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Richland Operations Office
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05-AMCP-0430

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EDMC

Mr. Michael A. Wilson, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton Boulevard
Richland, Washington 99354

Dear Mr. Wilson:

INITIAL ENGINEERING STUDY AND FUNCTIONS FOR PROCESSING MIXED LOW-LEVEL WASTE (MLLW) AND TRANSURANIC (TRU)/TRU MIXED WASTE THAT IS EITHER CONTACT-HANDLED (CH) IN BOXES/LARGE CONTAINERS OR REMOTE-HANDLED (RH) WASTE IN VARIOUS PACKAGES

The March 2004 M-91-03 Transuranic Mixed Waste and Mixed Low-Level Waste Project Management Plan included plans to complete three separate engineering studies for different waste streams for which additional processing facilities are needed. An alternative approach to address all three waste stream groupings together was agreed to by your Waste Management Project Manager, Deborah Singleton, as described in Attachment 1. In accordance with this agreement, we are submitting the attached report titled "Initial Engineering Study and Functions for Processing MLLW and TRU Waste that is Either CH in Boxes/Large Containers or RH waste in various packages" (Attachment 2).

The approach is consistent with meeting the Tri-Party Agreement Target Date M-91-05-T01 of December 31, 2007. Combining the processing requirements for CH TRU/TRU mixed waste in boxes/large containers and RH TRU/TRU mixed waste with the large container and RH MLLW provides early integration of common functions in the design of the new capabilities. In this integrated approach the work of the first two deliverables based on the M-91-03 Project Management Plan will feed directly into the final December 31, 2007 product.

This report is the first step in the planning processes needed to obtain the required capabilities and we look forward to working with your staff over the next year as we work on the second deliverable, the final Engineering Study and Functional Design Criteria, for the combined stream facilities. Michael Collins, who oversees T-Plant activities will be the staff contact for this project.

If you have any questions, please contact me, or your staff may contact Mark French, of my staff, on (509) 373-9863.

Sincerely,

Matthew S. McCormick, Assistant Manager
for the Central Plateau

AMCP:GLS

Attachments

cc w/attachs:
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Administrative Record (M-91)
Environmental Portal

cc w/o attach:
L. D. Crass, FHI
R. D. Morrison, FHI
R. E. Piippo, FHI

Attachment 1

M-91 Engineering Studies*

Requirement/ Source/ Due Date	Original Description	Agreed Upon Approach
CH large size MLLW ES/FDC M-91 PMP Appendix H 9/30/05	"Issue Engineering Study/ Functional Design Criteria for CH large/over-size MLLW containers by 9/30/05"	Initial engineering study and functions for defining additional capabilities needed to process CH MLLW & TRU/TRUM in large containers and RH MLLW & TRU/TRUM. Emphasis on detailed analysis of feed and applicable remote systems
M-91 Engineering Study for TRUM M-91-PMP Appendix I 9/30/06	"M-91 Engineering Study, Functional Design Criteria & Conceptual Design as Required" (Appendix I is M-91 TRUM Waste Processing Activities)	Engineering study and functional design criteria for additional capabilities/capacities to process CH MLLW & TRU/TRUM in large containers and RH MLLW & TRU/TRUM. Emphasis on use of size reduction/ handling tools for wide variety of feeds and load in/loadout systems
RH and large size TRUM Engineering Study /FDC M-91-05-T01 12/31/07	"Complete and submit RH TRUM, suspect RH TRUM, TRUM in boxes and large containers, and suspect TRUM in large containers retrieval and processing facilities engineering study/functional design criteria study to Ecology for facilities required by M-91-01 The TRUM Engineering/Functional Design Criteria Study will cover activities/facilities not considered commercially viable as documented in the approved TRUM PMP and associated agreement change requests.	Conceptual design study for additional capabilities/capacities to process CH MLLW & TRU/TRUM in large containers and RH MLLW & TRU/TRUM * **Note**: For DOE planning purposes these documents will include planning/volumes for non-mixed TRU waste. Any information regarding non-mixed TRU waste provided in these documents is for information purposes only and is not subject to the Resource Conservation and Recovery Act (RCRA) or the State of Washington Hazardous Waste Management Act (HWMA). The hazardous and/or dangerous waste portion of TRUM is subject the RCRA and HWMA. Statements and information related to TRU in a TRUM mixture or to non-mixed TRU waste are not commitments enforceable under either RCRA or HWMA.

Attachment 2

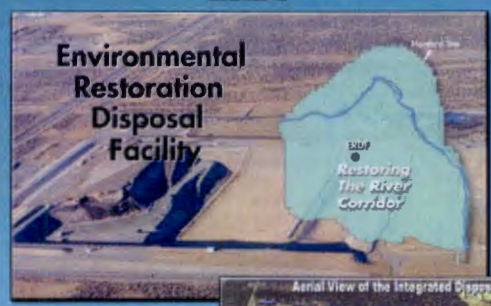
Fluor Hanford

Initial Engineering Study and Functions

For Processing MLLW and TRU Waste that is Either CH in Boxes/Large Containers or RH Waste in Various Packages

T Plant Complex

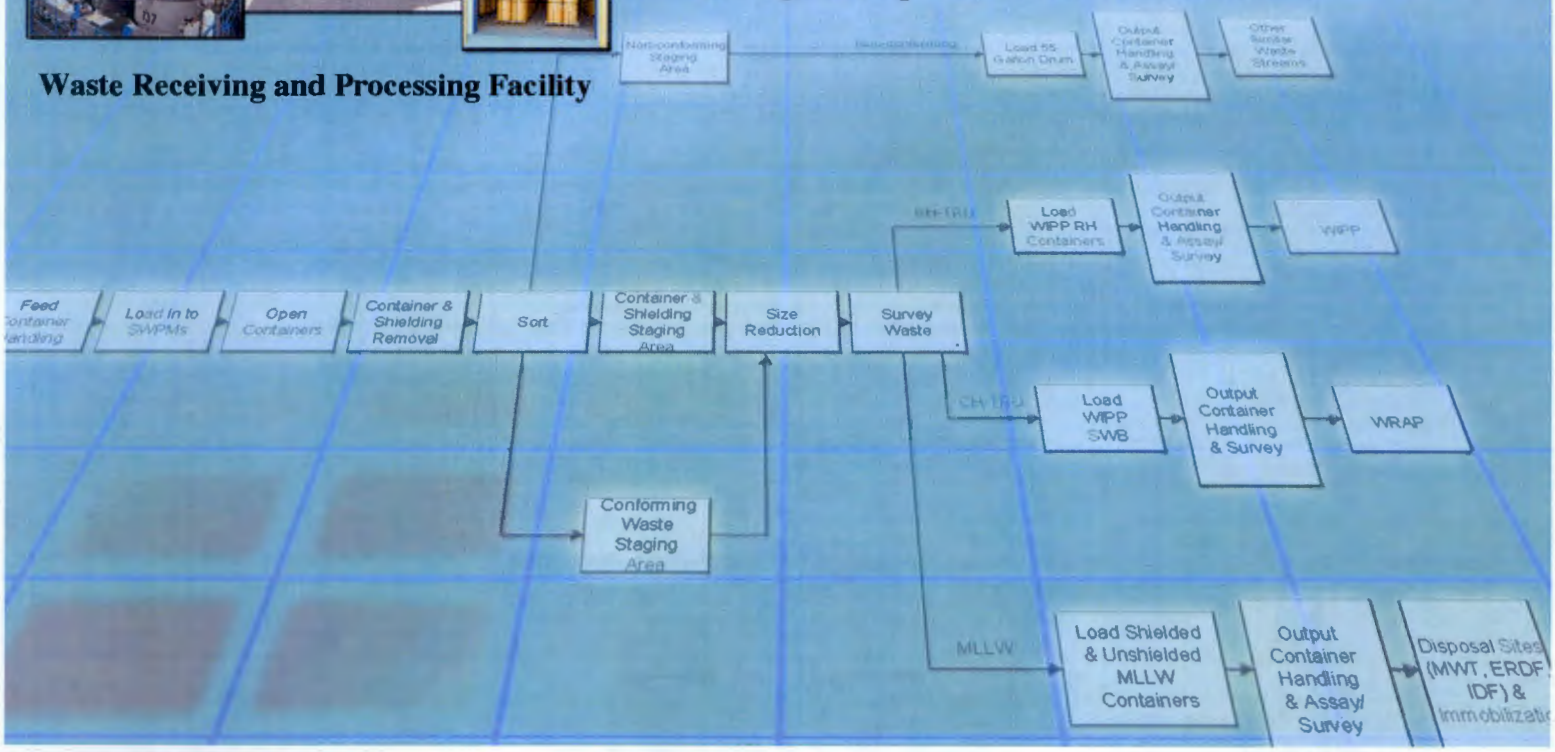
ERDF



Conceptual Drawing of IDF

Waste Receiving and Processing Facility

WIPP Transuranic
Package Transporter Model 2



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Executive Summary

More than 9,600 cubic meters (m^3) of mixed low-level waste (MLLW) and transuranic (TRU)/TRU mixed waste[1] that is either contact-handled (CH) waste in boxes/large containers or remote-handled (RH) waste in various-sized packages will be managed through the Richland Operations Office for the U.S. Department of Energy Hanford Site. The waste will require processing prior to disposal. Approximately 900 m^3 of this waste is forecast to be generated during site cleanup (including RH TRU waste from 618-10/11 burial ground cleanup), nearly 2,200 m^3 is now in above-ground storage, and nearly 6,500 m^3 (suspect[2] TRU waste) will be retrieved from storage in the post-1970 low-level burial grounds (LLBGs). Approximately 94% of the waste by volume is TRU or suspect TRU waste.

This initial Engineering Study defines the strategy and the functions (e.g., new capabilities) required to process these wastes for disposal in the Hanford mixed waste trenches (MWT), the Environmental Restoration Disposal Facility (ERDF)[3], or the future Integrated Disposal Facility (IDF) for MLLW and the Waste Isolation Pilot Plant (WIPP) in New Mexico for TRU waste.

Acquisition of capabilities and/or facilities will be required to remotely retrieve and package some suspect TRU waste (e.g., caisson waste in burial ground 4B) from the post-1970 LLBGs. Pilot retrieval of post-1970 LLBG 218-E-12B is planned this fall (2005) to help assess whether existing retrieval methods can be used. Results of these efforts will be integrated into the final Engineering Study and the Functional Design Criteria planned for completion in September 2006. Additional needs for processing waste generated from Hanford Site Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) cleanup actions will also be integrated as requirements are identified.

Commercial facilities are being used to remove non-conforming (e.g., Land Disposal Restriction [LDR]) items from stored regulated MLLW containers; repackage and treat (e.g., macro-encapsulate) regulated hazardous waste; and immobilize the waste package prior to disposal. Commercial facilities, within their license limits and container size and weight constraints, and the T Plant complex, within its waste acceptance criteria, are being used to process MLLW in boxes and large containers up to 15 m^3.

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[1] This report refers to transuranic/transuranic mixed waste as TRU waste. Planning and volumes for non-mixed TRU waste are included for DOE planning purposes. Any information on non-mixed TRU waste in this report is for information purposes only and is not subject to the Resource Conservation and Recovery Act (RCRA) or the State of Washington Hazardous Waste Management Act (HWMA). The hazardous and/or dangerous waste portion of TRUM is subject to the RCRA and HWMA. Statements and information related to TRU in a TRUM mixture or to non-mixed TRU waste are not commitments enforceable under either RCRA or HWMA.

[2] Post-1970 LLBGs retrieved waste is considered suspect TRU waste until it is assayed to determine whether it is TRU or LLW.

[3] Regulatory approval is required for waste disposal in ERDF.

This strategy modifies Hanford's T Plant complex, as defined in the TRU Mixed/Mixed Low-Level Waste Project Management Plan (PMP), to process large containers that cannot be processed at commercial facilities; RH MLLW; CH TRU waste in boxes/containers; and RH TRU waste. New T Plant capabilities include modular cells referred to as solid waste processing modules (SWPMs) in the T Plant canyon that process both MLLW and TRU waste and a Solid Waste Handling Facility (SWHF) added to the south end of the T Plant canyon. The strategy uses existing Hanford facilities (Waste Receiving and Processing Facility [WRAP], Central Waste Complex [CWC], 2706-T, MWT, and ERDF) and commercial facilities to support waste staging, processing, and disposal.

The ability to perform required basic functions such as 1) RH-72B or CNS 10-160B cask payload container RH TRU waste loading and sealing and 2) handling and processing of large containers will dictate the size and the cost of the new T Plant SWPMs and SWHF. Processing capacity is a function of the ability to routinely load-in and load-out containers with minimal contamination issues, maintain remote equipment in an operational condition, and staff for multi-shift operations. T Plant complex processing will include the following:

- ***Load-in/Load-out of Waste Containers*** – Activities include 1) receiving and load-in of containers up to 20 × 13 × 11 ft (these are the largest possible external dimensions), up to 38,000 kilograms (83,000 lb), and up to 20,000 R/hr at the waste container surface and 2) load-out of TRU waste in WIPP standard waste boxes (SWBs), non-conforming MLLW in 55-gallon drums, MLLW in 5 × 5 × 9 ft containers, and RH TRU waste in drums/payload containers for placement in shipping casks (i.e., RH-72B and/or CNS 10-160B).

- ***Opening Waste Containers*** – Remotely operated systems will open, section, and remove the container and loose shielding to provide access to the waste.

- ***Non-Conforming Waste Removal*** – Remotely operated systems will sort non-conforming MLLW for load-out and processing using existing capabilities (e.g., thermal treatment at commercial facilities).

- ***Size Reduction*** – Remotely operated systems will size-reduce containers, waste, and shielding for load-out in containers.

- ***Processing*** – Activities include staging waste, in-cell waste dose rate measurement, non-conforming TRU waste processing, cell cleaning, loading waste containers, and RH waste payload container sealing in an inert gas module (e.g., for the RH-72B vessel).

- ***Waste Container Handling*** – Staging waste containers, MLLW and RH TRU waste container assay, RH shipping cask handling and preparations for shipment, and MLLW container immobilization.

- ***Support Systems and Areas*** – Including T Plant canyon crane, SWPMs and SWHF cranes, self-contained heating, ventilation, and air conditioning (HVAC) system, fire suppression systems, operations and maintenance support space, decontamination areas, support systems for failed equipment load-out and replacement equipment load-in, and remote systems control room.

New T Plant capabilities requiring technology development and equipment testing include remote equipment; load-in/load-out systems; RH TRU waste container loading, sealing, assaying, and handling equipment; and module cleaning systems. Commercially available equipment will be used when possible. Remote equipment selection and development will require mockup and testing (e.g., RH container handling systems, container opening equipment, load-in/load-out systems) to support final design.

The 9,600 m^3 of waste to be processed weighs approximately 5,300,000 kg. Approximately 73% of this weight is the waste container, loose shielding, and waste known to be MLLW at load-in. After load-in to the SWPMs, the containers and loose shielding will be separated from the waste, placed in a lined 5 × 5 × 9 ft MLLW container (shielding will be based on receipt waste knowledge), loaded-out of the SWPMs into the T Plant canyon, transported to a new assay station near the 2706-T facility (location will be a function of background), immobilized in the 2706-T facility, and shipped to the MWT or ERDF for disposal.

The remaining 27% of waste weight consists of nearly 1,400,000 kg of suspect TRU waste, 350,000 kg of RH TRU waste, and less than 30,000 kg of non-conforming MLLW (based on current experience). The CH TRU and suspect CH TRU waste will be processed in the SWPMs, loaded into WIPP SWBs, and transferred from the SWHF to WRAP for assay to determine whether the waste is CH TRU waste or MLLW. The CH TRU waste will be transported to WIPP in TRUPACTs. The MLLW will be transferred to 2706-T (or commercial processor) for treatment, and then sent to the MWT, ERDF or IDF for disposal. The RH TRU and suspect RH TRU waste will be processed in the SWPMs, loaded into RH TRU waste containers, assayed, loaded-out of the SWPMs, placed in RH casks and sent to WIPP for disposal. Completing the processing by FY 2028 (the current T Plant closure date) requires a processing rate of 600 m^3 per year. This would generate approximately 67 MLLW containers (5 × 5 × 9 ft), 37 WIPP SWBs, and either 15 RH-72B casks or seven CNS 10-160B casks per year.

The combined life-cycle volume of waste in containers from SWPM processing is estimated to be 11,000 m^3. This volume includes an additional 100 m^3 of MLLW per year that is generated by SWPM operations. Overall, about a 10% increase in waste volume is estimated, not including waste from deactivation of the SWPMs at completion of operations in FY 2028.

This strategy supports the commitments in the Hanford Federal Facility Agreement and Consent Order, also known as the Tri-Party Agreement (Ecology et al. 1989), M-91 milestone series. It also supports Tri-Party Agreement Milestones M-16-67 and M-16-93 by integrating CERCLA requirements in that it allows expansion of processing capacities. WIPP needs to accept this

waste from Hanford. The Project Management Plan (PMP) will be updated to reflect this strategy. By September 30, 2006 a Functional Design Criteria study will be completed for the new T Plant capabilities. A conceptual design report will be completed by December 31, 2007.

Tri-Party Agreement Milestone M-91-15 requires acquisition of capabilities and/or facilities and initiation of treatment of RH and CH mixed waste in large boxes and containers by June 30, 2008. Tri-Party Agreement Milestone M-91-43 requires treatment of RH MLLW and boxes/ large containers of CH MLLW at a minimum rate of 300 m^3 per year beginning no later than June 30, 2008. Milestone M-91-44 requires processing RH TRUM waste and boxes/large containers of CH TRUM waste at a rate of 300 m^3 per year beginning no later than June 2012.

Using existing facilities, over 194 m^3 of RH and CH MLLW in large containers has been processed toward the M-91-43 commitment to date. An additional 55 m^3 of large container MLLW in above-ground storage may be treated using existing capabilities. This leaves only two large containers (80 m^3) of CH MLLW and 120 m^3 of RH MLLW now in above-ground storage that cannot be processed with available capabilities. No newly generated boxes/large containers of CH or RH MLLW are forecast before 2010. From 2010 through 2032, only 304 m^3 of RH MLLW is forecast, which includes only 35 m^3 through 2012. The two principal sources of RH MLLW are the Waste Treatment Plant (WTP) and the Waste Encapsulation and Storage Facility (WESF). A portion (estimated at 295 m^3, or 50%) of retrieved suspect TRU waste in large containers that can be treated commercially will be reclassified as MLLW with assay. The quantity of MLLW already processed and available for processing with existing facilities is projected to be sufficient to meet M-91-43 (300 m^3 per year) through January 2010.

Acquisition of the new T Plant capabilities for processing MLLW could be established using a phased approach by January 2010. The remaining capability for TRU waste could be completed by June 2012. The final Engineering Study will evaluate the benefits of this phased approach.

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1.0 Introduction

U.S. Department of Energy (DOE) Hanford Site mixed low-level waste (MLLW) and transuranic (TRU)/TRU mixed waste[1] forecast to be generated during site cleanup is now in above-ground storage and is planned to be retrieved from storage in the post-1970 low-level burial grounds (LLBGs). This waste will require staging and processing prior to disposal. Existing Hanford facilities (Waste Receiving and Processing Facility [WRAP], Central Waste Complex [CWC], and the T Plant complex) and commercial facilities are being used, within their waste acceptance criteria, to support these needs. For example, commercial facilities are treating most contact-handled (CH) MLLW in containers up to 15 m^3 in size. MLLW and TRU waste requiring new capabilities and/or facilities to retrieve and/or process include the following:

- CH MLLW in containers[2] larger than 15 m^3
- Remote-handled (RH) MLLW
- CH TRU waste in boxes[3] and large containers
- RH TRU waste.

The *TRU Mixed/Mixed Low-Level Waste Project Management Plan* (PMP) (FHI 2004) identified the T Plant complex for processing these remaining wastes. This initial Engineering Study defines the strategy and the new T Plant complex functions (e.g., new capabilities) required to process these wastes for disposal in the Hanford Mixed Waste Trenches (MWTs), the Environmental Restoration Disposal Facility (ERDF)[4], or the future Integrated Disposal Facility (IDF) for MLLW, and the Waste Isolation Pilot Plant (WIPP) in New Mexico for TRU waste.

The *Hanford Federal Facility Agreement and Consent Order,* also known as the Tri-Party Agreement (Ecology et al. 1989) M-91 milestone series, requires that capabilities be established to process mixed waste. M-91 requires acquisition of necessary capabilities and/or facilities to remotely retrieve, stage, and package transuranic mixed waste from the post-1970 LLBGs. Pilot retrieval of post-1970 LLBG 218-E-12B is planned this fall to assess whether existing retrieval methods can be used. Results of these efforts will be integrated into the final Engineering Study and the Functional Design Criteria planned for completion in September

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[1] This report refers to transuranic/transuranic mixed waste as TRU waste. Planning and volumes for non-mixed TRU waste are included for DOE planning purposes. Any information regarding non-mixed TRU waste in this report is for information purposes only and is not subject to the Resource Conservation and Recovery Act (RCRA) or the State of Washington Hazardous Waste Management Act (HWMA). The hazardous and/or dangerous waste portion of TRUM is subject the RCRA and HWMA. Statements and information related to TRU in a TRUM mixture or to non-mixed TRU waste are not commitments enforceable under either RCRA or HWMA.

[2] Large containers are greater than 10 m^3 in volume.

[3] Boxes are small containers with a volume less than a 55-gallon drum or with a volume greater than a 55-gallon drum and less than or equal to 10 m^3.

[4] Regulatory approval is required for waste disposal in ERDF.

2006. Tri-Party Agreement Milestones M-16-67 and M-16-93 address additional needs for processing mixed waste generated from Hanford Site Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) cleanup actions. These needs will also be integrated as requirements are identified. Appendix B lists applicable details from the Tri-Party Agreement.

1.1 Background

1.1.1 MLLW

Mixed waste is defined as radioactive waste that also contains dangerous and/or hazardous constituents (see Appendix A). Based on the May 1987 Byproducts Rule, the radiological constituents of mixed waste are governed by the Atomic Energy Act (AEA), and the chemical and hazardous constituents are governed by Resource Conservation and Recovery Act (RCRA) Title 40, Code of Federal Regulations, Part 260 (40 CFR 260). Washington Administrative Code (WAC) 173-303 implements the Hazardous Waste Management Act, as amended.

