WASTE STUDY

FOR THE

PLUTONIUM DISPOSITION PROJECT

IN THE K AREA COMPLEX

SK-DA-WM-0001
Revision ~~1~~ B BLW 11/9/06

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1.0 PURPOSE

The purpose of this Waste Study is to provide the overall Waste Management (WM) strategy for the Plutonium Disposition Project which is designated to be constructed and operated in the K Area Complex. The strategy covers both the Demolition and Removal (D&R) phase and the Operational phase. The strategies discussed within are based upon the best available information to date and are subject to revision over time as the project evolves.

This document supersedes the following:

- SK-DA-WM-0001, Revision 0, Waste Study for the Plutonium Disposition Project in the K Area Complex (KAC) issued June 26, 2006.

2.0 INTRODUCTION

The Plutonium Disposition Project will be located at the K Area Complex (KAC) to disposition 13 Metric Tons (MT) of Environmental Management (EM) owned surplus plutonium [1]. The project will utilize a vitrification process to vitrify plutonium into a lanthanide borosilicate (LaBS) glass matrix. This glass will be packaged into bagless transfer cans and placed inside a Defense Waste Process Facility (DWPF) type canister. The canister will be transported to DWPF and filled with High Level Waste (HLW) glass. The DWPF canisters will be stored in the Glass Waste Storage Buildings and later transported to the geologic repository at Yucca Mountain. The plutonium vitrification operations are currently slated for 2012 through 2018. The plutonium disposition project is critical to meet the Department of Energy's strategic goal of providing a responsible resolution to the permanent disposal of the nation's excess high-level radioactive materials and waste; and to enable the cleanup of Environmental Management site by 2025.

The Plutonium Disposition Project will generate waste during the Demolition & Removal (D&R) phase and the Operational phase of the project. The D&R phase will remove excess equipment from the main K reactor building to make room for the installation of the Plutonium Vitrification (Pu-Vit) Facility. D&R of the -20 and -40 areas (both inside and outside the current Contamination Areas) will be required. There is a potential for a variety of waste types to be generated during this phase. The Operational phase will also have the potential to generate a variety of waste types, both from the main process and maintenance activities.

3.0 ROLES AND RESPONSIBILITIES

Design Authority Engineering

- Responsible for maintenance of this study
- Responsible for development of initial Waste Management system design
- Responsible for approval of all documentation related to Waste Management system final design.
- Responsible for addition of requirements associated with this strategy into Facility Design Description and System Design Description documents.

Design Authority Operations

- Responsible for facility implementation of this strategy.
- Responsible for procedure development required to implement this strategy.

Design Engineering Services

- Responsible for design development to meet this strategy.

Analytical Laboratories Project /Nuclear Measurements Section (ALP/NMS) Group

- Responsible for specification and approval of NDA equipment used to implement this strategy.

4.0 WASTE TYPES

The different waste types expected to be encountered during either the D&R or Operational phases of the project are defined below.

A. Clean Waste: waste that reads no more than background when monitored in an area with low background radiation, or <20 dpm alpha, < 200 dpm beta-gamma (includes Green-is-Clean waste)

B. Low Level Waste (LLW): radioactive waste that does not meet any other definition

C. Transuranic Waste (TRU): waste that is contaminated with alpha-emitting Transuranic radionuclides (atomic number > than 92) with half-lives > 20 years, and at concentrations > 100 nCi/g of waste matrix at time of assay. The mass of the waste container or shielding cannot be used in calculating the TRU concentration. However, if stabilization is required of the waste, a reclassification would be performed to determine whether TRU or LLW remains.

D. Hazardous Waste (HW): clean waste that is designated hazardous by South Carolina Hazardous Waste Management Regulations (SCHWMR) and as defined in the Resource Conservation and Recovery Act (RCRA)

E. Mixed Waste (MW): waste that contains both radioactivity and RCRA constituents (heavy metals, solvents, Methyl Ethyl Keytone (MEK), etc.)

F. PCB Waste (PCBW): waste that is contaminated with PCBs (Bulk Product: paint, light ballasts, cables, oils, gaskets, etc.). PCBW could be clean, LLW or also characterized as a Mixed Waste.

G. Mixed TRU Waste (MTRU): waste that is TRU and contains RCRA constituents

H. Low Level Liquid Waste (LLLW): liquid waste that is contaminated with radioactivity (could also contain RCRA constituents and be categorized as Mixed)

I. Liquid Waste (LW): non radioactive liquid waste (could also contain RCRA constituents and be categorized as Hazardous)

J. Beryllium Waste: waste that is contaminated with non-hazardous beryllium waste forms in concentrations requiring specific packaging/labeling (IH limits) and or reporting to the Waste Management Area Project (WMAP) facilities (waste containers with >1g Be)

K. Asbestos Waste: all waste containing, or with the potential to contain, asbestos fibers and which requires disposal at permitted disposal site (friable and nonfriable)

5.0 ASSUMPTIONS

The following assumptions were made in the development of this Waste Study and the overall Waste Strategy for the Plutonium Disposition Project.

D&R:
None

Operations:

1. Waste Management operations are located on -20, except for limited staging space located on -40, and pre-shipment staging at 0' level.

2. For Green Fuel Disassembly (GFD), oxide pellets will be extracted from slender steel pins that are approximately 8 feet in length. Hundreds of these pins are located within a Driver Fuel Assembly (DFA) or Ident-69G, of which 4-7 are stored inside a Core Component Container (CCC). The CCC with contents will be transported from Hanford to SRS enclosed in a DOT Type-B shipping container called the Hanford Unirradiated Fuel Package (HUFP). Prior to start-up of Pu-Vit processing, 13 loaded HUFPs will be moved into the building, and due to their size, will remain in the building until the end of the project. The GFD will be designed to maximize waste being categorized as LLW vs. TRU waste, and certain portions (i.e., HUFP, CCC, and empty DFA/Ident) will be nested as an assembly after removal of the fuel pins, and stored until the completion of material processing. At that time, the assemblies will be removed from the facility for entry into appropriate waste streams or recycled if possible. Based on current knowledge, all assembly components are expected be clean with only minimal contamination potential (i.e., LLW)

for the DFAs/Idents. The pins are expected to be TRU waste, but based on the purity of the contained oxides, will not be Mixed-TRU. The pins will be cut to size that will fit a standard TRU-pail, and will be sent to the Pu-Vit process waste stream.

