to be present in paint at concentrations above screening limits for TC.
		2-(2-methoxy)-Ethanol, 2-Phthalocyanito-copper (copper phthalocyanine), 2,2,4-Trimethyl-1,3-pentanediolmonoisobutyrate, 2-propoxyethanol, Dibutyl Phthalate, N-Naphthalene, Hydroxypropylmethyl-cellulose	Nonvolatile paint constituents. Toxicity must be evaluated to determine the contribution to Dangerous Waste Criteria Equivalent Concentration per *Washington Administrative Code*173-303-100. ***NOTE**: Volatile paint constituents identified in Table 1-5 for exclusion cannot be excluded without objective evidence, see section 1.3.2 item 6.
	(Citristrip)	Methyl-2-pyrrolidone, D-Limonene	Citristrip constituents. Toxicity must be evaluated to determine the contribution to Dangerous Waste Criteria Equivalent Concentration per *Washington Administrative Code* 173-303-100 **NOTE:** D-Limonene is a Washington "Toxic D" waste if present at 10% or greater.
3	structural shielding that contains haz metals – lead bricks, lead shielding	radioactive COC list[1]	radioactive COC list[1]
		Pb	Major component in lead shielding
4	Broken fluorescent and incandescent light bulbs (ballasts/fixture assumed not present in the basin)	radioactive COC list[1]	radioactive COC list[1]
		TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	Metals present in fluorescent and incandescent bulbs
5	cartridge filters, disposable PPE, plastic, and other trash	radioactive COC list[1]	radioactive COC list[1]
6	materials used for decon of equipment: cloth, paper, plastic	radioactive COC list[1]	radioactive COC list[1]
7	process equipment: heat exchangers, piping	radioactive COC list[1]	radioactive COC list[1]

Table 1-6. Final List of COCs. (5 pages)

WS#	Material (Component)/ Category	COC	Rationale for Inclusion
8	Unpainted demolition debris, structural steel, rocks, gravel, metal, glass, concrete, ceramic, bricks, roofing material, wood drywall, siding	radioactive COC list[1]	radioactive COC list[1]
9	materials collected during general housekeeping: soil, sawdust, vegetation, debris, glass, plastic	radioactive COC list[1]	radioactive COC list[1]
10	HEPA filters	radioactive COC list[1]	radioactive COC list[1]
11	structural steel – fuel storage racks & bulkheads; structures used for fuel handling	radioactive COC list[1, 2] PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	radioactive COC list[1] Metals and PCBs have been identified in KE Basin Sludge at concentrations exceeding the TCLP Total Concentration screening level. If sludge is incompletely removed or if underwater items are porous, then the presence of residual sludge may cause the items to be designated as mixed waste.
12	process equipment – pumps, old canister washer, piping and piping components, rubber hoses	radioactive COC list[1, 2] PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	radioactive COC list[1] Metals and PCBs have been identified in KE Basin Sludge at concentrations exceeding the TCLP Total Concentration screening level. If sludge is incompletely removed or if underwater items are porous, then the presence of residual sludge may cause the items to be designated as mixed waste.
13	miscellaneous debris – electrical cables, light fixtures, long tools, brushes, PPE, metal, plastic	radioactive COC list[1, 2] PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	radioactive COC list[1] Metals and PCBs have been identified in KE Basin Sludge at concentrations exceeding the TCLP Total Concentration screening level. If sludge is incompletely removed or if underwater items are porous, then the presence of residual sludge may cause the items to be designated as mixed waste.

Table 1-6. Final List of COCs. (5 pages)

WS#	Material (Component)/ Category	COC	Rationale for Inclusion
14	Canisters/canister lids	radioactive COC list[1, 2] PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	radioactive COC list[1] Metals and PCBs have been identified in KE Basin Sludge at concentrations exceeding the TCLP Total Concentration screening level. If sludge is incompletely removed or if underwater items are porous, then the presence of residual sludge may cause the items to be designated as mixed waste.
15	IXMs	radioactive COC list[1] PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	radioactive COC list[1] PCBs in water at concentrations at or near the reported detection limit may be expected to bind to the hydrophobic IXM resin material. Toxic Metals in water at concentrations at or near the detection limit may concentrate to elevated concentrations in the spent IXMs.
16	floor tiles/ceiling tiles; sprayed on ceiling texture or acoustic surface coatings	Pb, if painted asbestos radioactive COC list[1]	ACM may be painted. If lead paint is applied, ACM must contain less than 0.05% wt. paint. The age of the KE and KW Basin facilities indicates that asbestos is likely to be present in numerous materials. radioactive COC list[1]
17	pipe and duct insulation and insulation mastic; mastic used as adhesive for plastic baseboard moldings	asbestos radioactive COC list[1]	The age of the KE and KW Basin facilities indicates that asbestos is likely to be present in numerous materials. radioactive COC list[1]
18	mineral based building insulation in walls and ceilings	asbestos radioactive COC list[1]	The age of the KE and KW Basin facilities indicates that asbestos is likely to be present in numerous materials. radioactive COC list[1]

Table 1-6. Final List of COCs. (5 pages)

WS#	Material (Component)/ Category	COC	Rationale for Inclusion
19	asbestos board (transite) used in walls, ceilings, siding	asbestos radioactive COC list[1]	The age of the KE and KW Basin facilities indicates that asbestos is likely to be present in numerous materials. radioactive COC list[1]
20	high temp gaskets and seals	asbestos radioactive COC list[1]	The age of the KE and KW Basin facilities indicates that asbestos is likely to be present in numerous materials. radioactive COC list[1]

[1]Radiological COCs are H3, Co-60, Ni-63, Sr-90, Sb-125, Cs/Ba-137, Pm-147, Sm-151, Eu-152, Eu-154, Eu-155, U-235, U-238, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, and Cm-244. Each radionuclide has been included because they meet one or more of the following criteria (1) the radionuclide is part of the N-Reactor uranium fuel cycle process, (2) the radionuclide is not gaseous and has a half-life greater than 1 year, (3) the beta/gamma emitting radionuclide was estimated to be present at greater than 1% of the Cs-137 activity of the waste, and/or (4) the alpha emitting or TRU radionuclide was estimated to be greater than 0.1% of the Cs-137 activity of the waste. The remaining radionuclides apply to all LLW from the K Basins. See Appendix B, Table B-1.

[2]Radioactive/LLW could potentially designated as TRU or mixed waste if the sludge is incompletely removed, or if the underwater debris items are porous.

[3]TC Metals in paint may cause this Radioactive/LLW to be designated as mixed waste.

Some debris removed from the basins may be contaminated from the sludge that has accumulated in the bottom of the basins. Because of the radionuclide contamination, PCBs, and metals concentrations in the sludge, residual sludge could potentially cause debris to designated as mixed, TRU, or mixed -TRU waste. Transuranic–designated waste is not eligible for disposal at ERDF.

Most of the accumulated sludge, therefore, will be removed through a pressure wash, conducted under water. Lead bricks and shielding, debris designated as mixed waste (e.g., painted debris exceeding TC limits), and debris that cannot be readily evaluated for compliance with LDR criteria after decontamination will be designated as hazardous, based on process knowledge, collected, and encapsulated for disposal at ERDF. Macro-encapsulation is a compliant alternative treatment technology for hazardous debris according to 40 CFR 268.45.

Ion-exchange modules will be drained of free-flowing liquids and managed as debris in accordance with the ROD definition of debris. As noted above, the IXMs may be designated as hazardous for TC metals (selenium). Because the concrete shell will be considered along with the IX columns when evaluating the IXM for waste designation and radionuclides concentrations, calculations indicate that PCBs and metals concentrations with the exception of selenium are below TC levels, due to the large debris mass. The EPA agrees that the unit includes the IX column and concrete shell and constitutes a HIC which is equivalent to encapsulation (see Appendix A). The project will proceed both to confirm this interpretation and the designation of the waste.

This DQO must establish a procedure for waste designation to allow a decision as to whether the debris can be disposed at ERDF.

Table 1-7. List of Preliminary Action Levels. (7 pages)

Waste Stream	COC	Preliminary Action Level			Basis
		TC mg/l	LDR mg/kg	ERDF WAC[3] pCi/g	
Painted Debris	radioactive COC list: H-3, Co-60, Ni-63, Sr-90, Sb-125, Cs/Ba-137, Pm-147, Sm-151, Eu-152, Eu 154, Eu-155, U-235, U-238, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cm-244 TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag Nonvolatile paint constituents: 2-(2-methoxy)-Ethanol, 2-Phthalocyanito-copper (copper phthalocyanine), 2,2,4-Trimethyl-1,3-pentanediolmonoisobutyrate, 2-propoxyethanol, Hydroxypropylmethylcellulose[1] Dibutyl Phthalate Naphthalene	TC metals As -5.0, Ba-100.0, Cd-1.0,Cr-5.0, Pb-5.0, Hg-0.2, Se-1.0, Ag-5.0	organics 28 5.6	radioactive COC list H-3: NL Co-60: NL Ni-63: 4.38 E+8 Sr-90: 4.38 E+9 Sb-125: NL Cs/Ba-137: 2.0E+7 Pm-147: NL Sm-151: 3.31E+10 Eu-152: 1.31E+13 Eu-154: NL Eu-155: NL U-235: 1.69E+3 U-238: 7.5E+3 Pu-238: 1.0E+5 Pu-239; 1.81E+4 Pu-240: 1.81E+4 Pu-241: 3.88E+6 Am-241: 3.12E+4 Cm-244: 1.0E+5	40 CFR 261.24, "Toxicity Characteristic" 40 CFR 268.48, "Universal Treatment Standards" *Washington Administrative Code 173-303-140* Rad Limits identified in ERDF WAC: "*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.

Table 1-7. List of Preliminary Action Levels. (7 pages)

Waste Stream	COC	Preliminary Action Level			Basis
		TC mg/l	LDR mg/kg	ERDF WAC[3] pCi/g	
Rags Contaminated with Stripped Paint Waste (Citristrip)	radioactive COC list[1] TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag Nonvolatile Paint Constituents: 2-(2-methoxy)-Ethanol, 2-Phthalocyanito-copper (copper phthalocyanine), 2,2,4-Trimethyl-1,3-pentanediolmonoisobutyrate, 2-propoxyethanol, Hydroxypropylmethylcellulose[1]. Citristrip: Methyl-2-pyrrolidone, D-Limonene	As -5.0, Ba-100.0, Cd-1.0,Cr-5.0, Pb-5.0, Hg-0.2, Se-1.0, Ag-5.0		rad limits above	40 CFR 261.24, "Toxicity Characteristic" "*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.
	Dibutyl Phthalate Naphthalene		28 5.6		40 CFR 268.48, "Universal Treatment Standards" *Washington Administrative Code 173-303-140*
structural shielding that contains haz metals – lead bricks, lead shielding	Pb	Pb-5.0		rad limits above	40 CFR 261.24, "Toxicity Characteristic" "*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.

Table 1-7. List of Preliminary Action Levels. (7 pages)

Waste Stream	COC	Preliminary Action Level			Basis
		TC mg/l	LDR mg/kg	ERDF WAC[3] pCi/g	
cartridge filters, disposable PPE, plastic, and other trash	radioactive COC list			rad limits above	"*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.
materials used for decon of equipment: cloth, paper plastic	radioactive COC list			rad limits above	"*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.
process equipment: heat exchangers, piping	radioactive COC list			rad limits above	"*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.
Unpainted demolition debris, structural steel, rocks, gravel, metal, glass, concrete, ceramic, bricks, roofing material, wood drywall, siding	radioactive COC list			rad limits above	"*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.
materials collected during general housekeeping: soil, sawdust, vegetation, debris, glass, plastic	radioactive COC list			rad limits above	*"Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.

Table 1-7. List of Preliminary Action Levels. (7 pages)

Waste Stream	COC	Preliminary Action Level			Basis
		TC mg/l	LDR mg/kg	ERDF WAC[3] pCi/g	
HEPA filters	radioactive COC list			rad limits above	"*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.
structural steel – fuel storage racks & bulkheads, structures used for fuel handling	radioactive COC list PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	As -5.0, Ba-100.0, Cd-1.0,Cr-5.0, Pb-5.0, Hg-0.2, Se-1.0, Ag-5.0		rad limits above PCBs – 500mg/kg	40 CFR 261.24, "Toxicity Characteristic" "*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.
process equipment – pumps, old canister washer, piping and piping components, rubber hoses	radioactive COC list PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	As -5.0, Ba-100.0, Cd-1.0,Cr-5.0, Pb-5.0, Hg-0.2, Se-1.0, Ag-5.0		rad limits above PCBs – 500mg/kg	40 CFR 261.24, "Toxicity Characteristic" "*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.