In November 1986, RCRA regulations were applied such that low-level waste (LLW) that was not already disposed of became subject to RCRA if it contained hazardous waste constituents. Consequently, in July 1986, the radioactive waste disposal operations undertook the practice of segregating LLW from mixed waste. Mixed waste was placed in RCRA permitted facilities.

In November 1987, the Washington State Department of Ecology (Ecology) was first authorized by the U.S. Environmental Protection Agency (EPA) to regulate mixed waste. Subsequently, representatives from DOE Richland Operations Office (DOE-RL) and Westinghouse Hanford Company (WHC), EPA Region X, and Ecology met to discuss the strategy needed to handle the mixed waste that was being generated at the Hanford Site. The resulting strategy, effective January 15, 1988, allowed all containerized mixed waste generated onsite (except for RH waste and ignitable waste) to be consolidated for temporary above-ground storage on retrievable storage pads. Mixed waste generated offsite could not be accepted for storage except on a case-by-case basis with concurrence from EPA and Ecology until the radioactive mixed waste storage buildings were in place. These new storage buildings were placed in service beginning in 1989.

1.1.2 TRU Waste

Waste containing greater than 100 nanocuries per gram of TRU that meets the definition in subsection (18) of Section 2 of the WIPP Land Withdrawal Act, Pub. L. 102-579 is defined as TRU waste. TRU waste that is subject to RCRA or Revised Code of Washington (RCW) 70.105 is referred to as mixed TRU waste (TRUM).

1.1.3 CH and RH Waste

CH waste is a waste package with a surface dose rate less than 200 mrem/hr. RH waste is a waste package with a surface dose rate equal to or greater than 200 mrem/hr. In some instances, RH waste has been shielded so it is now CH.

1.1.4 Mixed Waste Tri-Party Agreement Milestones

The Tri-Party Agreement contains milestones for treatment of mixed waste to ensure that legacy waste is treated to reduce the stored backlog and that newly generated waste is managed so it does not contribute to the legacy backlog. The Tri-Party Agreement also contains annual milestones for retrieval of post-1970 retrievably stored waste (RSW), and the acquisition of capabilities and/or facilities to process RH and large container TRU waste. The M-91 milestone series includes the following milestones (full text provided in Appendix B):

M-91-01 – Complete the acquisition of capabilities and/or acquisition of new facilities, modification of existing facilities and/or modification of planned facilities necessary for retrieval, designation, storage and processing of post-1970 RH TRUM and large container CH TRUM.

M-91-03 – Revise the Hanford Site TRUM Waste and MLLW PMP to comply with Tri-Party Agreement Section 11.5 requirements by December 31, 2003, March 31, 2009, and March 31, 2013.

M-91-05-T01 – Complete and submit RH and large container CH TRUM retrieval and processing facilities Engineering Study/Functional Design Criteria Study by December 31, 2007.

M-91-12A – Complete thermal treatment of at least 240 m^3 of CH Mixed Waste by September 30, 2005.

M-91-12 – Complete thermal treatment of an additional 360 m^3 of CH Mixed Waste by November 16, 2007.

M-91-15 – Complete acquisition of facilities and/or capabilities and initiate treatment of RH and CH mixed waste in large boxes and containers by June 30, 2008.

M-91-40 – Retrieve all CH-RSW within burial grounds 218-W-4C, 218-W-4B, 218-W-3A, and 218-E-12B by December 31, 2010.

M-91-41 – Initiate full-scale retrieval of RH RSW by January 1, 2011. Retrieval of non-caisson RH RSW shall be completed by December 31, 2014. Retrieval of the 200 Area caisson RH RSW in the 218-W-4B burial ground shall be completed by December 31, 2018.

M-91-42 – Treat specified newly generated CH and CH mixed waste in storage in accordance with the required treatment schedule through December 31, 2009. After June 30, 2009, treat all newly generated mixed waste in accordance with the treatment requirements in compliance with WAC 173-303-140 and 40 CFR 268.

M-91-43 – Designate all RH LLW and boxes[5] and large containers of CH mixed waste in above-ground storage as of June 30, 2003 by December 31, 2008. Begin treatment of CH and RH mixed waste and boxes and large containers of CH mixed waste at a minimum rate of 300 m^3/yr beginning no later than June 30, 2008.

M-91-44 – Designate and begin processing of RH and box/large container CH TRUM waste at a rate of 300 m^3/yr beginning no later than June 30, 2012.

M-91-45 – Submit a report describing completed and scheduled work relating to RH mixed waste and CH mixed waste in large boxes and containers by September 30, 2004 and annually thereafter to Ecology.

Other milestones that are integrated with the M-91 milestone series include:

M-16-67 – Submit a technology development summary report by March 31, 2007, for Phases I, II and III; an intermediate design report; a remediation schedule; and a treatability investigation work plan for remedial actions at the 618-10 and 618-11 burial grounds. The intermediate design report should represent a 60% complete design and should include, at a minimum, the remediation approach (i.e., process definition), evaluation of infrastructure requirements (M-91 and WIPP integration planning), and updated drawings/technical specifications.

M-16-93 – Submit an implementation work plan to EPA for the acquisition of capabilities necessary to prepare TRU and TRUM waste generated by CERCLA cleanup actions at the Hanford Site for disposal at WIPP by September 30, 2006. To avoid duplicative requirements, the M-16-93 work plan will integrate plans developed pursuant to the M-91 milestones to provide capabilities for RCRA mixed and suspect TRUM waste where such capabilities also can be used for CERCLA TRU/TRUM waste.

1.2 Purpose

The purpose of this study is to identify the strategy and functions (e.g., new capabilities) needed to stage and process Hanford Site CH MLLW and TRU waste in boxes/large containers and all sizes of packages that contain RH MLLW and RH TRU waste for disposal. This study supports Tri-Party Agreement M-91 milestone series, CERCLA cleanup M-16-67 and M-16-93 integration, and the M-91-03 PMP.

[5] Treatment of CH MLLW boxes is being credited toward Tri-Party Agreement milestone M-91-42.

1.3 Scope

Hanford Site MLLW and TRU waste that is 1) forecast to be generated during site cleanup, 2) currently in above-ground storage, and 3) planned to be retrieved from storage in the post-1970 LLBGs in boxes/large containers and all sizes of packages that contain RH waste is included in this study. CH TRU in drums and newly generated CH TRU in WIPP SWBs are not included. For DOE planning purposes this report includes planning/volumes for non-mixed TRU waste. Any information regarding non-mixed TRU waste provided in this report is for information purposes only and is not subject to the RCRA or the State of Washington Hazardous Waste Management Act (HWMA). The hazardous and/or dangerous waste portion of TRUM is subject the RCRA and HWMA. Statements and information related to TRU in a TRUM mixture or to non-mixed TRU waste are not commitments enforceable under either RCRA or HWMA.

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2.0 Waste Inventories and Projections

MLLW and TRU waste that is either CH waste in boxes/large containers or RH waste in various sized packages will require processing prior to disposal. The waste is from three sources: waste forecast to be generated during site cleanup (including RH TRU waste from 618-10/11 burial grounds cleanup), waste currently in above-ground storage, and waste (suspect[1] TRU waste) that will be retrieved from storage in the post-1970 low-level burial grounds (LLBGs).

The solid waste inventories and projections (Table 2.1) must be defined adequately to evaluate processing requirements. This evaluation includes waste volumes, weights, container types and counts, and dose rates. Information in this section is based on current waste inventories and projections and is subject to change as these are updated. Treatment of CH MLLW boxes is being credited toward Tri-Party Agreement milestone M-91-42.

Table 2.1. Waste Source Summary (cubic meters)

Waste Type	Container Size	Above Ground Storage	Post-1970 LLBGs	Forecast	Total
CH MLLW	Large	135			135
RH MLLW	Drums	3		304	307
	Medium	80			80
	Large	37			37
CH TRU	Drums		0.2		-
	Small		5		5
	Medium	1,405	1,231	42	2,677
	Large	363	5,099	90	5,552
RH TRU	Drums	4	26	75	105
	Small		24		24
	Medium	123	159	428	710
Grand Total		**2,150**	**6,544**	**939**	**9,633**

Multiple data sources were used to compile the information in this section. The Solid Waste Information Tracking System (SWITS) database was used to collect data for stored waste, both above-ground and in temporary trenches. The Solid Waste Integrated Forecast Technical Report (SWIFT) database and report (FHI 2005b) was used to collect data for the forecasted waste. The SWIFT database provides life-cycle information about the radioactive solid waste expected from onsite and offsite generators. The SWIFT forecast is updated annually to reflect changes in Program needs. The 618-10/11 burial ground data were compiled using background information on the history, contents, and plans for the burial grounds documented in multiple reports.

[1] Post-1970 LLBGs retrieved TRU waste is considered suspect TRU waste until it is assayed. Assay determines whether the waste is TRU waste or LLW.

Historical data are often incomplete or unavailable and assumptions must be made about the waste characteristics. Assumptions have been noted in the following discussion of the waste characteristics. The accuracy and completeness of the data are dependent on the correctness of the assumptions.

The total volume of MLLW and TRU waste that is either CH waste in boxes/large containers or RH waste in various sized packages identified as currently in above-ground storage, the post-1970 low-level burial grounds, and the newly generated forecasted waste is approximately 9,600 m^3. This does not include CERCLA waste, with the exception of RH TRU waste from the 618-10/11 burial grounds. Retrieval of 618-10/11 waste will include provisions for processing CH TRU and MLLW. The following sections discuss each waste type with subsections on the different sources of waste.

2.1 CH MLLW

2.1.1 CH MLLW in Above Ground Storage in Boxes and Large Containers

CH MLLW in above-ground storage that requires processing includes large containers. In some instances, RH MLLW shielded to CH may have been identified in SWITS as CH MLLW. Those wastes are included in this report as RH MLLW.

There are six containers identified in SWITS as containing large (>10 m^3) CH MLLW. All six containers are identified as metal boxes. The largest of these containers measures 17.7 × 9.7 × 13.6 ft and contains exhauster system equipment from underground storage tanks. The remainder of these containers range in size from 10.5 × 7.9 × 7.6 ft to 8 × 8 × 6 ft. There is potential to treat up to four of these large CH MLLW containers using existing capabilities. Table 2.2 lists the six large containers individually.

Table 2.2. Treatment Options for Large CH MLLW in Above-Ground Storage

Container ID	Size (m^3)	Gross Weight (kg)	Disposition Comments
Potential existing capabilities for treatment			
C5027F	18	6,270	Requires void fill prior to disposal.
HEXO-93-000300	15	7,950	Candidate for commercial treatment.
EFSG-95-1666	12	2,550	Waste contains PCBs, requires sorting of non-conforming items.
105N-89-001120	11	5,520	Requires void fill prior to disposal.
Sub-Total	56	22,290	
No existing capabilities for treatment			
9519114	66	6,900	Too large for commercial treatment.
WTFF-96-261-04	14	1,950	High dose waste (up to 64R) of individual items.
Sub-Total	80	8,850	
Totals	**135**	**31,140**	

The total mass of CH MLLW in permitted above-ground storage is approximately 31,100 kg. Nearly two-thirds of that total is assumed to be waste weight. The heaviest of the containers in

this group weighs approximately 7,950 kg; four containers weigh more than 5,000 kg. Weights are included in this inventory to estimate the number of containers generated from waste processing.

2.2 RH MLLW

The SWITS database indicates waste type and the presence of shielding. On occasion, RH MLLW shielded to CH may have been identified in SWITS as CH MLLW. Those wastes are included in this report as RH MLLW. It is also assumed that any CH MLLW identified in SWITS as LDR treatment code MLLW-07 that is smaller than 10 m^3 is also RH waste.

2.2.1 RH MLLW in Above-Ground Storage

All waste discussed in this section has been identified in SWITS as CH MLLW. The waste is assumed to be RH shielded down to CH due to a qualitative assessment involving the presence of shielding and dose rates and evaluation of record documents.

A total of 40 containers containing 120 m^3 of waste have been identified as probable RH MLLW in above-ground storage. Of these, three are larger than 10 m^3 by container volume. The largest of these containers measures 8 × 7.8 × 7.5 ft and contains high-efficiency particulate air (HEPA) filters contained in a steel box generated from tank farm activities. Twenty-two of the RH MLLW containers are metal boxes; the remainder consists of four 85-gallon drums and fourteen 55-gallon drums.

The total mass of the RH MLLW in permitted above-ground storage is 52,500 kg (Table 2.3). The majority of the weight is expected to consist of the container, shielding, and packing. The largest of the containers weighs approximately 7,400 kg with two containers weighing more than 5,000 kg. Twenty-seven weigh less than 1,000 kg gross weight.

Table 2.3. Weights (kg) of RH MLLW in Above-Ground Storage

Shielding	Number of Containers	Gross Weight (kg)	Waste Weight (kg)	Waste Percent
Oversized				
Lead	3	16,400	7,800	48%
Non-Oversized				
Lead	18	20,000	6,800	34%
Steel	2	940	110	12%
Other	1	180	150	83%
None/Blank	16	15,000	9,000	60%
Sub-Total	37	36,100	16,000	44%
Totals	**40**	**52,500**	**23,800**	**45%**

The dose rate for these containers is measured at the container surface and is not representative of the dose expected from the waste. Ten of the RH MLLW containers have a dose rate of

100 mrem/hr or higher, with a maximum recorded dose rate of 150 mrem/hr. The remaining 30 containers have a recorded dose rate of less than 70 mrem/hr.

2.2.2 Newly Generated RH MLLW

A total of 304 m^3 of waste is forecasted (see Figure 2.1) starting in FY 2010 and continuing through FY 2028. The waste comes from three sources, the Waste Encapsulation Storage Facility (WESF), the WTP, and T-Plant. The dates for waste generation and waste receipt are based on current estimates of facility operations. Dates and volumes may change as better planning information becomes available.

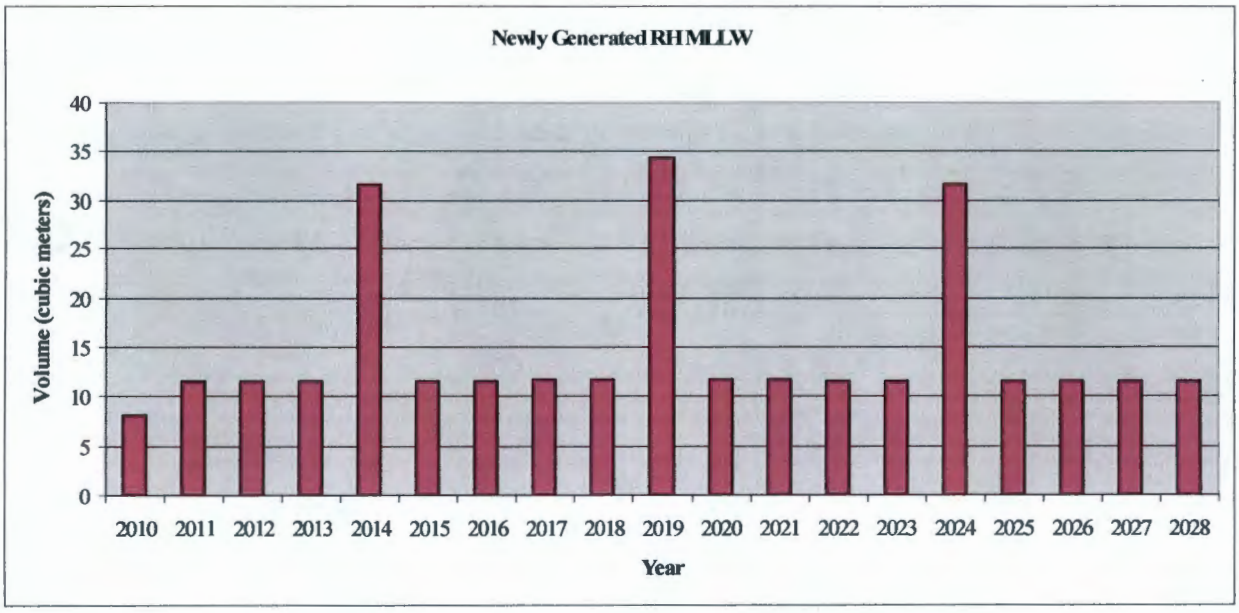


Figure 2.1. Annual Volumes of Newly Generated RH MLLW Requiring Treatment

The waste forecast by WESF is to be packaged in 55-gallon drums at the rate of five per year starting in FY 2017 continuing through FY 2021. The waste is expected to be debris containing metals (50% by volume), inorganics (25% by volume), and plastic/rubber (25% by volume).

The waste forecast by WTP is expected to be generated in association with normal operations and planned maintenance including routine filter and thermowell change out. The waste is to be packaged in 55-gallon drums starting in FY 2010 and continuing through FY 2028. The waste is expected to be debris containing inorganics (65% by volume), metals (30% by volume), and organics (5% by volume).

The waste forecast by T-Plant is reported in the CY2004 LDR Report (DOE 2005). The waste is from the 221-T tank system, the contents of which are evaporating. The waste is currently liquids with settled solids/sludges containing PCBs at TSCA regulated concentrations.

Waste weight and dose rate information is not collected from generators in the SWIFT forecasting process. The weights can be estimated using an assumed density of similar waste. The average density for RH MLLW in above-ground storage is approximately 440 kg/m^3. Using this density and applying it to the volume of forecasted RH MLLW, the total mass of newly generated waste would be 147,100 kg, with the containers weighing on the order of 110 kg each.

2.3 CH TRU Waste in Boxes and Large Containers

2.3.1 CH TRU Waste in Above-Ground Storage

CH TRU waste in above-ground storage is located primarily in the CWC. Some waste is stored at the 212-N Fuel Storage Building, T Plant, and temporarily at the WRAP as it is prepared for shipment to WIPP.

There are currently 328 containers of CH TRU in above-ground storage, comprising a volume of 1,770 m^3. Twenty-two of these containers are designated as large containers; the largest measures 15.5 × 16.8 × 7.8 ft, and five containers have a volume greater than 17 m^3. All five of these largest containers are stored at the 212-N Fuel Storage Building. The largest CH TRU waste container stored at CWC measures 17 × 7 × 5 ft. The remainder of this waste is packaged in medium-size containers.

The total mass of CH TRU waste in above-ground storage is estimated to be approximately 867,000 kg. Less than half of that mass is waste weight; the remainder is container, packaging, and shielding. The heaviest of these containers weighs 25,100 kg and is also the largest in waste volume (43 m^3). Thirteen containers weigh more than 10,000 kg; of these, seven are less than 1 m^3 in volume. Roughly one-third (97) of the containers weigh less than 1,000 kg.

The weight of the CH TRU waste, as opposed to the weight of the container, packaging, and shielding, is not recorded in all instances in SWITS. Table 2.4 identifies the number of records and the masses of those containers that have both gross and waste weight identified. The majority of CH TRU waste containers in above-ground storage have both identified; however, several of the larger containers do not.

Table 2.4. Weights of CH TRU in Above-Ground Storage

	No of Containers	Gross Weight (kg)	Waste Weight (kg)	
Waste weight not identified				
Medium	9	42,300	NA	NA
Large	8	104,000	NA	NA
Waste weight identified				
Medium	297	664,400	285,900	43%
Large	14	56,100	25,800	46%
Estimated Totals				
Medium	307	706,800	304,100	43%
Large	22	160,100	73,700	46%
Grand Total	329	866,900	377,800	44%

2.3.2 CH TRU Waste in Post-1970 LLBGs in Boxes and Large Containers

A portion of the retrieved waste from the post-1970 LLBGs is expected to be reclassified as MLLW after assay (see Section 2.6). The CH TRU waste in the post-1970 LLBGs was packaged in several different types of containers. Each of these is described in this section.

Fiberglass Reinforced Plywood Boxes – There is more than 4,700 m^3 in fiberglass reinforced plywood (FRP) boxes in 208 containers. The largest of the FRP boxes measure 20 × 12.7 × 9 ft (65 m^3). A total of 122 of these boxes are larger than 10 m^3, and the majority of those (95) are larger than 20 m^3.

Metal Boxes – There is approximately 970 m^3 of CH TRU suspect waste packaged in metal boxes within 169 containers. The largest of these containers measures 20 × 8 × 8 ft (36 m^3). Thirty-four of the metal boxes are larger than 10 m^3 and 54 are smaller than 1 m^3.

Concrete Boxes –Approximately 240 m^3 of waste is in concrete boxes in 43 containers. Only three are large containers; the largest measures 19.6 × 10.6 × 8 ft (48 m^3) and contains waste generated at the Plutonium Finishing Plant (PFP). Nearly 50% of the containers are less than 5 m^3.

Miscellaneous – The remaining 400 m^3 of CH TRU suspect waste is packaged in a total of 157 miscellaneous containers. These consist of boxes of unidentified construction, and items such as EBR II casks, HEPA filters, glove boxes, and ion exchange equipment. One-hundred thirty-one of the miscellaneous containers are less than 10 m^3.

The heaviest of the CH TRU suspect waste containers holds more than 37,600 kg of waste generated at PFP and is within a concrete box measuring 19.6 × 10.6 × 8.3 ft. A total of 75 containers have a weight in excess of 10,000 kg, and approximately half of those are larger than 35 m^3. Nearly one-third of the containers have a mass less than 1,000 kg.

The majority of the SWITS records for the CH TRU suspect containers do not list waste weight. Table 2.5 lists the number of containers by container type that identify both gross and container weight. The total mass of the CH TRU suspect waste to be processed is approximately 2,358,000 kg. Extrapolating from the known waste weight percents, approximately 57%, or 1,334,000 kg, is waste; the remainder consists of the container, packaging, and shielding.