3. Elevator(s) will be available to move waste containers from between the -20 and the -40 levels of the facility, and to the 0' level for exit through the Pu-Vit Entry Control Facility (ECF) to remote staging while awaiting shipment.

4. Fire suppression will include room sprinkler systems for portions of the process within the Plutonium Vitrification Facility (LW).

5. WM activities will be on a daily, if not 24/7, schedule, and an office area with computer station will be available in WM area.

6. Facility personnel, and not the Nuclear Measurements Section personnel, will operate the NDA equipment, unless special portable assays are requested.

7. WM area is RMA/RBA, no dress out required to perform waste activities once waste has left the individual process areas (contamination areas); even for drum loading (except for use of portable ventilation if needed).

8. Only waste from gloveboxes requires MC&A assays. Waste generated from general process rooms does not.

9. WSI will perform the SNM theft deterrent surveys upon removal of waste containers from MAA.

10. There are no security or MC&A issues associated with establishing MBAs outside of the MAA if required for waste containers staged while awaiting shipment to WMAP.

11. All TRU waste requiring packaging in an SWB will require assay prior to placement in the SWB as it is not practical to model a full SWB for assay (due to uncertain configuration of waste items inside SWBs).

12. All TRU pails, bagged HEPA filters, polyboxes, and drums, including drums direct loaded with waste that would not fit into a 5-gallon pail, will be subjected to assay on a LLW/TRU Waste Assay system.

13. Characterization as MW or MTRU waste (RCRA metal content), or as Beryllium Waste, is based on the following levels [6]:

Arsenic	5.0	mg/L (ppm)	
Barium	100.0	mg/L (ppm)	
Cadmium	1.0	mg/L (ppm)	
Chromium	5.0	mg/L (ppm)	
Lead	5.0	mg/L (ppm)	
Mercury	0.2	mg/L (ppm)	
Selenium	1.0	mg/L (ppm)	
Silver	5.0	mg/L (ppm)	
Beryllium	1.0	gram/container	(detection level for lab analysis to use 5 mg/L (ppm))

14. Glovebox waste will be directly bagged out of each glovebox. It was determined that this will be the most space efficient and cost effective option considering the layout of the facility. Automated waste removal utilizing a central waste hood was considered.

15. Glovebox waste (i.e., gloves and filters only) generation is estimated to be 7 m^3 per year. This is based upon the following assumptions:

Glovebox Filters:
Size: 12" x 12" x 5 7/8" = 0.5 ft^3
Qty: 60 filters per 5 GB; assume 12 filters per GB
Change out Rate: assume FPS 3x/yr, Other GB 1x/yr = 84/yr

Waste Generation: 42 $ft^3/yr = 1.2\ m^3/yr$

Gloves:
Assume all lead-lined
Qty: assume FPS and DMO = 48/GB; assume rest = 24/GB
Change out Rate: assume FPS and DMO = 1/mo; assume other GB = 1/3mo; = 1440 gloves/yr
Waste Generation: assume 5 gloves per pail; 0.67 ft^3 per pail; therefore, 193 $ft^3/yr = 5.5\ m^3/yr$

6.0 WASTE SOURCES

The three sources of waste related to the Plutonium Disposition Project include: D&R, Main Process, and Balance of Plant (maintenance activities).

6.1 D&R Phase:

D&R of the -20, -40, -14, Purification Cell and Trailer Space areas of the K reactor building will involve the removal of a variety of equipment and piping which will present challenges in the characterization and packaging for disposal in the appropriate Treatment, Storage, and Disposal Facility (TSDF). The main items that will require removal include heat exchangers, Bingham pumps, AC and DC motors, motor control centers, moderator storage and overflow tanks, and several hundred feet of process, cooling, and effluent piping (24", 36", 42", and 48" diameter). Other tanks, equipment and piping will also require removal from these areas. In addition, the 186 basin will be drained and the sludge will be required to be removed and disposed, and the 190 Cooling Water (CW) Pumphouse will be D&R'd. The different types of D&R waste that could be generated are listed below with examples of each.

1. Clean/Sanitary Wastes and Recyclable/Salvageable Items:

The majority of the D&R items to be removed from the -40 motor rooms and cross over, the -20 pipe corridors and cross over and the 190 CW Pumphouse are expected to be non-radioactive. There are a few contamination areas (i.e., against the pump room wall on -40) that would generate LLW (see #2). Radiological Controls Operations (RCO) personnel will have to be involved in determining which items can be free released, which items fall under the metals moratorium, and which items may have to be treated as LLW due to unknown history. In addition, all items will require evaluations for asbestos, PCB and RCRA constituents prior to determining a final disposition path.

2. Low Level Waste (LLW):

The majority of the D&R items to be removed from the -20 Heat Exchanger Bay,the -40 Pump Rooms, -14, Purification Cells, and Trailer Space are expected to be LLW. This waste will fall under the established routine process area waste stream. If a waste with suspect origin requires disposal, NMM waste certification engineering will develop an appropriate waste stream. Sampling and analysis to quantify the radionuclide content of the waste may be required to determine the appropriate disposal facility. Waste will be packaged and handled in accordance with the established NMM Waste Certification Program Plans (WCPP), procedures, and training in approved containers as dictated by the disposal facility and the waste size. A potential challenge with some of the larger items will be whether size reduction will be required for either removal from the facility or to meet disposal facility requirements. Characterization methodologies may also require further definition to ensure accurate accounting of waste activity. NMM Waste Management, RCO, and WMAP personnel will be required to work closely with the project in pre-planning the D&R activities.

