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RADIOLOGICAL EDC (ENGINEERING DOCUMENT CHANGE) FORM

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Faulkner, David E	A5-11	Ruane, Tom J	X3-74
Gentry, Rob E	X3-61	Southerland, D Todd	X3-68
Lewis, Kurt B	X3-85	Triner, Glen C	X3-74
Lucas, Chris D	X3-71	Veneziano, Timothy B	X4-01
Mata, George E	X3-79	Watson, Dave J	X3-79
Mathews, Jim	X3-71	Westcott, Jeffrey L	T4-05
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EDC (ENGINEERING DOCUMENT CHANGE) FORM (continued)

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UKB 9/15/061

Department of Energy
Richland Operations Office
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0602328
CC Recd: 09/06/2006

SEP 06 2006

06-KBC-0028

Mr. R. G. Gallagher, President
and Chief Executive Officer
Fluor Hanford, Inc.
Richland, Washington 99352

Dear Mr. Gallagher:

CONTRACT NO. DE-AC06-96RL13200 – APPROVAL OF 105-K EAST BASIN QUALIFIED PROCESS TO ACHIEVE END POINT CRITERIA, KBC-24721, REVISION 0A

The purpose of this letter is to respond to the July 12, 2006, (FH-0601667) request for RL and the U.S. Environmental Protection Agency (EPA) approval for the 105-K East Basin Qualified Process to Achieve End Point Criteria, KBC-24721, Revision 0A.

RL has reviewed the subject document and approves the qualified process to achieve end point criteria for the 105-K East Basin. A copy of EPA's approval letter is attached for your reference.

If, in my capacity as a Contracting Officer's Representative (COR), I provide any direction that your company believes exceeds my COR authority, you are to immediately notify the Contracting Officer and request clarification prior to complying.

If you have any questions, please contact me, or you may contact David Brockman, Federal Project Director for K Basin Closure, on (509) 373-9971.

Sincerely,

Matthew S. McCormick, Assistant Manager
for the Central Plateau

KBC:EBD

Attachment

cc: See Page 2

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(JKB 9/15/06)

cc w/attach:
G. Bohnee, NPT
S. W. Bork, FHI
N. Ceto, EPA
L. J. Cusack, Ecology
L. E. Gadbois, EPA
S. Harris, CTUIR
J. Hedges, Ecology
R. Jim, YN
P. M. Knollmeyer, FHI
T. M. Martin, HAB
R. D. Morrison, FHI
K. Niles, ODOE
R. E. Piippo, FHI
M. S. Strickland, FHI
D. J. Watson, FHI
Administrative Record
Environmental Portal

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10 HANFORD/ANL PROJECT OFFICE
309 Bradley Boulevard, Suite 115
Richland, Washington 99352

August 28, 2006

David Brockman
Federal Project Director, K Basins Closure Project
U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

Re: EPA Approval of 105-K East Basin Qualified Process to Achieve End Point Criteria, KBC-24721, Revision 0A

Dear Mr. Brockman:

The U.S. Environmental Protection Agency has reviewed and approves the subject document with a release date of August 15, 2006. Thanks for the many beneficial discussions with your staff and contractors during development of the qualified process and this document. The EPA looks forward to completion of sludge containment in the K East Basin as covered in this document. If you have any questions, please feel free to contact me at 509-376-9884.

Sincerely,

Larry Gadbois

Larry Gadbois
K Basins Project Manager

cc: Ellen Dagan, DOE
Dave Faulker, DOE
Paul Pak, DOE
Dave Watson, Fluor
Jeff Westcott, Fluor
Administrative Record, 100-KR-2

KBC-24721
Revision 0

RADIOLOGICAL

105-K East Basin Qualified Process to Achieve End Point Criteria

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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P.O. Box 1000
Richland, Washington

KBC-24721
Revision 0
EDC #: HNF-EDC-05-24722

105-K East Basin Qualified Process to Achieve End Point Criteria

Document Type: RPT Program/Project: KBC

J. E. Sailer
Xron

Date Published
June 2006

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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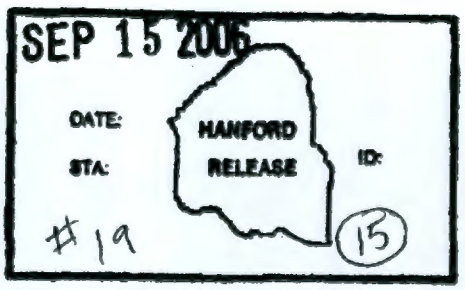
Richland, Washington



Janis Braden — 15Sept06
Release Approval — Date — Release Stamp

Janis Braden

Approved for Public Release;
Further Dissemination Unlimited

Total Pages: 57

(JCB 9/15/06)

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ATTACHMENT A - DEBRIS MANAGEMENT PLAN

ATTACHMENT B - DEBRIS INVENTORY PROCESS

ATTACHMENT C - QUALITY ASSURANCE INSPECTION PLAN

ACRONYMS

CCTV	Closed circuit television
Ci	Curies
DEP	Dummy Elevator Pit
DOE-RL	Department of Energy Richland Operations Office
EPA	Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FH	Fluor Hanford
FTS	Fuel Transfer System
KE	K East
KW	K West
LDC	Large Diameter Container
LDR	Land Disposal Restriction
MCO	Multi-Canister Overpack
M&TE	Measuring and Test Equipment
NLOP	North Loadout Pit
PNNL	Pacific Northwest National Laboratory
PPE	Personnel Protective Equipment
QA	Quality Assurance
QAE/I	Quality Assurance Engineers/Inspectors
QAPjP	Quality Assurance Project Plan
RDR/RAWP	Remedial Design Report / Remedial Action Work Plan
SAP	Sampling and Analysis Plan
SCS	Sludge Containerization System
SPR	Single Pass Reactor
SWS	Sludge Water System
SLOP	South Loadout Pit
TPA	Tri-Party Agreement
WAC	Waste Acceptance Criteria

DEFINITIONS

Bulk sludge containerization:

- Bulk sludge containerization means that a first pass with a vacuum has been completed to remove large amounts of sludge; racks, and debris have been removed from the area; additional vacuuming has been completed, as necessary, to expose the concrete surface of the basin; and debris has been washed to remove visible surface sludge. (DNFSB Recommendation 2000-1, Implementation Plan, Revision to Section 5.1, Hanford, November 2005)
- Bulk sludge containerization means that a first pass with a vacuum has been completed to remove large amounts of sludge; racks, and debris have been removed from the area; additional vacuuming has been completed, as necessary, to expose the concrete surface of the basin less any redeposition of sludge that is suspended in the basin water; and debris has been washed to remove sludge from internal spaces and visible surface sludge. (TPA Change M-34-05-04, January 9, 2006)

Coarse scrap: *Fuel scrap* greater than 1 inch in any dimension.

Debris: Debris is defined as anything (e.g., equipment and material) that is over 0.25 in. in largest dimension, is not used for current or planned operations or maintenance activity, and is not fuel or sludge. *Debris* includes such items as empty fuel canisters, old equipment, hand tools, and miscellaneous irradiated and non-irradiated items.

End Point Criteria: Defined conditions that must exist before deactivation and the overall K Basin CERCLA interim remedial action can be considered complete (DOE-RL, 2001).

Found Fuel: Found fuel refers to any fuel that is not "canistered fuel" and is "found" in K Basins during debris retrieval or sludge retrieval.

Fuel: *Fuel* is defined as all *spent nuclear fuel* that is greater than 0.25 inches in diameter (derived from WHC-SD-SNF-SP-005). For purposes of differentiating *fuel* from *sludge* and *debris*, any material that will pass through a screen with 0.25-inch openings is defined as sludge (HNF-SD-TI-015, Volume 2, Sludge, Section 3.0). This definition applies to all K Basins remediation activities.

Fuel Assembly: Fuel assembly consists of concentric inner and outer fuel elements of N Reactor fuel. Whole or partial elements containing an intact circular section for a portion of the element or segment length longer than 3 inches may be stacked into a multi-canister overpack (MCO) fuel basket in the form of assemblies.

Fuel Element: Fuel element can be either an inner or outer component of a *fuel* assembly of N Reactor fuel. A single piece of single pass reactor (SPR) fuel is also considered a *fuel element*.

Fuel Fragment: Fuel fragment is an informal term used to describe pieces of fuel of any size, implying that it is fuel, which is not a whole *fuel element* or *fuel assembly*. These would likely be classified as *fuel scrap* based on *size*.

Fuel Scrap: Any *fuel* that is not "loadable" in an MCO fuel basket (derived from K Basins SAR, Section 2.5.5.1.5). See *fuel assembly* definition.

Fine Scrap: Fuel scrap that is greater than 0.25 inch but less that 1 inch in all dimensions. By definition, *fuel* that is less than 0.25 inch is *sludge*.

Non-porous radioactive debris: Debris materials where radionuclide contamination is affixed on the surface such as metal, plastic, rubber, and glass.

Visual Comparator: A series of stepped disks, plates or machined increments with different diameters or dimensions. Comparators are placed in the basin after sludge removal from an area to visually determine the depth of resettled sludge through comparisons. The critical characteristics are flatness and height. Two types of comparators will be used. The thickness of a type 1 visual comparator will be: step one shall be 0.030 inches, step two shall be 0.050 inches, and step three shall be 0.075 (or similar). The thickness of a type 2 visual comparator will be: step one will be 0.10 inches, step two will be 0.125 inches and step 3 will be 0.15 inches (or similar). Tolerance shall be + 0.000 -0.003 inches. The flat or land between the step shall be 0.80 inches with a tolerance of ±0.06 inches for each flat or land. The comparators shall be flat with a tolerance of ± 0.004 inches. Each comparator shall be numbered.

Porous radioactive debris: Debris material where radionuclides could penetrate the material surface such as fabric, concrete, wood, and paper with the exception of intact or removed basin floor or wall material.

Qualified Process: A process approved by DOE-RL and EPA used to:

1. remove sludge to the maximum extent practicable from the KE Basin floor, pits and debris to meet end point criteria for sludge removal identified in the *End Point Criteria for the K Basins Interim Remedial Action,* HNF-20632 and implement the *Sampling and Analysis Plan (SAP) for the 105-K East Basin Monoliths* (FH, 2005b) related to sludge measurements

2. perform and document inspections of fuel canisters, sludge strainers, or other fuel collection devices, which have the potential to contain fuel to verify achieving end point criteria for found fuel,

3. perform and document found fuel inspections of the basin floor and pits to verify achieving end point criteria for found fuel, and

4. prepare debris for grouting and perform and document debris inventories to support achieving end point criteria for debris.

Sludge: Sludge is any material in the K Basins water that will pass through a screen with 0.25 in. (.64 cm) openings. Sludge on the floor and in the pits is a mix of fuel corrosion products (including metallic uranium, and fission and activation products), small fuel fragments, iron and aluminum oxide, concrete grit, sand, dirt, operational debris, and biological debris.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This remedial action is taking place under the *Remedial Design Report / Remedial Action Work Plan (RDR/RAWP) for the K Basins Interim Remedial Action* (DOE-RL, 2001) and approved RDR/RAWP changes. This document identifies the plans and processes to remove found fuel and sludge from the 105-K East (KE) Basin (Operable Unit 100-KR-2, Site 100-K-42), prepare below water debris for grouting and configure the KE Basin to achieve the end point criteria for found fuel and sludge removal and underwater debris cleaning identified in the *End Point Criteria for the K Basins Interim Remedial Action* (FH, 2005a). Processes described in this plan also implement the *Sampling and Analysis Plan (SAP) for the 105-K East Basin Monoliths* (FH, 2005b) related to sludge measurements and debris inventory collection.

1.2 BACKGROUND

The KE Basin is an unlined concrete structure 38 m (125 ft) long by 20.42 m (67 ft) wide. It is divided into three approximately equal bays with several pits east and west of the main basin. The dividing walls are cantilevered from the floor and do not tie into the outer walls. A 96-cm (38-in.) gap exists between each end of the dividing walls and the outer walls to allow a pathway between bays. Each basin is 6.4 m (21 ft), deep and the water is approximately 5.1 m (17 ft) deep and nominally contains 1.25 million gallons.

N Reactor fuel in the KE Basin was stored in open-top canisters. Some canisters had closed bottoms and others had screened bottoms. The open canisters released soluble fission products into the basin water and also allowed fuel corrosion products to deposit on the basin floor. This sludge also contains mixed fission products, rust, sand, spalled concrete, small fuel pieces and ion exchange resin beads. Sludge depths exceeding three feet were measured in the Weasel Pit. Under certain accident conditions, the basin water and sludge is postulated to leak to the environment because of the age and condition of the basin. These potential hazards provided the impetus for removing the sludge from the basins as soon as practical. The KE Basin is calculated to have approximately 42 cubic meters (1,483 ft^3) of sludge on the floor of the basin. For the purposes of differentiating fuel and debris from sludge, any material less than or equal to 0.64 cm (0.25 in.) is defined as sludge and will be stored and eventually disposed of as waste. There are pieces of equipment in the basin that must be moved, relocated or removed to facilitate sludge vacuuming.

1.3 OVERVIEW

The KE Sludge Containerization System (SCS) is designed to retrieve sludge from pits and floor areas of the KE Basin and place it into four containers located in the Tech View Pit and Weasel Pit. The SCS uses a combination of pump systems to move sludge from various locations into sludge containers. Under typical, planned operations these systems include the East and Center Bay Sludge Water System (SWS), the Tri-Nuclear pump, and an eductor pumping system[1]. Containers 3 and 4 could not be installed until Weasel Pit sludge was placed into Containers 1 and 2. Following completion of removal of visible sludge from the Weasel Pit, videos of the pit

[1] The SCS configuration used in any one area is based on materials encountered, effectiveness and other factors and therefore is subject to change.

was taken to document the as-left condition of the pits prior to placement of Containers 3 and 4. In parallel, pumping of sludge from the basin floor into the large containers will continue until at least one pass with a vacuum used with the SCS has been made over the basin and pit floors, it is determined that the SCS is no longer efficient or effective in removing the residual sludge and that a final vacuuming system will be used. During sludge containerization and vacuuming compacted sludge (referred to as hard pan sludge) and found fuel may be identified. Hard pan sludge will be removed to the extent practicable. Found fuel will be retrieved and dispositioned.