Table 2.5. CH TRU in TRU Retrieval Trenches

	No of Containers	Gross Weight (kg)	Waste Weight (kg)	Waste Percent
Waste weight not identified				
FRP	208	1,355,000	NA	NA
Metal	128	273,000	NA	NA
Concrete	43	337,000	NA	NA
Other	103	119,000	NA	NA
Subtotal	482	2,084,000		
Waste weight identified				
Metal	41	131,000	76,000	58%
Other	54	143,000	79,000	55%
Subtotal	95	274,000	155,000	56%
Total	577	2,358,000	1,332,000	56%

2.3.3 Newly Generated CH TRU Waste in Boxes[2] and Large Containers

The majority of forecasted CH TRU waste is packaged in WIPP-compliant containers, either 55-gallon drums or standard waste boxes (SWB). Only two generators, K Basins and the 327 Building, have forecast non-WIPP-compliant containers with a total volume of 133 m^3. K Basins forecasts CH TRU waste in the form of a concrete monolith measuring 29.5 ft long, 13.1 ft wide, and 8.2 ft high (90 m^3) and four ion exchange modules measuring 8.8 m^3 each for a total of 125 m^3. The monolith consists of six ion exchange columns and some water filters encapsulated together. The monolith will require some size reduction prior to receipt for processing. The 327 Building forecasts generating two containers of CH TRU waste packaged in metal boxes measuring 4 × 4 × 8 ft. The waste consists of ion exchange column parts.

The weights are not provided in the SWIFT forecast; however, using a density of 2,400 kg/m^3 for concrete, the total weight of the concrete monolith would be approximately 216,000 kg. Assuming an average density of concrete for the monolith and ion exchange modules and an average density for CH TRU waste in above-ground storage and the TRU retrieval trenches of 400 kg/m^3, the gross weight of newly generated CH TRU would be approximately 303,000 kg.

[2] Does not include SWBs.

2.4 RH TRU Waste

2.4.1 RH TRU Waste in Above Ground Storage

A total of 127 m^3 of RH TRU waste is stored above ground in 69 containers. The waste is stored at burial ground 218-W-3AE, T Plant, and the CWC in five types of containers: large diameter containers (LDCs)[3], boxes measuring 8.3 × 5 × 4.25 ft (5 m^3), Hittman liners, 55-gallon drums, and casks. The total mass of RH TRU waste in permitted above-ground storage is approximately 303,000 kg (see Table 2.6). Approximately 17.4% of that weight is actual waste; the rest is container, packaging, and shielding weight. The weights by container type are fairly consistent. The heaviest are the boxes, weighing 22,000 to 24,000 kg each; the LDCs weigh from 4,600 to 5,000 kg.

Table 2.6. RH TRU Waste in Above-Ground Storage

	No of Containers	Gross Weight (kg)	Waste Weight (kg)	Waste Percent
LDC	3	14,200	7,800	55%
Box	9	207,600	9,800	4.7%
Hittman Liners	35	55,100	32,700	59%
Drums	20	3,500	1,500	41%
Other	2	23,000	900	4.1%
Total	69	303,400	52,700	17.4%

The RH TRU in the Hittman liners has the highest measured dose rate of the containers. The highest recorded container surface spot dose rate is 20,000 R/hr measured at the bottom surface of one of the containers. The average container dose rates for the liners range from 0.4 to 720 R/hr. The drums have the next highest recorded dose rates measuring up to 80 R/hr at the container surface.

[3] Processing of LDCs and the waste is planned to be completed in 2006.

Table 2.7. Dose Rates of RH TRU Waste Containers in Above-Ground Storage

Dose Rate (mrem/hr)	No. of Containers
>100,000	10
>10,000	26
>1,000	17
>200	14
<200	2
Total	69

2.4.2 RH TRU Waste in Post-1970 LLBGs

There is a total of 208 m^3 of RH TRU waste in the post-1970 LLBGs to be processed. The waste includes containers intermingled with the CH TRU waste in the post-1970 LLBG trenches, as well as hot cell waste stored in caissons. The largest of the trench waste containers measures 6.3 × 5.5 × 5.5 ft. The caisson waste was generated in the 300 Area hot cells and is packaged mainly in 1-gallon paint cans; the remainder is 2- and 5-gallon cans and plastic wrapped equipment.

The heaviest of the RH TRU suspect waste containers is over 12,200 kg contained in a package measuring 6.3 × 5.5 × 5.5 ft. Forty-eight containers weigh more than 1,000 kg. The majority of the containers have a mass less than 50 kg.

The total weight of the RH TRU waste in the post-1970 LLBGs is approximately 169,000 kg. Very few container records list both gross weight and waste weight; however, it is assumed that the majority of the waste will be container, packaging, and shielding weight. Assuming the same waste weight percentage, 17.4%, as the RH TRU in above-ground storage, the waste weight of the RH TRU would be 29,400 kg.

The highest recorded dose rate for this waste is 30,000 mrem/hr in a 55-gallon drum. Fourteen containers measure greater than 5,000 mrem/hr. The dose rate of the caissons is not precisely known; they were measured in the caissons at up to 1800 R/hr in 1985 (Rockwell 1985). This was a gross caisson measurement; the dose rates of individual containers are unknown.

2.4.3 Newly Generated RH TRU Waste

A total of 503 m^3 is forecast (Table 2.8) to be received for processing between FY 2005 and 2034. The majority of the waste is related to the cleanup and closure of Hanford's underground waste storage tanks and is packaged in shielded metal boxes measuring 4 × 4 ×8 ft and containing mostly contaminated metal.

Table 2.8. Newly Generated RH TRU Waste

Generator	Drums	Medium	Total (m^3)
Tank Closure		305	305
618-10/11 Burial Grounds	2	79	82
M-91 Facility	41		41
Waste Treatment Plant	32		32
324 Building		22	22
K-Basins, CVDF, and CSB		22	22
PNNL	1		1
Totals	**75**	**428**	**503**

The newly generated RH TRU waste is forecast at a fairly consistent rate by the Tank Closure Project with an increase between 2013 and 2018. Smaller amounts of RH TRU waste are also forecast from the T Plant, WTP, 324 Building, K Basins, and Pacific Northwest National Laboratory (Figure 2.2).

The 618-10 and 618-11 burial grounds have been identified as having both CH and RH TRU waste. The burial grounds contain a number of trenches, caissons, and vertical pipe units (VPU) that were used between 1954 and 1967. Although this waste was disposed of pre-1970, the decision has been made to retrieve this waste, treat as necessary, and send it to WIPP for disposal. The burial grounds received primarily equipment and dry waste generated in the 300 Area that consists of a wide spectrum of low- to high-activity wastes including fission products and plutonium. The trenches are assumed to contain primarily LLW, while the caissons and VPUs are assumed to contain primarily RH TRU waste.

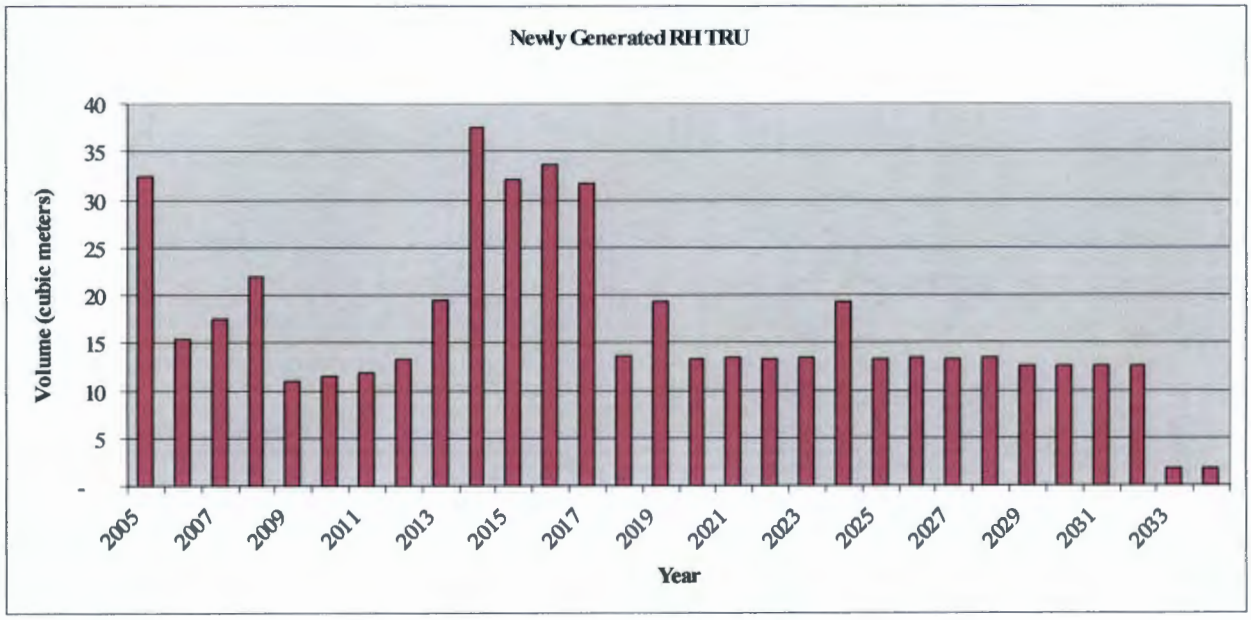


Figure 2.2. Newly Generated RH TRU Waste

2.5 Retrievably Stored Waste

It is assumed that 50% of the RSW will assay as LLW. Table 2.9 revises Table 2.1 to include the reclassification of waste.

Table 2.9. Volumes of Waste after Reclassification of Retrievably Stored Waste (m^3)

Waste Type	Container Size	Above Ground Storage	Post-1970 LLBGs	Forecast	Total
CH MLLW	Small		2		2
	Medium		616		616
	Large	135	2,549		2,684
RH MLLW	Small		13		13
	Drums	3	12	304	319
	Medium	80	80		160
	Large	37			37
CH TRU	Drums		0.2		-
	Small		3		3
	Medium	1,405	615	42	2,062
	Large	363	2,550	90	3,003
RH TRU	Drums	4	13	75	92
	Small		12		12
	Medium	123	79	428	630
Grand Total		**2,150**	**6,544**	**939**	**9,633**

2.6 Container Size and Weight Summaries

The total volume requiring treatment or handling is approximately 9,600 m^3. The total by gross weight is approximately 5,287,000 kg (Table 2.10). Records exist for gross weight for nearly all containers in above-ground storage and in the post-1970 LLBGs. Estimates for the forecasted waste were based on densities of similar waste types.

Table 2.10. Gross Weight Summary (in thousands of kg)

Waste Type	Above Ground Storage	Post-1970 LLBGs	Forecast	Total
CH MLLW	31	-	-	31
RH MLLW	52	-	157	210
CH TRU	867	2,358	53	3,278
RH TRU	303	169	1,296	1,768
Totals	**1,254**	**2,527**	**1,506**	**5,287**

The SWITS records for waste in above-ground storage and post-1970 LLBGs are much less reliable for calculating actual waste weight. Approximately 88% of the records by volume in above-ground storage list both the gross and waste weight; however, only 14% of the records by volume in post-1970 LLBGs list both. Assuming average densities for similar waste, the total waste weight to be processed is 2,292,000 kg (Table 2.11) or roughly 43% of the total weight.

Table 2.11. Waste Weight Summary (in thousands kg)

Waste Type	Above Ground Storage	Post-1970 LLBGs	Forecast	Total
CH MLLW	20	-	-	20
RH MLLW	24	-	72	96
CH TRU	378	1,332	25	1,734
RH TRU	53	29	251	333
Totals	**475**	**1,361**	**347**	**2,183**

The waste discussed in this chapter is forecast in many different containers in variety of configurations. A complete list of containers is listed in Appendix C. The recorded dimensions in SWITS do not always identify length, width, or height. The largest container by volume is 66 m^3 and contains CH MLLW and measures 17.7 × 9.7 × 13.6 ft. The largest individual dimensions for containers listed in SWITS are 20 ft (primary dimension), 13 ft (secondary dimension), and 11 ft (tertiary dimension).

3.0 Waste Disposal

CH MLLW and RH MLLW will be disposed in the Hanford LLBG MWTs (218-W-5, Trenches 31 and 34), the ERDF, or at a commercial disposal facility. Future waste disposal is planned at the Integrated Disposal Facility (IDF). CH TRU and RH TRU waste will be disposed at WIPP.

Each disposal site has specific WACs. The specific disposal site WACs are based in part on LDRs. Waste items that require additional treatment prior to disposal are referred to in this report as non-LDR-compliant waste. Some waste may contain non-conforming items that require removal during processing. Examples include free liquids, pressurized containers, etc.

As part of RCRA, LDR were promulgated in the late 1980s. Beginning in 1990, Tri-Party Agreement Milestone M-26-01 required a plan with subsequent yearly reports on the volume of mixed waste in storage at the Hanford Site. The data sheets in the latest report (DOE 2005) provide total waste volume for both the currently stored inventory and the waste forecast to be generated during the next five years. The data sheets describe how, where, and what volume of waste is stored and current information about the waste's disposition. There are two types of data sheets in the LDR Report: 1) Treatability Group and 2) location-specific data sheets.

The mixed waste is categorized by the necessary treatment path to ensure that this waste, once treated, will meet LDR requirements for disposal. DOE (2005) includes Treatability Group MLLW-07 (RH and large container).

3.1 MWTs

The first MWT (LLBG 218-W-5, Trench 34) was built in 1993, and the second (LLBG 218-W-5, Trench 31) was built in 1994. Waste storage in Trench 34 began in 1997, and disposal operations began in 1999 after the leachate that is generated from the cell was accepted for treatment at the 200 Area Effluent Treatment Facility (200 ETF). Waste storage and disposal in Trench 31 began in 2003. Both MLLW trenches are RCRA-compliant and meet Subtitle C disposal requirements. They have a double-liner system with leachate collection (Figure 3.1).

Figure 3.1. Container Disposal in the MWT

A substantial portion of Hanford's RCRA MLLW will be disposed in the MWTs. Waste for disposal in these

units must meet the Hanford Site Solid Waste Acceptance Criteria (HSSWAC) (FHI 2005a). Each disposal trench has a free air volume capacity of approximately 24,000 m^3. The actual disposed waste capacity will vary for each trench depending on the size of the disposed waste packages and the number of operational lifts ultimately used in each trench. Trench 34 is approximately one-third full (Figure 3.1). These trenches are projected to be filled by 2016.

Trenches 31 and 34 of the 218-W-5 Burial Ground are RCRA-compliant units for disposal of MLLW. Only LLW and MLLW originally designated with RCRA characteristic numbers D001 through D043, certain listed waste numbers (F001 through F005, and F039 derived from F001 through F005 waste), and Washington State-only dangerous waste (except waste number WSC2-acid) are accepted in trenches 31 and 34. With the recent approval of the 200 LEF Delisting Petition, significantly more listed waste codes are now acceptable for these trenches. All waste accepted at Trenches 31 and 34 must meet the applicable LDR treatment standards of 40 CFR 268 and WAC 173-303-140. There also are safety-based and environmentally based limits on the radionuclide concentrations of waste received.

The HSSWAC sets forth the baseline criteria for acceptance of waste at the MWTs. The WAC ensure that waste can be managed within the operating requirements, including environmental regulations, DOE Orders, permits, nuclear safety requirements, waste analysis plans, performance assessments, and other applicable requirements. The HSSWAC identifies non-conforming waste items and container requirements. Regulatory approval of in-trench treatment of conforming MLLW is being pursued. In addition, a Toxic Substances Control Act Chemical Waste Landfill Authorization is being pursued to allow disposal of PCB waste.

3.2 ERDF

The ERDF is authorized to operate through a CERCLA Record of Decision (ROD) issued by EPA. ERDF (Figure 3.2) is designed to serve as a waste isolation structure for bulk soil, demolition debris, and miscellaneous contaminated material from Hanford remediation activities conducted under CERCLA authority. An Explanation of Significant Difference (ESD) to the ERDF ROD was issued in 1996 to allow for disposal of investigation-derived waste, and in 1997, a ROD amendment was issued allowing treatment of waste by encapsulation or stabilization. Current plans have ERDF available to receive waste until closure in 2034. Regulatory approval for waste disposal in ERDF is required.

The ERDF WAC document (BHI 2002) sets forth the baseline criteria for acceptance of waste at ERDF. The WAC have been established to ensure that waste can be managed within the operating requirements, including environmental regulations, DOE Orders, permits, nuclear safety requirements, waste analysis plans, performance assessments, and other applicable requirements. The ERDF WAC identifies non-conforming waste items and container requirements.

Figure 3.2. ERDF

3.3 IDF

The IDF (Figure 3.3) is a planned facility that consists of a single landfill with two separate expandable cells. One cell will be permitted as a RCRA Subtitle C-compliant landfill system and the other will not be permitted. Both landfill cells will include a double liner, a leachate collection and removal system, and a leak detection system. The landfill liner system will comply with RCRA requirements for hazardous waste landfills. The IDF will be designed to allow for future expansion. Each future liner construction project will connect the previously constructed liner and the operations systems and then extend the disposal area. The disposal landfill cover will be designed and located to satisfy the dangerous waste disposal requirements once a decision is made to construct the final cover over the landfill. Plans are to begin operations before reaching the capacity limitation of the current MWTs and to close IDF after 2035.

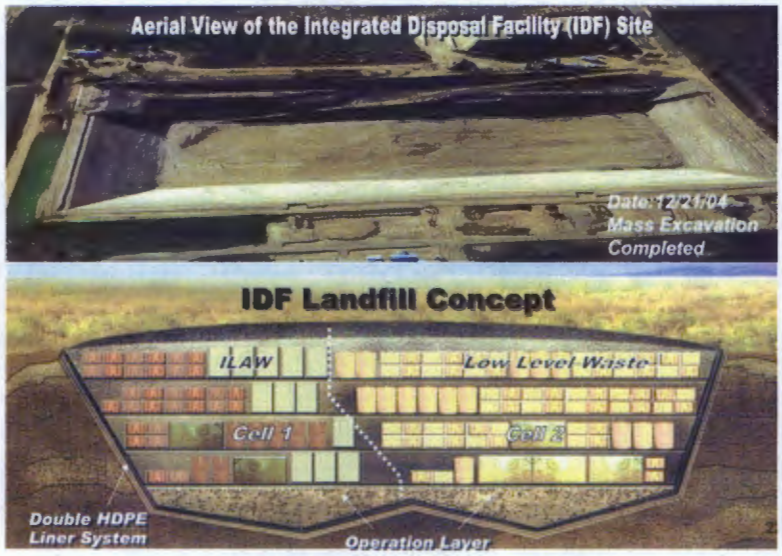


Figure 3.3. Conceptual Drawing of IDF

3.4 Commercial MLLW Disposal

Licensed commercial LDR-compliant disposal may be used for selected MLLW. Permitted and licensed commercial disposal facilities have been and will continue to be used for disposal of some MLLW from Hanford. The decision to use commercial disposal is driven by the waste treatment processes/practices used by commercial waste treatment businesses to treat non-LDR compliant MLLW (co-mingled Hanford and other DOE or commercial generator's waste).

3.5 WIPP

The WIPP is the world's first underground repository licensed to safely and permanently dispose of TRU waste left from the research and production of nuclear weapons. WIPP, pictured in Figure 3.4, began operations on March 26, 1999. Situated in the remote Chihuahua Desert of southeastern New Mexico, project facilities include disposal rooms mined 2,150 ft underground in a 2,000-ft-thick salt formation that has been stable for more than 200 million years. Since WIPP opened in 1999, DOE has prioritized and planned the removal, repackaging, and shipment of about 141,000 m^3 of TRU waste to the repository. WIPP plans to close in 2033.

Figure 3.4. WIPP Transuranic Package Transporter Model 2

In 1980, DOE committed to transporting TRU waste to WIPP in U.S. Nuclear Regulatory Commission (NRC)-certified Type B containers. DOE chose to have the NRC approve these containers even though it is not required. To obtain approval, DOE must submit a safety report for each transportation container, demonstrating compliance with applicable regulations. Waste acceptance requirements are defined in DOE/WIPP (2005a). Three types of containers are approved: the Transuranic Package Transporter Model 2 (TRUPACT-II) and HalfPACT were designed to carry CH TRU waste and the RH-72B to carry RH TRU waste to WIPP.

Each stainless steel TRUPACT-II (Figure 3.5) is approximately 8 ft in diameter and 10 ft high and constructed with leak-tight inner and outer containment vessels. The TRUPACT-II can hold up to fourteen 55-gallon waste drums, two standard (63 ft^3 capacity) waste boxes (Figure 3.6), or one 10-drum overpack (a container designed to provide additional protection for older, deteriorating drums). Some TRUPACT-II 55-gallon drums can weigh as much as 1,000 pounds. The HalfPACT can carry seven 1,000-pound waste drums.

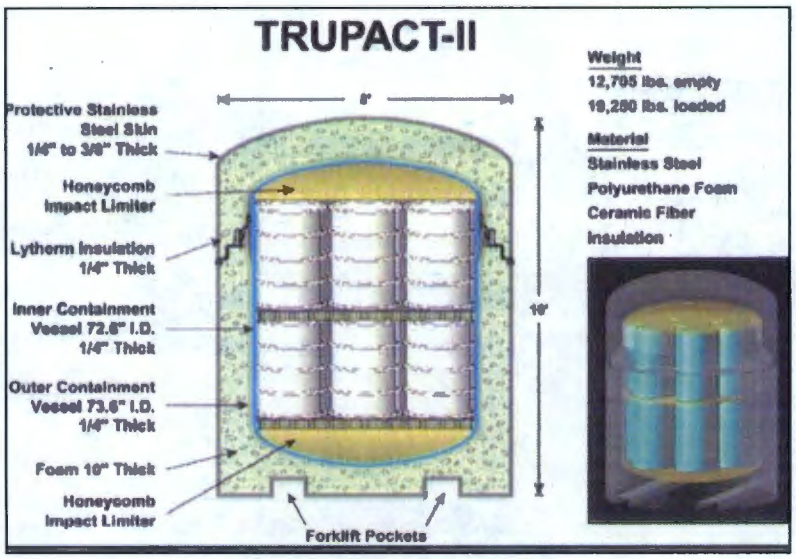


Figure 3.5. TRUPACT-II

Figure 3.6. WIPP SWBs

A new CH TRU waste transportation package may soon be in use for WIPP shipments. The new package, known as TRUPACT-III, is a rectangular large container that measures approximately 8 × 9 × 20 ft. This package would allow more efficient shipment of larger-sized waste items.

The RH-72B (Figures 3.7 and 3.8) was designed to safely transport RH TRU waste. Like the TRUPACT-II and the HalfPACT, the RH-72B is leak-tight and constructed with inner and outer containment vessels. A sealed payload container is loaded into the inner containment vessel. It is a large cylinder approximately 12 ft long and 3.5 ft in diameter. The cylinder fits into circular impact limiters, similar to shock absorbers, designed to protect the container and its contents in the event of an accident. The RH-72B has a 1 5/8-inch-thick lead liner to shield people from gamma rays. It also has an outer thermal shield to protect the container against fire damage. RH shipments are anticipated to begin in the near future.