Table 1-7. List of Preliminary Action Levels. (7 pages)

Waste Stream	COC	Preliminary Action Level			Basis
		TC mg/l	LDR mg/kg	ERDF WAC[3] pCi/g	
miscellaneous debris – electrical cables, light fixtures, long tools, brushes, PPE, metal, plastic	radioactive COC list PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	As -5.0, Ba-100.0, Cd-1.0,Cr-5.0, Pb-5.0, Hg-0.2, Se-1.0, Ag-5.0		rad limits above PCBs – 500mg/kg	40 CFR 261.24, "Toxicity Characteristic" "*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.
Canisters/canister lids	radioactive COC list PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	As -5.0, Ba-100.0, Cd-1.0,Cr-5.0, Pb-5.0, Hg-0.2, Se-1.0, Ag-5.0		rad limits above PCBs – 500mg/kg	40 CFR 261.24, "Toxicity Characteristic" "*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.
IXMs	radioactive COC list PCBs, TC metals –As, Ba, Cd, Cr, Pb, Hg, Se, Ag	As -5.0, Ba-100.0, Cd-1.0,Cr-5.0, Pb-5.0, Hg-0.2, Se-1.0, Ag-5.0		rad limits above PCBs – 500mg/kg	40 CFR 261.24, "Toxicity Characteristic" "*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.

Table 1-7. List of Preliminary Action Levels. (7 pages)

Waste Stream	COC	Preliminary Action Level			Basis
		TC mg/l	LDR mg/kg	ERDF WAC[3] pCi/g	
floor tiles/ceiling tiles; sprayed on ceiling texture or acoustic surface coatings	Pb if painted asbestos[2] radioactive COC list	Pb-5.0		rad limits above	40 CFR 261.24, "Toxicity Characteristic" "*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.
pipe and duct insulation and insulation mastic; mastic used as adhesive for plastic baseboard moldings	asbestos[2] radioactive COC list			rad limits above	"*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.
mineral based building insulation in walls and ceilings	asbestos[2] radioactive COC list			rad limits above	"*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.
asbestos board (transite) used in walls, ceilings, siding	asbestos[2] radioactive COC list			rad limits above	"*Environmental Restoration Disposal Facility Waste Acceptance Criteria*," BHI-00139, June 1998.

Table 1-7. List of Preliminary Action Levels. (7 pages)

Waste Stream	COC	Preliminary Action Level			Basis
		TC mg/l	LDR mg/kg	ERDF WAC[3] pCi/g	

[1]Nonvolatile paint constituent action levels will be based on a calculation for toxicity, as provided in *Washington Administrative Code* 173-303-100 (5).

[2]No action limits have been specified for asbestos. Note that ACMs shall be managed in accordance with 40 CFR 61.140 through 157. Detailed information on packaging and shipping can be found in ERDF Supplemental WAC (BHI 1997).

[3]The ERDF WAC (BHI 1998) radionuclide concentration limits are listed in units of Ci/m^3. These units have been converted to pCi/g using the following conversion factors:

Ci = 10^{12} pCi
1m3 = 10^6 cc
1.6 g/cc = Approximate estimated package density of waste. Actual waste densities will vary and final calculation will use actual weights and volumes.

the resulting unit is pCi/g.

[4]The listed WAC are the lowest limits for the COCs from consideration of Table 3 of the ERDF WAC, Class C limits from 10 CFR 61 and the TRU limit of 100 nCi/g.

2.0 STEP 2 - IDENTIFY THE DECISION

The purpose of DQO Step 2 is to define the principal study questions (PSQs) that need to be resolved to address the problem(s) identified in DQO Step 1 and to define the alternative actions that would result from the resolution of the PSQs. The PSQs and alternative actions are then combined into decision statements (DSs) that provide a basis for gathering information.

2.1 PRINCIPAL STUDY QUESTIONS

The PSQs are basic DQO questions that will require measurements (e.g., physical, chemical, or radiological data) to resolve. An initial operating assumption for this project is that all debris is radiologically contaminated. Therefore, PSQs are directed towards a determination of the level of contamination and whether debris is mixed waste, i.e., also contaminated with hazardous/dangerous waste constituents.

2.2 ALTERNATIVE ACTIONS

Table 2-2 identifies the alternative actions that could be taken once the PSQs have been resolved.

Table 2-1. Principal Study Questions.

PSQ#	Principal Study Question
1	Is the material radiologically contaminated with constituents that cause it to be regulated as TRU?
2	Does the material's radiological activity exceed the ERDF WAC (BHI 1998) limits?
3	Is the material a dangerous waste[a,b], PCB-regulated, or asbestos waste?
3a	Is the material a TC or Washington toxic waste?
3b	Does the material contain asbestos?
4	Is the material land disposal restricted?

[a] The definition of dangerous waste also includes hazardous waste.

[b] Process knowledge excludes waste being reactive, ignitable, or corrosive (see, for example, DOE-RL 1999b).

Table 2-2. Alternative Actions.

PSQ#	AA#	Alternative Action
1	1	The material is not radiologically contaminated above TRU waste levels and will be considered for disposition at the ERDF.
1	2	*The material is radiologically contaminated above TRU waste levels and will not* be disposed at ERDF. Waste will be segregated for alternate disposal.
2	1	The radiological activity of the material does not exceed the ERDF WAC (BHI 1998) limits. It will be evaluated per discussions #3 and 4.
2	2	The radiological activity of the material exceeds the ERDF WAC (BHI 1998) limits. It will be evaluated by ERDF on a case by case basis. If the waste cannot be accepted at ERDF, alternative disposal locations will be identified. *It is likely* that the alternative would be packaging and shipment to the CWC. The material will also be evaluated per discussions #3 and 4 below if it is determined appropriate to go to ERDF.
3a	1	The material is a TC waste and receives a characteristic waste code. The waste will be treated through macro-encapsulation before disposal.
3a	2	The material is not a TC waste and is disposed at ERDF without treatment.
3a	3	If the material exceeds state dangerous toxic criteria using calculations in *Washington Administrative Code* 173-303-100 (5), the waste will be disposed in ERDF. (**NOTE:** RCW 70.105.050 authorizes the disposal of extremely hazardous waste (EHW) that contains radioactive components after appropriate treatment at DOE facilities.)
3a	4	If the material is below the state dangerous toxic criteria using calculations in *Washington Administrative Code* 173-303-100 (5), the waste will be disposed in ERDF.
3b	1	The material is regulated due to asbestos content and will be managed appropriately prior to disposal.
3b	2	*The material is not regulated due to asbestos content.*
4	1	The material is land disposal restricted. Treatment in the form of macro-encapsulation is imposed on the material prior to disposal.
4	2	The material is not land disposal restricted. Treatment is not required for the material prior to disposal

2.3 DECISION STATEMENTS

Table 2-3 uses the PSQs and alternative actions to create decision statements (DSs) using the following format: *Determine whether or not [unknown conditions/issues/criteria from the PSQ] require (or support) [taking alternative actions].*

Table 2-3. Decision Statements.

DS#	Decision Statement
1	Determine whether the debris exceeds the radiological contamination limits for TRU waste material.
2	Determine whether the radionuclide content of the debris exceeds the WAC for the ERDF.
3	Determine whether the material designates as dangerous, TC, or is asbestos waste.
3a	Determine whether the characteristic waste code for toxicity or state dangerous waste toxic applies to the material.
3b	Determine whether the material is regulated due to asbestos content.
4	Determine whether LDRs require treatment prior to disposal.

Figure 2-1. Generic Waste Disposition Decision Logic.

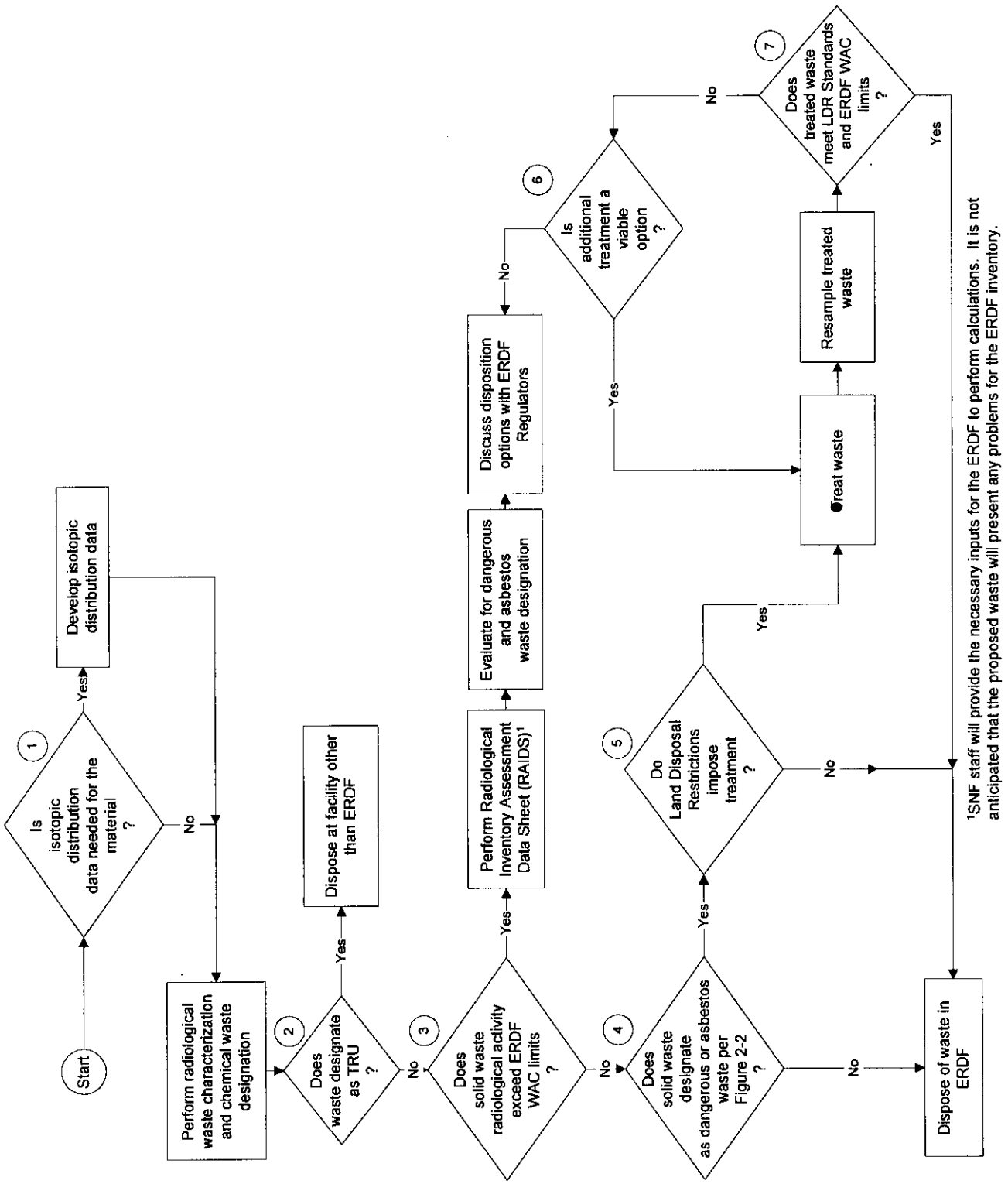
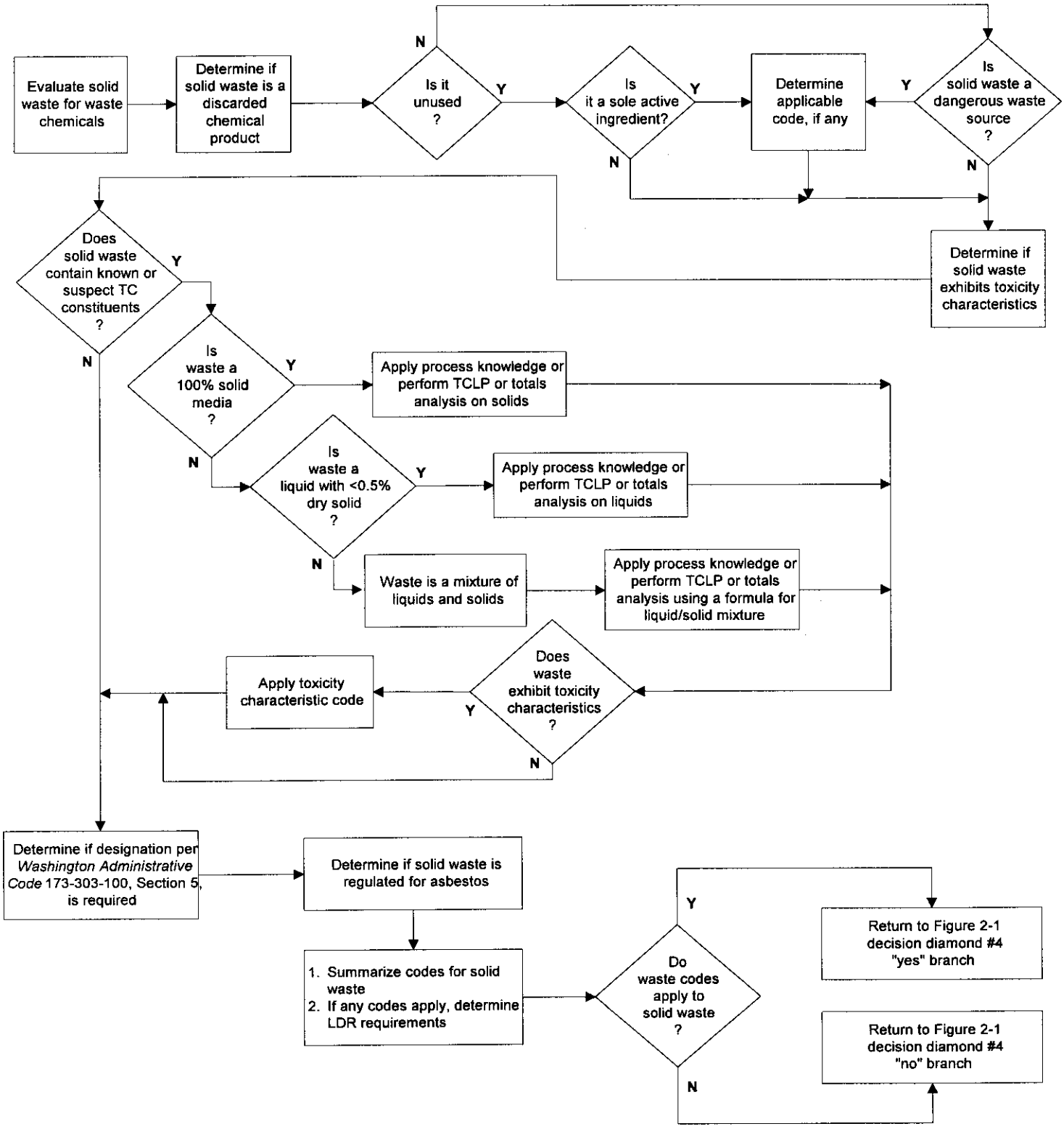


Figure 2-2. Chemical Waste Designation Decision Logic.