After bulk sludge is containerized, sludge retrieval operations will focus on demonstrating a final sludge vacuuming process in a 100 square foot section in the basin. The demonstration area floor and debris will be examined by Operations and KBC Waste Services, followed by DOE-RL and EPA to determine if the processes result in basin floor and debris that meet the sludge end point criteria. If the final sludge vacuuming process is determined to meet these criteria, the process will become qualified and will be used throughout the basin.

Upon completing implementation of the qualified processes in work areas or individual bays (depending upon the extent of debris and other obstructions), the basin floor and debris will be examined by Operations and the volume of sludge residues, if any, will be determined by Waste Services. If sludge has been removed to the maximum extent practicable and found fuel is not observed, then sludge resettling will be monitored and measured by Quality Assurance Engineers/Inspectors (QAE/I). Resettled sludge will be factored into determinations whether the sludge removal end point criteria are met. The basin may be re-vacuumed based on the inspections results until the end point criteria are met.

1.4 QUALIFIED PROCESS PLAN ORGANIZATION

This document is made up of a primary document and three supporting attachments as described below and depicted in Figure 1:

Section 1.0: Identifies the purpose of this plan and provides background of the project.

Section 2.0: Identifies the end point criteria applicable to the scope of work for cleaning the KE Basin from the *End Point Criteria for the K Basins Interim Remedial Action*, (FH, 2005a).[2]

Section 3.0: Describes the methodology for found fuel and sludge removal and underwater debris cleaning, and related inspections to meet the relevant KE Basin end point criteria.

Section 4.0: Describes the processes to develop, demonstrate and qualify processes to perform final sludge vacuuming from the floor and debris cleaning.

Section 5.0: Summarizes the Quality Assurance (QA) processes described in Attachment C to be implemented during this activity.

Section 6.0: Provides aspects of this plan for communications and training.

Section 7.0: Identifies references in this document.

Attachment A, *Debris Management Plan* - Provides details of the KE Basin debris removal, cleaning and relocation processes.

[2] End point criteria for removal of above water debris, water removal and preparation of the KE building interior are beyond the scope of the basin cleaning described in this document.

Attachment B, *Debris Inventory Process* - The plan describes the inventory process for debris that will be left in the basin for grouting. The debris inventory will support verification of end point criteria for underwater debris.

Attachment C, *Quality Assurance Project Plan (QAPjP)* - The QAPjP describes quality processes employed in this project, the methods for qualification of the remote visual inspection process, the review of the final sludge vacuuming process, the visual comparator inspection process and the process for the validation of the end point criteria described in Section 2.0. The QAPjP also identifies data validation and documentation and records management processes applicable to the project. The processes in the QAPjP are used together with QA processes described in the *SAP for the 105-K East Basin Monoliths* (FH, 2005b), Section 5.0, *Quality Assurance Project Plan.*

This plan includes sample forms to be used in the implementation of this process. Equivalent forms may be used.

1.5 ORGANIZATION, ROLES AND RESPONSIBILITIES

Project organization, roles and responsibilities are identified in the *SAP for the 105-K East Basin Monoliths,* Section 5.1. To the extent practicable these roles and responsibilities have been reflected in the context of this document. In general:

- Sludge, debris and found fuel removal shall be performed by Operations;
- Observations, examinations and inspections for found fuel and sludge residues on floor surfaces and debris shall be performed by Operations in accordance with quality processes and work instructions that satisfy the fundamentals of the quality criteria expressed in 10 CFR 830.122(e);
- Measurements and estimates of sludge residues shall be performed by Waste Services in accordance with quality processes and work instructions that satisfy the fundamentals of the quality criteria expressed in 10 CFR 830.122(e); and
- Visual comparator inspections and measurements shall be performed by QAE/I qualified and certified as Level II inspectors satisfying the fundamentals of the quality criteria expressed in 10 CFR 830.122(b) and 10 CFR 830.122(h).
- Surveillances shall be performed by QA as described in the *Quality Assurance Project Plan* (Attachment C) and the *SAP for the 105-K East Basin Monoliths*.

2.0 END POINT CRITERIA

End point criteria for the K Basins interim remedial action are contained in *End Point Criteria for the K Basins Interim Remedial Action* (FH, 2005a). This plan has been developed to describe the steps to achieve the end point criteria at the KE Basin for found fuel, sludge removal and underwater debris identified below. Meeting the end point criteria will be carried out in two phases.

The first phase will remove bulk sludge from the basin floor and pits to below water containers to meet the TPA Milestone of "Sludge Containerized." Integral with containerizing bulk sludge

is removing or relocating below water debris to gain access to the floor and removing sludge from debris. Debris relocation will be done in parallel with vacuuming sludge. Bulk sludge containerization activities should be conducted to maintain water clarity to the extent practicable to minimize the redistribution of sludge as resettled sludge and potential re-vacuuming.

The second phase of sludge removal is designed to achieve the end point criteria for found fuel, sludge removal and underwater debris. The end point criteria establish that the basins, when grouted and sectioned, will meet the Environmental Restoration Disposal Facility (ERDF) waste acceptance criteria (WAC) (BHI, 2002) as described in the *SAP for the 105-K East Basin Monoliths*. During this phase, debris and racks will be relocated or removed to allow unobstructed access to the basin floor for vacuuming.

End point criteria for found fuel removal, sludge removal and underwater debris are included below:

The found fuel removal end point criteria (FH, 2005a, Section 2.1.1) are:

1. A visual inspection of the floor has been performed using individuals familiar with fuel scrap visual characteristics and has been documented using standard, commercially available imaging methods (e.g., video, photographic, or similar), or written logs;
2. Objects that appear to be found fuel have either been removed from the basin or evaluated by a secondary process, such as radiation measurement, and determined to not be found fuel;
3. Fuel canisters, sludge strainers, or other fuel collection devices, which have the potential to contain fuel, have either been evaluated to ensure they contain no found fuel or have been removed from the basin.
4. Found fuel has been removed from the basin to a suitable location.

Sludge removal end point criteria (FH, 2005a, Section 2.2.1) are:

1. Sludge has been removed to the maximum extent practicable in accord with a qualified process approved by DOE-RL and EPA (this process).
2. Sludge has been removed to the extent that residues on the floor, on or in debris, and within other matrices grouted in each basin monolith do not result in the monolith exceeding the ERDF WAC, as determined according to an approved *Sampling and Analysis Plan* (SAP) (i.e., FH, 2005b); and
3. The volume of sludge residues remaining in each monolith section has been determined and documented according to an approved SAP (i.e., FH, 2005b).

Underwater debris end point criteria (FH, 2005a, Section 2.3.1) addressed through this process are:

1. A visual examination will be performed to identify those types of debris that have to be removed and disposed separately. These types of debris are those that would designate as a dangerous waste and can not be treated by such methods as macro encapsulation, washing, etc. which would allow this type of debris to be left in situ and grouted as part of the basin monoliths.
2. Debris that will remain in the basin has undergone a process to remove sludge from external surfaces to the maximum extent practicable and to the extent necessary such that that sludge

residues on the floor, on or in debris, and within other matrices grouted in the monolith do not result in the monolith exceeding the ERDF WAC, as determined according to an approved SAP (i.e., FH, 2005b);

3. Debris that could contain sludge in its internal volume; a) has been sectioned to expose internal volume such that sludge removal can be conducted to the maximum extent practicable, b) has undergone internal inspection or flushing to remove the sludge inventory to the maximum extent practicable and, c) has been accounted for such that that sludge residues on the floor, on or in debris, and within other matrices grouted in the monolith do not result in the monolith exceeding the ERDF WAC, as determined according to an approved SAP (i.e., FH, 2005b);
4. Underwater debris has been oriented or sectioned such that free liquids (i.e., basin water) in void spaces are displaced by grout to the extent necessary to meet ERDF WAC;
5. Debris has been inventoried as necessary for characterization as determined according to an approved SAP (i.e., FH, 2005b);
6. An inventory of aluminum remaining in the basin waste matrix has been established, as necessary.

3.0 PROCESS DESCRIPTION

The basin cleaning process will be accomplished using distinct but integrated activities. One or more activities may occur in parallel depending upon location in the basin, timing and other factors. These activities include bulk sludge containerization and removal; found fuel removal; hard pan sludge removal, if necessary; underwater debris cleaning and inspection, removal and relocation; final vacuuming and visual comparator inspections, and sludge and found fuel inspections of the basin, NLOP, South Loadout Pit (SLOP), Dummy Elevator Pit (DEP),Weasel Pit and Tech View Pit.

Prior to implementing the final cleaning and inspection processes, a demonstration area will be cleaned using the bulk sludge removal process described in Section 3.1 and hard pan sludge removal as described in Section 3.2 followed by development and demonstration of a final vacuuming process. The final sludge vacuuming process will be qualified in the demonstration area (Section 4.2) and upon qualification will be implemented throughout the basin as described in Section 3.4. A debris cleaning process will also be qualified as described in Section 4.3.

Underwater debris that is found during sludge removal will either be removed or be inventoried and redistributed in the basin for grouting as described in Section 3.3. Thereafter visual inspections will be performed in each area of the basin to verify sludge removal and resettling of sludge as described in Section 3.4. Inspections for found fuel will be performed as described in Section 3.5. Inspections of underwater debris will be performed as described in Section 3.6. A process summary is depicted in Figure 1. Details of the process are depicted in Figure 2 and Figure 3.

Videos, photographs, inspection forms and completed work packages generated during implementation of this process shall be maintained per Attachment C, Section 5.0, *Documentation and Records.*

3.1 BULK SLUDGE CONTAINERIZATION AND REMOVAL

The process for bulk sludge containerization and removal will consist of the following steps: 1.) bulk sludge containerization, 2.) bulk sludge removal by hose-in-hose transfer to the KW Basin, and 3.) removal of remaining portions of the bulk sludge in the NLOP.

3.1.1 Bulk Sludge Containerization

Bulk sludge containerization will be performed as follows or using similar, comparable methods.

1. Bulk sludge containerization will be accomplished using the SWS pumping systems. Sludge will be vacuumed and containerized in one of four underwater containers located in the Weasel Pit or Tech View Pit.
2. Hard pan sludge that is encountered during sludge containerization, if any, will be managed per Section 3.2,
3. Underwater debris that is encountered during sludge containerization will either be removed or be cleaned, inventoried and redistributed in the basin for grouting as described in Section 3.3.
4. Found fuel and debris that is unknown (i.e., has the potential to be found fuel) will be placed in canisters and transported via the FTS to the KW Basin.

Bulk sludge containerization is considered complete after a first pass with a vacuum has been completed to remove large amounts of sludge; racks and debris have been removed from the area; additional vacuuming has been completed, as necessary, to expose the concrete surface of the basin less any redeposition of sludge that was suspended in the basin water; and debris has been washed to remove sludge from internal spaces and visible surface sludge. Bulk sludge containerization may be accomplished and evaluated for completion area-by-area in the basin.

3.1.2 Bulk Sludge Removal

Bulk sludge removal (except for portions of the NLOP) will be performed by removing the sludge in the KE Basin underwater sludge consolidation containers using the hose-in-hose transfer system for placement in underwater sludge accumulation containers in the KW Basin.

3.1.3 Bulk Sludge Removal (NLOP)

Bulk sludge removal from the NLOP was performed in part by utilizing the SWS to remove the sludge and place it in large diameter containers (LDCs) in the transfer bay for shipment to T Plant. The remaining sludge will be removed by the bulk sludge containerization process and bulk sludge removal processes described above in Section 3.1.1 and 3.1.2 respectively.

3.2 HARD PAN SLUDGE REMOVAL

Compact sludge which resists normal vacuuming was previously encountered during sludge pumping activities in the KE discharge chute in 1994/95. A variety of tools were used in the past to break up this hard pan and allow removal via vacuuming. Long pole scrapers along with underwater sparging were the common approaches used in the discharge chute cleaning. Based

on this knowledge, the SWS project developed specific tools to break up any hard pan. If hard pan areas are encountered, similar practices used in the past will be employed to break up the hard pan and ensure sludge has been removed from the area to the extent practicable prior to final vacuuming. Areas of the basin that contain residues of hard pan sludge shall be identified for subsequent examination by KBC Waste Services after final vacuuming described in Section 3.4. Based on the outcome of waste calculations, additional hard pan removal may be required. The volume of residues that remain shall be estimated as described in the *SAP for the 105-K East Basin Monoliths* (Section 3.2) and documented on Figure 4, *KE Basin Floor Inspection Form* by Waste Services for use in developing waste characterization information. The location of residues shall be noted along with the estimated volume.

3.3 UNDERWATER DEBRIS CLEANING, REMOVAL AND RELOCATION

Underwater debris must be relocated to gain access to the floor for final vacuuming, to clear paths for hydrolasing, to identify debris that is not suitable for grouting and remove it, and to clean debris that is suitable for grouting and position and orient it for subsequent grouting. These activities will be performed as follows:

1. Fuel racks will be removed from the basin or relocated and washed to remove visible sludge, and the floor cleaned as described in Section 3.4. Racks that will remain for grouting will then be positioned optimally away from the established cut lines.
2. Debris that is found during sludge containerization that will remain for grouting will be identified and inventoried as described in the *Debris Inventory Process* (Attachment B). (*K Basins Debris Inventory* [FH, 1997] provides an inventory of known KE Basin debris.)
3. Debris identified as potentially found fuel and debris that is unknown (i.e., has the potential to be found fuel) will be evaluated as described in Section 3.5 to determine if the material is found fuel.
4. Found fuel and debris that is unknown (i.e., has the potential to be found fuel) will be placed in canisters and transported via the Fuel Transfer System (FTS) to the KW Basin.
5. Fuel canisters, sludge strainers, or other fuel collection devices, which have the potential to contain fuel scrap shall be evaluated and surveyed to ensure they contain no found fuel (see Attachment A, Section 2.3). Records of evaluations shall be retained and referenced on the *Debris Inventory and Inspection Form* (Attachment B, Figure B-1).
6. Debris that is defined as not suitable for grouting (see Attachment A, Section 2.2) will be cleaned to remove visible sludge and removed from the basin.
7. Debris that will remain in the basin that may have sludge within void spaces will be disassembled, size reduced or flushed using the *Qualified Process for Debris Cleaning* developed in Section 4.3. Still photographs or video shall be taken to document that the conditions meet visual sludge removal to the maximum extent practicable.
8. Debris that is to be grouted in place will be cleaned and prepared for grouting using the *Qualified Process for Debris Cleaning* as follows by operations personnel:
   - washed to remove readily visible sludge,
   - viewed during or after cleaning to verify sludge removal (see Section 3.6), (If residual sludge cannot be practicably removed, KBC Waste Services shall determine the

remaining volume as described in the *SAP for the 105-K East Basin Monoliths* (Section 3.2) and report that volume on the *Debris Inventory and Inspection Form* [Attachment B, Figure B-1]),

Note: If sludge resettling occurs after this phase of work, cleaning of debris may need to be repeated.