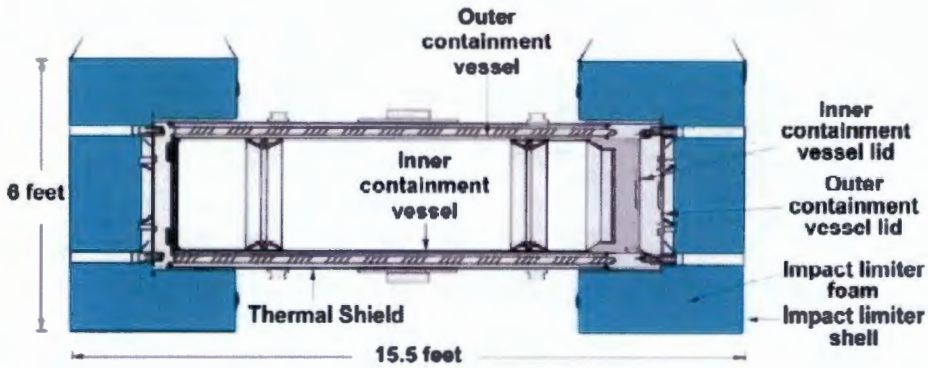


Figure 3.7. RH-72B

Figure 3.8. RH-72B Cask

An alternative RH TRU waste transportation option is the Chem-Nuclear Systems (CNS) (acquired by GTS Duratek in June 2000) 10-160B cask (Figure 3.9). This cask can handle ten 55-gallon drums (14,500 lb total weight of contents) rather than three in the RH-72B (8,000 lb total weight of contents). The 10-160B cask is more restrictive than the RH-72B, allowing a limit of 20 curies of plutonium (Pu-equivalent curies) per cask rather than the 80 curies of plutonium in the RH-72B. The 10-160B cask would require WIPP approval for use.

Figure 3.9. CNS 10-160B Cask

4.0 Existing Waste Processing Facilities

4.1 Commercial Waste Processing

Existing capabilities at commercial facilities are being used to remove non-conforming waste from stored regulated MLLW containers, repackage and treat (e.g., macro-encapsulation, thermal treatment) regulated hazardous waste; and immobilize the waste package prior to disposal. Commercial facilities, within their license limits and container size and weight constraints, are being used to process MLLW in boxes and large container up to 15 m^3. Some commercial facilities may be able to handle small quantities of RH and CH TRU waste.

To date, commercial facilities and T Plant have processed 194 m^3 of RH waste and CH MLLW in large containers. Commercial facilities can process approximately 10% of the remaining 9,600 m^3 of waste. Two CH MLLW waste containers in above-ground storage have been identified as being unable to be processed at commercial facilities.

4.2 T Plant Complex Waste Processing

The T Plant Complex (Figure 4.1) consists of the 221-T Canyon (Figures 4.2 and 4.3), 2706-T Facility, and several support structures. The T Plant canyon, built in 1944, was the original plutonium reprocessing facility using the bismuth phosphate separations process. The canyon has internal dimensions of 37 ft wide by nearly 800 ft long. There is 26 ft of clearance between the canyon deck and the crane rails. T Plant processing cells are 17 ft long, 13 ft wide, and 21 ft deep. Each cell cover block has bails for lifting. The T Plant canyon crane can lift 90,000 lb. The 221-T container size is limited to less than 22 ft long, 13 ft high, and 18 ft wide. The original inlet ventilation system just outside the south end of the canyon is no longer in use. Penetrations in the south canyon wall make it accessible for connecting additional process support facilities.

Figure 4.1. T Plant Complex

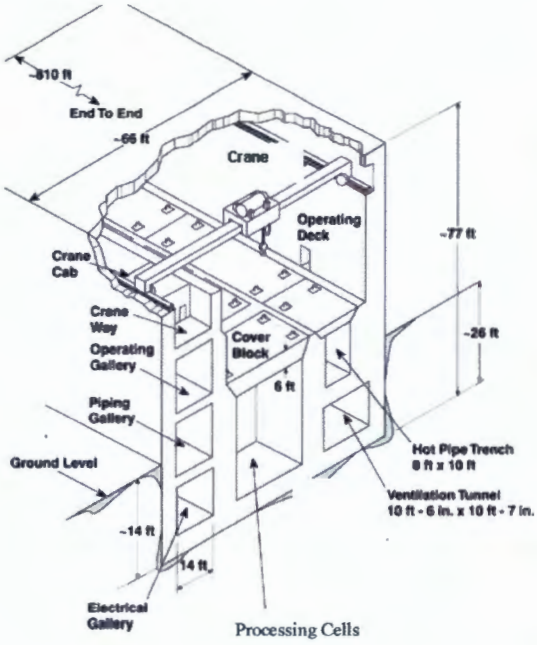


Figure 4.2. Typical Canyon Cutaway

Figure 4.3. 221-T Canyon

The plant was shut down in 1956 and converted to a decontamination facility. The 2706-T facility, constructed in 1959, was upgraded in 1999 to provide compliant storage of hazardous liquid wastes. Current activities at the facility include verification, treatment, and repackaging of CH waste. The T Plant Complex provides staging space for waste containers. Services performed in the 2706-T facility include segregation, treatment, repackaging, verification, and storage of CH waste in boxes and drums. Treatment processes consist of adding sorbent or grout material to the waste matrix, neutralization, or amalgamation of mercury with other metals. T Plant also has capability for macro-encapsulation of equipment and debris (e.g., North Load-out Pit Sludge from K Basin).

Additional services are venting of drums and headspace gas sampling to support the TRU waste program, processing of K Basin sludge, drum repackaging to reduce layers of confinement/ prohibited item removal and size reduction of CH TRU waste. The facility can also provide low-level decontamination services for the Hanford Site using steam or chemical sprays, abrasives, or immersion. When dose rate permits, hand cleaning can be used to remove loose contaminants from equipment surfaces.

The 2706-T container processing size is limited to less than 40 ft long, 14 ft high, and 12 ft wide. The 2706-T facility is limited to handling RH waste. The 2706-T decontamination services and ability to treat waste can support waste processing.

The HSSWAC sets forth the baseline criteria for acceptance of waste at the T Plant Complex. The WAC ensure that waste can be managed within the operating requirements of the unit,

including environmental regulations, DOE Orders, permits, nuclear safety requirements, waste analysis plans, performance assessments, and other applicable requirements.

4.3 WRAP Waste Processing

The WRAP (Figure 4.4) processes drums and WIPP SWBs of suspect TRU waste. After processing and certification, the CH TRU waste is shipped in the TRUPACT-II (Figure 4.5) container to WIPP. WRAP has automated processes to examine and characterize waste using x-ray (nondestructive examination), gamma, and neutron assay (nondestructive assay) equipment. Waste is repackaged as required to meet WIPP certification requirements. Most waste handling operations are performed in glove boxes to minimize exposure of personnel to radioactive materials. The WRAP facility provides staging space for waste containers.

The HSSWAC sets forth the baseline criteria for acceptance of waste at WRAP. The waste acceptance criteria ensures that waste can be managed within the operating requirements of the unit, including environmental regulations, DOE Orders, permits, nuclear safety requirements, waste analysis plans, performance assessments, and other applicable requirements.

Figure 4.4. WRAP Facility

Figure 4.5. Loading the TRUPACT II with TRU Waste Drums in WRAP

4.4 Central Waste Complex Waste Staging

The CWC, a series of buildings conforming to RCRA requirements, receives and stores radioactive waste in a safe and regulatory compliant manner. The CWC began accepting waste in August 1988. The storage facilities, located in the Hanford 200 West Area, include 12 small mixed waste storage buildings (2402 series); seven large storage buildings (2403/2404 series); and Building 2420-W, used for cask storage. 2404-WB and 2404-WC are permitted and operated under the WRAP facility. In addition, there are 27 modules for storing low-flash point mixed waste and 12 modules for storing alkali metals. A waste storage pad is also part of the CWC.

The CWC provides interim storage for mixed waste, TRU waste, and a small amount of LLW, awaiting processing or treatment and final disposition. The design storage capacity is approximately 81,000 55-gallon drum equivalents; the operational capacity is about 64,000 drum equivalents.

All newly generated waste must meet acceptance criteria set by the Hanford Site Solid Waste Acceptance Program. The waste acceptance criteria was established to ensure that waste can be managed within the operating requirements of the unit, including environmental regulations, DOE Orders, permits, nuclear safety requirements, waste analysis plans, performance assessments, and other applicable requirements.

Waste is generally packaged in 55-gallon drums (Figure 4.6) unless alternate packages are dictated by size, shape, or other form of waste. Each drum is handled individually using a hand truck, forklift, or crane. Drums are placed on pallets with a maximum of four drums banded together. The storage buildings or pads have physical features that provide for segregated storage areas to maintain appropriate separation between groups of incompatible waste and to comply with fire code requirements.

Figure 4.6. Drum Storage in CWC

5.0 Waste Processing Needs

5.1 Waste Processing Capability and/or Facility Needs

Approximately 95% (by volume) of the boxes/large containers and RH MLLW, TRU waste in boxes and large containers, and RH TRU waste cannot be processed by existing facilities. These waste processing needs are summarized in Table 5.1.[1] Assay during retrieval of post-1970 suspect TRU waste from the LLBGs should reclassify an estimated 295 m^3 as CH MLLW that can be processed commercially. It is assumed that all RSW is retrieved for processing.

Table 5.1. Waste Processing Volume (cubic meters) that Cannot Be Met by Existing Facilities

Waste Type	Container Size	Above Ground Storage	Post-1970 LLBGs	Forecast	Total
CH MLLW	Small				
	Medium				
	Large	80	2,254		2,334
RH MLLW	Small		13		13
	Drums	3	12	304	319
	Medium	80	80		160
	Large	37			37
CH TRU	Drums		0.2		-
	Small		3		3
	Medium	1,405	615	42	2,062
	Large	363	2,550	90	3,003
RH TRU	Drums	4	13	75	92
	Small		12		12
	Medium	123	79	428	630
Grand Total		**2,095**	**5,631**	**939**	**8,665**

Capabilities and/or facilities needed include:

- ***Load-in/Load-out of Waste Containers*** – Activities include receiving and load-in of containers with dimensions as large as 20 × 13 × 11 ft, up to 38,000 kg (83,000 lb), and up to 20,000 R/hr at the waste container surface; and load-out of suspect TRU waste in WIPP SWBs, non-conforming MLLW in 55-gallon drums, MLLW in 5 × 5 × 9 ft containers, and RH TRU waste in drums for placement in shipping casks (RH-72B and/or CNS 10-160B).

[1] Includes RH cleanup waste from 618-10 and 618-11 burial grounds.

- ***Opening Waste Containers*** – Remote operated systems will open, section, and remove the container and loose shielding to provide access to the waste

- ***Non-Conforming Waste Removal*** – Remote operated systems will sort non-conforming MLLW for load-out and processing using existing capabilities (e.g., thermal treatment at commercial facilities)

- ***Size Reduction*** – Remote operated systems will size reduce containers, waste, and shielding for load-out in containers

- ***Processing*** – Activities include staging waste; in-cell waste dose rate measurement; non-conforming TRU waste processing, cell cleaning; loading waste containers; and RH waste payload container sealing in an inert gas module (e.g., for the RH-72B vessel)

- ***Waste Container Handling*** – Staging waste containers, MLLW and RH TRU waste container assay, weighing, sampling, video-taping, RH shipping cask handling and preparations for shipment, and MLLW container immobilization.

- ***Support Systems and Areas*** – Support cranes; heating, ventilation, and air conditioning (HVAC) system; fire suppression systems; operations and maintenance support space; decontamination areas; support systems for failed equipment load-out and replacement equipment load-in; and remote systems control room.

5.2 Waste Processing Capability and Capacity Commitments

Tri-Party Agreement target Milestone M-91-05-T01 requires the completion of an Engineering Study and Functional Design Criteria for RH and large container CH TRUM retrieval and processing facilities by December 31, 2007. Tri-Party Agreement Milestone M-91-15 requires acquisition of capabilities and/or facilities and initiation of treatment of RH and CH mixed waste in large boxes and containers by June 30, 2008. Tri-Party Agreement Milestone M-91-43 requires treatment of RH mixed waste and boxes and large containers of CH mixed waste at a minimum rate of 300 m^3 per year beginning not later than June 30, 2008. Tri-Party Agreement Milestone M-91-44 requires processing RH and large container CH TRUM waste at a rate of 300 m^3 per year beginning no later than June 2012. In addition, Tri-Party Agreement Milestones M-16-67 and M-16-93 require that Hanford CERCLA needs be integrated as they are identified.

6.0 Waste Processing Analysis

To date, using existing facilities, 194 m^3 of RH MLLW and CH MLLW in large containers have been processed toward the M-91-43 commitment. An additional 55 m^3 of large container MLLW in above-ground storage may be treated using existing capabilities. This leaves only two large containers (80 m^3) of CH MLLW in above-ground storage and a total of 120 m^3 of RH MLLW in above-ground storage that cannot be processed with available capabilities. No newly generated boxes/large containers of CH MLLW and RH MLLW are forecast before 2010. From 2010 through 2032, only 304 m^3 of RH MLLW is forecast, which includes only 35 m^3 through 2012. The two principal sources of the RH MLLW are the WTP and WESF. A portion (estimated at 295 m^3, or 50%) of retrieved suspect TRU waste in large containers that can be treated commercially will be reclassified as MLLW with assay. The quantity of MLLW already processed and available for processing with existing facilities is projected to be sufficient to meet M-91-43 (300 m^3 per year) through 2010.

6.1 PMP Identified the T Plant Complex for Processing

The PMP identified the T Plant Complex for processing MLLW and TRU waste that is either CH waste in boxes/large containers or RH TRU waste in various sized packages that cannot be processed using existing facilities.

Applicable activities at other sites include:

- West Valley Demonstration Project - Approximately 75,000 ft^3 (2,124 m^3) of waste will be processed through the Remote Handled Waste Facility (RHWF) at the West Valley Demonstration Project (Hurst et al. 2004) After processing, the bulk of the waste is expected to be classified as LLW, CH TRU, RH TRU, and small amounts of mixed LLW.

  The facility will use a bagless waste packaging systems, high purity germanium (HPGe) gamma assay systems, power manipulators, overhead and wall-mounted cranes, a shielded forklift, and floor conveyors. The goal for the RHWF is to process the least contaminated, lowest dose material first and then the highest contaminated, highest dose material over a four-year period.

  Waste inventory includes long-shafted pumps, spent resins, water filters, and crane components. The RHWF, at approximately 190 × 90 ft, will handle 13 different waste streams with varying sizes, weights, and contamination levels. The process flow is generally through a central corridor of three connected rooms: the receiving area, the buffer cell, and the heavily shielded work cell. The rooms have 30-inch reinforced concrete walls.

  Container processing in the shielded work cell will include opening the container; visually inspecting its internals; sampling, dewatering, segregating, and size-reducing large

components using saws on power manipulators; nondestructive assaying; and repackaging. Waste removed from the facility will be packaged in 55-gallon TRU drums or B-25 (carbon-steel) waste boxes.

- Idaho Cleanup Project – The Idaho Cleanup Project will use existing facilities to prepare RH-TRU shipments to WIPP. Their preferred shipping container will be the 10-160B cask, and shipments may begin as early as September 2007. Idaho's RH-TRU waste is already stored in drums, and no repackaging is anticipated. They will remove some (but little) non-conforming items. Headspace gas sampling, real-time radiography, and a limited assay (cobalt and cesium) will be completed. Approximately 700 drums of waste are expected to be processed.

  The facility has 2-ft-thick shield walls that can be easily decontaminated. Should repackaging be necessary, the facility has a process hot cell with three windows, each with two mechanical master-slave manipulators. The cell also contains a side-mounted PaR and a crane. The cell has two areas, each approximately 15 × 25 ft, separated by a shield wall.

- United Kingdom - The Active Waste Vault Retrieval Project has a facility that has been constructed over active waste vaults. They remotely operate heavy duty manipulators for picking up waste from the vault and placing it in containers. These containers are then transferred via bogies in a shielded transfer tunnel to another shielded facility. A roller conveyor is used to transfer the container into the cell. There the container is tipped and the waste dumped onto a vibrating table. The waste passes along the table, under assay instrumentation, and into a container. Two remote cranes are used to assist in the cell. The waste is then grouted and container lidded (Smith 2002).

6.2 Needs, Processing and Container Requirements, and Disposal Options

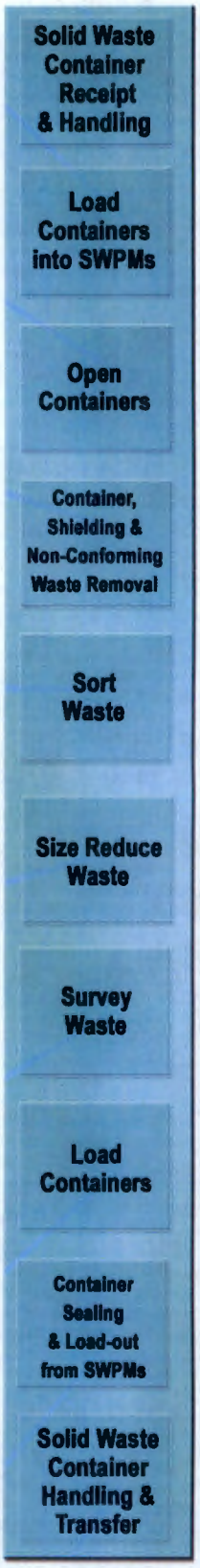
Waste processing needs (except most Hanford cleanup CERCLA needs), waste disposal container requirements, and waste disposal options are defined. Hanford projects are required to assure that all newly generated wastes are LDR-compliant prior to disposal (WTP and Fluor Hanford are exceptions). Non-conforming (e.g., LDR) items will be removed from containers, repackaged, and immobilized prior to disposal.

MLLW and TRU waste from above-ground storage and suspect TRU waste that will be retrieved from storage in the post-1970 LLBGs requires container opening and sorting to remove non-conforming waste. Conforming MLLW will need to be treated to immobilize it for disposal in either the MWT or ERDF. MLLW disposal in IDF is a future option. Some MLLW may be disposed at commercial facilities. MLLW containers can vary in size, weight, and volume as long as they meet the HSSWAC for the MWTs or ERDFWAC for ERDF. CH TRU waste will need to be packaged in containers for placement in the TRUPACT-II for transfer and disposal at WIPP. RH TRU waste will need to be packaged in drums for placement in either RH-72B or CNS 10-160B casks for transfer and disposal at WIPP.

6.3 Required Processing Functions

New T Plant capabilities required to process the waste include the following functions (see illustration in sidebar):

1. Solid waste container receipt and handling at the processing facility
2. Loading containers into the process
3. Opening the containers
4. Removal of non-conforming waste[1]
5. Sorting waste
6. Size reducing waste to meet packaging requirements
7. Surveying waste to determine if the waste is CH or RH
8. Loading containers
9. Container sealing and load-out from the process (include RH TRU waste assay)
10. Solid waste container handling and transfer.



6.4 Key Processing Requirements

Key processing requirements include:

- A wide range of container sizes and weights – 1-gallon containers up to 20 × 13 × 11 ft (largest of each of the dimensions)
- Containers with high dose rates – up to 20,000 R/hr at the container surface
- Capability to handle MLLW and TRU waste

6.5 T Plant Complex Processing Options

Two processing options at T Plant include the 2706-T and the 221-T canyon. Limitations on size, dose rate, and TRU make 2706-T an unacceptable option for processing waste other than low-activity wastes. The 221-T canyon can support most of the key processing requirements. A number of previous studies were reviewed to identify process functions and evaluations of processing strategies.

6.6 Performing the Required Processing Functions at the T Plant Complex

The T Plant Complex will need to be modified to perform the ten processing functions. Capabilities include modular cells, referred to in this report as

[1] Items not consistent with waste profile or prohibited items.

SWPMs in the T Plant canyon; a SWHF added to the south end of the T Plant canyon; and a new assay station for 5 × 5 × 9 ft containers near (location will be a function of background) the 2706-T facility (Figure 6.1). A processing logic flowchart is presented in Figure 6.2 that depicts how MLLW and TRU waste will be managed from its source through processing and disposal. Figure 6.3 is a flow schematic of the processing functions.

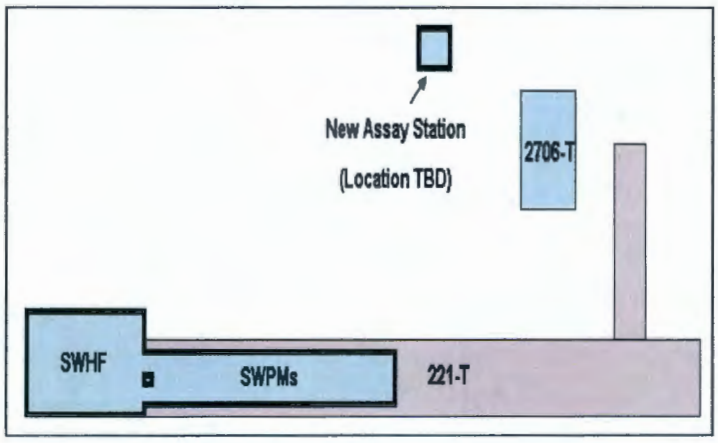


Figure 6.1. Location of New T Plant Complex Capabilities

RH waste will need to be processed in the SWPMs due to the high radioactivity and contamination of waste items. Some MLLW and TRU waste packages categorized as CH contain shielded higher activity RH waste. A processing line for RH waste requires a gantry mounted manipulator system; a heavy lift crane, conveyor, or other material transport systems; size reduction equipment; and at least one manipulator station consisting of a pair of manipulators and tools that can be used for coordinated work. More information on manipulators and gantry systems may be found in Appendixes D, E, and F.

The 9,600 m^3 of waste to be processed weighs approximately 5,300,000 kg. Approximately 73% of this weight is the container, loose shielding, and waste known to be MLLW at load-in. After load-in to the SWPMs, the containers and loose shielding will be sorted from the waste and reused when possible, placed in a lined 5 × 5 × 9 ft MLLW container (shielding will be based on receipt waste knowledge), loaded-out of the SWPMs into the T Plant canyon, transported to a new assay station near the 2706-T facility (location will be a function of background), immobilized in the 2706-T facility, and shipped to the MWT, ERDF, or IDF for disposal.

