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HAZARDOUS WASTE/MIXED WASTE TREATMENT BUILDING THROUGHPUT STUDY (U)

by

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1.0 EXECUTIVE SUMMARY

The HW/MW Treatment Building (TB) is the specified treatment location for solid hazardous waste / mixed waste at SRS. This report provides throughput information on the facility based on known and projected waste generation rates.

The HW/MW TB will have an annual waste input for the first four years of approximately 38,000 ft^3 and have an annual treated waste output of approximately 50,000 ft^3. After the first four years of operation it will have an annual waste input of approximately 16,000 ft^3 and an annual waste output of approximately 18,000 ft^3. There are several waste streams that cannot be accurately predicted (e.g. environmental restoration, decommissioning, and decontamination). The equipment and process area sizing for the initial four years should allow excess processing capability for these poorly defined waste streams.

A treatment process description (section 4) and process flow (section 5) of the waste is included to aid in understanding the computations (section 6) of the throughput.

A description of the treated wastes is in section 4.

2.0 INTRODUCTION

2.1 Background Information

The Savannah River Site (SRS) is a Department of Energy nuclear material processing facility operated by Westinghouse Savannah River Company (WSRC) to produce plutonium and tritium for defense applications. During the production process several hazardous, radioactive, and mixed waste streams are generated. One proposed waste project is the Hazardous Waste / Mixed Waste Treatment Building (HW/MW TB). This facility will process various solid hazardous and mixed wastes prior to disposal in Resource Conservation and Recovery Act (RCRA) permitted disposal vaults or incineration at the Consolidated Incinerator Facility (CIF). The HW/MW TB will maintain RCRA authorized storage for received waste and treated waste awaiting transport to disposal.

2.2 General Assumptions

1. Each HW/MW Vault is assumed to hold either 9000 55/ 71 gallon drums or 1200 B-25 sized (6'x4'x4') boxes.
2. HW/MW Vaults will be available to accept stabilized/treated waste.
3. Sludges/Soils can be successfully stabilized to meet the Toxicity Characterization Leaching Procedure (TCLP).
4. Stabilization of sludges and soils will approximately double the volume of those particular waste streams.
5. Fifty (50) percent of all lead in storage and generated in the future will be recycled/reused.
6. No radioactively contaminated elemental mercury (RCEM) will be sent to a stockpile (i.e. all RCEM will be amalgamated and disposed in the HW/MW Vaults for the purposes of this study).
7. All process equipment treated at the HW/MW Treatment Building (TB) will be sent to the HW/MW Vaults.

8. All combustible material will be separated in the HW/MW TB sorting area and sent to the Consolidated Incinerator Facility (CIF).

9. Containers and packing material increase the volumes of incoming waste by 25%.

10. 5% of containers and packing materials are combustible by the CIF.

11. 5% of containers and packing materials are recyclable.

12. Wastes sent to the size reduction process will be reduced in volume by fifty (50) percent.

13. Spent tower packing will be direct disposed and not stabilized.

14. Gold traps will be direct disposed.

15. ITP filters will be direct disposed.

16. Shredding and boxing of combustible material will increase the waste volume by 25%.

17. There is approximately 5% Cd by volume in the HEPA filter frames.

18. There will be a 80% packing efficiency for all final disposal containers.

19. Waste volumes used are from previous project documents with any current updates from Waste Management included.

20. 100,000 Gallons of wastewater per year.

21. Wastewater will be generated infrequently.

22. Significant potential source of wastewater is firewater.

23. Wastewater will be 98% H_2O, and 2% contaminants/solids by weight.

24. Effluent from treatment will be recycled for process use or decontamination.

3.0 WASTE VOLUMES AND GENERATION RATES

3.1 Wastes in Storage as of 12/91

WASTE INVENTORY TABLE FOR PROCESSING IN THE HW/MW TB

WASTE DESCRIPTION	NUMBER OF CONTAINERS	WASTE VOLUME (FT^3)
CONTAMINATED LEAD	161+	17,235
LETF FILTER PAPER	93	8,400
Cd PLATED HEPA FILTERS	18	1,400
CMP SOILS	500+	47,000
MERCURY SOILS	5	450
FLOOR SWEEPINGS	7	50
PROCESS BEDS	10	200
TRITIATED EQUIPMENT	10+	700
PLATING LINE SUMP WASTE	2	15
CONTAMINATED SOIL	27+	700+
SPENT FILTERS	4	30
MERCURY	2+	15
CONTAINERS & PACKING MATERIALS	N/A	20,000
SLUDGES	8	60

WASTE INVENTORY TABLE FOR DIRECT DISPOSAL IN HW/MW VAULTS

WASTE DESCRIPTION	NUMBER OF CONTAINERS	WASTE VOLUME (FT^3)
ITP FILTERS (generated by HW/MW startup)	1 (estimated)	72
GOLD MERCURY TRAPS	5	270
SPENT TOWER PACKING	22	125

3.2 Future Annual Waste Generation

ANNUAL WASTE GENERATION TABLE FOR PROCESSING THROUGH THE HW/MW TB

WASTE DESCRIPTION	NUMBER OF CONTAINERS	WASTE VOLUME (FT^3)
CONTAMINATED LEAD	10+	175
LETF FILTER PAPER	20	2000
Cd PLATED HEPA FILTERS	3	250
SLUDGES	UNKNOWN	?
MERCURY SOILS	UNKNOWN	?
FLOOR SWEEPINGS	1	10
PROCESS BEDS	1	20
TRITIATED EQUIPMENT	1	100
F&H BASIN SOLIDS	55	5000
CONTAMINATED SOIL	UNKNOWN	?
SPENT FILTERS	1	5
MERCURY	2+	15
CONTAINERS & PACKING MATERIAL	N/A	8000+
DECOMMISSIONING & DECONTAMINATION ACTIVITIES	UNKNOWN	?
CMP SOILS	UNKNOWN	?
ENVIRONMENTAL RESTORATION SOILS & SLUDGES	UNKNOWN	?