- placed in baskets (i.e., segregated into non-porous and porous to the extent practicable) as appropriate,
- baskets shall be tagged with an ID tag for tracking purposes,
- oriented or sectioned such that basin water in void spaces will be displaced by grout to the extent practicable (Attachment A, Section 2.4),
- inventoried as non-porous debris and porous debris waste streams. The debris inventory shall be developed per Attachment B, *Debris Inventory Process*.
- relocated to a final location for grouting or staging area (see Attachment A, Section 2.6).

Note: Debris that is staged for subsequent placement after cleaning and inventorying (instead of being placed in the final location) shall be tracked at the time of final placement using the *Debris Relocation and Inspection Form* (Attachment B, Figure B-3).

9. Debris that requires size reduction (see Attachment A, Section 2.4) for grouting will be size reduced using available remote tools.
10. Aluminum debris shall be managed per Attachment A, Section 2.6.1.
11. Activated metal shall be managed per Attachment A, Section 2.6.2.
12. Debris items or debris baskets shall be cleaned and inspected by Operations for visible sludge prior to relocation to an area of the basin that has undergone vacuuming, inspection and placement of visual comparators described in Section 3.4. Steps 1 through 5 (see Section 3.4, Step 6).

Note: The relocation of cleaned debris must be coordinated with final vacuuming activities described in Section 3.4.

13. Contractor Safeguards and Security shall perform inspections for fuel in work areas cleaned and inspected by Operations before final placement of debris or debris baskets.
14. If a cleaned and inventoried debris item or basket is moved from a previously identified final placement location, the relocation shall be noted on the *Debris Relocation and Inspection Form* (Figure B-3). The most recent date reflecting the debris location shall be used in developing characterization information.
15. If a cleaned and inventoried debris item or basket that was previously placed at a final placement location is removed from the basin, the removal shall be noted on the *Debris Relocation and Inspection Form* (Figure B-3) and the *Debris Inventory and Inspection Form* (Figure B-1) shall be marked to identify that the debris was removed from the basin.

3.4 FINAL VACUUMING, VISUAL COMPARATOR INSTALLATION AND INSPECTION

The last activities will be to final vacuum the floor using a water and particulate separations process, install the visual comparators used to evaluate resettling of suspended sludge and perform inspections to determine conformance with found fuel and sludge removal, and underwater debris end point criteria identified in Section 2.0. Final vacuuming will take place after:

- bulk sludge containerization has been completed in the bay,
- debris has been relocated from the work area or placed in final staging, and
- actions to mitigate redistribution of sludge to the bay are in place or sludge has been transferred to KW Basin.

Upon completion of final vacuuming, sludge collected using the final sludge vacuuming and separation process shall be removed from the basin and transferred to the appropriate storage facility.

The final vacuuming and inspections shall be performed as follows:

1. Operations will final vacuum each bay and the adjoining pits to the extent practicable (targeted at 0.05 inches or less including resettled sludge) using the *Qualified Sludge Removal Process*. Work will progress from work area to work area within a bay.

Note: Final vacuuming must be coordinated with debris cleaning and relocation described in Section 3.3.

2. After final vacuuming in a work area, Operations will verify through visual inspections that sludge has been removed to the extent practicable and that no found fuel is present in the work area (see Section 3.5, *Inspections for Found Fuel*). These inspections will be followed by notification to KBC Waste Services that residual volumes of sludge in the area, if any, must be determined.

Note: At the time of inspections noted below, basin water visual acuity shall be maintained such that a 0.08 cm (1/32 in.) black line can be seen on an 18% neutral gray card when using the human eye, still camera, or video camera. Prerequisites to inspection include completion of the visual comparator demonstration (Section 4.4). The organization performing the inspection or observation is responsible for making the determination.

3. Once it has been established that sludge has been removed to the extent practicable by Operations, KBC Waste Services shall determine the volume of residual sludge in each area as described in the *SAP for the 105-K East Basin Monoliths* (Section 3.2) and document the results on the *KE Basin Floor Inspection Form* (Figure 4). If the residual sludge volume exceeds the amount acceptable for disposal of the grouted monolith at ERDF as determined by Waste Services, additional cleaning will be required.

4. Sludge and found fuel visual inspection of the floors shall be performed by Operations as described in Section 3.5 and Attachment C, Sections 2.4 and 2.6. Inspections shall be recorded on still camera or video at a rate of 100% at the time sludge removal end point determinations are made except where interferences prohibit floor examination and shall be documented using the *KE Basin Floor Inspection Form* (Figure 4). Inspections shall be

conducted of 100% of the basin floor, SLOP, NLOP and DEP. Inspections of the Tech View Pit and Weasel Pit shall be conducted as described in Section 3.7.

5. After satisfactory inspection of a work area by Operations, type 1 or type 2 visual comparators, or both types of visual comparators will be placed at the locations specified in the *SAP for the 105-K East Basin Monoliths,* Appendix B (FH, 2005b). Determination of which type or types of comparator(s) will be placed at the location shall be made at the time of placement based on conditions observed in the field. Operations shall ensure visual comparators are not located in areas where the floor will be hydrolased or have interference from other objects.

Note: Visual comparators may be inspected intermittently by QAE/I to determine if resettling is occurring during final vacuuming of other basin areas.

6. After satisfactory inspection of a work area by Operations, debris removed from the area subject to final vacuuming and which has been cleaned and inventoried as described in Section 3.3 may be relocated to the area per Attachment A, Section 2.6. The final placement location for debris that is being relocated shall be documented on the *Debris Relocation and Inspection Form* (Attachment B, Figure B-3). Debris that has not previously been cleaned and inventoried shall be prepared as described in Section 3.3 and the final placement location documented using the *Debris Inventory and Inspection Form* (Attachment B, Figure B-1). Contractor Safeguards and Security shall perform inspections for fuel before final placement of debris or debris baskets.

7. Cleaning will progress to the next area in the bay. Operations will vacuum 100% of the accessible floor surface until the bay including adjacent pits has been cleaned.

8. Steps 1 through 6 are repeated until all bays are complete.

Note: With the uncertainty of sludge redeposition during sludge transfer from containers to KW or as the result of container cleaning, redeposition of sludge may occur. If verification of sludge removal from the basin floor and pits (other than the Weasel Pit and Tech View Pit) occurs prior to transfer of containerized sludge to KW, the need to perform additional visual comparator inspections will be determined by Operations, Waste Services and QA and post transfer vacuuming will be performed as necessary.

Note: If found fuel or fuel scrap in canisters or other collection devices is staged in an area previously verified to have no fuel, the area shall be re-inspected.

9. At the completion of cleaning the entire basin floor and adjoining pits (or isolated areas), the visual comparators will be inspected by QAE/I to determine resettled sludge depth (Attachment C, Section 2.8). Conditions will be documented with video or photography equipment specified in Attachment C, Section 2.3.

10. Once it has been determined through inspections and waste calculations that a monolith section has undergone the process described in this section and the residues of sludge in each monolith section (or isolated area) are equal to or less than amounts necessary for the monoliths to meet the ERDF WAC, sludge end point criteria 1, 2, and 3, and debris end point criteria 2, 3, and 5 will be considered to have been satisfied and no further inspections are necessary unless there has been additional sludge redeposition.

Note: The potential for additional sludge redeposition is a function of basin water suspended solids, i.e., turbidity. If the suspended solids concentration of the basin water is below a level whereby the equivalent settled material does not cause the monolith segments to exceed the ERDF WAC then there is no need for further inspections.

Note: Verification of achieving end point criteria in pits that are used to collect hydrolase spoils shall be completed prior to directing spoils to the pit.

11. If conditions are not met, additional vacuuming will be performed where necessary. Re-cleaning due to failure of visual comparator inspections shall include removal of resettled sludge from horizontal surfaces of debris if necessary to satisfy the *SAP for the 105-K East Basin Monoliths*.

3.5 INSPECTIONS FOR FOUND FUEL

Inspections to confirm that the end point criteria for found fuel have been met will be performed as follows:

1. A visual inspection of the floor of each bay and pit will be performed using a KBC Project Fuel Examiner (i.e., individual familiar with fuel scrap visual characteristics) and the KBC Primary Custodian to determine if the found fuel end point criteria 1 and 2 have been met. Debris that appears to be fuel scrap will be surveyed using an RO-7 probe or equivalent. Dose measurements of debris items determined not to be fuel scrap that will remain for grouting will be recorded using standard survey forms. Visual inspections will be documented using photographic or video equipment described in Attachment C, Section 2.3. If photographic or video equipment is not available, written records in logbooks or work package entries may be used. Found fuel inspections shall be documented using the *KE Basin Floor Inspection Form* (Figure 4).
2. Fuel canisters, sludge strainers, or other fuel collection devices, which have the potential to contain fuel scrap, and are to remain in the basin for grouting will be visually inspected by Operations and surveyed using an RO-7 probe or equivalent to ensure they contain no found fuel to verify achieving the found fuel removal end point criteria 3. Results of these inspections will be documented on the *Debris Inventory and Inspection Form* (Attachment B, Figure B-1) and using photography equipment described in Attachment C Section 2.3.
3. Operations shall declare that all found fuel has been removed from the KE Basin using final visual evaluations and fuel transfer records. QAE/I will review this information and completed *KE Basin Floor Inspection Forms* to verify achieving the found fuel removal end point criteria 4. The declaration shall be signed by the KBC Project Fuel Examiner(s), KBC Primary Custodian, Contractor Safeguards and Security and DOE-RL Safeguards and Security. A copy of the declaration shall be provided to the KBC Waste Services and KBC Environmental Protection to be included in the Project Closure Report.

3.6 INSPECTIONS OF UNDERWATER DEBRIS

Inspections to confirm that the end point criteria for underwater debris have been met will be performed as follows:

1. Inspections to determine if debris has met the end point criteria for sludge removal (debris end point criteria 2 and 3) are carried out on all debris surfaces as described below:

- Inspections will be carried out by Operations when debris is cleaned, inventoried and located in a previously cleaned and inspected area of the basin and noted on the *Debris Inventory and Inspection Form* (Attachment B, Figure B-1).
- Inspections will be conducted by Operations on previously cleaned, inspected and inventoried debris which has been staged and is relocated for final placement and noted on the *Debris Relocation and Inspection Form* (Attachment B, Figure B-3).
- Inspections conducted by Operations of debris already located in an area (such as immovable objects) being inspected after completion of final vacuuming will be recorded on the *KE Basin Floor Inspection Form* (Figure 4).

Video or still photographs shall be taken of 100% of cleaned debris, except where interferences prohibit examination. This may be performed at any time: for example, during debris cleaning, during debris relocation or after debris has been relocated to a bay. Video and still photographs shall be retained as described in Attachment C, Section 5.0.

2. Operators will receive instructions during demonstration of the debris orientation and size reduction techniques to reduce void spaces of debris for grouting as described in Section 3.3. The techniques will be verified as described in Section 4.3 and will satisfy underwater debris end point criteria 4.
3. Operations will review debris inventory information to verify conformance to underwater debris end point criteria 1, 5 and 6. Operations shall verify that aluminum has not been stacked to verify conformance with end point criteria 6 as described in Attachment A, Section 2.6.1.

Note: At the time of inspections, basin water visual acuity shall be maintained such that a 0.08 cm (1/32 in.) black line can be seen on an 18% neutral gray card when using the human eye, still camera, or video camera. Prerequisites to inspection include completion of the visual comparator demonstration (Section 4.4).

3.7 WEASEL PIT AND TECH VIEW PIT INSPECTIONS

The Weasel Pit and Tech View Pit were cleaned prior to development of end point criteria and this plan to enable the installation and use of underwater sludge accumulation containers. Upon completion of removal of sludge from the basin and transfer of sludge from the accumulation containers to KW, re-cleaning of the Weasel Pit, Tech View Pit and accumulation containers is required. Sludge will be vacuumed and debris washed as necessary to remove sludge that may have re-accumulated in the areas during the sludge containerization process. Sludge will be removed to the extent practicable.

Once it has been established that sludge has been removed to the extent practicable, Operations shall inspect the floors to the extent that the floor can be viewed without moving the fixed sludge containers. Operations may review available video tapes of pit conditions prior to placement of tanks into the pits to make comparisons. Operations shall note areas of the pits where visibility is obscured and any relevant information concerning the condition of adjacent areas. If adjacent areas are determined to be "cleaned to the extent practicable", areas obscured by the sludge containers or supports will be considered "cleaned to the extent practicable." Inspections shall be recorded on still camera or video at a rate of 100% at the time sludge removal end point

determinations are made except where interferences prohibit floor examination and shall be documented using the *KE Basin Floor Inspection Form* (Figure 4).

Note: At the time of inspections basin water visual acuity shall be maintained such that a 0.08 cm (1/32 in.) black line can be seen on an 18% neutral gray card when using the human eye, still camera, or video camera. Prerequisites to inspection include completion of the visual comparator demonstration (Section 4.4). Visual comparator inspections are conducted per Attachment C, Section 2.8.