The remaining 27% of waste weight consists of nearly 1,400,000 kg of suspect TRU waste, 350,000 kg of RH TRU, and less than 30,000 kg of non-conforming MLLW (based on current experience). The CH TRU and suspect TRU waste will be processed in the SWPMs, loaded into WIPP SWBs, and transferred from the SWHF to WRAP for assay to determine whether the waste is CH TRU or MLLW. The CH TRU waste will be transported to WIPP in TRUPACTs. The MLLW will be transferred to 2706-T (and/or commercially) for treatment, and then sent to the MWT, ERDF or IDF for disposal. The RH TRU and suspect RH TRU waste will be processed in the SWPMs, loaded into RH TRU waste containers, loaded-out of the SWPMs,

Above-Ground Storage 2,149 m^3											
MLLW 255 m^3			TRU Waste 1,894 m^3								
CH 135 m^3		RH 120 m^3	CH 1,767 m^3				RH 127 m^3				
Large Containers			Boxes 1,404 m^3		Large Containers 363 m^3						
≤15 m^3 55 m^3	>15 m^3 80 m^3										
Commerical Facilities	T Plant Complex		T Plant Complex				T Plant Complex				
MWT/ERDF/IDF	SWPMs		SWPMs				SWPMs				
	5' by 5' by 9' Container		CH		RH		CH		RH		
	Assay Station		WIPP SWB		55-Gallon Drum		WIPP SWB		55-Gallon Drum		
	2706-T		SWHF		In-Module Assay		SWHF		In-Module Assay		
	MWT/ERDF/IDF		WRAP		MLLW	TRU Waste	WRAP		MLLW	TRU Waste	
			MLLW	TRU Waste	5' by 5' by 9' Container	RH-72B or 10-160B	MLLW	TRU Waste	5' by 5' by 9' Container	RH-72B or 10-160B	
			2706-T	TRUPACT II	Assay Station	SWHF	2706-T	TRUPACT II	Assay Station	SWHF	
			MWT/ERDF/IDF	WIPP	2706-T	WIPP	MWT/ERDF/IDF	WIPP	2706-T	WIPP	
					MWT/ERDF/IDF				MWT/ERDF/IDF		

Post-1970 LLBGs 6,544 m^3											
Suspect TRU Waste 6,544 m^3											
Assay as MLLW 3,272m^3			TRU Waste 3,272 m^3								
CH MLLW		RH 105 m^3	CH 3,167 m^3				RH 185 m^3				
Boxes and Large Containers			Boxes		Large Containers						
≤10 m^3 618 m^3	[illegible] m^3 295 m^3	>15 m^3 2,254 m^3									
Commerical Facilities	Commerical Facilities	T Plant Complex	T Plant Complex				T Plant Complex				
MWT/ERDF/IDF	MWT/ERDF/IDF	SWPMs	SWPMs				SWPMs				
		5' by 5' by 9' Container	CH		RH		CH		RH		
Note: Credited toward M-91-42.		Assay Station	WIPP SWB		55-Gallon Drum		WIPP SWB		55-Gallon Drum		
		2706-T	SWHF		In-Module Assay		SWHF		In-Module Assay		
		MWT/ERDF/IDF	WRAP		MLLW	TRU Waste	WRAP		MLLW	TRU Waste	
			MLLW	TRU Waste	5' by 5' by 9' Container	RH-72B or 10-160B	MLLW	TRU Waste	5' by 5' by 9' Container	RH-72B or 10-160B	
			2706-T	TRUPACT II	Assay Station	SWHF	2706-T	TRUPACT II	Assay Station	SWHF	
			MWT/ERDF/IDF	WIPP	2706-T	WIPP	MWT/ERDF/IDF	WIPP	2706-T	WIPP	
					MWT/ERDF/IDF				MWT/ERDF/IDF		

Forecast to be Generated 939 m^3											
MLLW 304 m^3	TRU Waste 635 m^3										
RH 304 m^3	CH 132 m^3				RH 503 m^3						
	Boxes 42 m^3		Large Containers 90 m^3								
T Plant Complex	T Plant Complex				T Plant Complex						
SWPMs	SWPMs				SWPMs						
5' by 5' by 9' Container	CH		RH		CH		RH				
Assay Station	WIPP SWB		55-Gallon Drum		WIPP SWB		55-Gallon Drum				
2706-T	SWHF		In-Module Assay		SWHF		In-Module Assay				
MWT/ERDF/IDF	WRAP		MLLW	TRU Waste	WRAP		MLLW	TRU Waste			
	MLLW	TRU Waste	5' by 5' by 9' Container	RH-72B or 10-160B	MLLW	TRU Waste	5' by 5' by 9' Container	RH-72B or 10-160B			
	2706-T	TRUPACT II	Assay Station	SWHF	2706-T	TRUPACT II	Assay Station	SWHF			
	MWT/ERDF/IDF	WIPP	2706-T	WIPP	MWT/ERDF/IDF	WIPP	2706-T	WIPP			
			MWT/ERDF/IDF				MWT/ERDF/IDF				

Figure 6.2. Processing Logic Flowchart

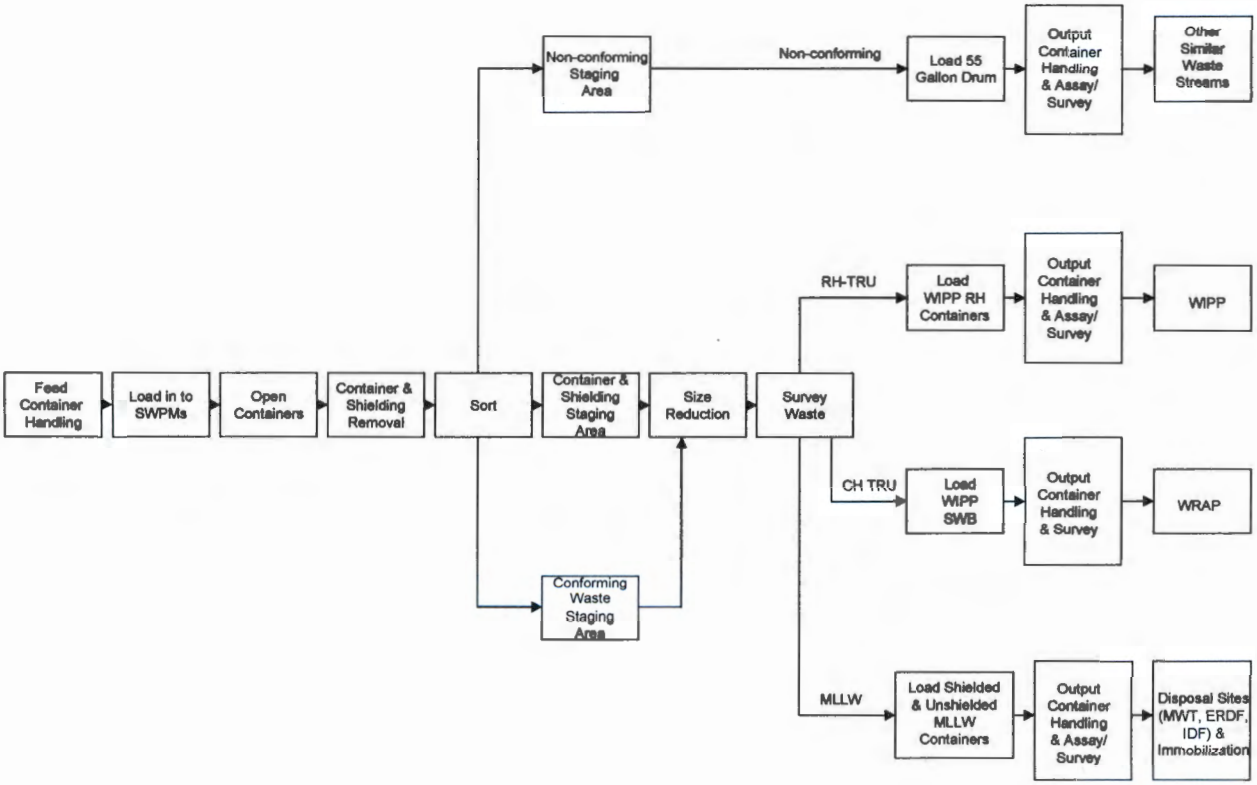


Figure 6.3. Flow Schematic of the Processing Functions

placed in RH casks, and sent to WIPP for disposal. To complete processing by FY 2028 (the current T Plant closure date) requires a processing rate of 600 m^3 per year. This would generate approximately 67 MLLW 5 × 5 × 9 ft containers (3,600 kg or 8,000 lb of waste per container), 37 WIPP SWBs (with 1,800 kg or 4,000 lb of waste per container), and either 15 RH-72B casks (with 1,500 kg or 3,300 lb of waste per payload container) or seven CNS 10-160B casks (with 3,000 kg or 5,900 lb of waste per cask container) per year.

The combined life-cycle volume of waste in containers from SWPM processing is estimated to be 11,000 m^3. This volume includes an additional 100 m^3 of SWPM operations MLLW per year that is generated. Overall about a 10% increase in waste volume is estimated; this does not include waste from deactivation of the SWPMs at completion of operations in FY 2028. The SWPMs will be designed to receive newly generated RH drums from other site processing for load-in to the 72B and/or 10-160B casks.

It may be possible to construct the SWPMs in two phases. Phase I would provide processes for MLLW containers by January 2010; Phase II would add TRU waste processes to the SWPMs by 2012 by connecting into the MLLW modules. The final Engineering Study, planned for completion in September 2006, will evaluate the benefits of this phased approach.

6.7 Assumptions and Rationale

- T Plant will be adequate for this work (e.g., seismically).
- Placement of the SWPM's inside the 221-T canyon allows use of canyon crane for receipt and staging of large containers of waste as well as load-out of large containers of MLLW. T Plant provides infrastructure to handle high-dose packages.
- The SWPMs will be designed for ease of disassembly and placement in the canyon cells for closure with T Plant. Some size reduction will be required. Additional cell cleanout may be required.
- The new SWHF will use the existing penetration into the T Plant canyon to transfer waste container and transportation casks from the SWPMs.
- Containers, shielding, and waste known to be MLLW at load-in will require survey, assay, and immobilization prior to disposal at the MWT, ERDF or IDF. Shielding will be reused as needed.
- Large MLLW containers were selected over drums to reduce size reduction requirements for containers, shielding, waste known to be MLLW at load-in, and drums found to be RH MLLW during assay.
- Assay and acceptable knowledge are sufficient to meet waste characterization requirements.
- Waste processing will be managed to minimize cross contamination of waste codes.
- SWBs were selected over drums to reduce size reduction requirements for suspect TRU waste and because SWB container assay capability is available at WRAP.
- The use of TRUPACT-III containers will be evaluated in the final Engineering Study.
- MLLW containers (5 ×5 × 9-ft SWBs) will need to have access ports (maybe the SWB vent port) for immobilization in 2706-T prior to disposal.
- A small amount of waste (approximately 70 m^3) is forecast after FY 2028 when closure of T Plant is planned. This will require the extension of T Plant operations or acceleration of the associated cleanup actions.

- The life of the WRAP facility is extended from 2012 to 2028 to support T Plant processing. Use established WRAP capabilities to:

  - Receive suspect CH TRU waste in SWBs from T Plant for assay, certification, and transport of CH TRU to WIPP in the TRUPACT II and MLLW in SWBs to 2706-T for immobilization prior to disposal in either the MWT, ERDF or IDF.

- Non-conforming CH MLLW will be packaged and loaded-out in 55-gallon drums. The waste will be sent to the CWC for staging with similar waste streams (e.g., thermal treatment). Some of these wastes require establishment of treatment paths. Options include commercial and 2706-T.

- Non-conforming waste that is TRU waste (assumed to be a small quantity) will require processing in the SWPMs.

- SWPMs will have a new ventilation system.

- An operating gallery will support SWPMs operations by providing in-cell viewing and remote systems control.

- Unpackaged MLLW/TRU waste or failed waste containers that were retrievably stored in the post-1970 LLBGs may be loaded into multi-use containers with an insert for T Plant processing. The insert container will be removed from the multi-use container in the T Plant canyon prior to loading into the SWPMs.

6.8 Technology Needs

New T Plant capabilities needing technology development and equipment testing include remote equipment; load-in/load-out systems; RH TRU waste container loading, sealing, assaying, and handling equipment; and systems for keeping modules clean. Commercially available equipment will be used where possible. Remote equipment selection and development will require mockup and testing of selected systems (RH-72B container handling systems, container opening equipment, load-in/load-out systems) to support final design.

6.8.1 Remote Equipment

Appendix F provides a list of potential remote equipment by process function. The list includes assessment of equipment failure and confidence to perform the required function as follows:

- Equipment Failure Assessment – A higher test level number does not necessarily equate to a higher risk of failure. For example, a fixed automation device to open paint cans is assigned a four for testing because a device such as this does not exist on the commercial market. However, this would be a very simple mechanical design that has a very high probability of success.

- Confidence to Perform the Required Function – The task completion confidence rating (high, medium, or no confidence) is used to illustrate how well the piece of technology or tool will perform the assigned task based on the anticipated inventory. This rating is tied more closely to a risk assessment for probability of success.

6.8.2 Component and System Testing

Recommended component and system testing fall into four categories:

1. **Operational Testing and Training** – This testing consists of post-installation acceptance testing at the system level and operator training at the T Plant Complex.

2. **Cold Mockup Functional Testing** – This testing covers system integration, interfaces, and overall functionality in a similar remote environment. All major modules/functions are subject to this testing, and anything tested at this level also needs to complete Operational Testing and Training.

3. **Equipment Functional Testing** – This is functional testing of commercial off-the-shelf (COTS) equipment and tools that have been adapted for use in a contaminated cell environment. The tests are particularly important for identifying effective tooling, which is critical to success and often the weak link in a functioning remote system. The user will need a clear understanding of the task to be completed and extensive testing to select and successfully deploy appropriate tools. General hand tooling used by people sometimes does not translate well to the motions or forces applied by a remote system such as a gantry. Further, the typical force feedback a person realizes while using a hand tool does not translate back to the operator of a remote system. Thus, any adapted tools will need to be tested extensively before fielding to avoid destroying tools or the waste items of interest. Anything tested at this level also needs to be included in the Cold Mockup Functional Testing and Operational Testing and Training.

4. **Equipment Design and/or Development** – There will be some tools and/or functions required within the SWPMs that are not commercially available. These items will need to be designed, fabricated, and tested. An example of this is a fixed automation device for remotely placing and securing the lid on the inner vessel of a 72B shipping container. Anything tested at this level also needs Equipment Functional Testing, Cold Mockup Functional Testing, and Operational Testing and Training.

6.9 Integration with the T Plant Complex

- The T Plant Complex will be maintained and operated through FY 2028.

- The T Plant Complex will be upgraded as necessary to support the new capabilities and facility operations (e.g., seismic upgrades, fire suppression, power, HVAC, canyon crane).

- The new T Plant capabilities (e.g., SWPMs, SWHF, new assay station) will require integration with ongoing T Plant Complex operations.

- T Plant Complex documentation will require updating to incorporate the addition of the new capabilities, including:

  - Safety documents
  - Criticality control
  - Operating procedures
  - Training material
  - Seismic documentation review.

6.10 Needs for Facilities to Support Retrieval Post-1970 Suspect TRU Waste

Acquisition of capabilities and/or facilities will be required to remotely retrieve and package some suspect TRU waste (e.g., caisson waste) from the post-1970 LLBGs. Pilot retrieval of post-1970 LLBG 218-E-12B is planned this fall to help assess whether existing retrieval methods can be used. Results of these efforts will be integrated into the final Engineering Study planned for completion in September 2006.

6.11 Hanford Cleanup CERCLA Waste Integration

Additional needs for processing waste generated from Hanford Site CERCLA cleanup actions will also be integrated as requirements are identified. WIPP would need to accept this waste from Hanford in a timely manner to support Hanford cleanup. Potential waste sources include:

- Waste sites that may contain areas of high concentrations and quantities of TRU constituents

  - Pre-1970 LLBGs
  - PFP cribs
  - Facility 361 tanks
  - 618-10/11 burial grounds.

- Facilities that may be closed under CERCLA which may contain areas of high concentrations and quantities of TRU constituents include:

  - Reduction Oxidation (REDOX) Plant canyon plutonium processing cell equipment/ vessels
  - Plutonium-Uranium Extraction (PUREX) Plant canyon plutonium processing cell equipment/vessels
  - PUREX tunnels equipment/vessels
  - PFP below grade equipment/vessels.

The following assumptions have been made for the types of Hanford cleanup CERCLA waste that may require processing:

- Unpackaged waste that is homogeneous (e.g., soil and sludge) and contains no non-conforming items will not require processing in T Plant.
- CH waste that is in a container that has not failed and RH waste will be placed into an insert container and the insert container placed in a multi-use container, staged, and transported to T Plant for processing.
- Unpackaged heterogeneous waste that will be processed in the field includes removal of non-conforming items, waste packaging, and shipment to WRAP (TRU) or commercial facilities (MLLW) for processing.
- Failed CH container waste and items too large for processing at WRAP will be transported in a multi-use container with an inner container to T Plant for processing.

6.12 T Plant Complex Processing Capacity

The ability to perform the required basic functions (RH-72B or CNS 10-160B cask payload container, RH TRU waste loading and sealing, and handling and processing of large containers) will dictate the size and the cost of the new T Plant SWPMs and SWHF. Processing capacity is a function of the ability to routinely load-in/load-out containers with minimal contamination issues, maintain remote equipment in an operational condition, and provide staffing for multi-shift operations.

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7.0 Waste Processing Strategy

7.1 Recommended Strategy

The recommended strategy[1] for solid waste processing of CH MLLW in boxes/large containers, RH MLLW, CH TRU waste in boxes/large containers, and RH TRU waste is as follows:

- Use commercial facilities within their license limits and existing processes at the T Plant Complex, when possible, to process waste.

- By January 2010, modify the T Plant Complex to process up to 300 m^3 per year of large-container MLLW and RH MLLW that is currently stored above ground, retrievably stored in the post-1970 LLBGs, or forecast to be newly generated (Phase I).[2]

- By June 2012, modify the T Plant Complex to process TRU waste that is currently stored above ground, retrievably stored in the post-1970 LLBGs, or forecast to be newly generated. The combined capacity (for MLLW and TRU waste) of 600 m^3 per year will be established (Phase II). T Plant Complex processing modifications will include:

  - New SWPMs that will be placed in the T Plant canyon to process MLLW and TRU waste. Processing includes load-in/load-out of waste containers, opening of containers, removal of non-conforming waste, size reduction, waste sorting, dose rate measurement, container sealing, and RH TRU waste container assay. SWPMs will have new HVAC and fire-suppression systems. An operating gallery will support SWPMs operations by providing in-cell viewing and remote systems control.

  - Reconfiguration of existing T Plant canyon processes as required, including waste container receiving and staging and MLLW container load-out.

  - A new SWHF at T Plant for waste container staging, waste container loading for transportation to WRAP, and RH TRU waste cask load-out. The old unused inlet ventilation system will be removed from the south end of the T Plant canyon to allow addition of the new SWHF, which provides access to the canyon.

  - Reconfigured 2706-T, as required, to immobilize MLLW containers.

  - A new assay station for 5 × 5 × 9-ft MLLW containers near the 2706-T facility (location will be a function of background).

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[1] The M-91-03 PMP will be updated to reflect this strategy.

[2] The final engineering study, planned for completion in September 2006, will evaluate the benefits of this phased approach.

- The ability to expand the capacity to meet potential future Hanford Site cleanup needs to process similar CERCLA waste. This supports Tri-Party Agreement Milestones M-16-67 and M-16-93 by integrating CERCLA requirements with new processes capabilities and capacities.

- The final Engineering Study will identify new capabilities and/or facilities required for suspect TRU waste retrieval. The study will integrate the acquisition of retrieval processes with the new T Plant Complex processes.

- Development of needed technology and equipment testing will be pursued. Examples include:

  - Remote equipment
  - Load-in/load-out systems
  - Waste assay and dose measurements
  - RH TRU waste container loading and handling
  - Systems for keeping cells clean.

- Extend the life of the WRAP facility from 2012 to 2028 to support waste processing.

  - Use WRAP to receive suspect TRU waste in SWBs from T Plant for assay, certification, and transport of CH TRU to WIPP in the TRUPACT II and transport of MLLW in SWBs to 2706-T for immobilization.

  - Use commercial facilities and 2706-T to support processing of non-conforming waste. 2706-T will be also be used to support T Plant operations and process development (i.e., container decontamination and SWPMs equipment testing).

- Dispose of MLLW in the Hanford MWTs or ERDF. Disposal at the IDF is a future option. Obtain regulatory approval on a case-by-case basis for in-trench treatment of conforming MLLW (e.g., very large containers).

- Dispose of TRU waste at the WIPP. Work with WIPP to obtain disposal space to meet future Hanford CERCLA needs.

- Complete T Plant processing by the end of FY 2028.

- Design the SWPMs for ease of disassembly/size reduction and placement in the canyon cells for closure with T Plant.

- By September 30, 2006, complete a functional design criteria study for the new T Plant Complex and retrieval processes. A conceptual design report will be completed by December 31, 2007. A summary schedule is provided in Figure 7.1.