3.0 STEP 3 - IDENTIFY INPUTS TO THE DECISION

The purpose of DQO Step 3 is to identify the type of data needed to resolve each of the DSs identified in Step 2, as well as the analytical performance requirements (e.g., practical quantitation limit [PQL] requirement, precision, and accuracy) for the data. If it is determined that the required data do not already exist, the data may be obtained by field measurements.

3.1 REQUIRED INFORMATION

Tables 3-1a through 3-3 deal with the information required to resolve the DSs. Existing data are evaluated for use, and computational and field measurement methods are identified that can supply the needed data.

Table 3-1 lists the data required for each DS. Source references for the data are provided along with a qualitative assessment as to whether or not the data are of sufficient quality to resolve the corresponding DS.

Table 3-1. Required Information and Reference Sources.

DS#	Required Data	Does Data Exist? (Y/N)	Source Reference	Sufficient Quality? (Y/N)	More Info Req'd? (Y/N)
1	Estimation of the TRU content (nCi/g) of each waste package.	Y	See Section 7.0.	Y	Y
2	Estimation of the radionuclide (Ci/m^3) content of each waste package.	Y	See Section 7.0.	Y	Y
3a 3b	See Table 3-1a				
4	Determine whether LDRs require debris to be treated prior to disposal.	Y	NHC-96-101,"Analytical Report for K Basin Paint –FT6112," September 11, 1996. Analytical Report for FAST Project FD1-7021, "K Basin Crane Removal," July 15, 1997. Discussion of total metals concentrations in K-Basin Sludge: KBSN-96-01, "K Basin Sludge Waste Stream Profile Sheet," 6/26/96. Toxic metals and PCBs potential to sorb onto the IX column, calculations in Appendix C.	Y	Y

Table 3-1a. Waste Designation Inputs.

DS#	Characterization Requirement	Criteria	WS#	Required Information/Media	Do Data Exist? (Y/N)	Source	Sufficient Quality? (Y/N)	More Info Req'd? (Y/N)
3a	Determine whether the characteristic waste codes for toxicity applies to the material.	*Washington Administrative Code* 173-303-090 (2)-(8)						
		40 CFR 268.40, 40 CFR 261.24, *Washington Administrative Code* 173-303-140	1 2 16	Toxic Metals concentrations in paint.	Y	NHC-96-101,"Analytical Report for K-Basin Paint – FT6112," September 11, 1996. Analytical Report for FAST Project FD1-7021, "K Basin Crane Removal," July 15, 1997.	Y	Y
			3	Toxic Metals concentration in Lead shielding	Y	Calculations provided in Appendix E	Y	N
			4	Toxic Metals concentration in broken fluorescent and incandescent bulbs	Y	Calculations provided in Appendix E.	Y	N
			15	Amount of Toxic Metals in K-Basin water that may concentrate on the IX column.	Y	Calculations provided in Appendix C.	To be discussed	To be discussed
3b	Determine if the material is regulated due to asbestos concentrations.	40 CFR 61, Subpart M.	16 17 18 19 20	Presence of asbestos in debris	N	N/A	N	Y

Table 3-2 identifies the DSs where existing data either do not exist or are of insufficient quality to resolve the DSs. For those cases, Table 3-2 identifies possible computational and/or surveying/sampling methods that could be used to obtain the required data.

Table 3-2. Information Required to Resolve the Decision Statements. (2 pages)

DS#	Informational Need	Required Data	Computational Methods	Available Survey/Sampling Methods
1	Estimate of the upper bound of the TRU content of the waste package, compare to TRU criteria.	TRU isotopic data. nCi/g	Apply dose-to-curie conversion to obtain Cs-137 levels in the waste. Apply predetermined radionuclide ratios to estimate the amount of each of the COCs from the Cs-137.	Dose meter, gamma survey, or NDA of individual pieces of debris or appropriate containers of debris. Media sampling and laboratory analysis of debris.
2	Estimate of the radionuclide content of the waste package. Compare to ERDF WAC (BHI 1998).	Radiological survey data for direct counting, analytical results of samples. Ci/m^3 or pCi/g	Apply dose-to-curie conversion to obtain Cs-137 levels in the waste. Apply predetermined radionuclide ratios to estimate the amount of each of the COCs from the Cs-137.	
3a	Toxic Metals concentrations in Lead shielding Toxic Metals concentration in broken fluorescent and incandescent bulbs	Metals concentrations	See Appendix D.	Process knowledge
3b	Presence of asbestos in debris.	Presence of asbestos fiber Process knowledge	N/A	Visual inspection of building materials by a certified AHERA inspector. Process knowledge

Table 3-2. Information Required to Resolve the Decision Statements. (2 pages)

DS#	Informational Need	Required Data	Computational Methods	Available Survey/Sampling Methods
4	(1)Determine if toxic metals concentrations in sludge exceed TC limits and amount of sludge present on debris. (2) Determine if toxic metals in painted debris, stripped paint, lead shielding, and broken fluorescent and incandescent bulbs exceed TC limits. (3) Determine if IXMs contain concentrated toxic metals at levels above TC limits.	Concentrations of toxic metals and PCBs	N/A	Items will be visually inspected. Painted debris, stripped paint, lead shielding, broken fluorescent and incandescent bulbs will be segregated, collected and macro-encapsulated prior to land disposal. Process knowledge Historical data

Table 3-3 identifies computational methods that may used to provide the data needed to resolve the DSs.

3.2 FIELD MEASURMENT METHODS AND ANALYTICAL PERFORMANCE REQUIREMENTS

The field measurement methods and analytical performance requirements that will support resolution of the DSs are developed in Tables 3-4 and 3-5. For Table 3-4, refer to Table 1-7 for a summary of the preliminary action levels for each of the COCs for each individual WS. Confirm that appropriate measurement methods exist to provide the necessary data. The possible limitations associated with each of these methods are also provided along with the estimated cost.

Table 3-3. List of Potential Computational Methods.

DS#	Computational Method	Source/Author	Application to Study
1	Conversion from dose rate or NDA gamma and neutron results to estimated TRU radionuclide levels in the waste package.	TBD, Depends on the vendor that performs the NDA. Past data, see PNNL (1999) and WHC (1996a, 1996b).	
2	Conversion from dose *rate or gamma* surveys to an estimate of the amount of COC that is in each waste package.	WHC (1996b), WHC (*1996a*)	Direct sampling and measurement of all *COC radionuclides on the waste in each* waste package is not feasible. Concentrations (Ci/m^3) of COC in the waste package will be inferred from external dose or gamma surveys of the packaged waste. Confirmation samples or additional external NDA measurements may be obtained and analyzed if anomalies (e.g. high dose rate, isotopic ratio changes) are observed.
3a		Calculations in Appendix C, D, and E.	Appendix C calculates the potential of the IX column to sorb PCBs and toxic metals from K-Basin water analyses. Appendices D and E calculate the potential lead content of debris and concentrations of TC metals and PCBs in sludge, respectively. Results are compared with TC levels for metals and PCBs.

Table 3-4. Potentially Appropriate Measurement Methods.

DS#	Individual Waste Stream	Informational Need	Potentially Appropriate Measurement Method	Possible Limitations or Reservations	Cost
1	All	TRU content of the waste package.	Dose rate, NDA, measurement of gamma and neutron emissions. Sampling and analysis.	Conversion of measured dose rate and/or gamma emissions and neutrons require application of estimated ratios and generic dose to curie conversions. Laboratory analysis is costly and will result in dose to samplers and analysts. WHC (1996 a,b), WHC (1996 f)	
2	All	Radionuclide COC content of waste package.	Measurement of dose rate, gamma emission rates. Sampling and laboratory analysis.		
3,4	1-20	TC metals concentrations	Process knowledge coupled with scaling factor. Laboratory analysis.	Scaling factors will provide conservative results. Laboratory analysis is costly and will result in dose to samplers and analysts	

Table 3-5 defines the analytical performance requirements for the data that need to be collected to resolve the DSs that require measurements. These performance requirements include the PQL and precision and accuracy requirements for each of the COCs.

Table 3-5. Analytical Performance Requirements.

Individual Waste Stream	COC	Analytical Method	Preliminary Action Level	Practical Quantitation Limit[a] Requirements	Precision Req't	Accuracy Req't
All	TRU COCs	Dose rate, gamma spectroscopy for Cs-137 for curie conversion of TRU COC radionuclides.	100 nCi/g	TBD	TBD	TBD
All	Radiological COCs	Dose rate, gamma spectroscopy for Cs-137 for curie conversion of TRU COC radionuclides.	ERDF radiological WAC.	TBD	TBD	TBD

[a] The PQLs are the appropriate limits in most cases. If the action levels are below the PQLs, minimum detection limits apply instead of the PQLs.

TBD = To be determined based on final selection of instruments. To be addressed in the SAP. PQLs, accuracy, and precision for any selected instrument and associated method or procedure must be adequate to meet the preliminary action levels for each WS.

4.0 STEP 4 - DEFINE THE BOUNDARIES OF THE STUDY

The primary objective of DQO Step 4 is to identify the geographic (spatial) and temporal boundaries of the facility under investigation, as well as practical constraints (e.g., hindrances or obstacles) that must be taken into consideration in the sampling design. Implementing this step ensures that the sampling design will result in the collection of data that accurately reflect the true condition of the facility.

4.1 GEOGRAPHIC BOUNDARIES

Prior to defining the boundaries of the facility, it is first necessary to clearly define the populations of interest that apply for each DS (Table 4-1). Table 4-1 clearly defines the attributes that make up each population of interest by stating them in a way that makes the focus of the study unambiguous.

Table 4-1. Characteristics that Define the Population of Interest.

WS#	DS #	Population of Interest	Characteristics	Unit Measurement Size	Total Number of Potential Measurement Units within the Population
11-14	1	Debris that is pressure washed prior to removal from the basins must be characterized for TRU.	TRU contaminants on debris	Bags, Barrels, Boxes, Canisters, Racks	Variable and unknown except canisters and racks TBD
1-20	2	All debris is assumed to be radiologically contaminated.	Radionuclide contaminants on debris	Bags, Barrels, Boxes, Canisters, Racks	Variable and unknown except canisters and racks
1	3a	Painted material is assumed to be a mixed waste, due to the presence of TC constituents. All painted debris will be macro-encapsulated.	TC constituents on painted debris	No measurements planned	No measurements planned
16-20	3b	Building materials will be inspected for the presence of asbestos.	Asbestos fiber content	Visual inspection of entire material	Entire material is considered, no subdivision
1,2,11,12,13	4	Materials macro-encapsulated in response to PSQ #3 concerns will be considered to be in compliance with LDR.	TC constituents, organics on painted debris surfaces	No measurements planned	No measurements planned

Table 4-2 identifies the geographic areas that apply to each DS. The term "geographic area" refers to the dimensions of the facility under investigation or the dimensions of the specific rooms or sections of the facility under investigation.

Table 4-2. Geographic Areas of Investigation.

DS#	Geographic Areas of Investigation
All	The geographic areas of investigation include the structures that house the KE and KW Basins, as discussed in the ROD as well as the IWTS.

Table 4-3 defines the zones or materials within the facility under investigation that have certain homogeneous characteristics. These zones or materials are identified by using existing information to segregate the elements of the population into subsets that exhibit relatively homogeneous characteristics, such as types of contaminants. This distinction reduces the overall complexity of the problem by segregating the facility or materials into more manageable pieces.

Table 4-3. Strata with Homogeneous* Characteristics.

WS#	DS#	Population of Interest	Strata	Homogeneous Characteristic Logic
2	3	Rags Contaminated with Stripped paint waste	Stripped paint will be collected on rags	This will consist of paint chips and Citristrip on rags/gloves. The paint was homogeneous on the applied surface and would be comprised of similar constituents. Using calculations to cover the area stripped versus the weight of the rags, the total paint on the rags will be estimated.
3	2, 3, 4	Lead shielding	Metal surface and content	Shielding will be of similar construction; high lead content
1-2, 11-13	4	Materials for which LDRs apply	Painted surfaces	Paint is relatively uniformly applied to surfaces composed of similar constituents, and the depth of the coating is relatively uniform.
14	3	Canister surfaces and all nonporous material from under water after pressure washing	Surface of metal	The metal surface should be homogeneous after washing.
15	2, 3	IX resins	IXMs	The water is recirculated making the constituents relatively uniformly mixed and deposited on the resin. Water flow is monitored during their service life.
16	2, 3	Asbestos fiber content, radiological constituents	Surfaces of materials	The asbestos is typically mixed in the tile material or on the applied dried adhesives, therefore, the manufacturing and usage result in relative homogeneity.