ANNUAL WASTE GENERATION TABLE FOR DIRECT DISPOSAL IN HW/MW VAULTS

WASTE DESCRIPTION	NUMBER OF CONTAINERS	WASTE VOLUME (FT^3)
ITP FILTERS	1	72
GOLD MERCURY TRAPS	1	10
SPENT TOWER PACKING	1	5

4.0 TREATMENT PROCESSES

4.1 Assumptions

1. The treatment processes used in this study are preconceptual processes and the actual process used in the facility may differ.

4.2 Treatment Process Descriptions

The processes to be included in the HW/MW TB are:

- Size Reduction - Size reduction allows efficient use of RCRA disposal space and assists in the repackaging of wastes to be shipped to the Consolidated Incineration Facility (CIF) and Solid Waste Disposal Facility (SWDF). Typical wastes are lead shielding, HEPA filters, and wastewater treatment filters.

- Macroencapsulation - The specific process recommended is thermoplastic polymer macroencapsulation based on regulations and SRS needs. Macroencapsulation is a specified technology for radioactive contaminated lead and could be used on other solid heavy metal wastes (by variance).

- Stabilization / Solidification - Stabilization / Solidification of wastes in a cement or polymer matrix. Sludges and soils are candidates for this process.

- Mercury Roasting/Retorting and Recovery - A specified technology for high mercury wastes (Hg > 260 ppm). The recommended method is a vacuum oven.

- Mercury Amalgamation - A specified technology for disposal of any radioactive contaminated elemental mercury. A batch system is recommended.

- Acid Leaching and Chemical Precipitation - A best demonstrated available technology (BDAT) for the removal of heavy metals from certain wastes.

- Wastewater Treatment - Any of several chemical processes treating the liquid streams generated by treatment processes, firewater, or decontamination of equipment.

4.2.1 Sorting/Size Reduction Process

The wastes scheduled to be handled by the facility are stored in a wide variety of containers. The exact contents of most waste containers are not fully known or the waste container has wastes requiring different treatment processes. As a result, a waste sorting module will be part of the HW/MW TB. After the wastes are characterized and verified some of the wastes will be repackaged for treatment at other SRS waste facilities and the rest will be treated at the HW/MW TB.

The solid mixed and hazardous wastes to be treated at the HW/MW TB will be handled ALARA (radiation exposure As Low As Reasonably Achievable). To keep unnecessary exposure to a minimum all wastes will be sorted into non-contact handled and contact handled. The third category of wastes, tritiated wastes, will be kept separate from all other wastes. After sorting, each waste category to be size reduced will have its own special considerations during the size reduction process.

Size reduction is not a regulatory requirement but size reduction or size standardization makes treatment processing more efficient and allows more wastes to be placed in the disposal vaults. There is a DOE requirement for volume reducing the amount of waste disposed and generated at DOE facilities that supports the inclusion of a size reduction module.

The initial size reduction step will be to further sort wastes and then to cut wastes into process suitable sizes. Size reduction operations will be campaign processes to minimize the co-mingling of the different waste codes and to prevent treatment difficulties resulting from mixed waste codes. The size reduction equipment will be decontaminated and cleaned between campaigns to prevent co-mingling of waste codes. The specific size reduction process will depend on the waste category.

- Non-Contact Handled Wastes (NCHW)

  Large wastes can be cut with mobile shears mounted on an articulated boom or crane (if required). The whole waste form will be placed on the cutting floor and cut or sheared into appropriately sized pieces for the hopper of the baler. A grapple on another boom or crane will lift the pieces into the baler. Small pieces the grapple cannot lift can be shoved with a scraper blade into a hopper for accumulation for transfer to the baler.

- Contact Handled Wastes (CHW)

  Large pieces of contact handled wastes can also be cut with the mobile shears. Waste not suitable for shearing (i.e. process equipment, etc) can be cut either with an acetylene torch or with a portable band saw. Portable exhaust systems will remove fumes generated by cutting torches to the ventilation system. A portable vacuum can collect sawdust and residues from the sorting and cutting area for processing with the waste to be treated. The pieces will be lifted into the baler with the grapple, or some other manual device, provided the baler will not cause cross-contamination of waste streams resulting in a more difficult treatment process. If the baler would cause cross-contamination resulting in more stringent disposal requirements, the cut up pieces of waste can be placed directly into containers for further treatment.

- Tritiated Wastes

  Tritiated wastes will be contact handled or handled with hoods or gloveboxes. A glovebox with a portable band saw (as opposed as to a industrial size bandsaw) or similar equipment will cut process equipment (i.e. mercury diffusion pumps) to expose the interior tubing to assist the mercury removal process with the added benefit of size reduction. No further size reduction of tritiated wastes is planned.

After sorting and cutting up large bulky wastes, the wastes would be sent to the next size reduction step required. The proposed size reduction module will contain a shredder and a baler.