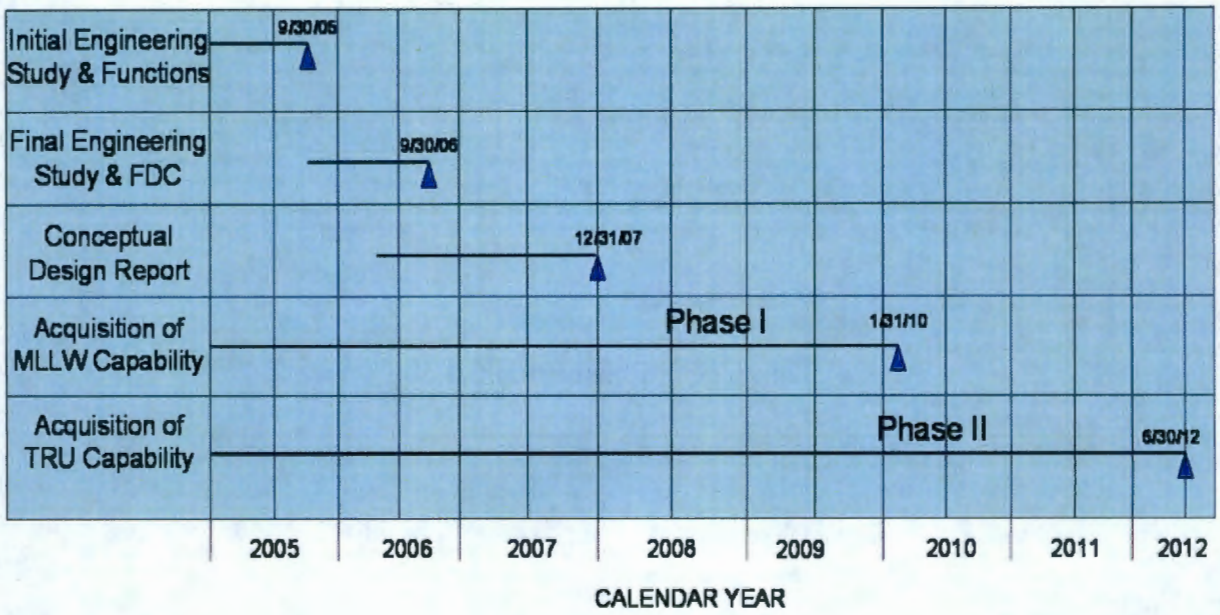

Figure 7.1. Summary Schedule

7.2 Assumptions

- Containers, loose shielding (e.g., lead blankets), and non-conforming waste is MLLW.
- WIPP accepts waste in a timely manner to support Hanford cleanup.
- WIPP would need to accept CERCLA waste from Hanford.
- WIPP accepts RH TRU in RH-72B or CNS 10-160B casks.
- All technology needs can be met.
- WRAP will be maintained and operated through FY 2028 rather than the current baseline of 2012.
- T Plant will be maintained and operated through FY 2028. The T Plant facility will be upgraded, as necessary, to support the new capabilities and facility operations (e.g., seismic upgrades, fire suppression, HVAC, canyon crane).

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8.0 New Processing Functions

Capabilities to perform ten major functions will be added to the T Plant Complex to process boxes/large containers and RH MLLW, TRU waste in boxes and large containers, and RH TRU waste. New systems are required (e.g., HVAC) to support operations and maintenance of the ten functions in T Plant. The functions (shown on the side bar) are:

- Solid Waste Container Receipt and Handling
- Load Containers into SWPMs
- Open Containers
- Container, Shielding and Non-Conforming Waste Removal
- Sort Waste
- Size Reduce Waste
- Survey Waste
- Load Containers
- Container Sealing and Load-out from SWPMs
- Solid Waste Container Handling and Transfer.

Space requirements for width and length have been estimated for the ten functions. These estimates account for space needed for remote systems but not for other support systems (e.g., HVAC). The SWPMs that are used to open the containers will need to be tall enough to allow for remote systems to remove the lids from large containers up to 20 × 13 × 11 ft. The SWPM used to seal the RH-72B payload container will need to be tall enough to vertically weld the container shut in an inert atmosphere environment and insert the payload container into the inner vessel. The RH-72B payload container is approximately 11 ft long.

Remote equipment technologies, summarized in Appendix F, are discussed below for each of the functions.

8.1 Solid Waste Container Receipt and Handling

- MLLW and TRU waste in boxes/large containers and RH waste will be transferred to the T Plant Complex. The containers will be received and loaded onto the deck using the T Plant canyon crane. The containers will be staged on the canyon deck awaiting load-in to SWPMs.

- Product waste containers and associated equipment will be staged for use (WIPP SWBs, 5 × 5 × 9 ft containers, 55-gallon drums, and RH-72B and/or 10-160 casks and associated containers).

8.1.1 Load Containers into SWPMs

- The T Plant canyon crane will place the waste container into an airlock for transfer into the SWPM transfer module.

- The waste containers will be loaded in the SWPM container opening module from the transfer module.

- The transfer module and airlock will be decontaminated as required.

Approximate Space Requirements:

- Airlock and Transfer Module – 15 by 40 ft.
- Container Load-In Staging Module – 18 by 35 ft.

8.1.2 Open Containers

- Containers are opened in the SWPM container opening module. This module contains an assortment of tools and utilities to facilitate the opening of any size container from the anticipated waste inventory.

- The container opening module will likely consist of a large remote gantry with manipulator (and/or gripper) and an additional heavy lift mechanism (w/gripper), as well as several stations for standard container opening and specialized tooling. The gantry system may be as large as 20 ft wide, 40 ft long, and 24 ft high to handle the largest possible container. The heavy lift device must be strong enough to lift the heaviest container entering the module. The most system flexibility would occur with the manipulator and heavy lift devices on separate rails/trolleys.

- At least one non-contact cutting tool (e.g., plasma torch or laser) will be required to open containers that cannot be opened with any other contact method.

8.1.2.1 Container Opening Tools

These technologies range from systems that need design and development to simple industrial tools. Each has advantages and disadvantages depending on the application.

Heavy Lift Hook – The heavy lift and hook combination should be used for opening most containers with a lifting bail. There are several large containers that have a lid simply set on the box. These may be opened and the lid transferred to size reduction while the rest of the box is sorted.

Fixed Automation Tools or Stations – The most efficient way to open standard containers may be to design and develop fixed automation tools or stations. These stations would perform a specific set of tasks to open a container. For example, a station might exist to open 5-gallon buckets. The station would pop or cut the lid and dispose of it before ejecting the bucket for sorting of its contents. This fixed automation may also occur as a tool that could be picked up by the manipulator or heavy lift and set on top of a container. This tool or station would need to be self aligning to perform many tasks. These stations may use adapted tools such as sockets to remove nuts, bolt cutters, concrete saws, and nibblers.

There may be fixed automation tools/stations for opening the following containers:

- 5-gallon buckets
- Paint cans
- 55 gallon drums
- Standard waste boxes.

8.1.2.2 Container Opening Tools (non-fixed automation)

Concrete Saw – A concrete saw is a power cutting tool used for cutting concrete or asphalt. The cutting blade generally generates a significant amount of heat that requires cooling. Concrete cutters also generally require large engines to power the tool and generate a large amount of dust if used dry. A concrete saw may be useful to open concrete casks or tanks.

Plasma Torch – A plasma torch uses a high voltage/current electric field between the head and the work piece to heat a fill gas (such as nitrogen). The ionized gas (plasma) is then forced through a vortex generator. The gas is then forced out of the generator at high speed. The plasma eats through most electrically conductive materials rapidly. The high speed of the ejected plasma blows the molten fragments of the target out of the way of the cutting jet.

Plasma torches are capable of quickly cutting though very thick metals. However, plasma torches are limited to conductive materials.

This mature technology approach is similar to laser cutting. An operator can select the best way to size-reduce individual items. A plasma torch may allow for separation of CH-TRU, RH-TRU, and MLLW by selective cutting. Using a plasma torch remotely requires a manipulator and a trained and dedicated operator. Commercial systems, including positioners, are available. Plasma cutting is not applicable to all waste types and requires treatment of fumes and off gases. Control of metal splatter must also be taken into account when using the plasma torch. Limitations of this technology include the consumable torch head, precise positioning between the head and the work piece, grounding the head to the work piece, and the high electromagnetic field generated by the process. Plasma torches cannot be used around combustible material or if there are combustibles in the associated waste.

Jackhammer – A jackhammer is a portable, percussive type drill that uses a jabbing motion (much like a hammer and chisel) to break up material, especially those that are brittle materials that break apart easily. Jackhammers rely on the inertia of the tool mass to break apart the material. Typically, this requires the tool to be operated in a vertical orientation such that gravity is aiding the tool motion. Jackhammers can be pneumatic, hydraulic, or electric powered.

Commercial systems are available and have been for use on demolition equipment such as backhoes. Disadvantages of this tool include the use only on brittle materials such as concrete, the amount of dust and debris generated, and the fierce vibration that must be supported by the tool holder.

Blade/Knife – A blade or knife may be used to open plastic bags found within waste containers. The blade may be fixed while the material is moved past the blade or the material may be held and the blade may be moved through the material. Orientation of this tool is critical to efficiently open the bags. The blade will require periodic replacement.

Abrasive Wheel – An abrasive wheel mounted on a manipulator is a proven technology for opening containers made of metals and some other materials. Abrasive wheels have been deployed remotely many times. Decontamination and maintenance of the tool may be difficult. The potential for airborne materials and contamination spread is great due to the high velocity of the blade. An abrasive wheel can be slow in operation and is not suitable for flammable materials. Associated equipment to hold the cutting tool and waste item may be complex.

Reciprocating Saw – A reciprocating saw could also be mounted to a manipulator or other positioning system to open containers. These are commonly used for cutting operation, and the initial cost of the equipment is low. A reciprocating saw can be difficult to operate using a remote manipulator, and it is not appropriate for all waste streams. It would not be suited for items with thick cross sections. Maintenance is an issue, depending on the material being cut. Frequent blade changing poses unique challenges.

Other Container Opening Tools – Opening of small or lightweight containers may require the development of a holding station that consists of several "arms" to grip a container as it is being opened. Containers the size of a 55-gallon drum or smaller will almost certainly require this to avoid tipping the container as an operator tries to open the container with a manipulator and tools.

Approximate Space Requirements: 36 × 75 ft.

8.1.3 Container, Shielding, and Non-Conforming Waste Removal

- Non-conforming waste and shielding are removed from the waste container in this module and transferred to the identified staging areas. The container pieces are also transferred to a staging area.
- Removal of waste items from the containers will entail the use of the gantry manipulator and heavy lift device. These items would be equipped with tools such as those described below.

8.1.3.1 Grippers, Hooks, and Clamshells

The primary method of material removal and sorting will be use of the manipulator grippers, heavy lift hook, and clamshells.

Grippers are good for picking up most items less than 200 pounds that are not fragile. Fragile items may require special tooling or force feedback, a technology that allows operators to gauge how tightly an object is grasped.

Hooks deployed by the heavy lift are efficient for removing objects with lifting bails, such as jumpers, or other items with bail-like features. Some heavy items may need rigging applied by the manipulator prior to lift. Rigging may be difficult to accomplish remotely.

Clamshells are robust technology for bulk items, such as piles of scrap metal or piles of bolts. Clamshell jaws are typically hydraulic or electric powered.

All of these technologies are fairly robust and effective when performed remotely, although none are high-throughput technologies because it is rather time-consuming to acquire items. Remote vision is a key enabling system for acquiring objects by one of these methods. Camera systems generally require the user to view multiple cameras from different views to ensure that an object has been grasped firmly. Acquiring objects is much easier if an operator can view the equipment operation through a window.

8.1.3.2 Scoops, Sweepers, and Vacuums

Small loose material such as dirt may best be captured by scooping, sweeping, or vacuuming. Liquids may also be captured in this method by first applying an absorbent to the liquid. Care must be taken when capturing liquids to avoid mixing non-compatible fluids.

Scoops are best used when the material is clumped together or near a wall. Scooping is a difficult task to accomplish remotely due to the complex motion required to scoop material effectively. Scooping also presents a contamination risk and possible criticality risk.

Sweepers are slightly easier to use remotely because the bristles provide some compliance. However, this task also requires a fair amount of practice to effectively acquire material. Sweeping will also require the positioning of a bin to collect the loose material. This bin must either be weighted or positioned such that it cannot be knocked over or moved while material is swept into it. Sweeping presents a contamination risk and possible criticality risk.

Vacuums are the easiest of these technologies and therefore require the least precision to acquire material. Numerous vacuuming technologies exist, including bagless and filterless vacuums that may be readily adaptable to a remote environment. Vacuuming does, however, present several hazards, including possible criticality due to the accumulation of material in the receptacle or filter media used with the system.

8.1.3.3 Other Tools

Some waste items will require the use of general equipment and/or specialized tools. The containers and shielding may best be sorted by intelligently laying out the conveyor system such that no other processing or tooling is needed to sort the waste prior to size reduction.

Some materials may be too small to sort/open efficiently with the gantry manipulator or heavy lift and must be transported to a manipulator station.

The manipulator station may consist of two 6-degrees of freedom (DOF) hydraulic or electric manipulators mounted to a pedestal, table, or the module wall. The two manipulators would share a work table (with lip) and have overlapping work envelopes to allow coordinated effort. This station is most likely the destination of bagged waste, paint cans, small boxes, and items requiring disassembly. The manipulators likely will require tooling and fixtures such as socket sets, screwdrivers, and other standard tool sets. Fixed tooling such as spikes or utility knives would be helpful in opening bags.

Items such as paint cans and bags may need to be opened prior to sorting. Paint can opening may be performed with manipulators and tools such as screw-drivers adapted for manipulator use. If enough paint cans (or other small containers) are expected, it may be advantageous to develop a fixed automation station to open these containers. This station would presumably be highly reliable and quick due to its limited functionality. Using manipulators for this type of work would be time consuming and result in low throughput.

Bagged items may be opened by the manipulators either by tearing them apart or using a fixed spike or blade to breach the bag. Individual items could then be independently sorted according to waste stream.

Fragile items such as glass bottles or light bulbs may require force feedback or special tool development for the manipulators. Special tooling must limit the force applied to an object. An example of this type of tool would be a grappler with flexible fingers. If more than the minimally required force is applied, the fingers will bend yet maintain a grip on the object.

Biological waste such as dead mice may be removed and sorted using sweeping, scooping, gripping, or vacuuming. Electromagnets may be useful to remove and sort ferrous materials.

Additional end-effectors and tools for the manipulator or heavy lift may be required to solve tasks as they arise. For example, a portable camera and lighting system may be necessary to aid in the acquisition or identification of a waste item, or a specific waste item may prove difficult to acquire with an existing method or tool and require a specialized tool to be designed. This tool will need to be passed into the module and acquired appropriately.

Approximate space requirements: 36 × 75 ft (same as container opening space).

8.1.4 Sort Waste

Non-conforming waste will be sorted from the conforming waste using the tools and equipment describe in Section 8.1.4. MLLW that has been removed and sorted as non-conforming will be

removed from the module and placed into 55-gallon drums. No size reduction or surveying is anticipated. Captured liquids are assumed to follow the conforming waste streams; thus, no special tooling is anticipated. TRU non-conforming waste will require space in the SWPMs for processing.

Approximate space requirements: 36 × 75 ft (same as container opening space).

8.1.5 Size Reduce Waste

Waste is size-reduced in this module to allow placement in the appropriate exit containers and/or to reduce output volume/void space.

There are numerous methods by which size reduction can be achieved (Bailey et al. 2001). The most efficient method of size reduction that will accommodate most of the waste is an industrial shredder. A hydraulic shear will be necessary to reduce long-length items for further size reduction (i.e., pre-shredder) or direct packaging. It may also be necessary to disassemble large components for sorting or size reduction. Manipulators and assorted tools are necessary to perform this function remotely.

8.1.5.1 Size Reduction Tools

These technologies range from very complex, expensive systems to simple industrial tools. Each has advantages and disadvantages depending on the application. Most of these tools are applicable to the inventory anticipated.

Shredder – Materials are fed into a hopper and mechanically shredded. Throughput and reliability are very good, although most industrial shredders sized to handle the anticipated input waste containers will produce much more throughput (~30 tons/hour depending on make, model, and size) than will be required by the SWPMs. Shredders are constrained to waste streams without thick metallic pieces. Decontamination and maintenance of a shredder may be difficult. Material jams in shredders and shredded material conveyance systems could present exposure risks. The shredder size and tooth geometry should be optimized to the anticipated waste stream (WHC 1993).

Waste items from the inventory that may be successfully size-reduced using an industrial shredder include:

- Long, hollow objects such as jumpers, pipes, ducting, well casings, flanges, telescoping pipes, coil assemblies, tube bundles, and conductivity probes, especially after pre-size reduction using a shear

- Paint cans
- Combustibles (paper, wood, cloth), foam, plastic, rubber, glass, small tools, construction debris, heaters
- Duct encased in concrete
- Concrete casks
- Concrete tank with steel liner
- Process vessels, dissolvers, condensers, feed waste containers
- Lead blankets.

Shears – Shears are used to cut long-length items into shorter, more manageable pieces. Industrial shears are simple and robust in design, and can be procured to handle very large components. Shears, usually hydraulically powered, generate local pressures in the material being cut greater than the ultimate strength of the material. The material being cut plastically deforms along the blade of the shear. The process is mechanical and the resulting thermal generation and airborne particulates are quite low. Care must be taken when performing shearing operations because the material being cut also elastically deforms. Once the shearing process if finished, the elastically deformed material may spring back to its original form. Hydraulic shears require a small hydraulic power unit (HPU).

Limitations of the shearing process are the robust fixturing required to hold the material being sheared, the hydraulic requirements (pressures range from 3,000 to >10,000 psi), and blade life. The shear blades must be periodically replaced, which would be difficult should they become contaminated.

Waste items from the inventory that may be successfully size-reduced using shear include:

- Long, hollow objects such as jumpers, pipes, ducting, well casings, flanges, telescoping pipes, coil assemblies, tube bundles, and conductivity probes, which may then be post-processed using an industrial shredder.

Disassembly – Disassembly is another method for size reduction that may be used regularly. The manipulators within the module may use specially adapted hand tools to size-reduce large items. For example, a collection of screwdrivers, sockets, and wrenches may be used by the manipulators to disconnect an electric motor from a pump assembly, allowing the pump assembly to be size-reduced in the shredder,

while the electric motor can be placed directly in the waste container because it is too dense for a typical industrial shredder. Other items that may require disassembly include:

- Centrifuges
- Agitators
- Pump assemblies
- Other motor/equipment combinations.

Plasma Torch – Plasma torches operate as described in Section 8.1.3.2. Waste items from the inventory that may be successfully size-reduced using a plasma torch include:

- Long, hollow metallic objects such as jumpers, pipes, ducting, well casings, flanges, telescoping pipes, coil assemblies, tube bundles, and conductivity probes
- Metallic ducting
- Metal waste boxes and other metal containers
- Steel liners
- Process vessels, dissolvers, condensers, feed waste containers
- Metal plates.

Jackhammer – Jackhammers operate as described in Section 8.1.3.2. Waste items from the inventory that may be successfully size-reduced using a jackhammer include concrete containers.

Blade/Knife – Blades/knives operate as described in Section 8.1.3.2. Waste items from the inventory that may be successfully size-reduced using a blade/knife include:

- Plastic sheets and/or bags
- Foam.

Baler – A baler is essentially a trash compactor for metal salvage operations. Material is fed into a hopper and the baler compresses the materials into a relatively dense cube or cylinder. Compacted waste streams would not require other processing. Handling requirements for feeding are minimal, and packing density is relatively high for metallic components. A baler may not work well for springy, low-density materials such as plastics and paper. A

baler will not work on thick-walled materials. Decontamination of a baler may be difficult; however, balers are proven technology operating in a vast number of salvage yards and recycling centers.

Waste items from the inventory that may be successfully size reduced using a baler include:

- Long, hollow metallic objects such as jumpers, pipes, ducting, well casings, flanges, telescoping pipes, coil assemblies, tube bundles, and conductivity probes
- Paint cans
- Process vessels, dissolvers, condensers, feed waste containers, or other large metallic vessels.

Crusher – A crusher can be used for items such as concrete boxes or other items that can be crushed to rubble or flattened. Crushers are simple in design, and adaptable for easy decontamination and maintenance. Crushers may not work well for springy, low-density materials such as plastics and paper. Crushers and balers handle similar waste items.

Waste items from the inventory that may be successfully sized reduced using a baler include:

- Concrete casks
- Concrete encased ducting
- Concrete tank with steel liner.

Band Saw – A horizontal or vertical fixed-location band saw is a proven technology for size reduction of metals and other materials. A band saw can be used on very thick cross sections and is extremely reliable. Binding of the blade may be problematic for size reduction of some components. Industrial band saws can be operated with or without a cutting fluid/coolant. Computer-controlled material positioning and cutting operations are available in standard saws. Low band speed can reduce the potential for airborne contamination; decontamination and maintenance may be difficult. Band saws and shears handle similar waste items.

Waste items from the inventory that may be successfully size-reduced using a band saw include:

- Long, hollow metallic objects
- Metallic ducting
- Metal lathes.

Abrasive Wheel – An abrasive wheel operates as described in Section 8.1.3.2.

Waste items from the inventory that may be successfully size-reduced using an abrasive wheel include:

- Jumpers, pipes, ducting, well casings, flanges, telescoping pipes, coil assemblies, tube bundles, conductivity probes
- Process vessels, dissolvers, condensers, feed waste containers.

Reciprocating Saw – Reciprocating saws operate as described in Section 8.1.3.2.

Size-Reduction Bypass – Some waste items may already be compact or, for other reasons, not require further size reduction. There should be provisions for bypassing the size-reduction equipment and sending items directly to waste loading.

Approximate space requirements:

- MLLW size reduction – 18 × 35 ft
- Suspect TRU waste size reduction – 18 × 35 ft
- Container load-in staging module – 18 × 35 ft.

8.1.6 Survey Waste (including RH TRU 55-gallon drum assay)

Waste will be surveyed inside the SWPMs to determine whether it is RH or CH. RH TRU drums will require assay in the SWPMs. Background fields will be an issue with in-cell assay.

Approximate space requirements: in-module dose rate measurement of waste items – 15 × 15 ft.

8.1.7 Load Containers

In this module, waste is loaded into the appropriate load-out containers. During container filling, MLLW and suspect CH-TRU must be radiologically surveyed to ensure the container meets the appropriate disposal criteria. It is assumed that all MLLW exiting from this module is packaged such that the containers are CH. To accomplish this, MLLW will require both shielded and unshielded boxes. It may be advantageous for the bagless transfer liner to be a uniform size, so that two sizes of outer waste container will exist; one to accommodate the liner only, and the other to accommodate both the liner and additional shielding. TRU waste also requires an assay to facilitate tracking and inventory of TRU material.

Approximate space requirements:

- MLLW container loading – 18 × 40 ft
- CH TRU SWB loading module – 12 × 25 ft
- RH TRU 72-B payload container – 12 × 20 ft.