* The term is used to mean relatively similar waste. None of the waste in these documents exhibits true homogeneity.

Table 4-4 identifies the spatial scale for decision making that may apply to each DS. The spatial scale for decision making identifies each decision unit, which is the smallest area or volumetric unit for which each decision applies.

Table 4-4. Spatial Scale for Decision Making.

DS#	Spatial Scale
All	The spatial scale of decision-making for the debris disposition DQO is the individual piece of equipment, component, or other debris or consolidated packages of similar debris removed from the facility being investigated.

4.2 TEMPORAL BOUNDARIES

Table 4-5 defines the temporal scale for decision making. A temporal scale for decision making may be necessary for certain types of studies.

Table 4-5. Temporal Scale for Decision Making.

DS#	Temporal Scale
All	The decisions identified in this DQO apply to the removal of all debris covered by the ROD during this initial phase of K-Basin remedial activities. The decisions may or may not be appropriate for later debris removal activities, particularly for those associated with D&D of structures not covered by this ROD.

4.3 PRACTICAL CONSTRAINTS

Access to the basins may require the removal of internal walls or other portions of the K-Basin structures. Sludge must be removed from debris prior to disposal. Sludge within the basins will create visibility problems during retrieval and washing of the debris from within the basins. Sampling and analysis of paint samples and other potential COCs from multiple objects would not be cost-effective, when considering the small potential volume of these materials. The large number of debris and the difficulty associated with collecting representative samples from the variety of matrices supports the use of field radiological measurements over sampling and laboratory-based analysis for radionuclides for each item.

5.0 STEP 5 - DEVELOP A DECISION RULE

The purpose of DQO Step 5 is to combine information provided in DQO Steps 1 through 4 with a parameter of interest (e.g., mean, median, or percentile) and an action level to provide a concise description of what action will be taken based on the results of the data collected. The parameter of interest specifies the characteristic or attribute that the decision-maker would like to know about the population, while the action level is a threshold value of the parameter of interest that provides the criterion for choosing between alternative actions.

5.1 STATISTICAL PARAMETER OF INTEREST

For each COC, Table 5-1 identifies the corresponding statistical parameter of interest (e.g., mean and upper 95th percent confidence interval).

Table 5-1. Statistical Parameter of Interest.

DS#	Decision Statement	Parameter of Interest
1	Determine if the potentially contaminated debris materials exceed the radiological contamination limits for TRU and, therefore, are not eligible for disposal at the ERDF.	The norm will be the maximum activity for Cs-137. Options will be developed as needed.
2	Determine if the radiological activity of the debris exceeds the ERDF WAC (BHI 1998) limits.	The norm will be the maximum activity for Cs-137. Options will be developed as needed.
3	Determine if the material designates as dangerous, TC or asbestos waste.	Process knowledge, or analytical results: Single sample concentrations.
3a	Determine if the TC waste codes or state dangerous/toxic codes apply to the material.	
3b	Determine if the material is regulated due to asbestos content.	Observed single sample fiber count or process knowledge.
4	Determine if LDRs impose treatment for material.	Process knowledge, material safety data sheet data, any analytical sample result.

5.2 FINAL ACTION LEVELS

Table 5-2 lists the final action level for each DS and COC.

Table 5-2. Final Action Level for the Decision.

DS#	COC	Action Level
1	Estimated concentration of TRU COC radionuclides.	100 nCi/g TRU radionuclides in waste.
2	Estimated concentration of all radiological COCs.	Disposal facility WAC limits. Units of Ci/m^3 on a per waste package basis.
3a	**TC Metals**	**TCLP Action Levels (mg/L)[a]**
	Arsenic	5.0
	Barium	100
	Cadmium	1.0
	Chromium	5.0
	Lead	5.0
	Mercury	0.2
	Selenium	1.0
	Silver	5.0
3b	Asbestos	<1% asbestos by volume
4	LDR constituents	See ERDF WAC (BHI 1998)

[a] If TC criteria are exceeded, evaluate waste for potential underlying hazardous constituents and evaluate any underlying hazardous constituents against the limits in the universal treatment standards criteria of 40 CFR 268.48.

5.3 DECISION RULES

Table 5-3 combines the parameter of interest, scale for decision making, action levels, and alternative actions into separate "IF...THEN..." statements that are referred to as decision rules (or DRs). Each DS identified in Table 2-3 that requires additional information (Tables 3-1 and 3-1a) has one or more DRs associated with it.

Table 5-3. Decision Rules. (2 Pages)

DR #	Decision Rule
1	If the estimated TRU COCs in the waste do not exceed 100 nCi/g, then the waste will be evaluated per DRs #2, 3, and 4 for disposal at ERDF. If the estimated TRU COCs in the waste exceeds 100 nCi/g, then the waste will not be sent to ERDF.
2	If the estimated radionuclide COCs in the waste do not exceed the radionuclide ERDF WAC (BHI 1998) (Ci/m^3), then the waste will be evaluated per DRs # 3, and 4. If the in estimated radionuclide COCs in the waste exceeds the radionuclide ERDF WAC (BHI 1998) (Ci/m^3), then the waste will be evaluated on a case-by-case basis and may not be sent to ERDF.

Table 5-3. Decision Rules. (2 Pages)

DR #	Decision Rule
3	If process knowledge, or single sample concentrations of the detected analytical value, or the observed fiber count indicates that the materials do not designate as TC or exceed ERDF WAC (BHI 1998), then they will be packaged for disposal at the ERDF as LLW. Waste which designates only as Washington State dangerous will not require treatment before disposal. If process knowledge, or single sample concentrations of the detected analytical value, or the observed fiber count indicates that the materials designate as TC, state dangerous EHW, or exceed ERDF WAC (BHI 1998), then they will be treated through macro-encapsulation and disposed of at ERDF.
4	If process knowledge or any detected analytical sample value dictates LDR imposed treatment, the materials will be treated with macro-encapsulation and disposed at ERDF. If process knowledge or none of the detected analytical sample values dictate LDR imposed treatment of the materials, the debris will be disposed in ERDF without additional treatment.

6.0 STEP 6 – SPECIFY TOLERABLE LIMITS ON DECISION ERRORS

The sampling design for the materials is performed in two stages. In Stage 1, facility or historical radiological sample data (99-SNF/CJS-024, PNNL 1999, Huisingh 1997, Numatec 1996, WHC 1997a, WHC 1997b, WHC 1996g, WHC 1990) will be used to establish the radionuclide/isotopic distribution of radiological COCs. The radionuclide distributions will be established for each waste WS and subsequently used to estimate the content of COCs other than cesium-137. The cesium-137 content of the waste will be estimated using a variety of instruments, including portable radiation detectors (WHC 1996a, WHC 1996b). Nondestructive analysis (gamma spectroscopy, neutron counting) equipment as described in previous characterizations (PNNL 1999, WHC 1996f) may be used. During Stage 2, K-Basin staff will use the correlation when evaluating data from radiological NDA, dose rate or gamma surveys to estimate isotopic inventories for waste shipments.

The purpose of DQO Step 6 is to develop tolerable error limits. To quantify error limits, statistical procedures may be used when sampling and analyzing the data. Because the goal for Stage 1 sampling is to determine radionuclide/isotopic distributions, suspect contaminated areas either have been, or will be, preferentially sampled. This design is judgmental, so the quantification of error limits is not feasible. Likewise, the radionuclide sampling for Stage 2 will also be preferentially determined, based on a qualitative probability of contamination.

It should be noted that the sampling design for certain material/waste accumulations may benefit from a statistical derivation. These situations are not expected, but if they arise, the statistical sampling approach should be developed on a case-by case basis. In those cases, the development of error tolerances and optimization of the sampling design will follow Steps 6 and 7 in the remediation DQO workbook template (http://www.hanford.gov/dqo/index.html).

6.1 STATISTICAL VS. JUDGMENTAL DESIGN

6.1.1 Radioactive Waste

One of the primary objectives normally accomplished in DQO Step 6 is the selection of a statistical or judgmental sample design. Statistically-based sampling for radiological COCs will not be used because of the cost associated with sampling and difficulty of sampling debris matrices. Each waste container will be either surveyed or contain surveyed waste. An estimated COC inventory for that waste container will be derived from measurements. Therefore, the sample design is judgmentally developed for the materials components that will ultimately be placed in the shipping container. Specific radiological survey requirements, procedures, and dose-to-curie relationships will be discussed in the subsequent sampling and analysis plan supporting K-Basin waste characterization.

6.1.2 Potentially Chemically Contaminated Waste

No sampling for chemical constituents is currently planned for most of the WSs. The basin water flowing into the IXM is sampled routinely and the radionuclide load estimated (WHC 1996e). Based on the analyses described previously in this document, the IXMs are presumed to be suitable for disposal as debris without further sampling. The WSs, other than IXM, that pose a potential for chemical contamination are:

- Dried paint, painted debris (WS#1)
- Rags Contaminated with Stripped paint waste (WS#2)
- Lead shielding (WS#3)
- Material that has contacted the sludge from the K Basin. (WS#12, 13, 14)

Waste streams # 1, 2, and 3 will be encapsulated; therefore, no sampling is needed to designate those wastes. Waste streams #12-14 will be pressure washed to remove potential TC metals and PCBs. Previous studies indicate that washing removes the metals and PCBs on debris that has been in contact with the sludge (WHC 1996d). Calculations supporting these studies are presented in Appendix D, which was part of a previous profile used for disposal at the CWC.

7.0 STEP 7 – OPTIMIZE THE DESIGN

7.1 MATERIAL (COMPONENT) CATEGORIES

Table 7-1 lists the material components to be characterized and the significance of the survey and sampling approach. Note that section 6.0 provides the logic for selection of a judgmental design and provides the reasons that chemical sampling will not be required. No survey or sampling is required, therefore, for DS #3 or 4.

Table 7-1. Material (Component) Categories.

DS#	Material (Components)/Categories	Survey/Sampling Significance
1	All WSs	Determine if the waste package contains TRU COCs at concentrations greater than 100 nCi/g.
2	All WSs	Determine if the waste package contains radionuclide COCs at concentrations greater than ERDF WAC (BHI 1998).

7.2 SURVEY/SAMPLING DESIGN ALTERNATIVES

Table 7-2 identifies, describes, and compares the survey/sampling design alternatives for the material (component) categories, including costs.

7.3 SELECTION OF THE SURVEY/SAMPLING DESIGN

The process of determining the sampling requirements and selecting the most resource effective design is presented along with a recommended design. Tables 7-2 and 7-3 discuss the analytical methods and design alternatives. Table 7-4 provides the design summary.

Table 7-2. Waste Designation Survey/Sampling Methods. (2 pages)

Materials (Components)/ Categories	Survey/Sampling Alternatives	Description	Relative Cost
All debris WSs except IXMs.	Dose rate, portable gamma spectroscopy, NDA.	Once the waste is packaged in a plastic bag barrel or box, measurement of gamma emitting radionuclides will occur and an estimate of the Cs-137 content of the waste package will be obtained. There are three main approaches:	
		1. The dose rate (mR/hr) may be estimated and published dose to curie relationships may be used (WHC 1997a, WHC 1997b) to estimate Cs-137. Provides data with the least accuracy and precision of the three approaches.	Low
		2. Portable gamma spectroscopy using shielded and/or collimated portable instruments. Can provide accurate data if properly calibrated to match waste types. Only measures gamma emitters, typically not adequate sensitivity to measure low energy gamma's such as emitted by Am-241.	Medium
		3. Perform NDA on a bag barrel or box of waste. NDA usually consists of a segmented gamma scan capability that performs multiple gamma spectroscopy measurements of a barrel or box on specific segments of the waste. NDA also usually includes measurement of passive neutron flux. Commercial NDA units also may have the capability of performing both passive and active neutron measurements. Can provide accurate data if properly calibrated to match waste types. Specifically designed to measure low energy gamma emissions, can provide estimate of TRU content based on neutron counts.	High

Table 7-2. Waste Designation Survey/Sampling Methods. (2 pages)

Materials (Components)/ Categories	Survey/Sampling Alternatives	Description	Relative Cost
All debris WSs except IXMs (cont.)	Laboratory analysis of samples to determine TRU and radiological COC content.	Waste sampling and radiochemical analysis. Generally provides most accurate measurement of radionuclides in the sample because geometry and matrix effects are largely eliminated in the laboratory. However, obtaining a sample that is representative of the waste may be difficult depending on the distribution of radionuclides on the waste and the difficulty in obtaining a sample from the waste. Can measure the gamma emitting COCs as well as pure alpha and pure beta emitters (Huisingh 1997, WHC 1996g).	High Cost
IXM	Sampling of fuel basin water that flows through the IXM.	The radionuclide COC content of IXMs will be estimated based on historical radiochemistry results of the basin water, measured flow rates and time in service (WHC 1996e, WHC 1996f).	No additional cost. Part of current operations.