3. Mixed (Non-TRU)/Hazardous:

There is a potential for MW/HW to be generated from the D&R activities. Process knowledge and sampling & analysis will be utilized to evaluate all waste items to appropriately categorize them to ensure proper handling, staging, packaging, labeling and shipment. When MW/HW is identified, it will be moved to a RCRA satellite accumulation area (SAA) or staging area (SA), depending on the volume of waste. If there is less than 55 gallons of the particular mixed/hazardous waste generated and additional generation is expected, the SAA will remain established at or near the point-of-generation until 55 gallons has accumulated. Once 55 gallons has accumulated (or if more than 55 gallons is generated initially), the waste will be moved to a SA. At this time, the 90-Day regulatory clock will begin within which time the waste must be characterized and transferred to an approved TSDF. Waste Management, Environmental Compliance Authority, and Environmental Services Section (ESS) personnel will be required to work closely with the project in pre-planning the D&R activities.

Examples of MW/HW that could be encountered include: circuit boards, mercury switches, silver contacts, fluorescent lightbulbs, oils, excess chemicals, painted items, and lead shielding (i.e., bricks).

4. Polychlorinated Biphenyl (PCB) Waste:

There is a potential for PCB waste to be generated from the D&R activities. Process knowledge and sampling & analysis will be utilized to evaluate all waste items to appropriately categorize them to ensure proper handling, staging, packaging, labeling and shipment. When PCB waste is identified, it will be moved to the appropriate temporary PCB waste storage area as designated by the Environmental Compliance Authority (ECA). Depending on which type of area is utilized, the regulatory timeframe within which the waste must be packaged, characterized and transferred to WMAP can range from 30 days to 180 days. Waste Management, ECA and ESS personnel will be required to work closely with the project in pre-planning the D&R activities. Examples of PCB waste that could be encountered include: painted items (including walls, floors), rubber gaskets, rubber & plastic electrical cables, oils, capacitors, voltage regulators, and light ballasts.

> ***NOTE: If PCBs are found in wall and/or floor paints that are to remain on the facility, there are requirements for painting over these areas with two coats of contrasting colors and labeling with the EPA Large Mark. Needs to be considered in the D&R and Construction phases of the project.***

5. Asbestos Waste:

There is a potential for asbestos waste to be generated from D&R activities. Process knowledge and sampling & analysis will be utilized to evaluate all waste items to appropriately categorize them to ensure proper handling, staging, packaging, labeling and shipment. Although there is no regulatory time clock associated with asbestos waste, there are specific packaging and labeling requirements. Waste Management, ECA and ESS personnel will be required to work closely with the project in pre-planning the D&R activities. Examples of asbestos waste that could be encountered include: electrical cables, Transite boards, gaskets and pipe insulation.

6. Liquid Waste (LW):

There is the potential for LW (nonradioctive) to be generated from the D&R activities. If LW is generated, it will be handled using the standard building procedures and capabilities. The disposal path for LW would include staging, sampling, and evaluating against allowable release criteria. If the LW meets the release criteria, it would be released per facility procedures. If the LW does not meet the release criteria, then evaluation against other disposition criteria would be completed. Mixing with grout (or some other type of absorbent/solidification agent) may be required. The final LW containers will be staged in a designated staging location until transferred to the final disposal location. Waste Management personnel will be required to work closely with the project in pre-planning the D&R activities. Examples of LW that could be encountered include: oils, sump liquids, and decontamination liquids.

7. Low Level Liquid Waste (LLLW):

There is a potential for LLLW to be generated from the D&R activities. Although most of the process water piping and components have been drained and/or vacuum dried, it is likely that residual amounts of tritiated liquids (i.e., moderator) will be discovered during line breaks and disconnections of equipment. This LLLW will be collected in appropriate containers (e.g., drums, TUFF tanks), sampled, characterized and dispositioned utilizing existing facility procedures. Depending on the amount generated, the purity of the tritiated liquid, and other sample results, the liquid may be placed into the moderator program versus the waste program. If determined to be waste, the final LLLW containers will be staged in a designated staging location until transferred to the final disposal location. Waste Management personnel will be required to work closely with the project in pre-planning the D&R activities. Other examples of LLLW that could be encountered include: tritiated oils, sump liquids, and decontamination liquids.

6.2 Operational Phase: Main Process and Maintenance Activities

The operational phase of the process will generate a variety of the waste types. There will be main process wastes which include glovebox waste such as the empty 3013 containers along with any additional cans inside the 3013s, failed bagless transfer cans, weld stubs, pin components from Green Fuel Disassembly, HEPA filters, contaminated equipment, gloves, wipes, and other glove box and Job Control Waste (JCW). Some of these wastes, due to their size and location in the process, may present challenges in the logistics of waste container movements within the Plutonium Vitrification Facility to the 0' Level, and beyond the Pu-Vit ECF for staging until shipment. The different types of Operational waste that could be generated are listed below with the general process, flow path, requirements, and examples of each.

1. Clean/Sanitary/Green-Is-Clean Wastes:

The operational phase of the project will generate clean/sanitary/Green-is-Clean (GIC) wastes from the Green Fuel Disassembly and Non-Nuclear Material Handling portions of the project. This will include the HUFP/CCC and likely DFAs/Ident-69Gs, empty packaging from supplies required for the process and any excess/unused chemicals. Excess/unused chemicals requiring disposition will be handled per established procedure with the assistance of the NMM Chemical Coordinator. GIC waste will consist of RMA waste that is non-radioactive and associated waste as defined per the WSRC 1S Manual.

2. Low Level Waste (LLW):

The operational phase of the project may generate LLW from glovebox operations in the Green Fuel Disassembly, Feed Preparation, Oxidation and Bagless Transfer portions of the process. In addition, general room waste and JCW are generated throughout the entire process. Additional LLW may be generated from the use of containment devices. The two sources of LLW will be differentiated as follows: GB-LLW for LLW from the glovebox processes and RM-LLW for LLW from the general rooms (outside of glovebox).

GB-LLW:

Feed Preparation and Oxidation GB-LLW consist of the outer 3013 cans, which have the potential of being LLW as they are cut and separated in a segregated glovebox cabinet (by way of an airlock) from where the inner containers/material will be accessed. Bagless Transfer GB-LLW consists of the weld stubs, which have the potential of being LLW due to limited contamination potential inherent in this post-vitrification portion of the process. However, until proven to be LLW, they will be handled as if TRU. The outer 3013 containers will be bagged out of the glovebox in the same manner as TRU waste, placed into 5-gallon pails, and taken to unassayed 5-gallon pail staging (see #3 below) to await assay. If when assayed these 5-gallon pails are determined to be LLW, they will be moved to the LLW staging area, where the bags will be removed from the 5-gallon pails and placed into a B12/B25. The 5-gallon pails will then be surveyed by RCO and if cleared, relocated to the -40 clean 5-gallon pail storage area for reuse. If they cannot be cleared, the 5-gallon pails will also be disposed of as LLW in the B12/B25.