Waste Services shall determine the volume of residual sludge in each area as described in the *SAP for the 105-K East Basin Monoliths* (Section 3.2) and document the results on Figure 4. If the residual sludge volume exceeds the amount acceptable for disposal of the grouted monolith at ERDF as determined by Waste Services, additional cleaning and inspection will be required.

Note: The potential for additional sludge redeposition is a function of basin water suspended solids, i.e., turbidity. If the suspended solids concentration of the basin water is below a level whereby the equivalent settled sludge in addition to other measured sludge volumes would not cause the monolith segments to exceed the ERDF WAC then there is no need for any further inspections.

Resettled sludge shall be determined by QAE/I as described in Attachment C, Section 2.8.

4.0 QUALIFIED PROCESS DEVELOPMENT AND DEMONSTRATION

This section describes the development and demonstration of the qualified processes for final sludge vacuuming and debris cleaning. Successful demonstration of the processes will be considered complete when DOE-RL and EPA verify that the application of these processes in the demonstration area have achieved the found fuel end point criteria 1, 2, and 3; sludge removal end point criteria 1, 2, and 3; and debris removal end point criteria 2 through 4. Upon this approval, the processes will be considered "Qualified Processes" and will be implemented throughout the basin as described in Section 3. The use of qualified processes will provide a level of confidence that the processes used will result in inspections that meet end point criteria upon completion of final sludge vacuuming in a work area. In addition, a demonstration of the visual comparator use will be conducted to validate the ability to place and read visual comparators. The steps to develop the qualified processes for sludge removal and debris preparation and cleaning, and a description of the visual comparator demonstration, are included below.

4.1 QUALIFED PROCESS PREREQUISITES

The following actions must be complete before demonstrating the qualified processes for sludge removal and debris cleaning:

- Found fuel removal, bulk sludge containerization and debris management activities identified in Sections 3.1, 3.2, 3.3 and 3.5 will be complete in the demonstration area.

The following must be complete before demonstrating the capability for viewing and interpreting visual comparators:

- Final sludge vacuuming using the demonstrated qualified process has been completed in the demonstration area.

- Basin water visual acuity shall meet the criteria for visual comparator inspections.

4.2 QUALIFIED PROCESS FOR FINAL SLUDGE VACUUMING

Sludge removal from the basin floor includes bulk sludge removal (Section 3.1), hard pan sludge removal (Section 3.2) followed by a final sludge vacuuming (Section 3.4). The qualified process for final sludge vacuuming from the floor, NLOP, SLOP and DEP of the basin will be developed and demonstrated in a test area as described below[3].

1. Operations will designate a 100 square foot area (minimum) in one of the bays to be used for the demonstration.
2. Operations will implement the final sludge vacuuming process in the demonstration area and record the process used. Examples of the type of information to be collected include but are not limited to: the estimated number of passes of the vacuum used over a unit area, direction or pattern of vacuuming (if an established overlapping pattern is used) or estimated time used to vacuum the unit area, pump operating conditions, filter change-out frequency (if applicable) and other factors determined by operations to be important to removing sludge to the extent practicable.
3. Operations and KBC Waste Services will inspect the demonstration area as described here and in Attachment C, Section 2.6 to verify sludge has been removed to the extent practicable (targeted at 0.05 inches or less including resettled sludge). Final vacuuming and examinations will be repeated until the process is shown to meet the "extent practicable." KBC Waste Services shall determine the volume of residual sludge and document the result.

Note: The total amount of sludge to remain on the basin floor is targeted at nominal average of 0.05 inches of sludge residue and resettled sludge.

4. If the process is found by DOE-RL and EPA to meet the sludge end point criteria as described in Section 4.0, the process will be considered qualified.

4.3 QUALIFIED PROCESS FOR DEBRIS CLEANING AND PREPARATION

The process for removal of sludge from debris to remain in the basin for grouting will be developed and demonstrated in the basin. Debris cleaning will include underwater washing to remove visible surface sludge, and where appropriate, size reduction to expose potential void spaces where sludge may be entrapped, or flushing.

Note: Neither the development nor qualification of the process nor the demonstrations are intended to be onerous. Rather they are intended to merely represent an independent organization's review of the processes.

1. Operations will demonstrate the removal of sludge from debris external surfaces.
2. Operations will demonstrate the removal of sludge from debris internal void spaces using flushing techniques, size reduction and other techniques.

[3] A separate process will be used to perform final cleaning of the Tech View Pit and Weasel Pit after containerized sludge is transferred to KW Basin. Based on pit configuration, the processes used to remove sludge from pits may vary from the qualified process used in the basin. End point criteria inspections in pits will verify effectiveness of methods used.

3. Operations will record the debris cleaning and preparation process used. Examples of the type of information to be collected include but are not limited to: water pressure used for external and internal washing, estimated time of internal flushing, distance water wash is held from debris, visual indicators of internal flushing completion and other factors determined by operations to be important to removing sludge to the extent practicable.
4. Operations and KBC Waste Services will verify that the techniques developed result in debris that has sludge removed to the extent practicable.
5. If the process is found by DOE–RL and EPA to result in debris that meets the end point criteria for removal of sludge from debris as described in Section 4.0, the process will be considered qualified.

4.4 VISUAL COMPARATOR DEMONSTRATION

Visual comparators will be installed in the demonstration area to demonstrate their placement and use. Visual comparators will be placed in the demonstration area after the *Qualified Process for Final Sludge Vacuuming* has been accepted in the demonstration area.

1. Operations will place visual comparator(s) in the demonstration area. Both type 1 and type 2 comparators shall be placed to determine usability and demonstrate the ability to read the comparators. QAE/I shall record the location(s) of comparator placement in the demonstration area with an accuracy of plus or minus one foot on *Visual Comparator Inspection Forms* (Attachment C, Figure C-1).
2. QAE/I will observe placement of visual comparators on the floor of the demonstration area.
3. QAE/I shall perform the visual comparator qualification and demonstration as described in the QAPjP (Attachment C, Section 2.7).
4. QAE/I will monitor the visual comparators in the demonstration area and document visual comparator inspections on Attachment C, Figure C-1, *Visual Comparator Inspection Form.*

Note: At the time of inspections basin water visual acuity shall be maintained such that a 0.08 cm (1/32 in.) black line can be seen on an 18% neutral gray card when using the human eye, still camera, or video camera.

5.0 QUALITY ASSURANCE

The *Quality Assurance Project Plan* (Attachment C) has been developed to provide guidance to the Operations, Waste Services and QAE/I to implement the inspection processes identified in the *SAP for the 105-K East Basin Monoliths* and verify that end point criteria have been met. The recording equipment used to capture as left conditions of the basin floor and debris must be as specified by QAE/I in Attachment C, Section 2.3. Basin water visual acuity shall be maintained such that a 0.08 cm (1/32 in.) black line can be seen on an 18% neutral gray card when using the human eye, still camera, or video camera. The records obtained by the process are Quality Records and will be maintained as defined in the *QAPjP*, Section 5.0, *Documentation and Records*.

6.0 COMMUNICATION AND TRAINING

The contents of this plan shall be communicated to personnel supervising the work through training or orientation, and to personnel performing the work during pre-work briefings. Communication of this plan is essential for the following reasons:

1. Communicates relevant end point criteria so individuals are aware of the basis for the work and the end state,
2. Ensure personnel understand the sequence and integration of found fuel, sludge and debris management activities,
3. Communicates how debris is managed in an integrated manner so that all sludge can be removed, while efficiently segregating debris for removal or relocation,
4. Ensure controls for inventorying debris are implemented,
5. Describes the differences between porous and non-porous debris to ensure appropriate segregation, inventory control implementation, and characterization,
6. Ensure the appropriate distribution of aluminum debris and activated metal,
7. Communicate the appropriate use of qualified processes for final sludge vacuuming from the floor and debris,
8. Communicate important characteristics of debris size reduction, orientation and placement between cut lines to ensure for an acceptable final grouted waste form,
9. Communicates the importance of the data collection and records needed to develop the waste characterization of the monoliths, and
10. Communicates the difference between an *observation* and an *inspection,* where appropriate.

7.0 REFERENCES

BHI, 2002, BHI-00139, Rev 4, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2005, BHI 0000X-DC-W0001, Rev. 6, *Supplemental Waste Acceptance Criteria for Bulk Shipments to the Environmental Restoration Disposal Facility,* Bechtel Hanford, Inc., Richland, Washington.

DOE-RL, 2001, DOE/RL-99-89, Rev. 1, *Remedial Design Report and Remedial Action Work Plan for the K Basins Interim Remedial Action*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

FH, 1997, HNF-SD-SNF-TI-052, Rev 0, *K Basins Debris Inventory*, Fluor Hanford, Richland, Washington.

FH, 2005a, *End Point Criteria for the K Basins Interim Remedial Action*, HNF-20632, Rev. 0, Fluor Hanford, Richland, Washington.

FH, 2005b, *Sampling and Analysis Plan for the 105-K East Basin Monoliths*, KBC-24414, Rev. 0, Fluor Hanford, Richland, Washington.