Table 7-3. Key Features of Sampling Design. (2 pages)

Material (Components)/ Categories	Survey/Sample Collection Methodology	Key Features of Design	Basis for Survey/Sampling Design
All debris WSs except fuel canisters and IXMs.	Obtain an estimate of the Cs-137 activity for a container of waste and apply historical cesium to radionuclide ratios to estimate the concentration of COCs other than cesium. Cs-137 activity in the waste may be obtained using measured dose rates, NDA, and/or gamma spectroscopy. If the estimated TRU content of the waste exceeds 100 nCi/g, the waste may be subjected to additional measurements. Additional measurements may include gamma spectroscopy or neutron emission. Judgmental samples of the waste may be obtained and subjected to laboratory radiochemistry analysis to confirm the estimated ratios of COC radionuclides to Cs-137.	Each container of debris will be surveyed for gamma and/or neutron emitters using one or more of the survey/sample collection methodologies. The radionuclide COC content of the waste (including TRU) will be estimated by applying historical radionuclide ratios to the measured Cs-137 activity (Appendix B). In some instances, the Cs-137, Am-241, and Pu-239/240, and other radionuclides will be estimated based on analytical data specific to the WS (Huisingh 1997, WHC 1997b, WHC 1996g). These actions will provide a more accurate estimation of TRU content when needed.	Consistent with previous practice at K-Basins and will provide an adequate, cost-effective estimate of radionuclide content of waste. Boxes or barrels containing multiple bags may be measured in bulk or may be estimated by summing the results of individual bags in the larger container. If the waste is super compacted, the final concentration of radionuclides in the compacted waste as packaged will be estimated from compaction ratios.

Table 7-3. Key Features of Sampling Design. (2 pages)

Material (Components)/ Categories	Survey/Sample Collection Methodology	Key Features of Design	Basis for Survey/Sampling Design
Fuel Canisters	Obtain an estimate of the Cs-137 activity for a fuel canister and apply historical cesium to radionuclide ratios to estimate the concentration of COCs other than cesium. Cs-137 activity in the waste may be obtained using measured dose rates, NDA, and/or gamma spectroscopy. If the estimated TRU content of the waste exceeds 100 nCi/g, the fuel canister may be subjected to additional measurements. Additional measurements may include gamma spectroscopy or neutron emission. Judgmental samples of the fuel canister may be obtained and subjected to laboratory radiochemistry analysis to confirm the estimated ratios of COC radionuclides to Cs-137.	Fuel canisters will be surveyed for gamma and/or neutron emitters using one or more of the survey/sample collection methodologies. The radionuclide COC content of the fuel canister (including TRU) will be estimated by applying historical radionuclide ratios to the measured Cs-137 activity. In some instances, the Cs-137, Am-241, and Pu-239/240, and other radionuclides will be estimated based on analytical data specific to the fuel canister WS (WHC 1997b, WHC 1996f). These actions will provide a more accurate estimation of TRU content when needed.	Consistent with previous practice at K Basins and will provide an adequate, cost-effective estimate of radionuclide content of fuel canisters. Boxes or barrels containing fuel canisters may be estimated by summing the results of fuel canister surveys in the larger container. If fuel canisters are super-compacted, the final concentration of radionuclide in the compacted canisters as packaged will be estimated from compaction ratios.
IXM	None	The concentration of radionuclides in the water of the KW and KE Basins is measured on a routine basis (WHC, 1996e). The flow rate of the basin water and the time in service for the IXM are also known. The concentration of radionuclides in the IXM waste package will be estimated based on these known values. (More detail on this sampling program will be provided in the SAP.)	Consistent with previous practice at K Basins and will provide adequate estimate of radionuclide content of waste package.

7.4 DESIGN SUMMARY

Table 7-4 summarizes the selected sampling frequencies and locations.

Table 7-4. Summary of Sampling Frequencies and Locations. (2 Pages)

Material (Components)/ Categories	Sample Collection Methodology	Sampling Frequency	Sampling Location
All WSs except fuel canisters and IXMs	Measurement of external dose rate, NDA, gamma spectroscopy, or sampling and laboratory analysis as appropriate to determine TRU and radiological COC content.	Every bag barrel or box of debris.	Survey measurements will be performed on the waste. Specific locations will be described in the SAP. Measurements may be taken on individual debris items, on a *suitable* container of debris. Survey location will be described in the SAP and associated procedures.
Fuel Canisters	*Measurement of external dose rate*, NDA, or gamma spectroscopy to determine TRU and radiological COC content.	*All fuel canisters* may be measured individually or in larger containers, depending on final survey methodology.	*Survey* measurements will be performed on the waste. Specific locations will be described in the SAP. Measurements may be taken on individual debris items, on a suitable container of debris. Survey location will be described in the SAP and associated procedures.

Table 7-4. Summary of Sampling Frequencies and Locations. (2 Pages)

Material (Components)/ Categories	Sample Collection Methodology	Sampling Frequency	Sampling Location
IXM	None	Radionuclide load for each IXM will be calculated based on the procedures on the SNF Project Basin Water Quality Control Procedure (SNF 2000) and non exchange module characterization plan (WHC 1997a).	None

8.0 REFERENCES

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40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.

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SNF Project, 1994, *Remove Debris from Storage Basin for Disposal*, SNF Operations Project Technical Procedure, OP-07,071, Rev. 0/E, SNF Project, Richland, Washington.

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APPENDIX A

BASIS FOR IXM RELEASE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10 HANFORD PROJECT OFFICE
712 Swift Boulevard, Suite 5
Richland, Washington 99352

April 11, 2000

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SUBJECT: Treatment of Potentially LDR Waste in IXMs From K Basins Prior to Disposal at ERDF.

Dear Messrs. Loscoe and Robertson:

During the Data Quality Objectives (DQO) process for debris from the K Basins, BHI personnel identified disposal of ion exchange modules (IXMs) in ERDF as an issue. Since the K Basins project has become a CERCLA remedial action, IXMs are to be disposed in ERDF. The IXMs contain resins used to remove radionuclides from the K Basins water, and in the process have the potential to accumulate sufficient RCRA-regulated metals to become land disposal restricted (LDR) waste. The resin chambers are fabricated as an integral component of the IXMs and are not accessable for sampling or treatment. Historically, as the IXMs have been taken out of service, they have been drained and the plumbing orifices fitted with HEPA filters prior to disposal in the low level burial grounds.

In response to the issue raised by BHI staff on March 9, 2000 during a DQO global issues resolution meeting, I provided the following strategy to resolve this issue:

> EPA will consider the IXMs – drained and fitted with HEPA filters – as having met the macroencapsulation immobilization technology as an alternative treatment standard for hazardous debris under 40 CFR 268.45. Therefore:
>
> The IXMs do not need to be sampled prior to disposal at ERDF.
>
> The bounding waste profile (including designation as non-TRU waste) for the IXMs may be based on operational records of volume of water treated and influent concentrations of metals and radionuclides.

This letter reaffirms EPA's position on macroencapsulation of IXMs. If you have any questions, please call me at (509) 376-9884.

Sincerely,

Laurence E. Gadbois

Laurence E. Gadbois
K Basins Project Manager

cc: Julie Atwood, BHI
Paul Day, MACTEC
Oscar Holgado, DOE
Randy Jackson, BHI
Chris Lucas, FH
Mitzi Miller, EQM
Jeff Westcott, WMH
Administrative Record, 100-KR-2

077459

Environmental Restoration Contractor **ERC Team**

Interoffice Memorandum

RECEIVED
APR 05 2000
BY DIS

Job No. 22192
Written Response Required: NO
Due Date: N/A
Actionee: N/A
Close CCN: N/A
OU: ERDF
TSD: N/A
ERA: N/A
Subject Code: 8560, 9820

TO: A. R. Michael H0-17

DATE: April 4, 2000

COPIES: B. P. Moyers T2-05
B. D. Schilperoort T2-05
J. M. Atwood H0-21
R. L. Weiss H9-03
J. D. Arana L5-64
Document and Info Services H0-09

FROM: M. A. Casbon
ERDF
T2-05/373-7328

Ref: Memo C. D. Lucas to File, Hydrogen Concentrations in Spent IXM's, Westinghouse Hanford Company, OAWH-074-95

SUBJECT: **K-BASINS IXM GAS GENERATION**

One of the waste streams that the Spent Nuclear Fuels (SNF) project would like to send to the Environmental Restoration Disposal Facility (ERDF) consists of a number of Ion Exchange Modules (IXMs). The IXMs generate gasses through radiolytic interactions with the water and resin remaining within them. My analysis indicates that the total amount of gas generated will have no deleterious effect on the operations or closure of the ERDF. My conclusion is based on the relatively small amounts of gas generated relative to available pore space within the waste soils disposed in the ERDF.

The ERDF will receive one IXM per month for the duration of the SNF project. This will yield a total of 24 to 36 IXMs. After reviewing the document referenced above, Richard Weiss of CHI determined that each IXM would generate between 30 and 150 liters per year of gasses. The gasses will contain hydrogen in concentrations ranging from <1% to 75% of the total gas volume. The gas generation rate and total gas generated is tied to the half-life of the primary radionuclides Cs-137 and Sr-90 (approximately 30 years). A calculation by Joel Arana, Environmental Technical Lead, shows that an IXM generating 150 liters per year initially; generating a total of 6,294 liters of hydrogen in the space of 7 half-lives. I confirmed Joel's calculation using a different methodology for my calculation.

The total gas generated will be 6,294 liters x 36 IXMs = 226,584 liters. This equals 8,002 ft^3 or 296 yd^3. Assuming that a total of 6,000,000 yd^3 of waste will ultimately be placed in the ERDF the gas will account for only 4.9 E-5 or 0.005% of the total volume. This is far less than the available pore space in the ERDF soils, no matter how highly compacted. Therefore, the gasses generated will not cause any problems with subsidence in the landfill.

MAC:mac

Attachments: e-mail, R. L. Weiss to M. A. Casbon, "IXM Gas Generation," dated April 4, 2000
e-mail; J. D. Arana to M. A. Casbon, "Hydrogen Generation," dated March 31, 2000

C:\temp\H2Generation From IXMs memo.doc

077459

Casbon, Michael A (Mike)

From: Weiss, Richard L
Sent: Tuesday, April 04, 2000 7:44 AM
To: Casbon, Michael A (Mike)
Subject: RE: IXM Gas Generation

Mike,

Sorry for the delay on this.

I reviewed the gas generation portions of the documents that you sent me. I did not attempt to recreate the calculations and no obvious flaws were noted. The range of generation rate and composition was bracketed due to many variables in the calculations. Based on the information presented gas generation rates will be approximately 30-150 liters per year. The hydrogen concentration potentially ranges from very low <1% to as great as 75%. This generation should continue for the foreseeable future and the generation rate will "decay" at the same rate the radioactivity present decays (approximately 30 y half-life from the primary radionuclides Cs-137 & SR-90).

Let me know if you have any additional questions.

Rich

—Original Message—
From: Casbon, Michael A (Mike)
Sent: Friday, March 31, 2000 9:52 AM
To: Weiss, Richard L
Cc: Atwood, Julie M
Subject: IXM Gas Generation

Rich,

Thank you for the information on K-Basin Ion Exchange Module gas generation. Please send me an e-mail to back up our conversation. I will use a 30 yr "half life" of the first year's maximum gas generation rate to calculate a total (7 half lives) gas volume to be generated.

MAC

077459

Casbon, Michael A (Mike)

From: Arana, Joel D
Sent: Friday, March 31, 2000 10:08 AM
To: Casbon, Michael A (Mike)
Subject: Hydrogen Generation

Importance: High

Mike,

Good thing you had me look at that formula. Your number was high by a factor of about 38! I did infact have to integrate. The actual number came out to be about 6,294 total liters produced over the period of 7 half-lives. I have attached the formula as a Word document.
Call me if you have any questions.


Hydrogen Production.doc

Joel Arana

Using the simple decay equation: $A_t=A_oe^{-\lambda t}$ where A_o is your conservative hydrogen generation estimate of 150 liters/year, t is the time of about 7 half-lives (210 years) and λ is your decay constant; $\lambda=\ln 2/30yr$ or $2.31E\text{-}2yr^{-1}$.

Since we want to know the cumulative hydrogen that has been generated over the 210 year period we must integrate. $\int A_oe^{-\lambda t}dt$ is simply $A_o(e^{-\lambda t}/\lambda)$. Evaluating this from 0 to 210 years yields a total of **6,294 liters of hydrogen** gas produced in 210 years or 7 half-lives.

Looking at a longer time frame is not necessary. After 210 years less than a liter a year of hydrogen is produced.