Combustible waste must be shredded and packed in cardboard containers, before it goes to the Consolidated Incineration Facility (CIF). The containers of combustible waste will be emptied into a shredder which will shred the waste into a size compatible with repacking into cardboard boxes meeting the CIF Waste Acceptance Criteria (WAC).

The packed boxes of shredded combustible waste will go to final assay (if required) and then to the CIF. There may be other waste streams requiring shredding (as opposed to compaction) prior to further treatment in the HW/MW TB. These wastes would be shredded and placed back into a container for movement to the next applicable process station in the TB.

For the baling process a commercially available scrap metal baler will compress waste into a suitably sized bale (i.e. 16" x 16" x 24").

The baler would eject the bales onto an automatic roller conveyor or be lifted by an overhead conveyor to take the baled waste to the next treatment process.

After the size reduced and/or treated wastes are ready for movement or final disposal, wastes will be packed into disposal containers. Packing wastes will be primarily a personnel procedure. Operating personnel would lift the wastes with a commercially available lifter attached to a pneumatically powered hoist (or manually as necessary). The hoist must be capable of lifting 10 tons.

4.2.2 The Macroencapsulation Process

Macroencapsulation is the process of surface coating a waste with a material such as polymeric organics or with a jacket of inert inorganic materials to substantially reduce surface exposure to potential leaching media. There is an EPA regulatory requirement to macroencapsulate radioactive lead solids and the HW/MW TB might possibly be able to macroencapsulate other waste streams. The recommended macroencapsulation process uses a thermoplastic polymer.

The process to macroencapsulate lead using thermoplastic polymers can be fully or partially automated or manually controlled. The amount of automation will be determined by the personnel protection requirements and by an economic analysis.

The proposed process will have four processing stages:

- Sorting and sizing of lead
- Thermoplastic polymer coating of lead
- Final cooling and inspection of waste form
- Final packaging for disposal.

This process flow would take the lead from unsorted bulk waste lead to a inspected/certified waste form to be transported to disposal vaults.

4.2.2.1 Sorting and Sizing Lead

At the sorting/size reduction module waste lead would be sorted into recyclable lead and lead to be macroencapsulated. The lead to be macroencapsulated would be placed into a baler/compactor and reduced into a standard specified size (i.e. 16" x 16" x 6"). A standard size will be the important parameter for the lead block (i.e. the weight and density of the block can vary). After compaction a heated stainless steel screw thread eyebolt would be inserted into the lead block. The eyebolt would be heated to melt lead but not vaporize lead. This process would provide a secure method to transport the lead block without causing lead shavings or air emissions. Another alternative would be a stainless steel wire net to support the lead for the thermoplastic polymer treatment.

4.2.2.2 Thermoplastic Polymer Macroencapsulation

The standard size lead blocks would be lifted by the eyebolt, using an overhead conveyor, to a series of heated tanks containing molten polymer. The lead would be alternately dipped in the thermoplastic polymer and cooled until the desired thickness of coating is achieved (process is not unlike making a candle). The series of tanks would contain polymers of different colors (i.e. red, white, and blue) to ease the Quality Control (QC) checks of the macroencapsulated lead. Inside the tanks would be a wire basket (similar to a french fry basket) to catch any pieces that could fall off the lead blocks during processing. These pieces would be placed back in the compactor to be reprocessed. The end product would be a block of lead covered in polymer with a eyebolt sticking out of the top ready for final cooling, inspection, and transport.

4.2.2.3 Final Cooling and Inspection

The blocks would continue to hang until the thermoplastic polymer is fully cooled and the coating is inspected. Any cracks or thin spots in the coating would be readily apparent to a visual inspection due to the different colors of thermoplastic polymers used in sequence in the coating process. The color seen through the crack would determine the depth of the crack. Any blocks failing inspection would be recycled through the thermoplastic polymer tanks until they pass. Any waste form that is destructively tested (i.e. cored) or the coating damaged in handling could be run through the tanks again to patch the damage.

4.2.2.4 Packaging for Disposal

The passed waste forms would be placed in disposal containers and any void space would be filled with a material (i.e. clean sand) to provide structural stability of the final waste form if the disposal container requires it. The lead blocks would be sized so the coated block can be efficiently placed in the disposal container.

4.2.3 Stabilization / Solidification Process

Stabilization / Solidification, as it relates to mixed waste, refers to transforming the wastes into a more manageable, less toxic, or non-leachable form. It involves the process of using cementitious binders or other binders for the immobilization of characteristic and listed metal constituents and radioactive contaminants. The leaching potential of the constituent of concern is reduced by isolating the contaminants from environmental influences by microencapsulating the waste particles. Solidification adds material to a liquid or semi-liquid waste to produce a solid monolith. Stabilization refers to the conversion of a waste to a more chemically stable form and includes use of a chemical reaction to transform the toxic components to a new, non-toxic compound or substance as toxicity is defined by TCLP. The regulatory requirement exists to treat selected wastes to Land Disposal Restriction (LDR) standards prior to disposal with solidification / stabilization being the Best Demonstrated Available Technology (BDAT).

The recommended alternative for the HW/MW TB will primarily use cementitious binders to treat wastes. The selected alternative provides the best flexibility based on the predicted wastes (soils and sludges) and economic viability. Incoming waste forms will be accumulated in storage containers or waste tanks to ensure economical processing. Consideration should be given to mixing similar coded wastes for a homogeneous mixture to ease processing. The mixture can then be pretreated as necessary to improve the stabilization / solidification process. Examples of pre-treatment include pH adjustment, soil segregation, and contaminant removal to ensure a waste form meeting disposal criteria. The waste form would be slurried and then mixed with the cement grout in a process providing good shear and agitation. The grouted waste would then be poured into the disposal container for disposal.