Green Fuel GB-LLW will include at least portions of the pins, after oxide pellet removal. The pins will be cut to pieces of a length compatible with a 5-gallon pail. Assay of the TRU pails containing the cut pin portions will confirm waste type, and the pail will either be handled as TRU or as discussed previously for glovebox LLW. If pin seal integrity has been maintained, and the DFA/Ident-69G has not been contaminated, the DFAs/Idents will be returned to the CCC from which they were removed for storage until the end of the project, at which time they will be removed from the facility, and either disposed of or recycled as appropriate. Contaminated DFAs/Idents will be size reduced, and removed as TRU or LLW depending on assay results. This process applies only to those pins in DFAs that were not exposed to Sodium. See Section 12.0, Item #5 for the issue with the Sodium Contaminated DFA Pins.

RM-LLW:

The general room waste and containment device waste is expected to consist of typical JCW, such as tape, cloth gloves, etc. RM-LLW will be collected in radioactive waste bags and segregated with regard to the waste stream. Receptacles, which are lined with a radioactive waste bag, will be located throughout the facility (i.e., at stepoff pads) for collection of LLW. Once full, each bag will be surveyed and cleared by RCO and then relocated to the LLW staging area. Each bag will then be weighed and tagged with a Radioactive Waste Tag, which includes the following information: generation location, date, alpha room posting, bag weight, contents and waste generator initials. The waste generator will ensure that RCO obtains the dose rate of the bag. The bags will then be loaded into a B12/B25 located on the -20 level, in a dedicated LLW processing room. A Curie logsheet is filled out for each B12/B25 listing every LLW bag (either GB or RM) that is loaded into that B12/B25. Once the B12/B25 is full, it is weighed, Tamper Indication Device (TID) attached, and relocated to the 0' Level Waste Staging location outside the MAA until shipment to the appropriate WMAP facility.

NOTE: Depending on the quantification of RCRA constituents in the plutonium oxide material that is to be processed through the Pu-Vit process, and how that transfers to the waste to be disposed from K Area, the LLW waste discussed above may in actuality be categorized as Mixed waste (either all or at least some portion). The exact volume will not be determined until either process knowledge or analysis can be conducted to complete the evaluations.

3. Mixed (Non-TRU)/Hazardous:

The operational phase of the project is expected to generate limited amounts of Mixed (Non-TRU)/Hazardous waste. Examples would be damaged, unused lead-lined gloves, decontamination chemicals, non-clearable fluorescent lightbulbs, non-clearable batteries (lead-acid, nickel-cadmium), painted items, etc. When MW/HW is identified, it will be placed into a RCRA satellite accumulation area (SAA) or staging area (SA), depending on the volume of waste accumulated by the end of that shift. This SAA or SA will be established within the MAA. If there is less than 55 gallons of the particular mixed/hazardous waste generated and additional generation is expected, the SAA will remain established at or near the point-of-generation until 55 gallons has accumulated. Once 55 gallons has accumulated (or if more than 55 gallons is generated initially), the waste will be moved to a SA. At this time, the 90-Day regulatory clock will begin within which time the waste must be characterized and transferred to an approved TSDF. Characterization of the waste may involve RCO surveys, NDA assays, and/or sampling & analysis, depending on the type of waste and the generation point. Once the drum is characterized, it will be relocated to a RCRA SA located to the 0' Waste Staging location outside the MAA in preparation for shipment to WMAP.

4. Transuranic (TRU) Waste:

The operational phase of the project will generate TRU waste throughout the glovebox operations. For clarification purposes, three "sources" of TRU waste have been identified. First is that from the Green Fuel Disassembly (GFD), referred to as GFD-TRU. The second source is the waste from processing material contained in 3013s, referred to as Vit-TRU. Though separated for ease of discussion, the two portions of the process will be interconnected, with Vit-TRU relying on GFD to handle any "high" TRU 5-gallon pails, and GFD-TRU being fed back into the Vit-TRU stream. The third source is from the Balance-of-Plant (BoP) operations, such as equipment and HEPA filter change-outs, and maintenance activities, referred to as BoP-TRU. The WM area will have a non-destructive LLW/TRU Waste Assay System available to determine waste package categorization (LLW or TRU). The LLW/TRU Waste Assay System must be located in an area of low background or shielded such that it can detect to the levels necessary to differentiate between the two. Consideration of separate spacing for TRU and Mixed TRU (MTRU) waste is required to facilitate expedited disposal requirements for MTRU.

Vit-TRU:

The waste generated by the processing portion of the facility consists primarily of empty inner 3013 cans, pin fuel cans used to transport material from GFD to the Feed Preparations glovebox, convenience cans, failed bagless transfer cans, weld stubs that cannot be classified as LLW, lead-lined gloves (MTRU) and other glovebox waste. It is assumed that all of the waste will be of a geometry that can be handled by standard 5-gallon pails. Based on a daily processing rate of five (5) 3013 containers, it is estimated that, along with JCW and a contingency, a total of 14 Vit-TRU 5-gallon pails will be generated by the process each day. The glovebox waste will be bagged out at each station utilizing established procedures, placed into 5-gallon pails and staged in the Unassayed Container Staging Room of Waste Management (WM). Unassayed 5-gallon pail staging will require a criticality-safe (i.e., minimum 2 foot surface to surface spacing) staging rack. Rack capacity should be based on thirty 5-gallon pails to account for a minimum of 25 spaces for TRU 5-gallon pails and 5 spaces for segregation of MTRU 5-gallon pails. When designated, 5-gallon pails will be assayed utilizing a LLW/TRU Waste Assay System. If at this time any 5-gallon pails can be categorized as LLW, they will be relocated to the LLW staging room and processed as described in #2 above. Any 5-gallon pails that exceed assay limits, will be classified as a "high pail", and sent to the "high pail" repackaging portion of GFD. Once repacked in GFD, they will either be assayed at GFD using a portable waste assay system, or brought back to the TRU Waste Assay Room for re-assay to determine if repackaging was successful. If not, repackaging continues until the 5-gallon pail(s) is below acceptable limits. The 5-gallon pails that are within assay limits are then moved to the Assayed Pail Staging Room (non-spacing-critical) with a capacity of 50 TRU 5-gallon pails and 10 MTRU 5-gallon pails.