CCN # 077459

CHRONED BY: MKW DATE: 4/4/00

MACRO COMPLETED: YES ✓

REPRO/DIST. COMPLETED: YES ✓ NO ___

DISTRIBUTED BY: MKW

CANCELLED BY: N/A

OU: ERDF

Distributed To:

- ☐ E. L. Adamson (BHI), T2-05
- ☐ J. M. Atwood (BHI), T2-05
- ☐ R. H. Bidstrup (BHI), T2-05
- ☐ M. A. Casbon (BHI), T2-05
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TO BE COMPLETED BY DIS

DATA ENTRY BY: dmw ✓

SCANNED BY: mc/5

RECORD TYPE: IOM

DOCSOPEN #21203,04,21,97

APPENDIX B

RADIONUCLIDE/ISOTOPES COPC SELECTION

To: Mitzi Miller

From: Al Robinson

Date: 2/28/00

Subject: Contaminants of Potential Concern (COPCs) and Rationale for Selection

The source term for all of the radionuclides that could reasonably be expected in the K-Basin is from N-Reactor fuel and associated activation products. The selection of COPCs was conducted by first listing all of the radionuclides that have been reported as present in the fuel or measured during historical characterization of the KE, KW, N, or 105-C fuel storage basins. Several of the documents refer to computerized simulations of the radionuclides content of nuclear fuel using the ORIGEN II computer code. The five sources that were used to supply this data are:

1. BHI Archive Number 0161426. "105-N Basin Deactivation Project Radioactive Waste Management Archive, Volumes 1 and 2". July, 1998. (BHI 1998).

2. WHC-SD-TP-SEP-028, Rev 0. "Safety Evaluation for Packaging the N Reactor/Single Pass Reactor Fuel Characterization Shipments", Oct. 1994. (WHC 1994)

3. WHC-SD-NR-RPT-005, Rev 0. "Characterization of Radioactive Waste at 100 Area", Nov. 1990. Written by John DeVanney (DeVanney 1990)

4. WHC-EP-0063-4 (Page Change 5), "Hanford Solid Waste Acceptance Criteria", April 1996, Appendix K, Table K-1, (WHC 1996)

5. Letter to CA Palmquist from S.P Roblyer Fluor Daniel Northwest, Inc. dated May 14, 1997. Subject: Radionuclides in the 105-C Fuel Transfer Pit Sediments.

The initial list of COPCs (Table 1) contained 80 radionuclides, which had been discussed as estimated components of the N-reactor fuel from fission or activation processes or had been reported in work associated with the fuel or the basin. The DeVanney report (DeVanney 1990) contained extensive analyses of sample from the KE and KW basin areas. These data provided valuable estimates of several radionuclides that had not been estimated from other sources (e.g. Ni-59, Cr-51, Mn-54) and the estimated ratios that were also included in the initial list. Since the data was obtained or calculated at various times over the last 16 years, the next step was to decay correct the estimated amount of each radionuclide. All decay corrections were performed to the year 2000. In order to put all of the radionuclides from the various sources on a normalized basis, all final estimates of radionuclide content of the fuel (from ORIGEN runs) or samples from KW and KE basins, were converted to a percent

of the estimated Cs-137 concentration. For instance if the reference indicated that the fuel would contain 500 Ci of Sr-90 and 1000 Ci of Cs-137, the percentage entered into Table 1 would be 50%.

Also tabulated in Table 1 are the ERDF radiological waste acceptance criteria BHI 1998). The acceptance criteria were also converted to a percentage of Cs-137 in order to assist the final selection of COPCs. The percentage of Cs-137 in the last column to the right in Table 1 represents the allowable maximum percentage of each radionuclide compared to Cs-137 at the maximum allowable concentration (Ci/m^3). During the selection process this column was evaluated against each criteria used to eliminate radionuclides from the COPC list. If any of the criteria would eliminate a radionuclide that had an estimated Cs-137 ratio within a factor of 10 of the maximum allowable contamination limits at ERDF, then the radionuclide was retained. The process of potential COPC elimination proceeded as follows:

1. The first step of the process involved eliminating any of the radionuclides that were not part of the N-Reactor uranium fuel cycle process. These radionuclides included radium, and thorium.
2. The next step involved the elimination of any radionuclides that were gaseous or have a radioactive half-life of less than 1 year.
3. Also eliminated were any beta/gamma emitting radionuclides that were estimated to be present at less than 1% of the Cs-137 activity of the waste (in the year 2000) by all of the five references listed.
4. For alpha emitters and transuranic radionuclides, any radionuclides that were less than 0.1% of the Cs-137 activity were eliminated.

These four step process was chosen to adequately define the term "major radionuclide content" in the ERDF WAC (BHI-00139). Table 2, lists only the radionuclides that are left as COPCs after application of the elimination process. Two isotopes of Europium (Eu-152, Eu-155) were left in Table 2 even though they did not meet the criterion (>1% of Cs-137) for inclusion. They were left in because they have been found in other on site graphite reactors and will be reported along with Eu-154, which was in the proposed final list of COPCs. Similarly, Ni-63 (an activation product) has been found in other graphite reactors at concentrations approximately equal to Sr-90 and Cs-137, thus has remained a COPC even though it is estimated by the ORIGEN run to be present in the fuel at less than 1% of the Cs-137. Also listed in Table 2 are the estimated ratios of the activity of each radionuclide compared to Cs-137 from historical data that may be used to estimate hard-to-measure radionuclides (e.g. Sm-151, H-3). The KE and KW basins have been listed separately because of the significant differences that were found in historical analyses of samples that are applicable to WSs from the two facilities (DeVanney 1996). The ratios listed in Table 2 may be used to estimate the radioactive content of the hard to measure COPCs (e.g. pure beta emitters, alpha emitters) in the waste from analysis of a subset of the easy to measure COPCs (e.g. gamma emitters such as Cs/Ba-137). In the event that the ratios in Table 2 are used, the most conservative applicable ratio will be used. In most cases there is more recent data for selected radionuclides in each specific WS. The more recent WS specific data will be

used where available to obtain the most accurate estimate of the radionuclide content of the waste. The ratios used to estimate the radionuclide content of the waste and/or to estimate the hard to measure radionuclides, will be referenced in the waste shipment documentation. It should also be noted that in Table 1 and 2 the measured ratios of various isotopes to Cs-137 in the DeVanney report vary markedly. Recent NDA for WS profiles common to KE and KW indicate similar concentrations of the major radionuclides (e.g. Pu-239, Sr-90, Cs-137) in the waste.

Table B-1. Comprehensive List of Radionuclide Contaminants of Potential Concern for K-Basin Waste. (3 pages)

Isotope Name	Isotope Symbol	Half Life Years	105-C Fuel Activity 1997 Ci/MTU[a]	105-C Fuel Activity 2000 Ci/MTU[a]	N-Reactor Fuel Activity 1994 Ci[c]	N-Reactor Fuel Activity 2000 Ci[c]	N-Reactor Table K-1 1988 Ci/MT[c]	N-Reactor Table K-1 2000 Ci/MT[c]	2000 105-C Activity % of Cs-137[b]	2000 N-Fuel Activity % of Cs-137[d]	2000 Table K-1 Activity % of Cs-137[d]	1990 DeVanney Report ratio KE[b]	2000 DeVanney Report ratio KE[b]	2000 DeVanney Report KE Ratio % to Cs-137[b]	1990 DeVanney Report ratio KW[b]	2000 DeVanney Report ratio KW[b]	2000 DeVanney Report KW Ratio % to Cs-137[b]	BHI-00139 WAC Ci/m³	BHI-00139 WAC Ratio % to Cs-137
Tritium	H-3	1.23E+01	1.58E+00	1.33E+00	2.17E+00	1.55E+00	1.60E+01	8.11E+00	0.13%	0.37%	0.33%	1.24E-03	8.86E-04	0.09%	0.0994	7.10E-02	7.10%	ul	
Beryllium	Be-10	1.60E+06					8.91E-08	8.91E-08			<0.00001%								
Carbon	C-14	5.73E+03					3.56E-06	3.56E-06			<0.00001%	7.72E-05	9.70E-05	0.01%				5.3	16.56%
Chromium	Cr-51	7.59E-02										0.0896	2.48E-41	0.00%				nl	
Manganese	Mn-54	8.56E-01													0.026	9.98E-06	0.00%	nl	
Iron	Fe-55	2.70E+00			1.71E+00	3.67E-01				0.09%								nl	
Nickel	Ni-59	8.00E+04										1.87E-04	2.35E-04	0.02%				2.10E+02	656%
Cobalt	Co-60	5.27E+00			5.70E-01	2.59E-01				0.06%		0.0285	9.62E-03	0.96%	0.0941	3.18E-02	3.18%	ul	
Nickel	Ni-63	1.00E+02			9.00E-02	8.63E-02				0.02%	<0.00001%	0.00292	3.43E-03	0.34%	0.00219	2.57E-03	0.26%	7.00E+02	2188%
Selenium	Se-79	6.50E+04					1.33E-02	1.33E-02			0.00055%							28	88%
Krypton	Kr-85	1.06E+01	3.16E+01	2.60E+01	3.84E+01	2.59E+01				6.21%								nl	
Strontium	Sr-89	1.38E-01										0.242	5.48E-23	0.00%	0.00638	1.45E-24	0.00%	nl	
Strontium	Sr-90	2.90E+01	1.04E+03	9.68E+02	3.59E+02	3.11E+02	2.80E+03	2.10E+03	98.28%	74.39%	86.21%	1.04	1.03E+00	103.01%	0.0112	1.11E-02	1.11%	7000	21875%
Zirconium	Zr-93	1.50E+06	5.19E-02	5.19E-02			6.26E-02	6.25E-02	0.01%		0.00%							140	438%
Molybdenum/ Niobium	Mo-93/ Nb-93m	3.50E+03	4.11E-02	3.53E-02					0.0036%									1.20E-02	0.04%
Niobium	Nb-94	2.00E+04					1.92E-04	1.92E-04			<0.00001%							1.20E-01	0.38%
Technetium	Tc-99	2.13E+05	3.53E-01	3.53E-01	7.00E-02	7.00E-02	4.49E-01	4.49E-01	0.04%	0.02%	0.02%							1.3	4.06%
Ruthenium	Ru-106	1.01E+00			1.31E+02	2.12E+00				0.51%								nl	
Palladium	Pd-107	6.50E+06	5.56E-04	5.55E-04			1.46E-03	1.45E-03	<0.001%		0.0001%							830	2594%
Silver	Ag-110m	6.90E-01			5.00E-02	1.21E-04				0.00003%								nl	
Cadmium	Cd-113m	1.46E+01	5.06E-02	4.39E-02	2.00E-01	1.50E-01	1.12E+00	6.35E-01	<0.001%	0.04%	0.03%								
Tin	Sn-119m	8.03E-01			9.00E-02	5.07E-04				0.0001%								nl	
Tin	Sn-121m	2.97E-03	1.09E-03	6.76E-308			3.94E-03	<0.00001%	<0.001%		<0.00001%							nl	
Tellurium	Te-123	3.28E-01			6.50E+00	2.03E-05				<0.00001%								nl	
Antimony	Sb-125	2.73E+00	2.29E-02	1.07E-02	2.66E+01	5.80E+00			0.0011%	1.39%		0.0245	2.43E-03	0.24%					
Tellurium	Te-125m	1.59E-01	5.58E-03	1.16E-08	2.30E-01	9.95E-13			<0.00001%	<0.00001%								nl	
Tin	Sn-126	2.00E+05	7.76E-03	7.76E-03			2.00E-02	2.00E-02	0.0008%		0.0008%							0.0085	0.03%
Antimony	Sb-126	3.40E-02	1.09E-03	2.88E-30					<0.00001%										
Antimony	Sb-126m	2.17E-03	7.76E-03	<1.0E-10					<0.00001%										
Iodine	I-129	1.59E+07	5.50E-04	5.50E-04			8.69E-04	8.69E-04	0.00%		0.00004%							8.00E-02	0.25%
Barium	Ba-133	1.07E-01					no value	no value											
Cesium	Cs-134	2.06E+00	7.48E-04	2.73E-04	5.81E+01	7.72E+00			0.00003%	1.85%		0.00401	1.74E-04	0.02%	0.0155			ul	
Cesium	Cs-135	2.30E+06	9.65E-03	9.65E-03			1.27E-02	1.27E-02	0.0010%		0.0005%							8.8	27.50%
Cesium	Cs/Ba-137	3.02E+01	1.13E+03	1.05E+03	4.80E+02	4.18E-02	3.22E+03	2.44E+03	100%	100%	100%	100%	100%	100%	100%	100%	100%	32	100.00%
Barium	Ba/La-140	3.50E-02										0.00153	2.48E-89	<0.001%					
Cerium	Ce/Pr-144	7.82E-01			1.17E+02	5.72E-01				0.14%		0.00248	4.40E-07	<0.001%	0.0282				

Table B-1. Comprehensive List of Radionuclide Contaminants of Potential Concern for K-Basin Waste. (3 pages)