The grout formulations would consist of mixtures of portland cement, flyash, slag, binders, and admixtures as required to stabilize/solidify the waste being treated. Since not all stabilization processes are compatible with all waste forms (i.e. high nitrate can inhibit cement solidification), bench-scale testing with waste forms would be necessary for optimum formulations. The cured waste form will require testing to verify it meets EPA and SRS disposal standards.

Some waste forms (i.e. mercury contaminated soils) are not suitable for a cement based system and will require a liquid polymer stabilization or other suitable treatment. These wastes are expected to be minor volumes and would be treated on a case by case basis. The significant increase in treatment costs makes these special processes undesirable for general use.

A process to recycle any stabilized material failing final analysis is required. The process will break up the waste form for reprocessing. Thorough waste characterization and specific formulations should minimize the failure rate.

The cement technology is readily available and is used routinely at Superfund sites. The polymer system is used in the nuclear waste industry at the present time.

4.2.4 Radioactive Contaminated Mercury Waste Treatment

The mercury wastes to be processed are contaminated with tritium (a radioactive isotope of hydrogen). The treatment technologies for tritiated mercury waste are no different from non-tritiated mercury waste. Tritiated mercury wastes will require careful control and separation from all other mercury wastes to minimize cross-contamination.

4.2.4.1 Monitoring and Sorting Area Process Description

The monitoring and sorting area will require the space to unpack contents, monitor, and sort. The anticipated size reduction module will contain only a bandsaw to cut up pumps and possibly process beds. Process equipment with mercury residue inside will be cut apart to expose the inner passageways to expedite the removal of mercury vapors before being placed into the mercury oven. Wastes requiring incineration will be repackaged (if needed) and sent to the CIF or interim storage as required.

The output of this module will be:

- Empty concrete culverts, drums, and stainless steel boxes for reuse or disposal as rad waste (level of radioactivity will determine where waste will be disposed).

- Oils and other wastes suitable for incineration. They will be repackaged and processed (if required) for shipment to CIF. The oils will be transferred into drums or tanks for transportation to the CIF. The oils have to meet certain viscosity and pumpability requirements to be accepted at the CIF. Another strategy can be to sorb the oils (i.e. oil dry) and place into the 21 inch boxes meeting the CIF WAC. Additionally, oils and other burnable wastes may require stockpiling to allow radioactivity to decay to the CIF WAC of 40 microcurie/ml before incineration. A permitted interim storage facility will be required for these wastes.

- Pumps and other process equipment already cutup and prepped for roasting and retorting.

- Process equipment needing no further treatment. It will be repackaged and sent to the appropriate disposal site.

The vast majority (>90%) of the volume of these wastes will be in the first two categories.

4.2.4.2 Roasting/Retorting Area

Roasting/Retorting and recovery of high mercury wastes (Hg > 260ppm) is a specified technology, per EPA regulation 40 CFR 268, before disposal of mercury wastes in the HW/MW Vaults.

The process to volatilize mercury from radioactive contaminated process equipment, soils, and other solid wastes with radioactive contaminated mercury has three major components:

- A Mercury Oven
- A Condenser/Decanter
- Offgas System with Tritium Removal

Each component will be required to process tritiated mercury wastes.

Process Flow

This is a brief description of the process required to roast/retort radioactive contaminated mercury from wastes. All of the technology to do this process exists and is used in the mercury industry and the DOE complex tritium facilities.

The mercury oven will be sized, at a minimum, to handle cut apart 8 liter sprengle pumps, mercury diffusion pumps, and tritium process beds.

The condenser (i.e. chevron baffle trap or centrifugal trap) will be connected to the offgas system of the oven to condense the mercury vapor. The liquid Hg would be drained off the bottom of the condensate receiver. Liquid organics would be decanted at the supernatant interface. The mercury will require further distillation, treatment, or amalgamation as necessary. The gas coming out of the condenser will be exhausted through the offgas system.

The offgas system will need the ability to remove any remaining mercury, tritium, organics, and any other undesirable air emissions.

Output

The expected output of the system will be elemental mercury to be amalgamated and process equipment suitable for RCRA disposal. If the waste is not classified as a high mercury waste (Hg>260 ppm) it will require testing before disposal.

4.2.4.3 Amalgamation Area

The amalgamation process will be a batch system sized to handle the annual projected volume of waste liquid Hg generated at SRS for disposal.

The mercury would be combined with zinc powder dampened with sulfuric acid to form an amalgam (EPA Procedure). This amalgam will be placed in specially designed stainless steel containers. These containers will have approximately a 2 gallon capacity and will have a machined screw closure to minimize vapor escape. The containers will weigh approximately 300 pounds when full (≈230 pounds amalgamated mercury and ≈70 pounds for the container).

The mercury would be drained into the two gallon container directly from the oven condenser (mercury from other sources would arrive in the specified two gallon stainless steel container) and moved to the amalgamation area.

The containers of amalgam can then be placed in disposal containers and be ready for shipment to the HW/MW vaults.

Output

The only output from this area will be containers of amalgamated mercury.