After determined ready by the Generator Certification Official (GCO) and/or Waste Certification Engineer (WCE), the assayed 5-gallon pails are evaluated for packaging into a TRU 55-gallon drum. The selected 5-gallon pails are relocated to the TRU Waste Loading Room where they are opened, the bags removed and placed into a TRU drum. Either a filtered containment device (i.e., hood) or a MAC-21 (or equivalent portable ventilation device) will be available for the drum loading operation, if determined necessary by RCO. The empty 5-gallon pails will be recycled back into the process if cleared by RCO. Non-cleared 5-gallon pails will be disposed of as LLW. The loaded drum will be weighed, TIDs attached, and undergo an accountability measurement (i.e., nuclear coincidence counter) to ensure no diversion of SNM has occurred. Drums that contain suspect or low levels of transuranics may be placed in the LLW/TRU Waste Assay System to determine if the contents meet LLW disposal limits. The drum will then be relocated to the 0' Waste Staging location outside the MAA until shipment to the appropriate WMAP facility. Production support requires the 0' Waste Staging location to have a capacity of 60 drums and to account for segregation of TRU and MTRU drums..

GFD-TRU:

Anticipated GFD-TRU waste includes the portion of the fuel pins in contact with the pellets, wipes, lead-lined gloves (MTRU), and other glovebox waste. It is anticipated that all other components of Green Fuel waste, including DFAs, Ident-69Gs, CCCs and HUFPs, will be categorized as either clean/sanitary or LLW. Due to the length of the fuel pins, size reducing equipment will be required as part of the process. The glovebox containing the size reduction capability required for GFD-TRU will also be fed by Vit-TRU to eliminate the need for a separate "high pail" repackaging glovebox. If size reduction of the pins to fit in a pail is impractical or other large items exist, drums and standard waste boxes (SWBs) may be required to package the waste. Waste that is TRU-5-gallon pail size compatible will be fed into the unassayed 5-gallon pail staging portion of Vit-TRU. Based on GFD production rate, equivalent to one 3013 container per day, it is anticipated that two (2) GFD-TRU pails will be contributed per day to Vit-TRU. Items too large to fit inside pails, but small enough to fit inside a drum, will require assay using a portable LLW/TRU Waste Assay system. Items that are too large to fit inside a drum, will either require size reduction to fit in a drum, or will require an alternate method of assay (TBD) prior to loading into SWBs as part of GFD. Once loaded with the assayed items, the full SWBs will be weighed, TIDs attached, assessed (method TBD) to ensure no diversion of SNM, then relocated to the 0' Waste Staging location outside the MAA until shipment to the appropriate WMAP facility. Partial SWBs will be staged in either the SWB Loading Area or the Failed Equipment Room until fully loaded. Any drums generated in GFD will be fed to the Vit-TRU process at the weigh and accountability stage.

BoP-TRU:

The waste generated by the balance-of-plant portion consists primarily of waste generated due to maintenance activities from all portions of the process. Examples include spent HEPA filters, lead-lined gloves (MTRU) and contaminated equipment. That waste removed from the glovebox with 5-gallon pails will be generated and follow the path as outlined in Vit-TRU. In the extraordinary event that a piece of equipment should fail while loaded, and the load cannot be completely removed (i.e., locked attritor mill grinding arms or melter vessel/pour heater failures), special procedure based response actions will be required to remove the failed piece of equipment, quantify the accountable material, potentially size reduce high-dose equipment, and process through the appropriate waste stream. Further description of the special circumstances associated with the loaded equipment failure, beyond the need for a special operations procedure and the requirement for a dedicated failed equipment room in the facility to deal with this maintenance activity, is outside the scope of this Waste Study at the CD-1 stage. All other items, too large for 5-gallon pails may be packaged directly into drums, HEPA filter polyboxes, or SWBs depending on size. If items fit into drums, drums will be brought to that portion of the process where equipment is to be removed. If items are too large for drums and SWBs cannot be placed directly at the point of waste generation, then with RCO approval, items will be bagged, assayed and then loaded into an SWB as close to the glovebox location as safely possible.

The HEPA filter polyboxes will be handled and treated similarly to 5-gallon pails in that, once filled, they will be relocated to the Unassayed Container Staging Room, (which will also require criticality-safe staging configuration), subject to assay using the LLW/TRU Waste Assay system, characterized as either LLW or TRU, if "high", repackaged if needed in GFD, and finally placed into assayed staging in the SWB Loading Area until GCO/WCE authorizes loading into a SWB.

Any direct loaded drums will have to be staged in the Unassayed Container Staging Room, and remain in a criticality-safe staging configuration until assayed. Once assayed, weighed, and TIDs attached, they will follow the path as outlined in Vit-TRU for drums.

Due to the size of SWBs, a dedicated SWB weigh room will be required. This room will also include SWB loading if the SWB cannot be taken to the process location where the waste is to be generated. The final Safeguards "no diversion of material" confirmation for a SWB, prior to removal from the facility is TBD, and is not documented here because of no current known method of accountability on items the size of a SWB.

NOTE: Depending on the quantification of RCRA constituents in the plutonium oxide material, in various concentrations [4],1 that is to be processed through the Pu-Vit process and how that transfers to the waste to be disposed from K Area, the TRU waste discussed above may in actuality be categorized as Mixed TRU waste (either all or at least some portion). The exact volume will not be determined until either process knowledge or analysis can be conducted to complete the evaluations. The key impact would be the required expedited timeframe from waste generation to shipment for disposal (RCRA 90 Day Clock requirements).