Isotope Name	Isotope Symbol	Half Life Years	105-C Fuel Activity 1997 Ci/MTU[a]	105-C Fuel Activity 2000 Ci/MTU[a]	N-React Fuel Activity 1994 Ci[c]	N-React Fuel Activity 2000 Ci[c]	N-React Table K-1 1988 Ci/MT[c]	N-React Table K-1 2000 Ci/MT[c]	2000 105-C Activity % of Cs-137[b]	2000 N-Fuel Activity % of Cs-137[d]	2000 Table K-1 Activity % of Cs-137[e]	1990 DeVanney Report ratio KE[a]	2000 DeVanney Report ratio KE[f]	2000 DeVanney Report KE Ratio % to Cs-137[g]	1990 DeVanney Report ratio KW[a]	2000 DeVanney Report ratio KW[a]	2000 DeVanney Report KW Ratio % to Cs-137[g]	BHI-00139 WAC Ci/m³	BHI-00139 WAC Ratio % to Cs-137
Promethium	Pm-147	2.62E+00	9.84E-01	4.45E-01	3.58E+02	7.34E+01			0.04%	17.56%								nl	
Samarium	Sm-147	1.08E-11					8.08E-09	<1.0E-10			<0.00001%							0.93	2.91%
Samarium	Sm-151	9.30E+01	1.58E+01	1.55E+01	4.26E+00	4.07E+00	5.43E+01	4.96E+01	1.47%	0.97%	2.03%							5.30E+04	165625%
Europium	Eu-150	3.60E+01					7.16E-08	5.68E-08			<0.00001%							170	531%
Europium	Eu-152	1.34E+01	1.46E-02	1.25E-02	6.00E-02	4.40E-02	1.12E-01	6.04E-02	0.0012%	0.011%	0.0025%							2.10E+07	65625000%
Gadolinium	Gd-152	1.10E+14					4.13E-15	4.13E-15			<0.00001%							nl	
Europium	Eu-154	8.20E+00	4.95E-01	3.84E-01	1.23E+01	7.41E+00	2.19E+01	7.95E+00	0.04%	1.77%	0.33%							ul	
Europium	Eu-155	4.76E+00	9.12E-01	5.89E-01	3.95E+00	1.65E+00			0.06%	0.39%								nl	
Lead	Pb-210	2.23E+01					1.65E-14	1.14E-14			<0.00001%							5.30E+05	1656250%
Radium	Ra-226	1.60E+03					1.31E-09	1.30E-09			<0.00001%							1.40E-04	0.0004%
Actinium	Ac-227	2.18E+01					6.78E-06	4.63E-06			<0.00001%							7.50E+04	234375%
Radium	Ra-228	5.75E+00					1.78E-11	4.20E-12			<0.00001%							2.20E-04	0.0007%
Thorium	Th-229	7.34E+03					2.38E-09	2.38E-09			<0.00001%							nl	
Thorium	Th-230	7.70E+04					1.43E-07	1.43E-07			<0.00001%							nl	
Thorium	Th-231	2.91E-03	1.39E-02	<1.0E-10					<0.00001%									nl	
Thorium	Th-232	1.00E+02	1.36E-04	1.33E-04			2.34E-11	2.15E-11	<0.00001%		<0.00001%							6.00E-03	0.02%
Thorium	Th-234	6.60E-02	3.34E-01	7.06E-15					<0.00001%									nl	
Protactinium	Pa-231	3.28E+04	2.21E-04	2.21E-04			1.55E-05	1.55E-05	0.00002%		<0.00001%							nl	
Protactinium	Pa-234m	2.23E-06	3.34E-01	<1.0E-10					<0.00001%									nl	
Protactinium	Pa-234	1.27E-05	4.34E-04	<1.0E-10					<0.00001%									nl	
Uranium	U-232	2.44E+05					3.06E-05	3.06E-05			<0.00001%							nl	
Uranium	U-233	1.59E+05					1.14E-06	1.14E-06			<0.00001%							0.074	0.23%
Uranium	U-234	2.44E+05	5.49E-03	5.49E-03			5.76E-04	5.76E-04	0.0005%		0.00002%	2.15E-04	2.70E-04	0.03%	5.96E-05	7.50E-05	0.01%	0.074	0.23%
Uranium	U-235	7.04E+08	1.39E-02	1.39E-02	6.46E-04	6.46E-04	1.82E-02	1.82E-02	0.0013%	0.0002%	0.0007%	3.69E-05	4.64E-05	<0.001%	8.22E-06	1.03E-05	0.00%	0.0027	0.01%
Uranium	U-236	2.43E+07	8.62E-03	8.61E-03			1.18E-02	1.18E-02	0.001%		0.0005%							nl	
Uranium	U-238	4.47E-09	3.34E-01	3.34E-01			3.33E-01	3.33E-01	0.03%		0.01%	1.70E-04	2.14E-04	0.02%	4.95E-05	6.23E-05	0.01%	0.012	0.04%
Neptunium	Np-237	2.14E+06	5.26E-05	5.26E-05			5.87E-03	5.87E-03	0.00%		0.0002%							1.50E-03	0.00%
Plutonium	Pu-238	8.77E+01	8.21E-03	8.01E-03	4.94E+00	4.71E+00	3.25E+00	2.96E+00	0.00%	1.13%	0.12%	1.78E-02	2.07E-02	2.07%	9.33E-04	1.08E-03	0.11%	1.5	4.69%
Plutonium	Pu-239	2.41E+04	2.97E+01	2.97E+01	5.80E+00	5.80E+00	5.12E+01	5.12E+01	2.83%	1.39%	2.10%	0.105	1.32E-01	13.20%	0.00716	9.00E-03	0.90%	0.029	0.09%
Plutonium	Pu-240	6.54E+03	2.82E+00	2.82E+00	4.11E+00	4.11E+00	1.23E+01	1.23E+01	0.27%	0.98%	0.50%	0.105	1.32E-01		0.00716	9.00E-03		0.029	0.09%
Plutonium	Pu-241	1.47E+01	4.26E+00	3.70E+00	4.66E-02	3.51E+02	6.48E+02	3.68E+02	0.35%	83.96%	15.08%	2.51	1.97E+00	197.05%	0.0976	7.66E-02	7.66%	6.2	19.38%
Plutonium	Pu-242	3.76E+05	1.57E-05	1.57E-05			6.55E-04	6.55E-04	0.00%		<0.00001%							0.11	0.34%
Plutonium	Pu-244	8.30E+07					3.66E-12	3.66E-12			<0.0001%							0.033	0.10%
Americium	Am-241	4.32E+02	6.04E-01	6.01E-01	4.48E+00	4.44E+00	1.78E+01	1.74E+01	0.06%	1.06%	0.71%	13.50%	16.71%	16.71%	0.54%	0.66%	0.66%	5.00E-02	0.16%
Americium	Am-242m	1.83E-03					1.28E-03	<1.0E-10			<0.00001%							nl	
Americium	Am-243	7.38E+03					2.38E-04	2.38E-04			<0.0001%							5.70E-02	0.18%

Table B-1. Comprehensive List of Radionuclide Contaminants of Potential Concern for K-Basin Waste. (3 pages)

Isotope Name	Isotope Symbol	Half Life Years	105-C Fuel Activity 1997 Ci/MTU[a]	105-C Fuel Activity 2000 Ci/MTU[b]	N-React Fuel Activity 1994 Ci[c]	N-React Fuel Activity 2000 Ci[d]	N-React Table K-1 1988 Ci/MT[e]	N-React Table K-1 2000 Ci/MT[f]	2000 105-C Activity % of Cs-137[g]	2000 N-Fuel Activity % of Cs-137[d]	2000 Table K-1 Activity % of Cs-137[g]	1990 DeVanney Report ratio KE[h]	2000 DeVanney Report ratio KE[i]	2000 DeVanney Report KE Ratio % to Cs-137[n]	1990 DeVanney Report ratio KW[j]	2000 DeVanney Report ratio KW[k]	2000 DeVanney Report KW Ratio % to Cs-137[k]	BHI-00139 WAC Ci/m³	BHI-00139 WAC Ratio % to Cs-137
Curium	Cm-242	1.63E+02	1.71E-05	1.68E-05					<0.00001%			0.0255%	0.0307%	0.03%				2.00E+04	62500.00%
Curium	Cm-243	2.85E+01	2.92E-07	2.71E-07			6.12E-05	4.57E-05	<0.00001%		<0.00001%	0.0720%	0.0710%	0.07%	0.00%	0.00%	0.0022%	85	265.63%
Curium	Cm-244	1.81E+01	1.69E-07	1.51E-07	1.45E+00	1.15E+00	2.63E-02	1.66E-02	<0.00001%	0.28%	0.0007%	0.0720%	0.0618%		0.00%	0.00%		40	125.00%
Curium	Cm245	8.50E+03					1.49E-07	1.49E-07			<0.00001%							5.50E-02	0.17%
Curium	Cm-246	4.73E+03					1.34E-09	1.34E-09			<0.00001%							1.10E-01	0.34%
Curium	Cm-247	1.56E+07					1.80E-16	1.79E-16			<0.00001%							3.00E-02	0.09%
Curium	Cm-248	3.39E+05					1.86E-17	1.86E-17			<0.00001%							2.80E-02	0.09%

[a] Data from letter to C.A. Palmquist from S.P. Roblyer, Fluor Daniel Northwest, Inc., dated May 14, 1997. *Subject radionuclides in the* 105-C Fuel Transfer Pit Sediments. Not decay corrected.
[b] Data from letter to C.A. Palmquist from S.P. Roblyer, Fluor Daniel Northwest, Inc., dated May 14, 1997. Subject radionuclides in the 105-C Fuel Transfer Pit Sediments. Decayed for 3 years.
[c] WHC-SD-TP-SEP-028, Rev. 0. Not decay corrected.
[d] WHC-SD-TP-SEP-028, Rev. 0. Decay corrected 6 years.
[e] From Table K-1, WHC-EP-0063, Rev. 5. Not decay corrected.
[f] From Table K-1, WHC-EP-0063, Rev. 5. Decay corrected to the year 2000, used 12 years.
[g] From Table K-1, WHC-EP-0063, Rev. 5. Decay corrected to the year 2000, used 12 years.
[h] WHC-SD-NR-RPT-005, Rev. 0, *Characterization of Radioactive Waste at 100 Area*, November 1990, Written by John DeVanney. Not decayed out. Sampling in *1989-1990* (Appendix B).
[i] WHC-SD-NR-RPT-005, Rev. 0, *Characterization of Radioactive Waste at 100 Area*, November 1990, Written by John DeVanney. Decayed out to the year 2000. Sampling in 1989-1990 (Appendix B).
[j] WHC-SD-NR-RPT-005, Rev. 0, *Characterization of Radioactive Waste at 100 Area*, November 1990, Written by John DeVanney. Not decayed out. Sampling in 1989-1990 (Appendix C).
[k] WHC-SD-NR-RPT-005, Rev. 0, *Characterization of Radioactive Waste at 100 Area*, November 1990, Written by John DeVanney. Decayed out to the year 2000. Sampling in 1989-1990 (Appendix C).

Table B-2. Final COPCs for K-Basin Waste.

Isotope Name	Isotope Symbol	Half Life Years	2000 105-C Activity % of Cs-137	2000 N-Fuel Activity % of Cs-137	2000 Table K-1 Activity % of Cs-137	2000 DeVanney Report KE Ratio % to Cs-137	2000 DeVanney Report KW Ratio % to Cs-137	BHI-00139 WAC Ratio % to Cs-137
Tritium	H-3	1.23E+01	0.13%	0.37%	0.33%	0.09%	7.10%	
Cobalt	Co-60	5.27E+00		0.06%		0.96%	3.18%	
Nickel	Ni-63	1.00E+02		0.02%	<0.00001%	0.34%	0.26%	2188%
Strontium	Sr-90	2.90E+01	98.28%	74.39%	86.21%	103.01%	1.11%	21875%
Antimony	Sb-125	2.73E+00	0.0011%	1.39%		0.24%		
Cesium	Cs/Ba-137	3.02E+01	100%	100%	100%	100%	100%	100.00%
Promethium	Pm-147	2.62E+00	0.04%	17.56%				
Samarium	Sm-151	9.30E+01	1.47%	0.97%	2.03%			165625%
Europium	Eu-152	1.34E+01	0.0012%	0.011%	0.0025%			65625000 %
Europium	Eu-154	8.20E+00	0.04%	1.77%	0.33%			
Europium	Eu-155	4.76E+00	0.06%	0.39%				
Uranium	U-235	7.04E+08	0.0013%	0.0002%	0.0007%	0.0046%	0.0010%	0.01%
Uranium	U-238	4.47E+09	0.03%		0.01%	0.02%	0.01%	0.04%
Plutonium	Pu-238	8.77E+01	0.00%	1.13%	0.12%	2.07%	0.11%	4.69%
Plutonium	Pu-239	2.41E+04	2.83%	1.39%	2.10%	13.20%	0.90%	0.09%
Plutonium	Pu-240	6.54E+03	0.27%	0.98%	0.50%			0.09%
Plutonium	Pu-241	1.47E+01	0.35%	83.96%	15.08%	197.05%	7.66%	19.38%
Americium	Am-241	4.32E+02	0.06%	1.06%	0.71%	16.71%	0.66%	0.16%
Curium	Cm-244	1.81E+01	<0.00001%	0.28%	0.0007%			0.09%

APPENDIX C

ESTIMATION OF METALS AND PCBs SORBED ONTO ION-EXCHANGE MODULES AT K BASINS

Estimation of Metals and PCBs Sorbed onto Ion-exchange Modules at K-Basins

Spreadsheet Prepared by: CW Miller, EQM
Spreadsheet Prepared on: 9-Mar-00 *note corrected values for TC screening concentration

The following spreadsheet was used to conservatively estimate the potential content of PCBs and toxic metals that may sorb onto the ion exchange resins contained within the ion exchange modules used to maintain water quality in the K-Basins. To support these calculations, the following factors were considered:

1. The contaminants of concern were assumed to be present in the basin water at the reported detection limit(s). The samples used for this evaluation were reported to have been collected from the middle of the basin.
2. The decontamination factor for the IX resin was assumed to be 100% (i.e., all dissolved constituents passing through the resin are sorbed).
3. The metals are assumed to be sorbed by the anion/cation exchange complex of the resin.
4. The PCBs are assumed to be sorbed preferentially to the non-polar ion exchange resin matrix.
5. The total volume of water treated by an IXM during ***a 90-day*** service life is ***20,736,000*** gallons ***(per Paul Day)***
6. The weight of an IXM, including the concrete housing is 42,000 pounds (per Rodney Jochen)
7. The volume of IX resins and void space within the exchange columns is 21 cubic feet (per Rodney Jochen)
8. The density of hydrated ion exchange resin is assumed to be 1.0 g/ml.