4.2.5 Acid Leaching and Chemical Precipitation

Low mercury wastes have a Best Demonstrated Available Technology (BDAT) of acid leaching and chemical precipitation. The process should be capable of handling a wide variety of low volume wastes. The process would be capable of handling almost any heavy metal problem (i. e. chromium, etc).

Acid leaching and chemical precipitation is a liquid based batch treatment requiring:

- Storage Tanks
- Acid Tanks
- Precipitant Chemical Tanks
- Pre-Treatment Tanks
- Treatment Tanks
- Precipitation Tanks
- Settling Tanks(for effluent treatment)
- Piping and Valving to Support System
- A Sludge Dewatering System (i.e. centrifuge)

4.2.6 Wastewater Treatment Process

Any wastewater generated at the HW/MW Treatment Building will have to be treated to the applicable disposal standards prior to final disposal. Processes generating wastewater will be minimized to the maximum extent possible.

The following processes are expected to generate wastewater in the HW/MW Treatment Facility:

- Decontamination process during normal operation.
- Cleanup activities between campaigns to minimize cross contamination and multiple waste code wastes.
- Size reduction and compaction.
- Macroencapsulation and stabilization.
- Analysis of wastes and treated waste forms.

The wastewater generated will probably be a RCRA waste stream due to the "derived from rule." The wastewater will probably contain trace elements of regulated materials (i.e. lead, cadmium, mercury, organics, radionuclides). The actual composition of the waste water will vary depending on the generating source and waste going through processing. The capability to analyze wastewater to categorize treatment may be economically feasible. The other possibility is to determine a worst case wastewater content and treat all wastewater to that standard. The high cost of analysis makes this option attractive.

PROCESS DESCRIPTION

Wastewater will be accumulated in the storage tanks. Wastewater will be piped from the storage tanks to settling / storage tanks at the wastewater plant. The wastewater treatment plant would have 2 clarification / settling tanks, a inclined plate separator, a ultraviolet light system (biological inhibitor), a sand filter, and sludge handling / treatment equipment. The effluent will be piped to the recycle tank. The sludge will be solidified using a cement or similar solidification. The solidified waste forms will be placed in boxes and disposed in the HW/MW vaults.

4.3 Final Treated Waste Descriptions

4.3.1 Contaminated Lead

Treated contaminated lead will be 12"x12"x12" (1 ft^3) and coated in polymer. Each cube will weigh approximately 711 pounds. Approximately 19 lead blocks will fit into a B-12 sized box (25 ft^3) for a total weight of approximately 13,500 pounds.

4.3.2 LETF Filter Paper

LETF filter paper will be shredded and placed into 21" boxes for shipment to the CIF. Each box will weigh 180 ± 25 pounds (for moisture content and packing efficiency variations).

4.3.3 HEPA Filter Frames

The metal hydroxide residue, with the Cd, from the acid leaching process will be stabilized and placed in 96 ft^3 containers. A full container of stabilized waste will weigh approximately 17,000 pounds.

The cleaned steel frames will be compacted and placed in 96 ft^3 containers. Each container has 90 ft^3 of waste space. There will be a 80% packing efficiency for a total of 72 ft^3 of steel frames. Each container will weigh approximately 27,000 pounds.

4.3.4 Gold Mercury Traps

Mercury traps will be disposed in stainless steel boxes inside 7'x7'2" concrete culverts. They are presently stored in this manner.

Note: Repackaging into the standard 96 ft^3 may save on final disposal volume.

4.3.5 Mercury Soils, Sludges, Contaminated Soils, Floor Sweepings, CMP Soils, F&H Seepage Basin Groundwater Remediation Residues, Wastewater Treatment Sludges, and Plating Line Sump Waste.

Stabilized wastes will be in 96 ft^3 containers. Each container will contain 90 ft^3 of stabilized waste and weigh approximately 17,000 pounds.

4.3.6 Tritiated Equipment and Process Beds

Roasted and processed equipment will be packed in 96 ft^3 containers holding 90 ft^3 of waste and weigh approximately 20,000 pounds.

4.3.7 Mercury

Amalgamated mercury will be placed in commercially available mercury containers. The mercury containers will then be placed in 96 ft^3 containers for placement in the vaults. Each container is estimated to weigh 15,000 pounds.

4.3.8 ITP Filters

ITP filters will be in a specially designed container approximately 72 ft^3.

4.3.9 Spent Tower Packing

Wastes will be disposed in 55 gallon drums. They are presently stored in these containers.

Note: Variance will be required to dispose of in this manner.

4.3.10 Containers and Packing Materials

Combustible material will be placed into 21" boxes for shipment to the CIF.

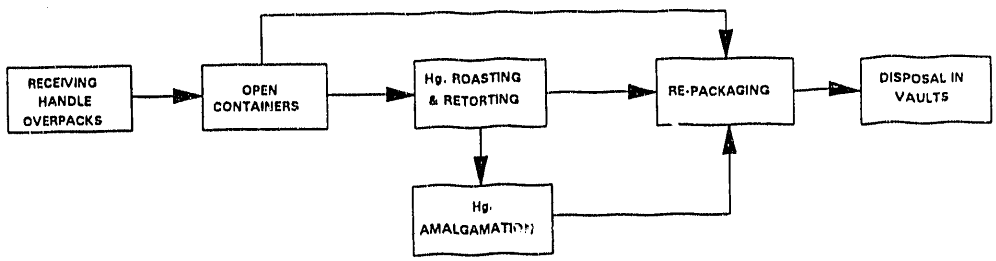
Size reduced material will be placed in 96 ft^3 containers holding 90 ft^3 of waste. Weight of this container will vary from 15,000 to 27,000 pounds depending on the actual waste material.