5. Liquid Waste (LW):

The operational phase of the project is expected to be dry throughout. However, there is the potential for LW generation from eyewash stations, decontamination activities, emergency events such as fire, and any lubricating or cooling fluids required for equipment operation. If LW is generated, it will be handled using the standard building procedures and capabilities. The disposal path for LW would include staging, sampling, and evaluation against allowable release criteria. If the LW meets the release criteria, it would be released per established facility procedures. If the LW does not meet the release criteria, then evaluation against other disposition criteria would be completed. If those criteria are met, the LW will be packaged to meet the received TSDF's requirements. Solidification/absorption of the LW may be required to meet the TSDF Waste Acceptance Criteria (WAC) or chosen as an option for disposal, which could include mixing with grout (or some other type of absorbent/solidification agent). This evolution would preferably take place outside the Plutonium Vitrification Facility itself. The LW containers would be relocated outside the MAA to 0' level via the elevator either for further processing or relocation to a designated staging area while awaiting shipment to WMAP.

6.3 Operational Phase: Generation Rates

The expected waste generation rate for the Operational Phase of the Pu-Vit facility waste streams has been estimated on an annual basis assuming a 24 hour 7 day a week operation. The generation rates per waste stream are summarized in the table below:

Waste Stream	Estimated Annual Generation Rate (m^3/year)
Clean/Sanitary/GIC	50
Low Level Waste	250
Mixed Waste (non-TRU)	80
Hazardous Waste	80
TRU/MTRU	460
Liquid Waste	0 (expected)

7.0 WASTE ASSAY EQUIPMENT

All waste leaving the MBA/MAA will be assayed for accountability values and diversion. LLW may be assayed for accountability values and diversion prior to being placed in B12/B25 containers. All material placed in B12/B25 containers will be under two-person control during use and locked and TID'd between uses.

A LLW/TRU waste assay system will be used to perform the initial assay of 5-gallon pails to obtain accountability values and determine if the pail is LLW or TRUW. Large items, such as removed equipment and filters, are assayed with a portable waste assay system to obtain the accountability values. This portable waste assay system will consist of a HPGe detector on cart with a turntable. Full loaded drums will be assayed with an APNMC prior to leaving the facility to ensure that no diversion of SNM has occurred. Larger items such as SWBs will require special equipment for assay prior to leaving the facility to ensure no diversion of SNM has occurred. This equipment has yet to be determined.

As part of waste minimization, a LLW/TRU NDA instrument must be located in a shielded area to reduce background radiation levels to determine if certain categories of TRU waste are in actuality LLW.

Space must be allocated for TRU pails, 5-gallon pails and drum NDA equipment, LLW/TRU instrument and drum loading. Special discard limits will be established and approved for all waste by MC&A closer to the startup of the project once waste streams are established.

The following assay instruments will be utilized in the Waste Management System:

Quantity	Instrument Type	Function
5	Scale	One scale to weigh pails One scale to weigh drums One scale to weigh SWBs One scale to weigh bags One scale to weigh B12s/B25s
1	LLW/TRU Waste Assay System	Assay waste pails, drums, polyboxes for determination as LLW or TRU, and to obtain accountability values used for characterization.
1	Active Passive Neutron Multiplicity Counter	Assay waste drums for SNM diversion data.
1	Portable Waste Assay System	Assay removed equipment, items too large to fit in pail or drum, and other items as needed for accountability values used for characterization.

8.0 WASTE MANAGEMENT AREA DESCRIPTION

The Pu-Vit Waste Management System consists of several rooms located throughout the facility on the -40, -20 and 0' levels. These rooms have various purposes to support the generation, transport, staging, assaying, loading/packaging, and shipping of waste. Listed below is each room with a short description of its purpose, general location, and room content. As the project matures and waste streams are defined, the room content with respect to number of waste containers/cuts for each may change, as well as required equipment. The information described below is based on the best available data to date.

1. Unassayed Container Staging Room: This room is to be located on -20 and will be used to stage unassayed waste containers in criticality safe arrays. The maximum amount of containers to be staged in this room include: 30 5-gallon pails, 10 small HEPA polyboxes, and four (4) 55-gallon TRU drums. If large polyboxes are to be utilized or staged in this room, then the number of containers would be limited to within the finalized allowed inventory for the room.

2. TRU Waste Assay Room: This room is to be located on -20 and will be used for the assay of waste containers including 5-gallon pails, HEPA polyboxes, drums, large items, etc. Only one item at a time will be brought into the room for assay, unless determined by ALP/NMS that more than one assay machine can be utilized at a time. The room or equipment within the room will be shielded as necessary to ensure that the background levels are low enough to allow for differentiation between LLW and TRUW when assayed. The equipment to be located in this room include: 2 scales, the LLW/TRU Waste Assay System, the APNMC, and a Portable Waste Assay System.

3. Assayed Pail Staging Room: This room is to be located on -20 and will be used for staging 5-gallon pails after they have been assayed. Space for up to 60 pails will be allocated, which includes an area for "high" pails while awaiting relocation to GFD for repackaging. The pails will be staged on shelving, at most two high.

4. TRU Waste Loading: This room is to be located on -20 and will be used for loading assayed 5-gallon pail waste into 55-gallon TRU waste drums. A MAC-21 or ventilation hood will be available for use during waste loading if determined necessary by RCO. Up to four (4) drums worth of waste can be staged in this room at one time. Pails will be opened, the bagged waste cuts removed and then placed directly into the designated drum. Once the drum is loaded and sealed, it will be transported back to the TRU Waste Assay Room for weighing and assaying in the APNMC for SNM checks.

5. SWB Loading Area: This room is to be located on -20 and will be used for loading SWBs with assayed waste such as HEPA filter polyboxes or large items. Unassayed waste cuts may be staged in SWBs in this room temporarily if needed until the waste cuts can be relocated to the TRU Waste Assay Room for assaying. Up to 2 SWBs and 12 assayed small polyboxes may be staged in this room at one time. Shelving for staging the assayed polyboxes (to fit both the small and large), hoisting equipment to assist with the loading of the SWBs, and a scale to weigh the SWBs will be provided. The hoisting equipment should be able to lift a full SWB if needed.

6. Outgoing Waste Staging Area: This room is to be located on -20 and will be used for staging a pallet to collect up to 4 full TRU waste drums. Once four drums have been collected, the pallet will be relocated by elevator to 0' level for removal from the MAA.