Figure 1. Qualified Process Overview

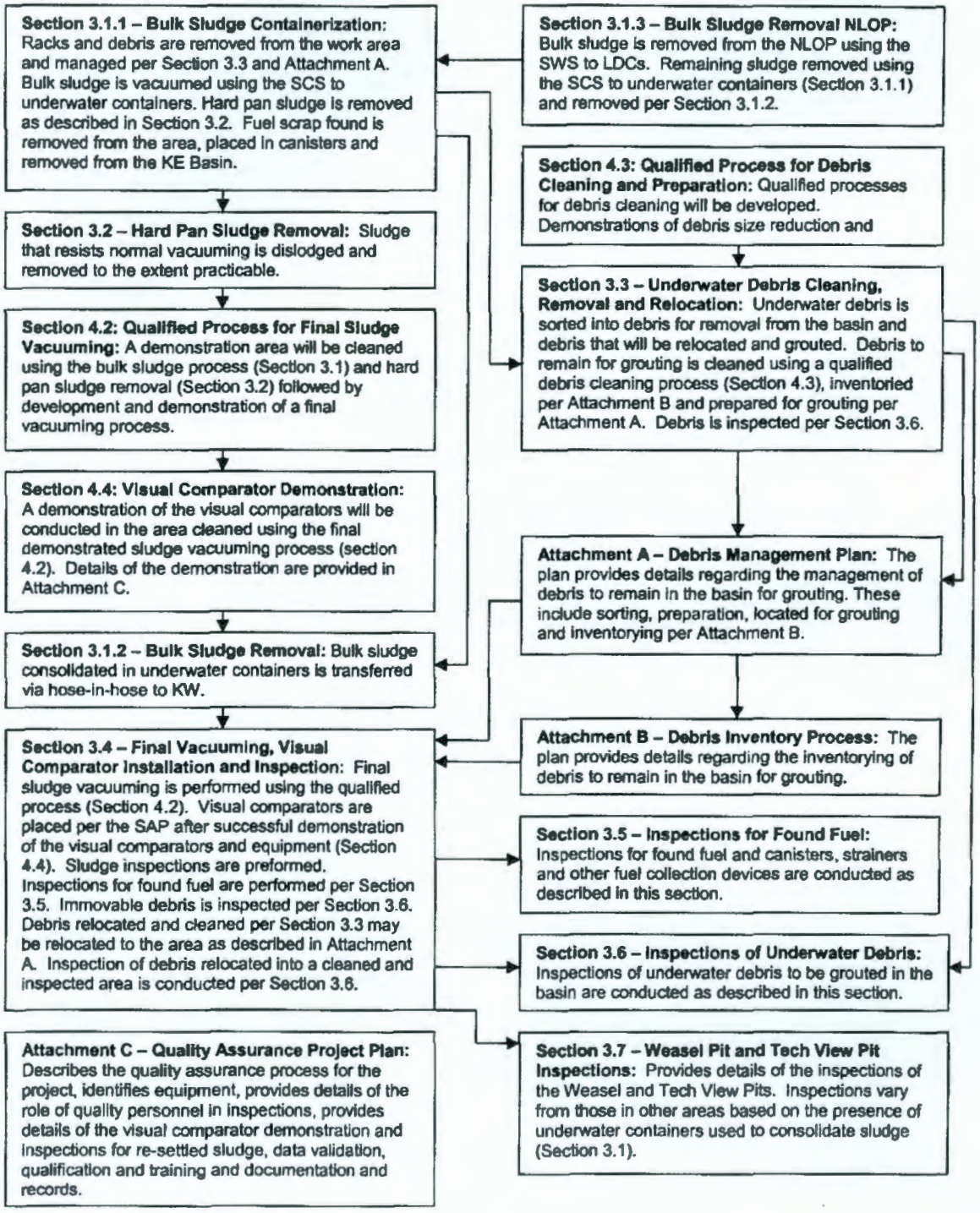


Figure 2. Qualified Process Implementation

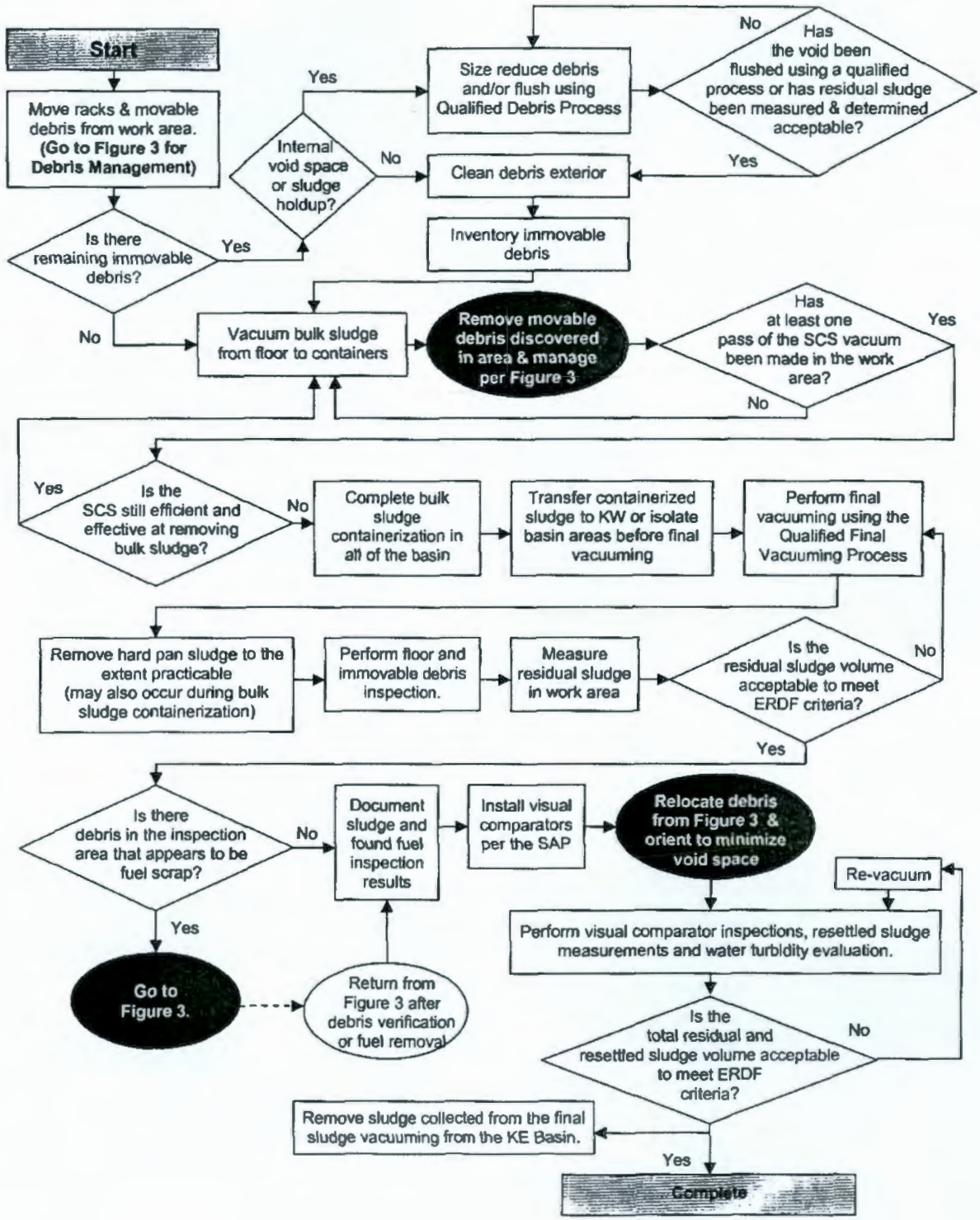


Figure 3. Debris Sorting and Preparation

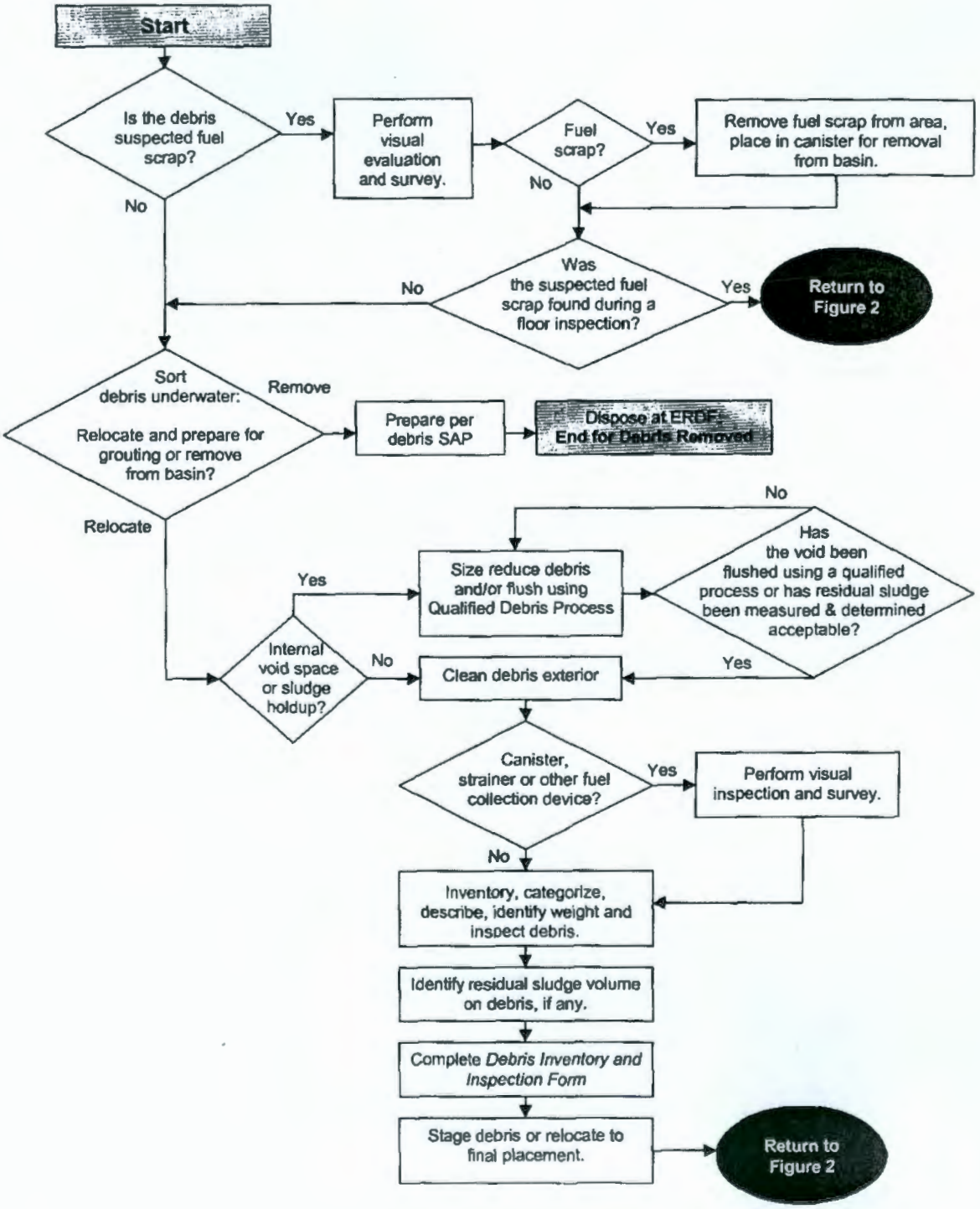


Figure 4. KE Basin Floor Inspection Form

Location and Conditions	
1. Date:	**2. Location:**
3. Monolith No.:	**4. Inspection area size:** (ft^2) _____ (to be prepared by Waste Services)
5. Video/Still Photo: ☐ Video ☐ Still photo	**6. Video or film identification:** (number or other)

7. Visibility:

a. ☐ Yes ☐ No Was the entire floor area within the location described above visually inspected for sludge and found fuel? (If no, explain why and the limits of the inspection. [e.g., immovable object])

b. ☐ Yes ☐ No Were remote devises, e.g. underwater lights and TV camera needed to perform the inspection of the basin floor?

c. ☐ Yes ☐ No At the time of inspections was the basin water visual acuity such that a 0.08 cm (1/32 in.) black line could be seen on an 18% neutral gray card?

Sludge Inspection – Final Vacuuming

8. Floor residues:

a. ☐ Yes ☐ No Were visible sludge residues present? (If No, go to question 9.)

b. ☐ Yes ☐ No Were residues present in a measurable amount? (for example hard pan or sludge in inaccessible areas) (If No, go to question 9.)

(If yes, identify the number of areas [c.] and provide vertical and horizontal extent of residues in the inspection area [d.] and total volume [e.].) (If more than two areas of residue exist in an inspection area, attach additional sheets.)

c. Number of areas with sludge residues? _____

d. Residues estimated area (inches): (to be prepared by Waste Services)

Length: _____ x Width: _____ x Depth: _____ = Volume: _____ in^3

Length: _____ x Width: _____ x Depth: _____ = Volume: _____ in^3

e. Total estimated residue volume: (measurements or estimates) _____ in^3

f. Sludge residue location(s):

9. Debris residues:

a. ☐ Yes ☐ No Is debris present in the inspection area? (If No, go to question 10.)

Note: Each debris basket or item must have completed *Debris Inventory and Inspection Form* Figure B-1). If a form has not been completed it must be completed at this time.

b. ☐ Yes ☐ No Are the debris surfaces clean of visible sludge? (If No, estimate the volume of sludge residues on debris or re-clean.)

c. Estimated volume of sludge (to be prepared by Waste Services): _____

Page 2. KE Basin Floor Inspection Form

Found Fuel Inspection		
10. Fuel Examiner: (Individual familiar with fuel scrap visual characteristics participating in visual inspection)		
Name (Print):	Signature:	Date:
11. Inspection result:		
a. ☐ Yes ☐ No Is there debris that visually appears to be fuel scrap? (If yes, identify dose survey number used to determine if the item(s) is debris or fuel.)		
b. Survey No.:_____		
c. ☐ Yes ☐ No Are fuel canisters, strainers or other fuel collection devices present in the inspection area? (If No, go to end.)		
d. ☐ Yes ☐ No Have canisters, strainers or other fuel collection devices been inventoried, inspected and surveyed and documented on a *Debris Inventory and Inspection Form*? (If No these actions must be completed on at this time.)		
e. ☐ Yes ☐ No Based on a, b, c and d above, is there any fuel scrap within the location described?		
Primary Custodian:		
Name (Print):	Signature:	Date:
Signatures		
Operations Field Work Supervisor:		
Name (Print):	Signature:	Date:
Waste Services: (signature for measurements, calculations and information in items 8.d., 8.e. and 9.c.)		
Name (Print):	Signature:	Date:

Debris Management Plan

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This plan provides details of the 105-KE Basin underwater debris management processes described in the *Qualified Process to Achieve End Point Criteria*, Section 3.3. Underwater debris includes items such as equipment, pumps, hoses, fuel racks, strainers, filters, and other miscellaneous items. Debris that is suitable for grouting and can be adequately characterized will be washed, inventoried and relocated for grouting. Debris that is not suitable for grouting or which cannot be characterized adequately will be washed and removed from the basin for characterization and disposal.

This plan describes:

- The process to inventory newly identified small debris uncovered during bulk sludge containerization that will remain in the basin,
- The bases for sorting debris for removal or relocation and the sorting requirements for debris to be grouted in the basins to support characterization,
- Inspections and surveys of fuel canisters, sludge strainers and other fuel collection devices, which have the potential to contain fuel scrap and will be grouted in the basin,
- Debris size reduction for debris to be grouted in the basin to minimize void spaces, expose internal spaces in equipment to enable sludge removal or inspection, and ensure basin debris height[4] does not exceed 48 inches (unless approved by KBC Engineering),
- A description of the cleaning process to be used to remove sludge from debris prior to relocation for grouting,
- A description of the requirements to relocate debris from within the monolith cut lines for grouting,
- Debris inventory requirements for debris to be grouted in the basin to support the radiological characterization of non-porous and porous debris, and basin weight calculations for transportation,
- Identification of characterization requirements for disposal of debris removed from the basin.

2.0 DEBRIS MANAGEMENT

2.1 INVENTORYING FOUND DEBRIS

The recognized list of KE Basin debris is documented in the *K-Basins Debris Inventory* (FH, 1997) and subsequent updates. During vacuuming additional debris will be uncovered that may require placement into an inventory system. Debris that will remain for grouting will be identified on a *Debris Inventory and Inspection Form* (Attachment B, Figure B-1). Debris that will be removed from the basins, including but not limited to found fuel, will be segregated from debris that will remain in the basin.

[4] Debris placed in pits may exceed 48 inches in height since pits will be filled to nearly the top with grout.

2.2 SORTING DEBRIS FOR REMOVAL OR GROUTING

Debris that does not conform to the ERDF WAC or cannot be treated to meet WAC requirements through macro-encapsulation must be identified and removed. Such items include but are not limited to:

- fuel,
- debris with void spaces that can not be adequately cleaned of sludge or verified to contain no sludge,
- dangerous waste debris for which grouting is not the accepted treatment technology to comply with Land Disposal Restrictions (LDRs) [5],
- debris that cannot be adequately characterized for grouting or is not characterized according to the *SAP for the 105-K East Basin Monoliths* (FH, 2005b),
- debris with void spaces that may result in unacceptable waste form stability or free liquids (i.e., debris with void spaces that grout will not displace is bounded as rack pipes with a total 70 ft^3, while that of the remaining debris is estimated to be less than 5.3 ft^3).

Debris that will remain for grouting has been divided into two primary categories for characterization purposes: non-porous debris and porous debris.

- *Non-porous radioactive debris:* Debris materials where radionuclide contamination is affixed on the surface such as metal, plastic, rubber, and glass.
- *Porous radioactive debris:* Debris material where radionuclides could penetrate the material surface such as fabric, concrete, wood, and paper with the exception of intact or removed basin floor or wall material.

Porous and non-porous debris are characterized separately as described in the *SAP for the 105-K East Basin Monoliths*. Therefore, porous and non-porous debris shall be segregated into separate baskets to the extent practicable to enable inventory estimates for each to support characterization. For each of these waste streams to remain in the basin for grouting characterization must be completed.

Note: If porous debris and non-porous debris that is to remain for grouting is not segregated into separate baskets, debris inventories for each basket must reflect the amount of non-porous and porous debris in each basket.

2.3 INSPECTING FUEL CANISTERS, STRAINERS AND OTHER FUEL COLLECTION DEVICES

Fuel canisters, sludge strainers, or other fuel collection devices, which have the potential to contain fuel scrap shall be examined and surveyed by Operations to ensure they contain no found fuel. Evaluations shall be documented on *Debris Inventory and Inspection Forms* (see Attachment B, Figure B-1). Dose surveys using an RO-7 probe or equivalent shall be collected using standard survey forms and referenced on *Debris Inventory and Inspection Forms*.