4.3.11 Miscellaneous Wastes

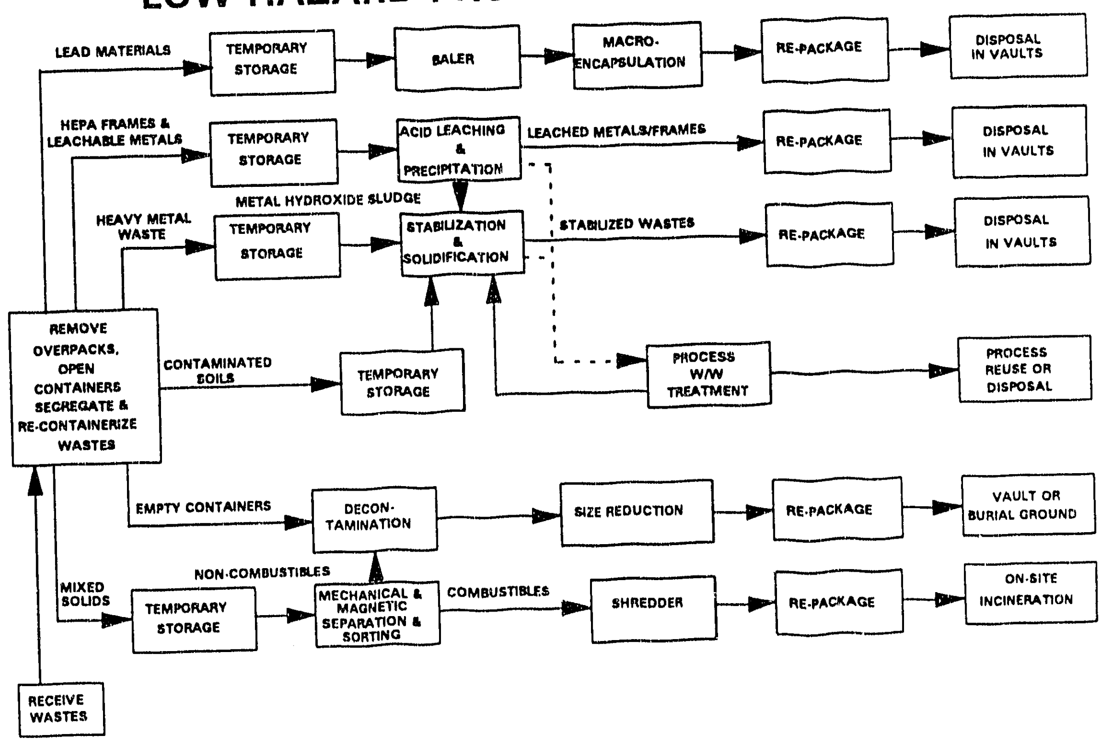
Wastes will be placed in 96 ft^3 containers holding 90 ft^3 of waste. Weight of this container will vary from 15,000 to 27,000 pounds depending on the actual waste material.

5.0 PROCESS FLOW

HW/MWDF TREATMENT BUILDING MODERATE HAZARD PROCESS FLOW DIAGRAM 1.0 (TRITIATED WASTE PROCESS)



HW/MWDF TREATMENT BUILDING LOW HAZARD PROCESS FLOW DIAGRAM 2.0



6.0 THROUGHPUT AND DISPOSAL VOLUMES

HW/MW PROCESSED WASTE DISPOSAL VOLUMES SUMMARY TABLE

WASTE DESCRIPTION	NUMBER OF CONTAINERS (1ST 4 YRS/ALL YRS)	DISPOSAL VOLUME (FT^3) (1ST 4 YRS/ALL YRS)
CONTAMINATED LEAD	17/2	1632/192
TRITIATED EQUIPMENT	4/2	365/127
Cd PLATED HEPA FILTERS	4/2	345/146
CONTAINERS & PACKING MATERIAL	70/40	6250/3600
STABILIZED WASTES	380+/110+	34,200+/10,000+
MISCELLANEOUS WASTES	1+	10+
MERCURY	2/1	192/96

WASTE DISPOSAL VOLUMES FOR DIRECT DISPOSAL IN HW/MW VAULTS

WASTE DESCRIPTION	NUMBER OF CONTAINERS (1ST 4 YRS/ALL YRS)	WASTE VOLUME (FT^3) (1ST 4 YRS/ALL YRS)
ITP FILTERS	2/1	144/72
GOLD MERCURY TRAPS	5/1	270/10
SPENT TOWER PACKING	2/1	125/5

SECONDARY WASTE DISPOSAL VOLUMES

WASTE DESCRIPTION	CONTAINERS	WASTE VOLUME FT^3 (ALL YRS)
PROCESS WASTEWATER SLUDGE	12	1200

RECYCLE VOLUMES

WASTE DESCRIPTION	CONTAINERS	RECYCLE VOLUME FT^3 (1^{ST} 4 YRS/ALL YRS)
CONTAINERS & PACKING MATERIAL	N/A	1000/400
WATER	N/A	99,000 GPY