Estimated **PCB** Loading of IXM

Water Volume		PCB Conc.	PCB Mass	IXM Mass		PCB Conc. in IXM	Exceeds Screening Level?
(gallons)	(liters)	(mg/l)	(mg)	(lb)	(kg)	**(mg/kg)**	
20736000	78485760	< 0.50	39242880	42,000	19,051	**2,060**	Yes

Estimated **Lead** Loading of IXM (**selenium and arsenic** have same detection limit)

Water Volume		Lead Conc.	Lead Mass	IXM Mass		Lead Conc. in IXM	
(gallons)	(liters)	(mg/l)	(mg)	(lb)	(kg)	**(mg/kg)**	
20736000	78485760	< 0.10	7848576	42,000	19,051	**412**	Yes

Estimated **Chromium** Loading of IXM (**silver and barium** have same detection limit)

Water Volume		Cr Conc.	Cr Mass	IXM Mass		Cr Conc. in IXM	
(gallons)	(liters)	(mg/l)	(mg)	(lb)	(kg)	**(mg/kg)**	
20736000	78485760	< 0.01	784858	42,000	19,051	**41**	No

Estimated **Cadmium** Loading of IXM

Water Volume		Cd Conc.	Cd Mass	IXM Mass		Cd Conc. in IXM	
(gallons)	(liters)	(mg/l)	(mg)	(lb)	(kg)	**(mg/kg)**	
20736000	78485760	< 0.001	78486	42,000	19,051	**4.12**	No

Toxicity Characteristic Screening Levels for Total Metal Analysis (TCLP x 20)

Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
100	2000	20	100	100	4	20	100

Maximum Concentration of Toxic Metals Reported in KE-Basin Sludge

Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
not reported	430	37	957	480	not reported	133	13

PCBs Measured in KE-Basin Sludge Samples (per PCB Spill Response Plan)

Samples Collected	21
Samples Screened for PCBs	10
Samples with PCBs detected	3
Maximum PCBs detected	220 mg/kg
Minimum PCBs detected	47 mg/kg

The following COPC concentrations were reported in a sample of IXM outlet water in August 1997.
These values are not comparable to the non-detects reported for the mid-basin samples and
cannot be used to support IXM loading calculations.

PCBs (ug/l)
< 1.0

Arsenic (ug/l)	Barium (ug/l)	Cadmium (ug/l)	Chromium (ug/l)	Lead (ug/l)	Mercury (ug/l)	Selenium (ug/l)	Silver (ug/l)
< 2.3	5.8	< 3.4	< 2.7	< 1.5	< 0.10	< 3.6	< 3.6

APPENDIX D

DRAFT WASTE PROFILE CONTAINING DATA COLLECTED AFTER SPRAY WASHING TO REMOVE PCB/TCMETALS

Only Appendices B & F from Profile Apply and are included.

D.1 RADIATION EXPOSURE EVALUATION FOR DETERMINATION OF WORKER RADIOLOGICAL CONTROLS

Attachment C Calculations

QUESTION: How much sludge would regulate the waste as a Mixed waste?

Given:

Maximum Concentration of Chromium in the sludge = 1910 $\frac{mg}{kg}$ (Total Metals Analysis)

Maximum Concentration of PCBs in the sludge = 220 $\frac{mg}{kg}$

Regulatory limit for Chromium = 5 $\frac{mg}{L}$ (TCLP Extract)

PCB Characteristic of Persistance = 100 $\frac{mg}{kg}$

Equation:

$$\frac{C_s X_s}{X_w} = R_L$$

Where: C_s = Concentration of Sludge for chromium or PCBs

X_s = mass of sludge

X_w = mass of Waste

R_L = Regulatory limit Concentration for Chromium or PCBs

Solution:

$X_w = X_s + X_m$ where: X_m is weight of metal waste

for Chromium: Doon code

$$\frac{1910 \frac{mg}{kg}(X_s)}{X_s + X_m} = 5 \frac{mg}{L} \times \frac{20L}{kg}$$

→ Assuming 20 TO 1 dilution for TCLP ANALYSIS and extract Density is 1 g/mL

$\Rightarrow 100 X_s + 100 X_m = 1910 X_s$

$\Rightarrow X_m = 18.1 X_s$

Calculations Continued:

mass of metal = $1 lb \times \frac{kg}{2.2 lb} = 0.454 kg$

$\Rightarrow 0.454 kg = 18.1 X_s$

$\Rightarrow X_s = 0.025 kg \times 2.2 \frac{lb}{kg} =$ **0.055 lb regulate for Chromium**

for PCBs: Persistance

$$\frac{220 \frac{mg}{kg}(X_s)}{X_s + X_m} = 100 \frac{mg}{kg}$$

$\Rightarrow 100 X_s + 100 X_m = 220 X_s$

$\Rightarrow X_m = 1.2 X_s$

$X_s = .378 kg \times \frac{2.2 lb}{kg} =$ **0.83 lbs regulate for PCBs**

6-26-~~96~~97

APPENDIX E

LEAD INVENTORY

Westinghouse Hanford Company — **Internal Memo**

From: RCRA Compliance Support — 88410-93-161
Phone: 376-3870 H6-30
Date: August 3, 1993
Subject: DESIGNATION OF WASTE MATRICES CONTAINING LEAD SOLDER

To: N. P. Willis T3-05

cc:
D. L. Allen	T3-05
R. L. Austin	T3-04
B. J. Dixon	G7-33
B. G. Erlandson	H6-20
D. T. Foley	L8-09
J. E. Gamin	G6-57
E. M. Greager	H6-30 EMG
P. J. Mackey	B3-15
A. G. Miskho	H6-30 AGM
B. L. Vedder	H6-22
H. T. Tilden	P7-68
W. E. Toebe	H6-22 WET
G. C. Triner	N3-13
RCS Staff (10)	
MJS File/LB	

Per this memo, a dangerous waste designation (DW-D008) is being established for certain waste matrices containing lead solder. In addition, this letter is providing a methodology to complete waste designations on waste matrices which contain lead solder. This letter is not encouraging the dismantling of equipment to determine lead solder percentages or to remove lead solder components from equipment prior to excessing or disposal.

When applicable, best engineering judgement shall be used for determining the lead solder weight percentages in a waste matrix. In most cases, this judgement will constitute sufficient process knowledge to determine that equipment including, but not limited to, motors, pumps, and computer hardware need not be managed as a dangerous waste due to lead solder considerations. RCRA Compliance Support believes that equipment like this should be managed as non-dangerous wastes in accordance with standard industry practice.

On the other hand, this letter is intended to address situations when equipment is disassembled, or maintenance is performed which generates a waste stream. In these cases, the waste streams generated shall be evaluated to determine if they should be managed as a dangerous waste based on the lead solder weight percentages. The information in this letter can be refuted on a case-by-case basis through additional sampling. There is nothing preventing an individual facility from taking additional samples of a waste stream to obtain an alternate waste designation.

The following waste streams were sampled: (1) pure lead solder, (2) small light bulbs (tail light lamps, annunciator panel lights), (3) fuses visibly containing lead solder, (4) computer circuit boards, (5) incandescent light bulbs (varied wattage), and (6) mercury vapor lamps. Attachment 1 presents the analytical data obtained from the sampling efforts. Attachment 2 presents the information that will be used to designate other waste matrices containing lead solder.

The sampling efforts that obtained the analytical results were completed in accordance with all applicable Resource Conservation and Recovery Act (RCRA) requirements. All equipment used in obtaining the samples were decontaminated prior to the sampling efforts in accordance with RCRA protocols. Proper chain-of custody and sample handling procedures were adhered to and all holding times were met. Preservatives were not used for these sampling efforts. In all cases except the mercury vapor lamps, the waste matrix met the Toxicity Characteristic Leaching Procedure (TCLP) particle size criteria in the field on the Hanford Facility by either cutting, smashing or shearing the waste. The mercury vapor lamp sampling effort was conducted at the Idaho National Engineering Laboratory so particle size reduction considerations are not known. Reducing the particle size in the field eliminated as much laboratory error as possible. The reduced particles were all well mixed and composited so that two identical samples would be submitted for analysis. Duplicate analyses help address the accuracy of the sampling effort.

All of the samples, including the mercury vapor lamps, are considered representative of Hanford Facility waste streams. The samples were submitted to the S-Cubed laboratory under contract through the Hanford Analytical Services Management group. The services of the Mobile Sampling Team were used to provide all of the equipment necessary and expertise to ship the samples off site to S-Cubed in addition to maintaining appropriate field log books of the sampling efforts. Once at S-Cubed, the samples were subjected to SW-846 method 1311, and followed with SW-846 Method 7421 for the lead analysis.

If the duplicate analyses for a waste matrix yielded sample results which appeared reproducible, they were averaged to obtain the value that is to be used for storage or disposal paperwork. If the results did not appear reproducible, the more conservative value will be used for designation purposes, unless additional sampling efforts are pursued to determine otherwise.

In summary, the data in Attachment 1 should be used for designating waste matrices identified in Attachment 1. As can be seen from the data in the table, pure lead solder would be designated as an extremely hazardous waste (EHW-D008). In addition, small light bulbs, lead solder fuses, computer circuit boards, incandescent light bulbs, and mercury vapor lamps would be designated as a dangerous waste (DW-D008). To obtain a lead designation status for waste matrices not identified in Attachment 1, the wt% of lead solder in the waste matrix should be compared to the table at the bottom of Attachment 2.

88410-93-161

Please reflect these changes in all storage and disposal paperwork from this point forward. The effective date of this letter will be used as the effective date for managing waste matrices containing lead solder as dangerous wastes. If you have questions or comments, please contact me on 376-3870.

M. J. Stephenson
RCRA Compliance Support

rlm

Attachments

88410-93-161
ATTACHMENT 1
Page 1 of 1

Lead Solder Analysis Summary Table

Waste Matrix	Sample #1 (mg/l)	Sample #2 (mg/l)	Value used for storage or disposal paperwork (mg/l)
Pure Lead Solder	525	594	560 (avg.)
Small Light Bulbs	1.01	12.9	12.9
Lead Solder Fuses	59	20.8	40 (avg.)
Computer Circuit Boards	372	31	372
Incandescent Light Bulbs	0.538	22.7	22.7
Mercury Vapor Lamps	44.7*	40.2*	42.5 (avg.) *

* Results received from the Idaho National engineering Laboratory (INEL).

Toxicity Characteristic regulatory thresholds for lead (D008):

DW = 5.0 mg/l EHW = 500 mg/l

Calculation Summary

The following summary is provided for matrices that require evaluation for lead solder designation, but were not addressed during the sampling efforts. This methodology will be used to complete waste designations in those matrices.

An averaged TCLP analysis for the pure lead solder sample yielded a result of 560 mg/l of lead. The pure lead solder consisted of three typical tin/lead ratios: tin/lead at 63/37, 60/40, and 50/50 wt%. A ratio was used to calculate the amount of lead solder in a waste matrix that would cause it to exceed the Toxicity Characteristic regulatory thresholds of 5 mg/l (dangerous waste) and 500 mg/l (extremely hazardous waste) for lead. For the purposes of these calculations, it is assumed that other matrices containing lead solder will leach lead according to the following ratio:

$$\frac{\text{100 wt\% lead solder}}{\text{560 mg/l of lead}} = \frac{\text{X or Y}}{\text{mg/l designation limit for lead}}$$

X = (100 wt% solder / 560 mg/l Pb) x 5 mg/l DW designation limit for Pb

X = 0.893 wt% solder for DW-D008 designation limit

Y = (100 wt% solder / 560 mg/l Pb) x 500 mg/l EHW designation limit for Pb

Y = 89.3 wt% solder for EHW-D008 designation limit

Wt% of lead solder in waste matrices not listed in Attachment #1	Designation status for lead
Less than 0.893	Non-regulated
Greater than or equal to 0.893, but less than 89.3	DW-D008
Greater than or equal to 89.3	EHW-D008

DISTRIBUTION SHEET

To	From	Page 1 of 1
R. B. Wilkinson	J. L. Westcott	Date May 11, 2000
Project Title/Work Order		EDT No. 621183
Data Quality Objectives Process for Designation of K Basins Debris		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
R. B. Wilkinson	R3-11				x
J. L. Westcott	T4-05	x			
R. R. Connolly	T3-04				x
J. R. James	L6-06				x
M. A. Casbon	T2-05	x			
W. S. Thompson	H9-03	x			
R. W. Jackson	X5-54	x			
J. M. Atwood	H0-02				x
B. D. Shilperoort	T2-05	x			
C. D. Lucas	X3-74				x
D. J. Watson	X3-79	x			
P. T. Day	R3-11	x			
J. H. Wicks	X3-71				x
J. H. Zimmerman	X3-67	x			
N. O. Hinojosa	X3-67	x			
G. C. Triner	T3-04				x