[5] Lead is the primary dangerous waste debris that has been identified. Light bulbs may also be found in the KE Basin. No dangerous waste debris for which grouting (macroencapsulation under 40 CFR 268.45) is not the accepted treatment technology has been identified.

Instruments used in dose surveys shall conform to the field instrument performance requirements in Table A-1.

Table A-1. Field Instrument Performance Requirements.[a]

Measurement	Measurement Method	Action Level/ Detection Limit	Accuracy Requirement	Precision Requirement
Dose Rate	Bicron microrem meter or ion chamber	Lower 5% of scale range	In accordance with manufacturer specifications.	In accordance with manufacturer specifications.
a – Adapted from the *SAP for the KE Basin Monoliths*, Table 1-6.				

2.4 DEBRIS SIZE REDUCTION AND ORIENTATION FOR GROUTING

Debris in the basin can be grouted in place if characterized and prepared to meet end point criteria for underwater debris. Size reduction is primarily required to remove void spaces, ensure sludge is removed from internal spaces and to ensure debris is adequately encapsulated in the grouted basin (i.e., is generally less than 48 inches in height from the basin floor after relocation for grouting in the basin[6]). Removal of void spaces minimizes the potential for basin water to become entrapped in debris during grouting and ensures that sludge that may be within void spaces can be cleaned from the debris surface.

The total ungrouted void space of debris rack pipes was estimated to be a total of 70 ft^3, while that of the remaining debris was estimated to be less than 5.3 ft^3 (FH, 2005b). Debris shall be size reduced or oriented for grouting to ensure that these estimated volumes are not exceeded.

2.5 DEBRIS CLEANING PRIOR TO RELOCATION

Debris shall be cleaned using a qualified process as described in the *105-KE Basin Qualified Process for Achieving End Point Criteria*, Section 4.3, *Qualified Process for Debris Cleaning and Preparation*. Debris shall be cleaned and inspected prior to relocation to an area of the basin floor that has been cleaned using final vacuuming according to the process described in the *105-KE Basin: Qualified Process to Achieve End Point Criteria,* Section 3.3 and 3.6. If debris is relocated to a previously final-vacuumed floor area prior to cleaning, inspection of the debris and floor area affected will be necessary and re-vacuuming of the floor may be necessary based on the inspection result.

2.6 DEBRIS RELOCATION FOR GROUTING

The grouted sections of the KE Basin will be cut into segments prior to transportation and disposal at ERDF. Basin cut lines (Figure A-1) will be hydrolased or otherwise decontaminated prior to grouting to reduce exposure at the grout/concrete interface after removal. The debris must be managed to maintain cut lines free of debris and to achieve the appropriate setback of debris prior to grouting. Debris to be grouted in the basin shall be positioned as follows:

- not in cut lines (if positioned prior to hydrolasing),

[6] Debris placed in pits may exceed 48 inches in height since pits will be filled to nearly the top with grout.

- a minimum of approximately 2 feet from the surface of any side of the solidified waste form after cutting (i.e., outer basin concrete side or cut line), and
- be stacked no higher than 48", except in pits. Exceptions will be approved by KBC Engineering on a case-by-case basis and documented on the *Debris Inventory and Inspection Form* (Attachment B, Figure B-1).

Final debris placement shall be confirmed with KBC Engineering prior to placement to ensure the appropriate distribution of weight in the basin monoliths.

2.6.1 Relocating Aluminum for Grouting

Aluminum has the potential to generate hydrogen under certain grouting conditions (PNNL, 2005). The primary sources of aluminum are empty fuel canisters, poles, and ID plates used during the fuel segregation project. To mitigate the potential for hydrogen generation the following should be performed[7]:

- Aluminum, especially the fuel canisters, is not stacked on top of one another. This will prevent over-concentrating the aluminum metal inventory over a small surface area of the basin floor.
- Aluminum should be distributed across the area of the basin to the extent practicable to avoid regions with high aluminum surface area concentrations (exceed 33 m^2 of aluminum surface area per m^2 of basin floor area).
- Based on assumptions used in the model, aluminum long handled tools should be placed horizontally on the basin floor.

2.6.2 Relocating Activated Metal for Grouting

Activated metal content of a monolith will not be controlled, but rather a maximum radionuclide inventory stated in the *SAP for the 105-K East Basin Monoliths*, Table 2-1 will be apportioned to each monolith such that when summed it will equal the total inventory presented on the table. The stated quantity of radionuclides is the maximum amount from activated metal that may be resident in the K East Basin after found fuel and sludge removal as calculated per the *Estimate of Activated Metal in K East Basin Debris* (FH, 2005d).

Therefore, activated metal that may be identified should not be collected into any single basket or other container and should be distributed across the area of the basin to the extent practicable. For activated metal that previously has been collected in canisters or other containers, the collection containers should be distributed in the basin and not consolidated in any one monolith section.

2.7 DEVELOPING DEBRIS INVENTORY FOR GROUTED DEBRIS

Each grouted monolith section that is disposed of at ERDF must identify the radionuclide source term of the monolith to determine conformance with the WAC. The source term for each monolith is developed from the sum of the radioactivity contributed by residual sludge, contaminated debris, and contaminated concrete (intact or as hydrolase spoils). To accurately

[7] The following were derived from *Potential for Generation of Flammable Mixtures of Hydrogen from Aluminum-Grout Interactions in the K Basins during Basin Grouting* (PNNL, 2005) Section 2.0 *Assumptions*, Section 5.0 *Conclusions* and Attachment A.

develop the debris source term for each monolith, an inventory of contaminated debris that will be grouted must be developed and maintained. Inventory information is required for non-porous debris and porous debris since they are characterized separately (FH, 2005b). A debris inventory process to support the collection of appropriate debris information is described in the *KE Basin Debris Inventory Process*, Attachment B and shall be implemented for all debris placed in the basin for grouting.

Note: It is recognized that a small quantity of radioactive debris left in the basin may not be on an inventory or characterized. This debris is typified by small and/or irregular items and extreme measures to re-inventory miscellaneous items which may already be in baskets, or inventory small debris is not the focus of the inventory process. These small items that do not get inventoried is expected to be <1% of the radioactive debris surface area in a monolith as determined by visual examination (FH, 2005b).

Debris inventories shall be performed in accordance with quality processes and work instructions in Attachment B.

2.8 DISPOSAL OF DEBRIS REMOVED FROM THE BASIN

Debris removed from the basin shall be cleaned and disposed of in accordance with the *Sampling and Analysis Plan for K Basin's Debris* (FH, 2001).

3.0 REFERENCES

FH, 1997, *K-Basins Debris Inventory*, HNF-SD-SNF-TI-052, Fluor Hanford, Richland,

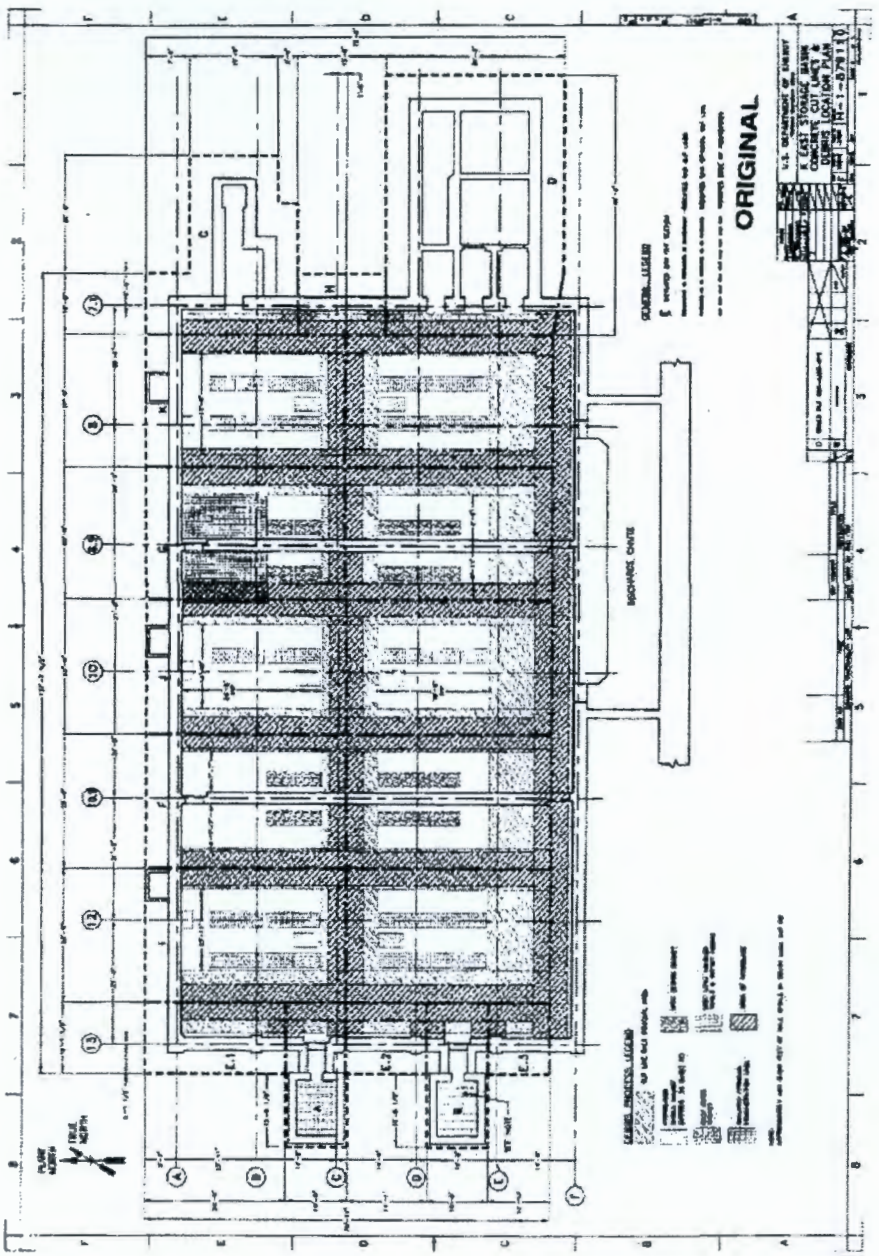
FH, 2005, *Sampling and Analysis Plan for K Basin's Debris*, HNF-6495, Rev. 2, Fluor Hanford, Richland, Washington.

FH, 2005b, *Sampling and Analysis Plan for the 105-K East Basin Monoliths*, KBC-24414, Rev. 0, Fluor Hanford, Richland, Washington.

FH, 2005d, *Estimate of Activated Metal in K East Basin Debris*, KBC-23699, Fluor Hanford, Richland, Washington.

PNNL, 2005, *Potential for Generation of Flammable Mixtures of Hydrogen from Aluminum-Grout Interactions in the K Basins during Basin Grouting*, PNNL-15156, Battelle Pacific Northwest National Laboratory, Richland, Washington.

Figure A-1. Conceptual KE Basin Cut Lines. The conceptual final configuration of the basin prior to grouting including debris basket locations, floor hydrolasing areas and cut lines is identified on drawing H-1-87911, *K East Storage Basins Concrete Cut Lines & Debris Location Plan* (reduced version provided below). The actual volume and placement of debris and hydrolase spoils may vary from that depicted in this figure. Hydrolase spoils disposition will include use of one or more pits and may include the basin.



DEBRIS INVENTORY PROCESS

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this plan is to describe the debris inventory process for debris that will be left in the 105-KE Basin for grouting. The debris inventory collects information required in the *SAP for the 105-K East Basin Monoliths* (FH, 2005b) to support characterization of debris grouted in the basin and supports verification of end point criteria for underwater debris and found fuel.

Above water debris and underwater debris removed from the basin for disposal at the ERDF are not part of this inventory.

1.2 BACKGROUND

The KE Basin had a significant volume of debris on the floor. Debris is defined as anything (e.g., equipment and material) that is over 0.25 inches in largest dimension, is not a permanent structure within the basin (i.e., in the basin water or under the grating of either the basin or one of the adjacent pits), is not used for current or planned operations or maintenance activity, and is not fuel scrap or sludge. Debris includes the following:

- Process equipment
- Activated metal debris
- Fuel storage equipment including empty fuel canisters, canister lids and ID plates
- Structural steel such as fuel storage racks and bulkheads
- Piping and piping components
- Miscellaneous debris consisting of an assortment of commodities and consumables such as electrical cables, light fixtures, tools, brushes, and personnel protective equipment (PPE).

Grout will be poured into the basin after the basin and debris is prepared and the grouted monolith will be cut into sections (monoliths) and disposed of at the ERDF. Found fuel, sludge, and portions of the debris will be removed prior to the addition of grout into the basins. Debris that remains in the basin will be grouted in place and removed within the monoliths to ERDF. The monoliths including any encapsulated debris must meet the ERDF WAC (BHI, 2002).

The bases for establishing what debris can be left in the basin for grouting is the ability to effectively remove sludge, meet the ERDF WAC, support debris distribution recommendations for aluminum, and support activated metal assumptions used to develop the waste characterization. Requirements to inspect and inventory debris that will be grouted in the KE Basin are described in the *SAP for the 105-K East Basin Monoliths*. The processes included in this document were developed to prepare the basin monolith to meet the ERDF WAC and therefore meet the *End Point Criteria for the K Basins Interim Remedial Action* (FH, 2005a).

The methodologies for developing radiological inventories of contaminated debris are identified in the *SAP for the KE Basins Monolith* as follows:

Radionuclide inventories for racks that remain in the basin for grouting are developed through the derivation of contamination per surface area (Ci/ft^2) (since contamination is a surface phenomena) followed by extrapolation of the value to the surface area of racks in the monolith

segments. The estimated surface area of racks is developed through inventories and measurements and/or engineering information.

Remaining non-porous debris and porous debris is characterized separately but using similar methods to determine surface loading or other acceptable unit factor where a representative amount of debris is removed from the basin, packaged and characterized using the processes described in the *SAP for K Basin's Debris*, (FH, 2005) which is used for debris removed from the basin for disposal at ERDF. The data is then extrapolated to like non-porous or porous debris remaining in the basin. The estimated amount of non-porous and porous debris is developed through inventories and use of measurements and/or engineering information.