7. Failed Equipment Staging Room: This room is to be located on -20 and will be used for staging SWBs containing failed equipment from the gloveboxes (e.g., melter, furnace, and attritor) with various amounts of MAR. The room or containers within the room may require shielding for personnel protection. These items will require staging while characterization and MC&A issues are resolved for their final disposition. Up to three (3) SWB may be staged in this room at one time. Hoisting equipment to assist with the loading of the SWBs and relocating of the loaded SWBs, if necessary, will be provided.

8. LLW Staging Room: This room is to be located on -20 and will be used for staging bags of RM-LLW from the various process rooms and containers of GB-LLW until time to package into the B12s/B25s. Up to 2 B25s worth of LLW will be staged in this room at a time. A scale for weighing the bags of LLW will be located in this room.

9. LLW Loading Room: This room is to be located on -20 and will be used for loading the LLW into the B12s/B25s. Once all information from the RM-LLW bags and/or GB-LLW pails is obtained, the LLW will be added to the B12s/B25s. Once full, the B12/B25 will be sealed, weighed and TID'd then relocated to 0' level for removal from the MAA. The scale for weighing the B12/B25 will be located in this room.

10. Waste Staging Room: This room is to be located on -40 and will be used for temporarily staging LLW until it is transported to -20. No TRUW is to be staged in this location. Up to one (1) B25's worth of LLW may be staged in this room at a time.

11. HW/MW (Non-TRU) Staging: This room is to be located on -40 and will be used for the establishment of Satellite Accumulation Areas (SAA) if needed. Up to two (2) drums worth of HW/MW may be staged in this room at one time. Once a SAA drum is full, it will be relocated, within the same room, to a Staging Area (SA) and the 90-Day clock initiated. Once the drum is characterized and cleared through SNM checks, it will be relocated to 0' level for removal from the MAA.

12. 0' Level Waste Staging: This room/building is to be located on 0' and will be used for the staging of full, characterized waste containers awaiting shipment to WMAP. The containers will consist of drums, SWBs, and B12/B25s. A capacity of 60 TRU drums, 10 SWBs and 30 B12s/B25s will be provided. This building must be a Hazard Category 2 facility. Fork truck access and hoisting equipment will also be required. Shelving may be utilized for TRU drum and SWB staging if needed. If HW/MW (Non-TRU) drums requiring staging in this facility, they will be part of the 60 drum staging portion. TRU drums and SWBs shall not be stacked directly on top of each other. B12s/B25s may be stacked two (2) high.

9.0 WASTE STAGING AND INVENTORY CONTROL

All LLW waste staging areas in and around the KAC have been designated as Hazard Category 3 facilities. Therefore, the total inventory of all LLW waste staged (regardless of actual location or waste stream) in and around K Area must meet the DSA requirements (<20% of the HC2 TQ and the fissile mass limits). No credit is taken for waste stored in physically separated areas. It is assumed all LLW waste is staged together (as if in one big "pile") and subject to the proposed accidents described in the DSA.

Due to the radionuclide content of TRU waste and that the inventory of only one or two 5-gallon pails of TRU waste can exceed the Hazard Category 3 limits, all TRU waste staging areas must be within a Hazard Category 2 facility until transferred out of the KAC. The specific structural requirements of the waste staging facilities (e.g., PC-2, PC-3, Seismic qualifications, ventilation, etc.) will be determined through Consolidated Hazards Analysis Process (CHAP) evaluation.

During the CHAPs process, the various waste processing and staging rooms were defined and assigned a Material at Risk (MAR). The maximum FGE Pu-239 values per container type are assumed to be as follows [2,3,4]:

TRU drum = 195 g	Large Polybox = 100 g
Pail = 20 g	Small Polybox = 40 g
SWB = 325 g	B12/B25/LLW drum = 31 g

The table below summarizes the MAR assumed per room utilized in the WM CHAPS process:

Waste Management Room	Location	Contents	MAR (FGE Pu-239; grams)
Unassayed Container Staging Room	-20	32 Pails, 6 Drums, 12 Small Polyboxes	2490
TRU Waste Assay Room	-20	1 Drum or 1 Pail or 1 Polybox	195 (max)
Assayed Pail Staging Room	-20	64 Pails	1280
TRU Waste Loading Room	-20	4 Drums (equivalent)	780
SWB Loading Area	-20	12 Small Polyboxes (equivalent), 2 SWBs	1130
Outgoing Waste Staging Area	-20	4 Drums	780
Failed Equipment Staging Room	-20	3 SWBs	975
LLW Staging Room	-20	2 B25s (equivalent)	62
LLW Loading Room	-20	4 B25s	124
Waste Staging Room	-40	1 B25 (equivalent)	31
HW/MW (Non-TRU) Staging	-40	2 LLW-Drums	62
0' Waste Staging Location	0'	60 Drums, 10 SWBs, 30 B12/B25	15,880

As a waste container is issued (5-gallon pail, drum, SWB, B12/B25, etc) it is assumed to be full at that time with a bounding activity as determined by WCE. This is for inventory tracking purposes. Prior to shipment to WMAP for disposal, actual activities for the waste cuts will be determined and waste package contents adjusted as required. All waste packages will be verified to meet the requirements of the WSRC 1S Manual prior to shipment to WMAP.

10.0 WASTE PLANS, PROCEDURES, AND TRAINING

The NMM LLW and MW Certification Program Plan, the KAC TRU and MTRU Waste Certification Program Plan, the LLW/TRU waste procedures, the LLW/TRU waste training, etc. will all require revision to implement the details of the process described in this document. In addition, WCE personnel will develop the waste stream(s), distribution(s) and bounding activities for the various waste container types for characterization, inventory tracking and disposal purposes. The potential for beryllium and RCRA content will be addressed in the Waste Certification Program Plans (WCPP), procedures, training, and waste stream(s) development. These activities are to be completed prior to the generation of the first waste from the Plutonium Vitrification Facility. Established procedures and training will ensure that all waste handlers have the required security, radiological control, and waste qualifications (e.g., HRP, 2-person rule training, RWT, etc.). Lessons learned from the K Area Interim Surveillance (KIS) and the Container Surveillance and Storage Capability (CSSC) projects will be incorporated into the overall KAC waste program and specifically to the Plutonium Disposition Project where benefits would be gained.