WASTE VOLUMES FOR INCINERATION AT THE CIF

WASTE DESCRIPTION	NUMBER OF CONTAINERS (1^{ST} 4 YRS/ALL YRS)	WASTE VOLUME (FT^3) (1^{ST} 4 YRS/ALL YRS)
LETF FILTER PAPER	1020/500	5100/2500
CONTAINERS & PACKING MATERIALS	200/80	1000/400

6.1 Contaminated Lead

INPUT

Lead in Storage . . . . 17235 ft^3
50% recycle rate leaving . . . . 8620 ft^3
for macroencapsulation

A 25 % work off rate (per the FFCA) . . . . 2155 ft^3
to be processed in the first 4 years

plus annual generation of . . . . 175 ft^3

For a annual total of . . . . 2330 ft^3

OUTPUT

Size reducing lead
will decrease volume by 50% . . . . 1165 ft^3
Each 96 ft^3 container will hold 20 3.56 ft^3 blocks of lead
for a total of 71.2 ft^3 of lead per container.

1165 ÷ 71 = ... 17 Containers
96 ft^3 x 17 = ... 1632 ft^3 Annually

This total amount of lead will require processing during each of the first four years of operation.

After the initial work off the rate will drop to 175 ft^3 annually.

Size reducing lead
will decrease volume by 50% . . . . 90 ft^3
Each 96 ft^3 container will hold 20 3.56 ft^3 blocks of lead
for a total of 71.2 ft^3 of lead per container.
90 ÷ 71 = ... 2 Containers
96 ft^3 x 2 = ... 192 ft^3 Annually

6.2 LETF Filter Paper

INPUT

Filter Paper in Storage . . . . 8400 ft^3
for shredding

A 25 % work off rate (per the FFCA) . . . . 2100 ft^3
to be processed each of the first 4 years

plus annual generation of . . . . 2000 ft^3

For a annual total of . . . . 4100 ft^3

OUTPUT

Shredding and boxing
will increase volume by 25% . . . . 5100 ft^3
Each 21 inch square container
will hold 5 ft^3 of shredded filters
for a annual total of . . . . 1020 Boxes

This amount will require incineration at the CIF during each of the first four years of operation.

After the initial work off the rate will drop to 2000 ft^3 annually.

Shredding and boxing
will increase volume by 25% . . . . 2500 ft^3

Each 21 inch square container
will hold 5 ft^3 of shredded filters
for a annual total of . . . . 500 Boxes

6.3 HEPA Filter Frames

INPUT

Filter Frames in Storage . . . . 1400 ft^3
for shredding and acid leaching
followed by stabilization of the removed Cd

A 25 % work off rate (per the FFCA) . . . . 350 ft^3
to be processed each of the first 4 years

plus annual generation of . . . . 250 ft^3

For a annual total of . . . . 600 ft^3

OUTPUT

Shredding and acid leaching will remove ≈99% of the Cd
for a total of 5% of the waste volume . . . . 30 ft^3

Stabilization of Cd doubles the volume

for a annual total of . . . . 60 ft^3

There will be 570 ft^3 of cleaned stainless steel frames for disposal at the SWDF or the HW/MW Vaults. Compaction should reduce this roughly 50% to a annual volume of . . . . . . 285 ft^3

After the initial work off the rate will drop to 250 ft^3 annually.

Shredding and acid leaching will remove ≈99% of the Cd for a total of 5% of the waste volume . . . . 13 ft^3

Stabilization of Cd doubles the volume for a annual total of . . . . 26 ft^3

There will be 237 ft^3 of cleaned stainless steel frames for disposal at the SWDF or the HW/MW Vaults. Compaction should reduce this roughly 50% to a annual volume of . . . . . . 120 ft^3

6.4 Gold Mercury Traps

Mercury traps in storage for direct disposal in the first year . . . . 270 ft^3

plus annual generation of . . . . 10 ft^3

For a annual total of . . . . 280 ft^3

After the initial work off the rate will drop to 10 ft^3 annually for direct disposal.

6.5 Mercury Soils, Sludges, Contaminated Soils, Floor Sweepings, CMP Soils, F&H Seepage Basin Groundwater Remediation Residues, Wastewater Treatment Sludges, and Plating Line Sump Waste.

INPUT

Material in storage for stabilization . . . . 48275 ft^3

A 25 % work off rate (per the FFCA) . . . . 12100 ft^3 to be processed in the first 4 years

plus annual generation of . . . . 5000+ ft^3

For a annual total of . . . . 17100+ ft^3

NOTE: Soil washing could reduce this volume

OUTPUT

Stabilization doubles the volume
for a annual volume of . . . . 34,200+ ft^3

Approximately 90 ft^3 of stabilized waste will be stored in 96 ft^3 containers.

34200+ ÷ 90 = ... 380+ Containers Annually

This amount of material will require processing during the first four years of operation.

After the initial four years work off the rate will drop to 5000+ ft^3 annually for stabilization and disposal.