2.0 METHODOLOGY

Debris will be inventoried to obtain sufficient information to implement the measurement and inventory processes described in the *SAP for the 105-K East Basin Monoliths* and prepare waste stream profiles for each monolith that are acceptable to ERDF.

Debris will be inventoried by basket or by debris item (for items not placed in baskets) using the *Debris Inventory and Inspection Form* (Figure B-1). Details of basket contents will be identified on Figure 1 and the *Debris Inventory Continuation Form* (Figure B-2) if additional space is needed.

The inventory information collected will include the following:

1. Basket Number or Debris Item Number (for larger debris not managed in baskets):
2. Location: Identification if the debris basket or item is being placed in a final location for grouting. If the location is the final location enter the location that best identifies the location of the debris basket or item to enable location within a specific monolith.
3. Basin Water Visibility: Identify if remote devises (e.g. underwater lights and TV camera) were needed to perform the inspection of the debris. Enter the result (yes/no) if at the time of inspections the basin water visual acuity was such that a 0.08 cm (1/32 in.) black line could be seen on an 18% neutral gray card.
4. Description: Physical description of debris item or items (e.g., canister, pump, metal pipe, rubber hose, fuel element springs, spacers, clips, etc.) Like items listed may be combined provided the number of items is included (e.g. 20 metal pipes). Include weight information and units of weight.
5. Category: (i.e., non-porous or porous debris) Enter the estimated percentage by volume of non-porous and porous debris. (Note: if baskets of mixed non-porous and porous debris are identified, information on this form must be described separately to support characterization and enable tracking of porous and non-porous debris in each monolith.)
6. Canister, strainer or other fuel collection device? (yes/no)
   a. If "Yes" are visual inspections and dose survey complete to ensure no fuel? (yes/no)
   b. Survey Number: (Dose survey of canister)
   c. Identify if found fuel was identified through the survey.

d. Identify if found fuel was removed from the canister, strainer or other fuel collection device.

KBC Primary Custodian: Acceptance of inspection and dose survey verifying no fuel.

Note: Survey instruments used shall be identified on the survey form and include the calibration, if applicable.

7. Material characteristics:

   a. Metal? (yes/no) aluminum, lead, or other

   b. Light bulb? (yes/no) number to be provided as well as a description of type if readily known (e.g., incandescent, mercury vapor, or fluorescent)

   c. Batteries? (yes/no) (Type if readily known (e.g., Carbon-Zinc [i.e. household], Ni-Cad)

8. Prohibited Items:

   Are there prohibited items (as listed in Attachment A, *Debris Management Plan*, Section 2.2) in the basket or debris item? (yes/no) Prohibited items must be removed. This item is to be completed and initialed by Operations.

9. Physical characteristics:

   a. Dimensions: Provide measurement or best estimate of the debris item or debris basket dimensions. If the dimensions are for a basket of debris the dimensions should include the volume of debris and not simply the dimensions of an empty or partially empty basket.

   b. Weight: Weight may be calculated from dimensions and material type, actual measurement or may be obtained from other sources (i.e., design or other information)

   c. External surface area: The external surface area is required for only racks that will remain for grouting. Information may be calculated from dimensions or from other sources (i.e., design or other information)

   d. Internal void volume: (yes/no) If present, to be calculated from available information to support potential sludge or void space estimations

Note: Debris inventory information may be collected on an individual debris basis or on an aggregated unit basis, such as a debris basket, provided consistent methods are employed. Therefore if a basket contains debris similar to another basket that has already had weight estimated, the same estimates may be used. A reference to the comparable basket should be included on the *Debris Inventory and Inspection Form*.

Note: Physical measurements, calculations or referenced material to develop physical characteristic information shall be provided by KBC Waste Services. Measurements shall at a minimum include the following information: If measurements are used, note the date of measurement, material identification and location where measurement was taken, person taking the measurements and instrument and calibration, if applicable. See the *SAP for the 105-K East Basin Monoliths*, Section 3.2.5, *Physical Measurements* and 5.2.3, *Instrument Calibration and Calibration Frequency*. Field instrument performance requirements are provided in Table B-1. Field instruments including weigh scale, tapes, and rods will be calibrated in accordance with quality processes and work instructions

that satisfy the fundamentals of the quality criteria expressed in 10 CFR 830.122(e). Calibration does not apply to tapes and rods used for length measurement.

10. Sludge Inspection: Inspections of debris for sludge shall be noted by Operations in a and b of this section. The volume of sludge residues (if any) determined by KBC Waste Services shall be included in item c.

    a. Has sludge been removed from void spaces to the maximum extent practicable? This question is considered not applicable (N/A) if there are no void spaces. If the debris void space has been cleaned to the extent practicable and residues remain the residual volumes of sludge shall be determined. The item may require additional cleaning based on KBC calculations.

    b. Are the debris surfaces clean of visible sludge? If No, KBC Waste Services shall determine volume of the sludge residues on debris. The item may require additional cleaning based on Waste Services calculations.

    c. Sludge residue volume: The volume of sludge residue (if any) on or within void spaces of debris shall be noted by KBC Waste Services.

11. References: Drawings, engineering document, or other documents used to assist in debris surface area or weights, if used.

12. Comments/Miscellaneous: Material not fitting the above categories may be described here. Case-by-case exceptions granted by KBC Engineering for debris that exceeds the 48 inch height limit for debris in the basin shall be noted in this area (see *Debris Management Plan*, Section 2.6).

Table B-1. Field Instrument Performance Requirements.

Measurement	Measurement Method	Action Level/ Detection Limit	Accuracy Requirement	Precision Requirement
Length	Tapes, Rods	Lower 5% of scale range	In accordance with manufacturer specifications.	In accordance with manufacturer specifications.
Weight	Weigh scale	Lower 5% of scale range	In accordance with manufacturer specifications.	In accordance with manufacturer specifications.
a – Adapted from the *SAP for the KE Basin Monoliths*, Table 1-6.				

Debris may be inventoried before, after or at the time of final placement in a location that has received final vacuuming. Therefore the location of final placement may not be known at the time of completing the *Debris Inventory and Inspection Form* (Figure B-1, Item 2). If the debris basket or item subject to the inventory is not being placed in its final location and is being staged for final placement, this should be noted on the *Debris Inventory and Inspection Form* (in the space provided). Thereafter staged baskets and items will be tracked at the time of movement to its final location using the *Debris Relocation and Inspection Form* (Figure B-3).

The Operations Field Work Supervisor and KBC Waste Services shall sign the *Debris Inventory and Inspection Form*. Copies of debris inventory forms shall be provided to KBC Waste Services. Forms will be used to support characterization of each monolith. *Debris Inventory Forms* will be retained as described in the *Quality Assurance Project Plan*, (Attachment C, Section 5.0).

3.0 REFERENCES

BHI, 2002, *Environmental Restoration Disposal Facility Waste Acceptance Criteria,* BHI-00139 Rev. 4, Bechtel Hanford Inc.

DOE-RL, 2001, *Remedial Design Report and Remedial Action Work Plan for the K Basins Interim Remedial Action,* DOE/RL-99-89 Rev. 1, U.S. Department of Energy, , Richland Operations Office, Richland, Washington.

FH, 1997, *K Basins Debris Inventory,* HNF-SD-SNF-TI-052 Rev. 0, Fluor Hanford, Richland, Washington.

FH, 2005, *Sampling and Analysis Plan for K Basin's Debris,*HNF-6495, Rev. 2, Fluor Hanford, Richland, Washington.

FH, 2005a, *End Point* Criteria *for the K Basins Interim Remedial Action*, HNF-20632, Rev. 0, Fluor Hanford, Richland, Washington.

FH, 2005b, *Sampling and Analysis Plan for the 105-K East Basin Monoliths*, KBC-24414, Rev. 0, Fluor Hanford, Richland, Washington.

Figure B-1. Debris Inventory and Inspection Form

DEBRIS INVENTORY AND INSPECTION FORM
(Example)

1. Basket/Item No.:	2. ☐ Yes ☐ No **Is the debris basket or item in its final location?** (If Yes, complete a). a. Location: _____

3. Basin Water Visibility:

a. ☐ Yes ☐ No Were remote devises (e.g. underwater lights and TV camera) needed to perform the inspection of the debris?

b. ☐ Yes ☐ No At the time of inspections was the basin water visual acuity such that a 0.08 cm (1/32 in.) black line could be seen on an 18% neutral gray card?

4. Description: (Identify and describe the debris item(s). Attach *Debris Continuation Sheets* (Figure B-2) as needed. Weight may be provided on an aggregate basis for a debris basket.

Description	**Weight** (Identify units)

5. Category:
(identify percentage of each) ☐ Non-porous: _____ % ☐ Porous: _____ %

6. Canister, strainer or other fuel collection device? ☐ Yes ☐ No
(If No go to 7. If Yes answer a. b. c. and d.)

a. ☐ Yes ☐ No Visual inspection and dose surveys complete?

b. Survey No.: _____

c. ☐ Yes ☐ No Was found fuel identified? (If Yes answer d.)

d. ☐ Yes ☐ No Was found fuel relocated from the area?

Primary Custodian:

Name (Print):	Signature:	Date:

Page 2. Debris Inventory and Inspection Form

7. Material characteristics: (Complete a – c for item(s) described in box 4.)
a. ☐ Yes ☐ No Metal? (circle) aluminum, lead, other

b. ☐ Yes ☐ No Light bulbs? (type [if readily known], number)

c. ☐ Yes ☐ No Batteries? (type [if readily known], number)

8. Prohibited Items: Are there prohibited items (as listed in Attachment A, Debris Management Plan, Section 2.2) in the basket or debris item? (to be completed by Operations)

☐ Yes ☐ No Initials: _____

9. Physical characteristics: (to be provided by Waste Services) (If for a single debris item provide information for that item. If information is for a basket of debris summarize information from the *Debris Continuation Sheet.*

If physical measurements are used, identify the person taking the measurement(s), date, and instrument(s) and calibration (if applicable) for each type of measurement. The weight and surface area may be calculated from design or other information, measured, or determined by measuring like or similar items. Debris inventory information may be collected on an aggregated unit basis, such as a basket provided the contents are similar. If the estimated weight from another basket is used as the basis for the basket weight, identify the basket number.

a. Dimensions: (Identify the dimensions for the debris item or basket. For a debris basket, this should reflect the estimated volume of debris in the basket.)

b. Total weight: units:
c. Total surface area: (only required for fuel racks)
(ln^2)

d. Void:
☐ Yes ☐ No Internal void spaces? (if yes, estimate volume for other than rack pipes):

10. Sludge Inspection: (volume estimates to be prepared by Waste Services)
a. ☐ Yes ☐ No ☐ N/A Has sludge been removed from void spaces to the maximum extent practicable? (N/A if no void spaces)
(if no estimate sludge volume or re-clean):
b. ☐ Yes ☐ No Are the debris surfaces clean of visible sludge? (If No, estimate sludge residues on debris or re-clean.)
c. Sludge residue volume: _____

11. References:

12. Comments/Miscellaneous: (Provide description of debris not matching above categories)

Operations Field Work Supervisor:

Name (Print):	Signature:	Date:

Waste Services: (signature for measurements, calculations and information in items 7, 8.c. and 9 when used)

Name (Print):	Signature:	Date:

Figure B-2. Debris Inventory Continuation Form

Debris Inventory Continuation Form
Debris Basket

Basket No.:

Description	Weight (identify units)

The weight may be calculated from design or other information, measured, or determined by measuring like or similar items.

Figure B-3. Debris Relocation and Inspection Form

(Only for use on debris baskets or individual debris items for which a *Debris Inventory and Inspection Form* has been completed.)

Basket/Item No.	Location	Monolith No.	Date	Debris free of visible sludge	FWS [a] Initials/Date
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	
				☐ Yes ☐ No	

[a] FWS – KBC Field Work Supervisor

Quality Assurance Project Plan

DEFINITIONS

Clean: The as-left condition after the level of sludge remaining on the floor of the KE Basin is less than or equal to that specified in the *SAP for the 105-K East Basin Monoliths* and related end point criteria have been approved by DOE-RL and EPA. The targeted amount is an average depth of 0.05 inches (0.127cm), including any resettled sludge.

Prohibited Debris: Any debris that must be removed from the basin in accordance with the *Debris Management Plan.*

Remote Inspection Qualification Standard: A 1/32inch (0.8mm) black line on an 18% neutral gray card.

Direct Method: The direct visual inspection method is used when access is sufficient to place the eye with in 24 inches of the surface to be examined, and at an angle not less than 30 degrees to the surface to be examined. Mirrors may be used to improve the angle of vision, and aids such as magnifying lenses may be used to assist in the inspection.

Remote Method: Remote visual inspection methods include use of visual aids such as mirrors, telescopes, borescopes, fiber optics, cameras, video equipment or other suitable instruments. Remote methods will be typically used in the inspections described herein.

Visual Comparator: A series of stepped disks, plates or machined increments with different diameters or dimensions. Comparators are placed in the basin after sludge removal from an area to visually estimate the depth of resettled sludge through comparisons. The critical characteristics are flatness and height. Two types of comparators will be used. The thickness of a type 1 visual comparator will be: step one shall be 0.030 inches, step two shall be 0.050 inches, and step three shall be 0.075 (or similar). The thickness of a type 2 visual comparator will be: step one will be 0.10 inches, step two will be 0.125 inches and step 3 will be 0.15 inches (or similar). Tolerance shall be + 0.000 -0.003 inches. The flat or land between the step shall be 0.80 inches with a tolerance of ± 0.06 inches for each flat or land. The comparators shall be flat with a tolerance of ± 0.004 inches. Each comparator shall be numbered.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this Quality Assurance Project Plan (QAPjP) is to provide guidance to the QAE/I describing the methods for qualification of the remote visual inspection process, the qualification of the sludge and debris cleaning processes and the inspection process for the validation of the end point criteria of the 105-KE Basin closure activities described in the *105-KE Qualified Process for Achieving End Point Criteria*, Section 2.0.