Further details regarding the required sampling for the process waste and the overall process for the GFD-TRU will be determined, as well as any other final refinements to the Pu-Vit waste strategy and will be documented in this Waste Study. Developing requirements resulting from the evolving Pu-Vit process design will be accumulated and documented in future revisions of this study.

11.0 CHARACTERIZATION OF WASTE

Characterization of the D&R and Operational phases of the Plutonium Disposition Project will involve a variety of techniques. These will include, but are not limited to, process knowledge, sample & analysis, dose-to-cure (DTC), smear-to-curie (STC), nondestructive assay (NDA), and inline sampling (operational phase only) if possible. The constituents of concern for each phase include:

D&R: radionuclides, RCRA, PCBs, asbestos
Operational: radionuclides, RCRA, Be

Proper characterization of D&R waste during the planning stages is essential to success. The characterization determines the required packaging, labeling, and disposal facility. The packaging will impact the amount of size reduction required. In addition, proper characterization will ensure that all regulatory time clocks will be established and complied with in accordance with the appropriate regulations. The waste streams utilized for D&R waste are those already established for NMM process areas.

Proper characterization of the Operational process waste is equally important. There are potentially two key constituents of the process waste that must be characterized appropriately, beryllium and RCRA. Beryllium limits the amount of fissile material allowed in a waste container and RCRA institutes the 90 day clock within which waste must be shipped to the proper TSDF. Improper characterization of either could have severe consequences, such as receipt of Notices of Violation from the regulators, violations of the KAC or other facilities', DSA and/or TSR requirements, etc.

To assist with the process control of glass production via elemental analysis of the feeds, inline sampling will be conducted. The process sampling system can not be used to identify quantities of RCRA or Be due to the very low detection levels required. For this reason, WCE will need to determine an alternative sampling method for in-process waste to accurately characterize the waste.

The WCE will also utilize process knowledge backed by analysis to try to provide the facility with Go/No-Go levels of the Be and RCRA constituents to facilitate waste segregation. As information on the isotopic and impurity composition of the materials, to be processed through the Plutonium Vitrification Facility, become available, evaluations will be conducted to determine if this is a viable option to minimize the time and effort in the field.

12.0 ISSUES REQUIRING FURTHER INVESTIGATION/RESOLUTION

The following issues require further investigation or require information that is not yet available.

1. Green Fuel Disassembly: to minimize the size reduction required to make items fit into 5-gallon pails, larger items may be removed from the glovebox and placed directly into drums, SWBs or even B25s if determined LLW. MC&A requires assay to confirm if LLW or TRU waste. Issue is related to the definition of the assay equipment that will be required for large items and SWBs.

2. Anticipated Radiological Classification for Waste Management Areas: Confirm with RCO if WM areas will be RMA/RBA or if dress out required, especially in the TRU Waste Loading Room.. Also, can bagged items, even if potentially TRU be transported through facility on cart to a SWB if the SWB cannot be taken to each process area (in case of large equipment change out from glovebox).

3. GFD Process Procedure to Minimize TRU: Verify Green Fuel Disassembly process; how will the outer containers be removed from inner, nested for long term storage, and how likely will outer containers be clean vs. LLW.

4. Sample Method for RCRA Metals and Beryllium: Determine alternate method or process to obtain required analysis data on the RCRA metals and Beryllium constituents. Even if it is decided to categorize all TRU waste as MTRU with

Beryllium contamination, it is required by the 1S Manual to quantify the amounts of each of these constituents present in each waste container. Possibilities to explore include 1) sampling the waste itself and/or 2) obtaining a sample of the product material and sending to an outside laboratory for the required analysis.

5. GFD Sodium Contaminated DFAs: If DFAs with previous sodium exposure have not been adequately decontaminated, subsequent cutting of pins will result in, unoxidized sodium on cut or abraded surfaces. The sodium has unique fire/explosion related hazards that are not addressed as part of this study. In addition, waste contaminated with/containing pure Sodium metal, is highly reactive and considered a RCRA waste. If the pins are determined to be TRUW, there currently is no disposal path as Reactive RCRA wastes are currently prohibited from TRU Waste disposal per the WAC. If the pins are determined to be LLW from a radioactive standpoint, then disposal as MW is a potential pathway. If the pins are "treated" in KAC to remove the Sodium prior to processing, a RCRA permit may be required, which could impact larger permit issues. Further investigation by WMAP is being conducted. Additional information on amount of Sodium present on pins, the decontamination to be performed by Hanford, and number of pins involved is required.

13.0 CONCLUSION

The waste processes described within are the best estimation of how the Plutonium Disposition Project wastes, both from D&R and from Operations, will be handled based upon the information available at the time of the revision date of this Study. As the project evolves, lessons are learned from both KIS and CSSC, and the TRU waste program matures, the waste management flow path, requirements, and layout will to become more defined. As details and information regarding the other portions of the facility, that involve major impacts to the waste management processes described become available, they will be incorporated into future revisions of this Study.

14.0 REFERENCES

1. Y-ADS-G-00002, Alternative Study for Locating a Plutonium Vitrification Process in Existing Savannah River Site Process Facilities, June 8, 2004.
2. WSRC Manual 1S, Savannah River Site Waste Acceptance Criteria Manual, Procedure 3.06, "E-Area TRU Pads Transuranic Waste Acceptance Criteria", Revision 11, 4/30/05.
3. WSRC Manual 1S, Savannah River Site Waste Acceptance Criteria Manual, Procedure 3.17, "Low-Level Radioactive Waste Acceptance Criteria", Revision 9, 1/14/05.
4. SVP-OPD-2006-00003, Revision 0, Chemical Impurities in Candidate Alternate Feedstock Oxides for the MOX Fuel Fabrication Facility: 2006 Analysis Update, July 31, 2006.
5. U-CLC-K-00002, Revision 0, Pu-Vit CHAP Input, Confirmed Calculation, E.G. Estochen, November 2006.
6. 40 CFR 260-279, Hazardous Waste Management (Resource Conservation and Recovery Act) Regulations