Stabilization doubles the volume
for an annual volume of . . . . 10,000+ ft^3

10,000+ ft^3 ÷ 90 = ... 110+ Containers Annually

6.6 Tritiated Equipment and Process Beds

INPUT

Equipment in storage
for roasting/retorting . . . . 900 ft^3

A 25 % work off rate (per the FFCA) . . . . 225 ft^3
to be processed each of the first 4 years

plus annual generation of . . . . 120 ft^3

For a annual total of . . . . 345 ft^3

OUTPUT

Roasting and Retorting will
remove 1% Hg . . . . 3.4 ft^3

Amalgamation of Hg increases the volume

by a factor of 6 for a annual total of . . . . 20 ft^3

There will be 345 ft^3 of roasted equipment for disposal at the SWDF or the HW/MW Vaults. Waste will be packed in 96 ft^3 containers holding 90 ft^3 of waste for a annual total of . . . . 4 containers

This amount of material will require processing during the first four years of operation. After the initial four years work off the rate will drop to a annual generation of . . . . 120 ft^3

Roasting and Retorting will remove 1% Hg . . . . 1.2 ft^3

Amalgamation of Hg increases the volume by a factor of 6 for a annual total of . . . . 7 ft^3

There will be 120 ft^3 of roasted equipment for disposal at the SWDF or the HW/MW Vaults. Waste will be packed in 96 ft^3 containers holding 90 ft^3 of waste for a annual total of . . . . 2 containers

6.7 Mercury

INPUT

Mercury in storage for amalgamation . . . . 15 ft^3

A 25 % work off rate (per the FFCA) . . . . 4 ft^3 to be processed each of the first 4 years

plus annual generation of . . . . 15 ft^3

For a annual total of . . . . 19 ft^3

OUTPUT

Amalgamation of Hg increases the volume by a factor of 6 for a annual total of . . . . 114 ft^3

Amalgamated mercury containers will be placed in 96 ft^3 containers holding 90 ft^3 of waste for a annual total of . . . . 2 containers

This amount of material will require processing during the first four years of operation. After the initial work off the rate will drop to 15 ft^3 annually.

Amalgamation of Hg increases the volume by a factor of 6 for a annual total of . . . . 90 ft^3

Amalgamated mercury containers will be placed in 96 ft^3 containers holding 90 ft^3 of waste for a annual total of . . . . 1 container

6.8 ITP Filters

ITP filters in storage for direct disposal in the first year . . . . 72 ft^3

plus annual generation of . . . . 72 ft^3

For a annual total of . . . . 144 ft^3

After the initial work off the rate will drop to 72 ft^3 annually for direct disposal.

6.9 Spent Tower Packing

Spent Tower Packing in storage for direct disposal in the first year . . . . 125 ft^3

plus annual generation of . . . . 5 ft^3

For a annual total of . . . . 130 ft^3

After the initial work off the rate will drop to 5 ft^3 annually for direct disposal.

6.10 Containers and Packing Materials

<u>INPUT</u>

Material in storage	20,000 ft^3
5% recycle rate	- 1000 ft^3
5% incineration rate	- 1000 ft^3
Total in storage	18,000 ft^3

A 25 % work off rate (per the FFCA) . . . . 4500 ft^3
to be processed each of the first 4 years

plus annual generation of . . . . 8000 ft^3

For a annual total of . . . . 12500 ft^3

<u>OUTPUT</u>

Size reducing
will decrease volume by 50% . . . . 6250 ft^3

Each 96 ft^3 container will hold 90 ft^3 of waste.

6250 ÷ 90 = ... 70 Containers Annually

The containers would go to the SWDF or the HW/MW Vaults.

This amount of material will require processing during each of the first four years of operation.

After the initial work off the rate will drop to 8000 ft^3 annually.

Annual total	8000 ft^3
5% recycle rate	- 400 ft^3
5% incineration rate	- 400 ft^3
Total	7200 ft^3

Size reducing
will decrease volume by 50% . . . . 3600 ft^3

Each 96 ft^3 container will hold 90 ft^3 of waste.

3600 ÷ 90 = ... 40 Containers Annually

The containers would go to the SWDF or the HW/MW Vaults.

6.11 Wastewater Treatment

INPUT

100,000 gallons wastewater with 2% solids produces . . . . 535 ft^3 of waste

OUTPUT

Stabilization doubles the volume for an annual volume of . . . . 1070 ft^3

Each 96 ft^3 container will hold 90 ft^3 of waste.

1070 ÷ 90 = ... 12 Containers Annually

The containers would go to the HW/MW Vaults.

The wastewater plant effluent will be returned to the recycle tank for recycling.

7.0 REFERENCES

1.0 SRS Mixed Waste Characterization Catalog for the HW/MW DF, WSRC-TR-90-226, M.S. Hay, et. al., May 31, 1990.

2.0 HW/MW DF - Recommended Treatments and Related Waste Management Issues (U), WSRC-RP-90-1143, C.A. Langton, et. al., November 16, 1990.

3.0 Hazards Assessment Document - HW/MW Treatment Building (U), Line Item 89-D-175,G.B. Woolsey, June 12, 1991.

4.0 HW/MW DF Phase II Treatment Building Basic Data Report, WSRC-TR-91-120, L.L. Bailey, March 28, 1991.

5.0 "Review of the SRS Solid Waste Forecast -FY 92", NMP-WMO-91-0155, M.E. Gorden, September 17, 1991.

6.0 Core Treatment Recommendations for the HW/MW TSB (U), WSRC-TR-90-602, J.L. England, December 26, 1990.

7.0 HW/MW DISPOSAL FACILITY- Phase 2 Waste Processing Building Basic Data, Revision 1, OPS-WMP-89-2512, M.S. Peters & C.B. Stevens, July 25, 1989.

8.0 Cost Assessment of Processing Tritiated Mercury Waste (U), WSRC-RP-91-724, J.L. England, August 23, 1991.

9.0 A Perspective of Hazardous Waste and Mixed Waste Treatment Technology at the SRS (U), WSRC-MS-91-117, J.L. England et. al., June 28, 1991.

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END

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