8.1.8 Container Sealing and Load-Out from SWPMs

Savannah River has developed a bagless drum filling concept that may be suitable for filling and sealing waste containers (Milling et al. 1998). This method would facilitate removal of waste from a module without the spread of contamination. The concept was originally designed for 55-gallon drums but may be adaptable to other waste container geometries or materials. A brief description follows:

- An empty liner with a hollow plug is inserted into the bagless port of the module, pushing the previous liner stub into the module. The plug is removed from the new liner and staged within the module while the container is filled. When full, the plug is re-installed in the liner and the liner welded to the plug. If the weld passes inspection, the liner is cut through the center of the weld, leaving clean surfaces on top of the filled liner and on the bottom of the liner stub. The full liner can then be removed and placed inside the final storage container (see Figure 8.1).

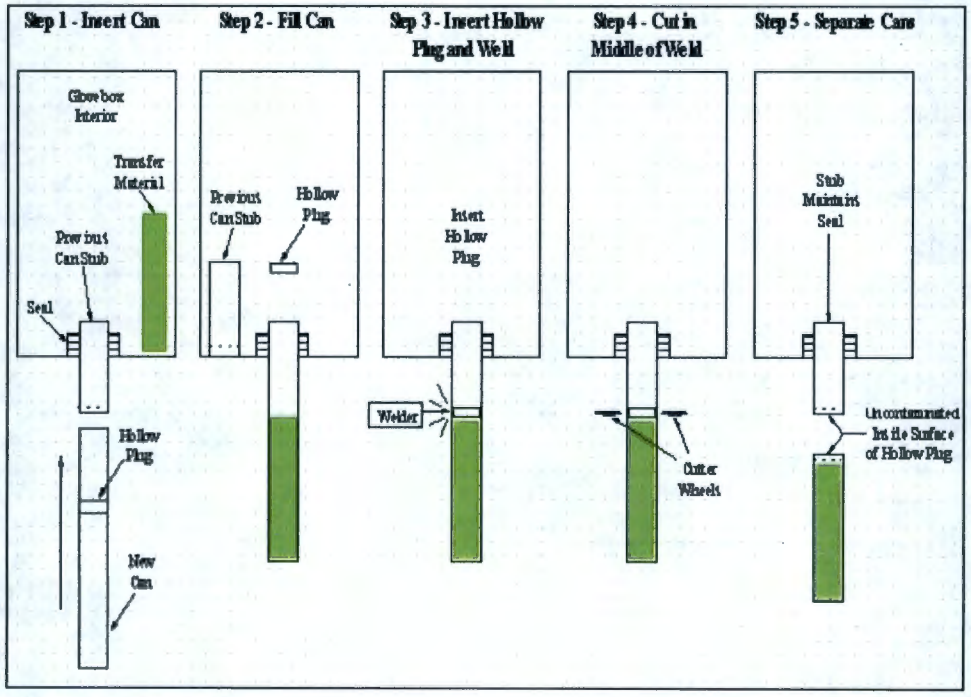

Figure 8.1. "Split Plug" Bagless Transfer Process

The RH-TRU material will require additional steps to certify the container for WIPP, including inspecting the weld on the metallic payload canister, inserting the payload into the inner vessel, sealing the inner vessel, leak testing the inner vessel, inserting the inner vessel into the outer container, sealing the outer container, and leak testing the outer container.

8.1.8.1 Container Loading Tools and General Transport Equipment

These technologies range from systems that need design and development to simple industrial tools. Each has advantages and disadvantages depending on the application (DOE/EIPP 2003a, 2003b, 2004, 2005b).

Fixed Automation Stations – The most efficient way to handle the loading and transport of standard containers may be to design and develop fixed automation stations. These stations would perform a specific set of tasks on a container. Examples of fixed automation would be the sealing of a bagless transport liner and the associated handling of empty liners and plugs.

Fixed automation stations may be beneficial for handling the following tasks:

- Insertion of input waste containers into SWPM
- Positioning of bagless transfer liner
- Insertion of bagless transfer plug
- Removal of bagless transfer plug
- Laser weld of bagless transfer plug
- Inspection of bagless transfer weld
- Separation of bagless transfer liner
- Transport of liner to empty container
- Positioning of empty container
- Insertion of liner into container
- Applying and sealing the lid of waste container
- Welding of WIPP RH payload canister
- Inspection of WIPP RH payload weld
- Installation of payload canister into inner vessel
- Installation of inner vessel lid
- Leak test of inner vessel
- Installation of inner vessel into outer vessel
- Installation of outer vessel lid
- Leak test of outer vessel
- Transport of full containers
- Transport of empty containers and lids.

Conveyors – Conveyor systems are a useful tool to transport material around the module. These systems must be implemented intelligently to avoid material loss and minimize paths between equipment. Containers can be filled easily with size reduced material by using a conveyor directly from the size-reduction equipment to the container loading station.

Grippers, Hooks, and Clamshells – Loading or unloading of waste items may require manipulator grippers, heavy lift hooks, and/or clamshells, which operate as described in Section 8.1.4.1. Occasionally, material may need to be recovered due to overfilling or exceeding the dose limits of a partially loaded container.

Approximate space requirements:

- MLLW container load-out – 18 × 40 ft (same as container loading space)
- CH TRU SWB load-out – 12 × 25 ft (same as container opening space)
- RH TRU 72-B payload container sealing – 12 × 20 ft
- RH TRU waste assay – 12 × 25 ft
- RH TRU 72B inner vessel placement in the outer vessel – 12 × 25 ft
- RH TRU 72-B containers load-out – 12 × 25 ft.

8.1.9 Solid Waste Container Handling and Transfer

- MLLW in 5 × 5 × 9 ft containers will be staged on the T Plant canyon deck, loaded-out of the canyon using the canyon crane, and transferred to a T Plant complex assay station. After assay, the MLLW will be immobilized in 2706-T prior to disposal.

- Non-conforming MLLW in 55-gallon drums will be staged on the canyon deck and transferred to the CWC for staging prior to treatment and disposal.

- Suspect CH TRU waste WIPP SWBs will be staged in the SWHF awaiting load-out and transfer to WRAP for assay. Suspect CH TRU waste determined to be MLLW will be transferred to 2706-T for immobilization prior to disposal.

- RH TRU waste casks will be staged in the SWHF awaiting transport to WIPP.

8.2 Support Functions

New functions to support operations and maintenance of the new SWPMs and the SWHF include:

- Remote Equipment (Appendixes D and E)
- Systems for Keeping Modules Clean
- HVAC Systems
- Inlet and Exhaust Systems
- Electrical
- Control Room
- Airlocks.

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Appendix A

Definition of Terms and Glossary

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Appendix A

Glossary and Definition of Terms

A.1 Definitions of Terms

Contact-Handled Waste – Contact-handled waste is a waste package with a surface dose rate less than 200 mrem/hr.

Mixed Low-Level Waste (mixed waste) – Mixed waste, also referred to as low-level mixed waste, is low-level waste that is subject to Resource Conservation and Recovery Act or Revised Code of Washington 70.105. Mixed waste contains both low-level radioactive materials and low-level hazardous chemicals.

Remote-Handled Waste – Remote-handled waste is a waste package with a surface dose rate equal to or greater than 200 mrem/hr.

Retrieval of Contact-Handled Retrievably Stored Waste – This is defined as uncovering contact-handled waste within the U.S. Department of Energy's (DOE's) retrievably stored waste trenches, and removing such contact-handled waste from the trenches to a permitted and compliant treatment, storage, or disposal facility, the Environmental Restoration Disposal Facility, or for waste designated in accordance with WAC 173-303-070 through 100 as non-mixed to a storage or disposal facility that DOE determines is appropriate. Storage of any contact-handled HSW that has not been designated as non-mixed pursuant to WAC 173-303-070 through 100 shall include secondary containment pursuant to WAC 173-303-630(7).

Retrieval of Remote-Handled Retrievably Stored Waste – This is defined as uncovering remote-handled waste within DOE's retrievably stored waste trenches and caissons, and removing such remote-handled waste from the trenches to a permitted and compliant treatment, storage, or disposal facility, the Environmental Restoration Disposal Facility, or for waste designated in accordance with WAC 173-303-070 through 100 as non-mixed to a storage or disposal facility that DOE determines is appropriate. Storage of any remote-handled HSW that has not been designated as non-mixed pursuant to WAC 173-303-070 through 100 shall include secondary containment pursuant to WAC 173-303-630(7).

Transuranic Waste – Transuranic (TRU) waste is defined as waste that meets the definition in subsection (18) of Section 2 of the Waste Isolation Pilot Plant Land Withdrawal Act, Public Law 102-579. Transuranic waste includes both "mixed transuranic waste" and non-mixed transuranic waste, and comprises the following categories: contact-handled transuranic waste, contact-handled mixed transuranic waste, remote-handled transuranic waste, and remote-handled mixed transuranic waste.

Waste Designation – Designation is defined as the process for determining (1) which containers of low-level waste are mixed waste and (2) which containers of transuranic waste are mixed transuranic (contact-handled or remote-handled mixed transuranic waste). Designation of waste will be performed pursuant to WAC 173-303-070 through 100. These regulations allow the use of "Acceptable Knowledge," surrogate sampling, and other measures for designation to minimize workers radiation exposure and to reduce costs. Where applicable, DOE intends to use information gathered through the certification of transuranic waste in support of its designation of related low-level waste treatability groups. Where appropriate, DOE will use measures allowed under state and federal regulations to perform accurate and cost-effective designations of low-level waste.

A.2 Acronyms and Definitions

200 ETF	200 Area Effluent Treatment Facility
AEA	Atomic Energy Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CH	contact-handled
CNS	Chem-Nuclear Systems
COTS	commercial off-the-shelf
CWC	Central Waste Complex
DOE	U.S. Department of Energy
DOE-RL	DOE Richland Operations Office
DOF	degrees of freedom
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ERDFWAC	ERDF Waste Acceptance Criteria
ESD	explanation of significant difference
FRP	fiberglass reinforced plywood
FY	fiscal year
HEPA	high-efficiency particulate air (filter)
HPU	hydraulic power unit
HSSWAC	Hanford Site Solid Waste Acceptance Criteria
HVAC	heating, ventilation, and air conditioning
HWMA	Hazardous Waste Management Act (Washington State)
IDF	Integrated Disposal Facility
LCD	liquid crystal display
LDC	large diameter container
LDR	land disposal restriction
LLBG	low-level burial ground
LLW	low-level waste

MLLW	mixed low-level waste
MWT	mixed waste trench
NRC	U.S. Nuclear Regulatory Commission
O/C	organic/carbonaceous
PFP	Plutonium Finishing Plant
PMP	Project Management Plan
PUREX	Plutonium-Uranium Extraction Plant
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
REDOX	Reduction Oxidation Plant
RH	remote-handled
ROD	record of decision
RSW	retrievably stored waste
SWB	standard waste box
SWHF	Solid Waste Handling Facility
SWIFT	Solid Waste Integrated Forecast Technical Report
SWITS	Solid Waste Information Tracking System
SWPMs	Solid Waste Processing Modules
TRU	transuranic waste
TRUM	transuranic mixed waste
TRUPACT-II	Transuranic Package Transporter Model 2
VPU	vertical pipe units
WAC	Washington Administrative Code
WESF	Waste Encapsulation and Storage Facility
WHC	Westinghouse Hanford Company
WIPP	Waste Isolation Pilot Plant
WM	waste management
WRAP	Waste Receiving and Processing Facility
WTP	Waste Treatment Plant

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Appendix B

M-91 TPA Milestones

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Appendix B

M-91 TPA Milestones

Number	Milestone	Due Date
M-016-67	SUBMIT A TECHNOLOGY DEVELOPMENT SUMMARY REPORT FOR PHASES I,II AND III, AN INTERMEDIATE DESIGN REPORT, A REMEDIATION SCHEDULE AND A TREATABILITY INVESTIGATION WORK PLAN FOR REMEDIAL ACTIONS AT THE 618-10 AND 618-11 BURIAL GROUNDS. THE TECHNOLOGY DEVELOPMENT SUMMARY REPORT FOR PHASES I, II AND III WILL DOCUMENT THE RESULTS OF THE EM-50 ACQUISITION STRATEGY RELATING TO THE IN-SITU DELINEATION AND WASTE REMOVAL OF RADIOACTIVE WASTE AT THE HANFORD 618-10 AND 618-11 BURIAL GROUNDS. THE INTERMEDIATE DESIGN REPORT SHOULD REPRESENT A 60% COMPLETE DESIGN REPORT AND SHOULD INCLUDE AT A MINIMUM, THE REMEDIATION APPROACH (i.e., PROCESS DEFINITION), EVALUATION OF INFRASTRUCTURE REQUIREMENTS [i.e., M-91 AND WIPP INTEGRATION PLANNING], AND UPDATED DRAWINGS/TECHNICAL SPECIFICATIONS. THE REMEDIATION SCHEDULE MUST IDENTIFY: 1) DATES FOR INITIATING AND COMPLETING INTERIM REMEDIAL ACTIONS AT WASTE SITES; AND 2) ANY DOCUMENTS REQUIRING EPA AND/OR ECOLOGY APPROVAL PRIOR TO INITIATING REMEDIAL ACTIONS (E.G., RD/RA WORK PLANS, ETC.). DEPENDING ON THE OUTCOME OF THE TECHNOLOGY DEVELOPMENT ACQUISITION STRATEGY, A TREATABILITY INVESTIGATION WORK PLAN FOR KEY ASPECTS OF THE FINAL REMEDIATION APPROACH WILL BE REQUIRED. THE TREATABILITY INVESTIGATION WORK PLAN MUST BE CONSISTENT WITH WIPP'S ACTUAL (OR, IF NOT YET APPROVED, ANTICIPATED) RH-TRU/TRUM WASTE ACCEPTANCE CRITERIA, INCORPORATE THE RESULTS FROM THE TECHNOLOGY DEVELOPMENT SUMMARY REPORT, AND WILL BE SUBMITTED AS A TRI-PARTY AGREEMENT PRIMARY DOCUMENT.	03/31/2007
M-16-93 LEAD AGENCY: EPA	SUBMIT AN IMPLEMENTATION WORK PLAN TO EPA FOR THE ACQUISITION OF CAPABILITIES NECESSARY TO PREPARE TRU AND TRUM WASTE GENERATED BY CERCLA CLEAN UP ACTIONS AT THE HANFORD SITE FOR DISPOSAL AT THE WASTE ISOLATION PILOT PLANT (WIPP). THIS WORK PLAN WILL REFLECT RETRIEVAL DECISIONS, PROJECTED WASTE VOLUMES, AND SCHEDULES FROM ALL CERCLA CLEANUP ACTIONS AUTHORIZED IN RECORDS OF DECISION AND ACTION MEMORANDA AT THE HANFORD SITE, AND WILL PROVIDE FOR UPDATES AND REVISIONS AS NEW INFORMATION BECOMES AVAILABLE (AT A MINIMUM, THE WORK PLAN MUST BE REVISED IN 2009 (AFTER ALL 200 AREA RODS ARE ISSUED) AND IN 2012). AS PART OF THE APPROVAL PROCESS, EPA WILL CONSULT WITH ECOLOGY TO ENSURE THAT WSTES FROM CERCLA OPERABLE UNITS FOR WHICH ECOLOGY IS THE LEAD REGULATORY AGENCY ARE PROPERLY PLANNED FOR. THIS WORK PLAN WILL PROVIDE A SCHEDULE FOR ACQUIRING THE CAPABILITIES FOR TRU AND TRUM MANAGEMENT NECESSARY TO SUPPORT ALL CERCLA CLEANUP ACTIONS.	09/30/2006

Number	Milestone	Due Date
	IN ORDER TO AVOID DUPLICATIVE REQUIREMENTS, THE M-16-93 WORK PLAN WILL INTEGRATE PLANS DEVELOPED PURSUANT TO THE M-91 MILESTONES TO PROVIDE CAPABILITIES FOR RCRA MIXED AND SUSPECT MIXED TRANSURANIC WASTE WHERE SUCH CAPABILITIES ALSO CAN BE USED FOR CERCLA TRU/TRUM WASTE. THE WORK PLAN WILL BE SUBMITTED PURSUANT TO SECTION 11.6 OF THE TRI-PARTY AGREEMENT.	
M-091-00	COMPLETE THE ACQUISITION OF NEW FACILITIES, MODIFICATION OF EXISTING FACILITIES, AND MODIFICATION OF PLANNED FACILITIES NECESSARY FOR RETRIEVAL, STORAGE, AND TREATMENT/PROCESSING, OF ALL HANFORD SITE RCRA MIXED AND SUSPECT MIXED LOW-LEVEL WASTE AND RCRA MIXED AND SUSPECT MIXED TRANSURANIC WASTE. DEFINITIONS THE FOLLOWING DEFINITIONS APPLY TO THIS SERIES OF MILESTONES. "BOXES AND LARGE CONTAINERS" AS USED HEREIN IS DEFINED AS WASTE CONTAINERS THAT ARE NOT 55-GALLON DRUMS AND THAT CANNOT BE PLACED IN SUCH DRUMS. "DESIGNATION" AS USED HEREIN IS DEFINED AS THE PROCESS FOR DETERMINING: (1) WHICH CONTAINERS OF LOW-LEVEL WASTE ARE MLLW; AND, (2) WHICH CONTAINERS OF TRANSURANIC WASTE ARE MIXED TRANSURANIC WASTE (CH-TRUM OR RH-TRUM). DESIGNATION OF WASTE WILL BE PERFORMED PURSUANT TO WAC 173-303-070 THROUGH 100. THESE REGULATIONS ALLOW THE USE OF "ACCEPTABLE KNOWLEDGE," SURROGATE SAMPLING AND OTHER MEASURES FOR DESIGNATION TO MINIMIZE WORKERS' RADIATION EXPOSURE AND TO REDUCE COSTS. WHERE APPLICABLE, DOE INTENDS TO USE INFORMATION GATHERED THROUGH THE CERTIFICATION OF TRANSURANIC WASTE IN SUPPORT OF ITS DESIGNATION OF RELATED LOW-LEVEL WASTE STREAMS. WHERE APPROPRIATE, DOE WILL USE MEASURES ALLOWED UNDER STATE AND FEDERAL REGULATIONS TO PERFORM ACCURATE AND COST EFFECTIVE DESIGNATIONS OF LOW-LEVEL WASTE. "LOW-LEVEL WASTE" AS USED HEREIN IS DEFINED AS RADIOACTIVE WASTE THAT IS NOT SPENT FUEL, HIGH-LEVEL WASTE, TRANSURANIC WASTE, BYPRODUCT MATERIAL, OR NATURALLY OCCURRING RADIOACTIVE MATERIAL. LOW-LEVEL WASTE INCLUDES BOTH "MIXED LOW-LEVEL WASTE" AND "NON-MIXED LOW-LEVEL WASTE." "MIXED LOW-LEVEL WASTE" (MLLW) IS LOW-LEVEL WASTE THAT IS SUBJECT TO RCRA OR 0.105 RCW. "NON-MIXED LOW-LEVEL WASTE" (LLW) IS LOW-LEVEL WASTE THAT IS NOT SUBJECT TO RCRA OR 70.105 RCW. LLW AND LLW CAN BE CONTACT-HANDLED (CH), I.E., CH-LLW OR CH-MLLW, OR REMOTE-HANDLED (RH), I.E., RH-LLW OR RH-MLLW. "CONTACT HANDLED" (CH) WASTE IS A WASTE PACKAGE WITH A SURFACE DOSE RATE LESS THAN 200 MILLIREM PER HOUR.	To Be Determined *

Number	Milestone	Due Date
	"REMOTE HANDLED" (RH) WASTE IS A WASTE PACKAGE WITH A SURFACE DOSE RATE EQUAL TO OR GREATER THAN 200 MILLIREM PER HOUR. "RETRIEVABLY STORED WASTE" (RSW) AS USED HEREIN IS DEFINED AS WASTE THAT IS OR WAS BELIEVED TO BE CONTAMINATED WITH SIGNIFICANT CONCENTRATIONS OF TRANSURANIC ISOTOPES WHEN IT WAS PLACED IN THE 218-W-4B, 218-W-4C, 218-W-3A AND 218-E-12B BURIAL GROUND TRENCHES AFTER MAY 6, 1970. DURING THE RETRIEVAL PROCESS, CONTAINERS OF RSW WILL BE SEGREGATED INTO TWO CATEGORIES: (1) CH RSW AND (2) RH RSW. SUBSEQUENT ANALYSIS AND CATEGORIZATION OF RSW PURSUANT TO RCRA, CH. 70.105 RCW, THE ATOMIC ENERGY ACT, AND THE WIPP LAND WITHDRAWAL ACT WILL RESULT IN MOST OR ALL OF THIS WASTE BEING CLASSIFIED AS ONE OF THE FOLLOWING TYPES OF WASTE: LLW, RH-LLW, CH-MLLW, RH-MLLW, CH-TRU, CH-TRUM, RH-TRU OR RH-TRUM. RSW DOES NOT INCLUDE WASTE IN CONTAINERS THAT HAVE DETERIORATED TO THE POINT THAT THEY CANNOT BE RETRIEVED AND STABILIZED (E.G. PLACED IN OVERPACKS) IN A MANNER THAT WOULD ALLOW THEM TO BE TRANSPORTED AND DESIGNATED WITHOUT POSING SIGNIFICANT RISKS TO WORKERS, THE PUBLIC OR THE ENVIRONMENT. WITH RESPECT TO ANY SUCH CONTAINERS, AND WITH RESPECT TO ANY RELEASE OF RSW, THE DECISION AS TO HOW TO MOVE FORWARD WILL BE DETERMINED THROUGH THE CLEANUP PROCESS SET FORTH IN RCRA, CH. 70.105 RCW, AND/OR CERCLA AS APPROPRIATE. THOSE PROCESSES MAY RESULT IN ADDITIONAL REQUIREMENTS FOR THE REMEDIATION OF SUCH WASTES. "CAISSON WASTE" AS USED HEREIN IS DEFINED AS RSW IN THE 218-W-4B BURIAL GROUND CAISSONS ALPHA-1 THROUGH ALPHA-4. "TRANSURANIC WASTE" AS USED HEREIN IS DEFINED AS WASTE THAT MEETS THE DEFINITION IN SUBSECTION (18) OF SECTION 2 OF THE WASTE ISOLATION PILOT PLANT LAND WITHDRAWAL ACT, PUB. L. 102- 579. TRANSURANIC WASTE INCLUDES BOTH "MIXED TRANSURANIC WASTE" (TRUM) WASTE" AND "NON-MIXED TRANURANIC WASTE" (TRU), AND COMPRISES THE FOLLOWING CATEGORIES: CH-TRU, CH-TRUM, RH-TRU, AND RH-TRUM. "RETRIEVAL OF CH RSW" IS DEFINED AS UNCOVERING CH WASTES WITHIN DOE'S RSW TRENCHES, AND REMOVING SUCH CH WASTES FROM THE TRENCHES TO A PERMITTED AND COMPLIANT TREATMENT, STORAGE OR DISPOSAL FACILITY, THE ENVIRONMENTAL RESTORATION AND DISPOSAL FACILITY (ERDF) OR FOR WASTE DESIGNATED IN ACCORDANCE WITH WAC 173-303-070 THROUGH 100 AS NON-MIXED TO A STORAGE OR DISPOSAL FACILITY THAT DOE DETERMINES IS APPROPRIATE. STORAGE OF ANY RETRIEVED CH RSW THAT HAS NOT BEEN DESIGNATED AS NON-MIXED PURSUANT TO WAC 173-303-070 THROUGH -100 SHALL INCLUDE SECONDARY CONTAINMENT PURSUANT TO WAC 173-303-630(7).	