The processes described in this QAPjP shall be used together with quality assurance processes described in the *SAP for the 105-K East Basin Monoliths* (FH, 2005b), Section 5.0, *Quality Assurance Project Plan.*

This QAPjP applies to QAE/I personnel who review processes developed for sludge removal and debris preparation, perform visual inspections of the as-left condition of KE Basin and for the qualification of the Remote Visual Inspection Process. This QAPjP also applies to Operations and KBC Waste Services personnel that perform work identified in this plan. Specific elements of this process plan include:

- Description of the scope of inspections
- A summary of the primary requirements for inspections
- Description of general QAE/I reviews required for quality implementing processes related to this scope of work
- Identification of equipment related to this scope of work
- Found fuel inspections
- Debris inspections and inventories
- Floor and pit inspections to verify "Cleaned to the extent practicable"
- Description of the visual comparator qualification and demonstration process
- Inspections for resettled sludge
- Data validation
- Qualifications and training
- Documentation and records

2.0 INSPECTION PROCESSES

Inspections and verifications of the KE Basin for the scope of work described in the *105-KE Qualified Process for Achieving End Point Criteria* include:

- Inspections to verify that found fuel has been removed;
- Inspections of canisters, strainers and other fuel collection devices to ensure they contain no fuel scrap;

- Inspections to verify that sludge has been removed from the basin floor and pits to the extent practicable, and where residual sludge cannot be removed it is measured and its volume estimated;
- Inspections of resettled sludge using visual comparators;
- Inspections of debris internal void space flushing or other sludge removal technique to ensure sludge is removed to the extent practicable, and where residual sludge cannot not be removed it is measured and its volume estimated;
- Verification of debris or debris inventory forms to ensure aluminum debris is managed as described in Attachment A, *Debris Management Plan*, Section 2.6.1 and activated metal is managed as described in Section 2.6.2; and
- Verification of completeness of *Debris Inventory and Inspection Forms*.

2.1 REQUIREMENTS

a. Observations, examinations and inspections for found fuel and sludge residues on floor surfaces and debris shall be performed as described herein.

b. Measurements and estimates of sludge residues shall be performed as described herein.

c. Visual comparator inspections and measurements shall be performed by personnel qualified and certified as Level II inspectors satisfying the fundamentals of the FH quality assurance program.

d. Inspections and measurements shall be performed according to the sampling design identified in the *SAP for the 105-K East Basin Monoliths*.

e. The qualification of the remote inspection process shall include personnel qualified and certified as Level II Basic inspectors per the FH quality assurance program.

f. Visual comparators shall not be placed in an area until Operations and KBC Waste Services concur that the area has been cleaned to the extent practicable.

g. Visual comparators used for the validation of the remote inspection process shall have the height/thickness dimension and flatness inspected and documented prior to installation/placement in the basin by Level II inspection personnel per the FH quality assurance program.

h. Placement/location of the visual comparators in the demonstration area and the inspection results shall be documented on the *Visual Comparator Inspection Form* (Figure C-1).

i. Fourteen visual comparators will be placed at the locations specified in the *SAP for the 105-K East Basin Monoliths*, Appendix B. The location of visual comparators in all the pits except the Weasel Pit and Tech View Pit is at the aerial center of the pit. The location of visual comparators for the Weasel Pit and Tech View Pit is at the throat of each pit. If the comparator can not be located as specified, locate the comparator as close as possible and document the actual location. Placements of comparators shall be documented on the *Visual Comparator Inspection Form* (Figure C-1).

j. Photographs or videos shall be taken from above (i.e., near perpendicular to the basin floor surface) and at an angle at least 45 degrees from perpendicular to the basin floor surface to allow differentiation between the two thicknesses. The pictures or video shall be identified as to location and the date and time recorded.

k. Debris inventory information shall be collected as described herein.

l. Field instruments including cameras, weigh scale, tapes, and rods shall be calibrated where applicable, tested, inspected and maintained as described herein.

Note: Calibration and control measures may not be required for rulers, tape measures, levels, and other such devices, if normal commercial equipment provides adequate accuracy.

m. All calculations demonstrating conformance to the waste acceptance criteria shall be performed per the FH quality assurance program.

n. Correction of nonconformances shall be in accordance with quality processes and work instructions per the FH quality assurance program.

o. Basin water visual acuity shall be determined prior to each inspection or series of inspections by determining that a 0.08 cm (1/32 in.) black line can be seen on an 18% neutral gray card below the water surface.

2.2 GENERAL

Surveillances by QA personnel for the purpose of verifying compliance with the qualified process shall be scheduled at least one of every five planned working days commencing upon the completion of bulk sludge containerization or as field conditions warrant.

Surveillances by QA personnel shall also be performed periodically to verify compliance with the implementation of the *SAP for the 105-K East Basin Monoliths.*

2.3 EQUIPMENT

a. Remote inspection qualification stands.

b. Visual comparators.

c. Closed circuit television (CCTV) camera with light. The camera shall be capable of tilting at an angle greater than 45 degrees as determined from perpendicular to the basin floor. The camera system shall be capable of video or still photographs.

d. Poles/Rods used for supporting the CCTV equipment shall be of suitable lengths to extend to the basin and pit floors.

e. Logbook(s).

2.4 FOUND FUEL INSPECTIONS

KBC Operations shall use individuals familiar with fuel scrap visual characteristics to perform inspections to verify that no fuel scrap is present (FH, 2005a). Inspections for found fuel are described in the *105-KE Basin Qualified Process for Achieving End Point Criteria,* Section 3.5.

2.5 DEBRIS INSPECTIONS AND INVENTORIES

KBC Waste Services and Operations shall review the debris cleaning process. If the process is found by Waste Services and Operations to result in debris that meets the debris end point criteria for sludge removal and DOE-RL and EPA concur and approve of the process, the cleaning process will be considered qualified.

Operations shall inspect debris as described in the *105-KE Basin Qualified Process for Achieving End Point Criteria,* Section 3.5, *Inspections of Underwater Debris.*

Operations shall verify aluminum debris is managed as described in Attachment A, *Debris Management Plan*, Section 2.6.1. Verification shall be limited to review of debris inventory forms during routine surveillances.

QAE/I shall perform surveillances of the completeness of *Debris Inventory and Inspection Forms* and *Debris Relocation and Inspection Forms* described in the *Debris Inventory Process*, Attachment B.

2.6 FLOOR AND PIT INSPECTIONS TO VERIFY "CLEANED TO THE EXTENT PRACTICABLE"

KBC Waste Services and Operations shall review the *105-KE Basin Qualified Process for Achieving End Point Criteria,* Section 4.2, *Qualified Process for Final Sludge Vacuuming* to remove sludge to the extent practicable. If the process is found by Waste Services and Operations to result in sludge removal that meets the end point criteria for sludge removal, and DOE-RL and EPA concur and approve of the final vacuuming process, the cleaning process will be considered qualified.

Operations shall inspect areas that have undergone final vacuuming as described in the *105-KE Basin Qualified Process for Achieving End Point Criteria,* Section 3.4, *Final Vacuuming, Visual Comparator Installation and Inspection*

Operations shall inspect the Weasel Pit and Tech View Pit floors and sludge containers after transfer of sludge to KW and upon notification from operations that the pits, containers and any remaining debris have been cleaned to the extent practicable as described in the *105-KE Basin Qualified Process for Achieving End Point Criteria,* Section 3.7.

At the completion of cleaning the entire basin floor and adjoining pits (or isolated areas), the visual comparators will be inspected by QAE/I to determine resettled sludge depth (Attachment C, Section 2.8). Conditions will be documented with video or photography equipment specified in Attachment C, Section 2.3.

2.7 VISUAL COMPARATOR QUALIFICATION AND DEMONSTRATION

The qualification and demonstration of visual comparators is performed by QA as described below.

2.7.1 Qualification of Remote Visual Comparator Inspection Process

a. Assemble the equipment and standards described in Section 2.3.

b. Place the remote inspection qualification standard and the visual comparator under water. The remote inspection qualification standard shall be suspended at or as near as possible to the visual comparator surface to be appraised.

c. Qualification of the remote visual inspection process shall be by demonstrating the ability to detect a 1/32 inch (0.8mm) black line on an 18% neutral gray background using the same artificial lighting that is to be used during the inspection process.

d. Verify the ability of the camera system to pan and to achieve a tilt angle of at least 45 degrees from perpendicular to the basin floor surface.

e. With the CCTV camera at an angle of at least 45 degrees from perpendicular to the basin floor take a picture or video to verify the ability to clearly discern the various heights of the visual comparator and detect the 1/32 inch black line on the visual qualification standard.

f. The viewing distance, the viewing angle, illumination and location of the remote inspection qualification standard shall be typical of all remote inspections. Camera zoom or movement shall be used if necessary to aid in the visual observations and magnify the area of interest.

g. Document the acceptance of the remote inspection method prior to use.

2.7.2 Visual Comparator Demonstration

a. The 10ft X 10ft demonstration area shall be identified by cubicle numbers or other location system.

b. The demonstration area shall be cleared of equipment and debris by Operations.

c. The demonstration area shall be vacuumed to remove sludge and resettled sludge.

d. Operations and KBC Waste Services shall concur that the demonstration area has been cleaned to the extent practicable.

e. After concurrence that the selected placement areas are clean, visual comparators shall be placed and their locations identified on *Visual Comparator Inspection Forms* (Attachment C, Figure C-1). The date and time of placement and the type of comparator(s) (i.e., Type 1 and or Type 2) shall be documented.

f. Upon placement of visual comparators, each shall be inspected by QAE/I to verify that the visual comparator was not damaged during placement and that it is located as prescribed.

g. After 48 hours minimum wait time, the selected areas shall be examined using the validated remote inspection process and the specified acceptance criteria. A total sludge thickness of 0.127 cm (0.05 in.) across the floor (i.e., sludge residue and resettled sludge) is the target maximum depth. Results of inspections shall be identified on Attachment C, Figure C-1, *Visual Comparator Inspection Form.*

h. Photographs and or videos shall be taken as necessary to support the process. This documentation shall be traceable by date, time and location and shall be noted on the *Visual Comparator Inspection Form* (Figure C-1).

2.8 VISUAL COMPARATOR INSPECTIONS FOR RESETTLED SLUDGE

Visual comparator inspections shall only be performed using the qualified and demonstrated process in Sections 2.7.1 and 2.7.2 of this QAPjP.

a. After debris removal activities and final vacuuming of an area is complete the area has been determined to have been cleaned to the extent practicable, visual comparators shall be inspected using the qualified remote inspection process developed in Section 2.7.

b. QAE/I will perform random interim visual comparator inspections after comparator placement in cleaned areas to determine resettling prior to final visual comparator inspections to support operations. Appreciable increases in the observed depth of settled sludge shall be reported to KBC Engineering, KBC Waste Services, and Operations management. Upon completion of sludge removal and transfer to KW, visual comparators shall be inspected by QAE/I for a final verification and documented on Figure C-1.

c. The results of the visual comparator inspections shall be documented using Figure C-1, *Visual Comparator Inspection Form.*

d. Inspections of the visual comparators shall be recorded on still camera or video at a rate of 100% at the time sludge removal end point determinations are made.

e. Photographs and or video recordings shall be controlled and maintained as records. These records shall include the date, time and location of the examination and shall be noted on Figure C-1.

Note: Final resettled sludge measurements are averaged for each bay or pit separately by KBC Waste Services. Residual sludge that could not be removed from the basin floor is totaled with the average resettled sludge. The total average sludge remaining (i.e., residual sludge and resettled sludge) over the KE Basin is targeted at 0.05 inches.

f. Should basin conditions, equipment failures or other factors preclude the inspections as required, the inspections shall be performed at the first opportunity.

3.0 DATA VALIDATION

Weight and length measurements, if used; visual observation and inspection data and monolith inventory data shall be validated as described in the *SAP for the 105-K East Basin Monoliths*, Section 5.4, *Data Review, Validation and Useability* using the forms in the SAP Appendix C. Data shall be evaluated for comparability, accuracy, precision and completeness as described in the SAP, Section 5.1.5. Copies of physical measurement records shall be provided to KBC Waste Services for data validation and KBC Engineering in order to support determination of a monolith inventory. All calculations shall be checked. Records shall be maintained as described in Section 5.0.

4.0 QUALIFICATIONS AND TRAINING

QAE/I shall meet the qualification requirements identified in Section 2.1 of this QAPjP. In addition, QAE/I shall perform the following required reading:

- *End Point Criteria for the K Basins Interim Remedial Action* (FH, 2005a);

- *Sampling and Analysis Plan for the 105-K East Basin Monoliths* (FH, 2005b),
- *105-KE Basin Qualified Process for Achieving End Point Criteria* (this document in its entirety including attachments).

Inspections that are identified as being performed by operations or waste services personnel do not require specialized training in accordance with the FH quality assurance program. These personnel shall be trained in accordance with established Administrative and Operations procedures which are also a part of the FH quality assurance program.

5.0 DOCUMENTATION AND RECORDS

Documentation, records and visual recordings shall be maintained in accordance with a records management program meeting the requirements the FH quality assurance program. and as described in the *SAP for the 105-K East Basin Monoliths,* Section 5.1.6. The organization responsible for generating the visual, measurement, inspection or inventory information shall be responsible for ensuring that the information is managed accordingly. Records include inspection reports, photographs, videos, completed debris inventory forms, and field measurements. Inspection reports, photographs and videos shall be traceable to the location and include date and time of observation or inspection.

Copies of completed and verified forms identified in this plan, or equivalent forms used to document found fuel, sludge, and debris inspections and debris inventory information, and visual comparator placement and measurements shall be provided to KBC Waste Services and KBC Environmental Protection.

6.0 REFERENCES

FH, 2005a, *End Point Criteria for the K Basins Interim Remedial Action*, HNF-20632, Rev. 0, Fluor Hanford, Richland, Washington.

FH, 2005b, *Sampling and Analysis Plan for the 105-K East Basin Monoliths*, KBC-24414, Rev. 0, Fluor Hanford, Richland, Washington.