Number	Milestone	Due Date
	"RETRIEVAL OF RH RSW" IS DEFINED AS UNCOVERING RH WASTES WITHIN DOE'S RSW TRENCHES AND CAISSONS, AND REMOVING SUCH RH WASTES FROM THE TRENCHES TO A PERMITTED AND COMPLIANT TREATMENT, STORAGE OR DISPOSAL FACILITY, THE ENVIRONMENTAL RESTORATION AND DISPOSAL FACILITY (ERDF) OR FOR WASTE DESIGNATED IN ACCORDANCE WITH WAC 173-303-070 THROUGH 100 AS NON-MIXED TO A STORAGE OR DISPOSAL FACILITY THAT DOE DETERMINES IS APPROPRIATE. STORAGE OF ANY RETRIEVED RH RSW THAT HAS NOT BEEN DESIGNATED AS NON-MIXED PURSUANT TO WAC 173-303-070 THROUGH -100 SHALL INCLUDE SECONDARY CONTAINMENT PURSUANT TO WAC 173-303-630(7). NOTE: THE REQUIREMENTS OF THIS MILESTONE WITH REGARD TO THE ACQUISITION OF NEW FACILITIES, MODIFICATION OF EXISTING FACILITIES AND MODIFICATION OF PLANNED FACILITIES NECESSARY FOR TREATMENT/PROCESSING OF RCRA MIXED AND SUSPECT MIXED TRANSURANIC WASTE DO NOT APPLY AS TO FACILITIES FOR LDR TREATMENT (OR FOR CERTIFICATION IN LIEU OF SUCH TREATMENT) OF MIXED TRANSURANIC WASTE PRIOR TO A FINAL APPEALABLE JUDGMENT ON THE MERITS OF THE LDR STORAGE AND TREATMENT CLAIM IN WASHINGTON V. ABRAHAM, NO. CT-03-5018-AAM, AND AFTER SUCH A JUDGMENT, ONLY AS SET FORTH IN THE ACCOMPANYING SETTLEMENT AGREEMENT. * NOTE: THE M-91 SERIES MILESTONES (INCLUDING THIS NOTE) DO NOT INCLUDE ANY REQUIREMENTS TO ESTABLISH SCHEDULES FOR THE MANAGEMENT OF PRE-1971 TRU/TRUM. SCHEDULES FOR THE MANAGEMENT OF PRE-1971TRU/TRUM WILL BE ESTABLISHED, PURSUANT TO APPLICABLE PROVISIONS OF THE HFFACO OTHER THAN THE M-91 SERIES MILESTONES, FOLLOWING THE ISSUANCE OF OPERABLE UNIT RECORDS OF DECISION (RODS).	
M-091-01	COMPLETE THE ACQUISITION OF CAPABILITIES AND/OR ACQUISITION OF NEW FACILITIES, MODIFICATION OF EXISTING FACILITIES, AND/OR MODIFICATION OF PLANNED FACILITIES NECESSARY FOR RETRIEVAL, DESIGNATION, STORAGE, AND TREATMENT/PROCESSING PRIOR TO DISPOSAL OF ALL HANFORD SITE POST 1970 RH TRUM AND SUSPECT RH TRUM, TRUM IN BOXES AND LARGE CONTAINERS, AND SUSPECT TRUM IN BOXES AND LARGE CONTAINERS. NOTE: THE REQUIREMENTS OF THIS MILESTONE WITH REGARD TO COMPLETING THE ACQUISITION OF CAPABILITIES AND/OR ACQUISITION OF NEW FACILITIES, MODIFICATION OF EXISTING FACILITIES AND/OR MODIFICATION OF PLANNED FACILITIES NECESSARY FOR TREATMENT/PROCESSING OF HANFORD SITE POST 1970 RH TRUM AND SUSPECT RH TRUM, TRUM IN BOXES AND LARGE CONTAINERS, AND SUSPECT TRUM IN BOXES AND LARGE CONTAINERS DO NOT APPLY AS TO CAPABILITIES AND FACILITIES FOR LDR TREATMENT (OR FOR CERTIFICATION IN LIEU OF SUCH TREATMENT) OF RH TRUM AND TRUM IN BOXES AND LARGE CONTAINERS PRIOR TO A FINAL APPEALABLE JUDGMENT ON THE MERITS OF THE LDR STORAGE AND TREATMENT CLAIM IN WASHINGTON V. ABRAHAM, NO. CT-03-5018-AAM, AND AFTER SUCH A JUDGMENT, ONLY AS SET FORTH IN THE ACCOMPANYING SETTLEMENT AGREEMENT.	6/30/2012

Number	Milestone	Due Date
M-091-03	SUBMIT REVISION OF THE HANFORD SITE TRUM AND MIXED LOW-LEVEL WASTE PROJECT MANAGEMENT PLAN (PMP) TO ECOLOGY PURSUANT TO, AND IN COMPLIANCE WITH THE REQUIREMENTS OF AGREEMENT SECTION 11.5. REVISIONS OF THE PMP SHALL ADDRESS RCRA MIXED AND SUSPECT MIXED TRANSURANIC AND LOW LEVEL WASTE AND WILL CONSIDER AND EXPRESSLY EVALUATE THE IMPACT ON M-91 RETRIEVAL, TREATMENT AND PROCESSING CAPABILITIES, THAT MAY RESULT FROM RETRIEVAL, TREATMENT AND/OR PROCESSING OF ANY OTHER TRANSURANIC OR SUSPECT TRANSURANIC WASTE INCLUDING BUT NOT LIMITED TO OFF-SITE TRANSURANIC WASTE AND HANFORD SITE TRANSURANIC WASTE GENERATED AFTER 1/1/03. REVISIONS OF THE PMP SHALL BE SUBMITTED ON 12/31/2003, 3/31/2009 AND 3/31/2013. EACH REVISION IS A DISTINCT WORK REQUIREMENT INDEPENDENTLY SUBJECT TO THE ENFORCEMENT PROVISIONS OF THIS AGREEMENT. WITH RESPECT TO RH MIXED WASTE AND MIXED WASTE IN BOXES AND LARGE CONTAINERS, THE PMP SUBMITTED ON 12/31/2003 WILL SPECIFICALLY IDENTIFY MEASURABLE ACTIONS TO BE TAKEN BY DOE TO ACQUIRE CAPABILITIES TO MANAGE SUCH WASTES. THE PMP SHALL IDENTIFY SUCH MEASURABLE ACTIONS AT LEAST YEARLY. NOTE: WITH RESPECT TO PMP REVISIONS ON 3/31/2009 AND 3/31/2013, THE REQUIREMENTS OF THIS MILESTONE CONCERNING PMP REVISIONS TO ADDRESS TRUM SHALL NOT APPLY PRIOR TO A FINAL APPEALABLE JUDGMENT ON THE MERITS OF THE LDR STORAGE AND TREATMENT CLAIM IN WASHINGTON V. ABRAHAM, NO. CT-03-5018, AND AFTER SUCH A JUDGMENT, ONLY AS SET FORTH IN THE ACCOMPANYING SETTLEMENT AGREEMENT. IN ADDITION, THE PMP SUBMITTED ON 12/31/2003 WILL NOT BE REQUIRED TO CONTAIN PLANS AND SCHEDULES FOR THE LDR TREATMENT (OR CERTIFICATION IN LIEU OF SUCH TREATMENT AS PROVIDED FOR IN M-91-42 AND M-91-44) OF TRUM WASTE. WITHIN SIX MONTHS OF ECOLOGY'S APPROVAL OF DOE'S PROPOSAL OR ECOLOGY'S ISSUANCE OF A DETERMINATION PURSUANT TO THE ACCOMPANYING SETTLEMENT AGREEMENT, FOLLOWING RECEIPT OF A FINAL APPEALABLE JUDGMENT ON THE MERITS OF THE LDR STORAGE AND TREATMENT CLAIM IN WASHINGTON V. ABRAHAM, NO. CT-03-5018-AAM, DOE SHALL REVISE THE PMP TO INLCUDE PLANS AND SCHEDULES FOR LDR TREATMENT (OR CERTIFICATION IN LIEU OF SUCH TREATMENT AS PROVIDED IN M-91-42 AND M-91-44) OF TRUM WASTE IN THE MANNER REQUIRED BY DOE'S APPROVED PROPOSAL OR ECOLOGY'S DETERMINATION. PMP REVISIONS WILL BE SUBMITTED TO ECOLOGY FOR REVIEW AND APPROVAL AS PRIMARY DOCUMENTS PURSUANT TO AGREEMENT ACTION PLAN SECTION 9.2.1. DOE SHALL IMPLIMENT THE PLAN AS APPROVED. ONCE APPROVED, THE PMP SUBMITTED ON 12/31/2003, IN ACCORDANCE WITH THIS MILESTONE SHALL SUPERSEDE THOSE PORTIONS OF PREVIOUSLY SUBMITTED DOE PMPS THAT CONCERNED RCRA MIXED WASTE, SUSPECT MIXED TRANSURANIC AND SUSPECT MIXED LOW LEVEL WASTE.	DUE DATES AS INDICATED IN THE DESCRIPTIVE TEXT OF THIS MILESTONE

Number	Milestone	Due Date
M-091-05-T01	COMPLETE AND SUBMIT RH TRUM SUSPECT RH TRUM, TRUM IN BOXES AND LARGE CONTAINERS, AND SUSPECT TRUM IN BOXES AND LARGE CONTAINERS RETRIEVAL AND PROCESSING FACILITY(IES) ENGINEERING STUDY/FUNCTIONAL DESIGN CRITERIA STUDY TO ECOLOGY FOR FACILITIES REQUIRED BY M-91-01. THE TRUM ENGINEERING/FUNCTIONAL DESIGN CRITERIA STUDY WILL COVER ACTIVITIES/FACILITIES NOT CONSIDERED COMMERCIALLY VIABLE AS DOCUMENTED IN THE APPROVED TRUM PMP AND ASSOCIATED AGREEMENT CHANGE REQUESTS.	12/31/2007
M-091-12	COMPLETE THERMAL TREATMENT OF AN ADDITIONAL 360 CUBIC METERS OF CONTACT HANDLED MLLW. THIS BRINGS THE CUMULATIVE TOTAL TO AT LEAST 600 CUBIC METERS OF CONTACT HANDLED MLLW THERMALLY TREATED.	11/16/2007
M-091-12A	COMPLETE THERMAL TREATMENT OF AT LEAST 240 CUBIC METERS OF CONTACT HANDLED MLLW.	09/30/2005
M-091-15	COMPLETE ACQUISITION OF FACILITIES AND/OR CAPABILITIES ANDINITIATE TREATMENT OF RH MLLW AND CH MLLW IN BOXES AND LARGE CONTAINERS.	06/30/2008
M-91-40	REGARDING THE RETRIEVAL AND DESIGNATION OF CONTACT-HANDLED (CH) RETRIEVABLY STORED WASTE (RSW) AND TREATMENT OF SUCH WASTES DESIGNATED AS MIXED TO MEET APPLICABLE FEDERAL AND STATE LAND DISPOSAL RESTRICTION (LDR) STANDARDS (ALL CH RSW WASTE REGARDLESS OF PACKAGE SIZE): 1. DOE SHALL RETRIEVE ALL CH-RSW WITHIN BURIAL GROUNDS 218-W-4C, 218-W-4B, 218-W-3A, AND 218-E-12B BY DECEMBER 31, 2010. IN ACHIEVING THIS RETRIEVAL REQUIREMENT, DOE SHALL FIRST INITIATE RETRIEVAL AT ITS BURIAL GROUND 218-W-4C NO LATER THAN NOVEMBER 15, 2003, AND SHALL RETRIEVERSW AT THE FOLLOWING RATES : - 1,200 CUBIC METERS (CUMMULATIVE) BY 12/31/04, - 2,700 CUBIC METERS (CUMMULATIVE) BY 12/31/05, - 4,700 CUBIC METERS (CUMMULATIVE) BY 12/31/06, - 7,200 CUBIC METERS (CUMMULATIVE) BY 12/31/07, - 9,700 CUBIC METERS (CUMMULATIVE) BY 12/31/08, - 12,200 CUBIC METERS (CUMMULATIVE) BY 12/31/09, - COMPLETE RETRIEVAL OF CH-RSW BY 12/31/2010. DOE SHALL CONTINUE RETRIEVAL ACTIONS IN 218-W-4C UNTIL ALL CH RSW IS RETRIEVED. SUBSEQUENT RETRIEVAL ACTIONS, SHALL BE UNDERTAKEN SEQUENTIALLY AT BURIAL GROUNDS 218-E-12B, 218-W-3A, AND 218-W-4B. RETRIEVAL OF WASTE OUT OF THE ORDERED SEQUENCE SHALL NOT BE COUNTED TOWARD THE MILESTONE REQUIREMENT UNLESS JOINTLY AGREED TO BY ECOLOGY AND DOE. DOE MAY REQUEST SUCH APPROVAL WITH RESPECT TO WASTE IN BOXES AND LARGE CONTAINERS. IN REVIEWING SUCH REQUEST, ECOLOGY WILL CONSIDER AMONG OTHER FACTORS; WHETHER THE WASTE CONTAINER HAS BEEN UNCOVERED, INSPECTED AND FOUND TO BE INTACT AND NOT POSING A THREAT TO HUMAN HEALTH AND THE ENVIRONMENT	DUE DATES AS INDICATED IN THE DESCRIPTIVE TEXT OF THIS MILESTONE

Number	Milestone	Due Date
	(OR RE-PACKAGED TO PREVENT RELEASE TO THE ENVIRONMENT) AND EXISTING DOCUMENTATION DOES NOT INDICATE THE PRESENCE OF FREE LIQUIDS. ECOLOGY MAY CONDITION ITS AGREEMENT ON A DOE COMMITMENT TO PERFORM ADDITIONAL SPECIFIED REQUIREMENTS (E.G. CONTAINER INSPECTIONS, COVERING CONTAINERS, ETC.) TO PREVENT RELEASES TO THE ENVIRONMENT. THE RETRIEVAL SEQUENCE IS PRIORITIZED BASED ON ENVIRONMENTAL RISK AND INTENDED TO ENSURE THAT DOE FIRST RETRIEVE WASTE FROM THE 218-W-4C BURIAL GROUND, WHICH HAS POTENTIAL CARBON TETRACHLORIDE CONTAMINATION ISSUES, AND TO SUBSEQUENTLY RETRIEVE WASTES FROM BURIAL GROUND 218-E-12B AND 218-W-3A WHERE CONTAINERS WERE PLACED IN CONFIGURATIONS THAT ALLOWED DIRECT CONTACT WITH THE SOIL. DOE SHALL CONCLUDE RETRIEVAL ACTIONS WITH BURIAL GROUND 218-W-4B. 2. AS RSW RETRIEVAL PROCEEDS, DOE SHALL SAMPLE AND ANALYZE TRENCH SUBSTRATES WITH THE PURPOSES OF DETERMINING WHETHER OR NOT RELEASES OF CONTAMINANTS TO THE ENVIRONMENT HAVE OCCURRED, AND, IF SO, THE NATURE AND EXTENT OF CONTAMINATION. SUCH SAMPLING AND ANALYSIS SHALL BE IN ACCORDANCE WITH ECOLOGY APPROVED SAMPLING AND ANALYSIS PLANS (SAP). THE SAP WILL BE DEVELOPED USING A DQO PROCESS TO ESTABLISH SAMPLING REQUIREMENTS FOR SAMPLING OF BURIAL GROUND VENT RISERS AND SUBSTRATE SOILS. DOE PROVIDED ECOLOGY WITH A DRAFT 218-W-4C SAP ON 8/12/03. ECOLOGY'S INTENTION IS TO ISSUE A FINAL SAP WITHIN 30 DAYS. WITH RESPECT TO THE REMAINING BURIAL GROUNDS, DOE WILL PROVIDE ECOLOGY WITH UPDATED SAPS, IF NEEDED, FOR REVIEW AND APPROVAL AT LEAST 45 DAYS PRIOR TO STARTING RETRIEVAL IN EACH BURIAL GROUND. DOE WILL IMPLEMENT APPROVED SAPS, AS A REQUIREMENT OF THIS MILESTONE, DURING RETRIEVAL OF ALL RSW. THE RESULTS OF BURIAL GROUND VENT AND SUBSTRATE SAMPLING AND ANALYSIS PURSUANT TO APPROVED SAPS SHALL BE SUBMITTED TO ECOLOGY BY LETTER REPORTS QUARTERLY. SUCH REPORTS SHALL DOCUMENT RESULTS AND METHODOLOGIES, SHALL ASSESS RESULTS AGAINST REGULATORY REQUIREMENTS, SHALL INCLUDE A DESCRIPTION (OR DESCRIPTIONS) OF DOCUMENTED CONTAMINANT RELEASES TO THE ENVIRONMENT, AND SHALL DESCRIBE PLANNED AND/OR SCHEDULED ADDITIONAL WORK. 3. WITHIN 90 DAYS OF RETRIEVAL, DOE SHALL DESIGNATE ALL CH RSW RETRIEVED FROM THE RSW TRENCHES PURSUANT TO WAC 173-303-070 THROUGH 100, AND SHALL SPECIFICALLY IDENTIFY INDIVIDUAL BOXES AND LARGE CONTAINERS THAT CANNOT BE DESIGNATED BASED ON AVAILABLE PROCESS KNOWLEDGE. FOR THE BOXES AND LARGE CONTAINERS DETEREMINED TO BE LOW-LEVEL WASTE THAT CANNOT BE	

Number	Milestone	Due Date
	DESIGNATED BASED ON THE AVAILABLE PROCESS KNOWLEDGE, DOE SHALL DESIGNATE SAID WASTE ACCORDING TO THE REQUIREMENTS OF WAC 173-303-070 THROUGH 100, BY DECEMBER 31, 2008 (SIX MONTHS AFTER THE RH AND LARGE CONTAINER MLLW FACILITIES AND/OR CAPABILITIES ARE REQUIRED TO BE OPERATIONAL). FOR BOXES AND LARGE CONTAINERS DETERMINED TO BE TRANSURANIC WASTE THAT CANNOT BE DESIGNATED BASED ON THE AVAILABLE PROCESS KNOWLEDGE, DOE SHALL DESIGNATE SAID WASTE ACCORDING TO THE REQUIREMENTS OF WAC 173-303-070 THROUGH 100, BY DECEMBER 31, 2012 (SIX MONTHS AFTER THE RH AND LARGE CONTAINER TRANSURANIC FACILITIES AND/OR CAPABILITIES ARE REQUIRED TO BE OPERATIONAL). 4. FOR ALL RETRIEVED CH-RSW DETERMINED TO BE LOW LEVEL WASTE AND DESIGNATED IN ACCORDANCE WITH WAC 173-303-070 THROUGH 100, AS MIXED AND AS CONTAINING LDR RESTRICTED CONSTITUENTS, DOE SHALL TREAT SUCH WASTES TO MEET LDR REQUIREMENTS IN ACCORDANCE WITH THE SCHEDULE PROVIDED IN MILESTONE M-91-42(2) AND M-91-43(3). 5. IN REGARD TO THE CARBON TETRACHLORIDE VAPOR PLUME IN THE VADOSE ZONE IN THE VICINITY OF TRENCH 4 IN BURIAL GROUND 218-W-4C, DOE SHALL: START VAPOR EXTRACTION BY NOVEMBER 15, 2003, TO REDUCE CARBON TETRACHLORIDE VAPORS. START RETRIEVAL IN TRENCH 4 BY JANUARY 15, 2004 COMPLETE RETRIEVAL OF TRENCH 4 BY DECEMBER 31, 2006. (WITH THE EXCEPTION OF THOSE BOXES AND LARGE CONTAINERS THAT THE PARTIES HAVE AGREED, IN WRITING, MAY BE RETRIEVED OUT OF SEQUENCE.) RETRIEVAL WILL CONTINUE IN TRENCH 4 UNTIL IT IS COMPLETE. VAPOR EXTRACTION AND RETRIEVAL OPERATIONS IN TRENCH 4 WILL BE INTEGRATED BY DOE TO MINIMIZE POTENTIAL WORKER EXPOSURE TO CARBON TETRACHLORIDE VAPORS, AND TO MITIGATE ANY POSSIBLE RELEASES OF CARBON TETRACHLORIDE FROM TRENCH 4 CONTAINERS. 6. FOR ALL RETRIEVED CH-RSW DETERMINED TO BE TRANSURANIC WASTE AND DESIGNATED IN ACCORDANCE WITH WAC 173-303-070 THROUGH 100, AS MIXED AND AS CONTAINING LDR RESTRICTED CONSTITUENTS, DOE SHALL TREAT SUCH WASTES TO MEET LDRR EQUIREMENTS IN COMPLIANCE WITH THE SCHEDULE IN M-91-42(4) AND M-91-44(3). NOTE: THE REQUIREMENTS OF ITEM 6 OF THIS MILESTONE DO NOT APPLY PRIOR TO A FINAL APPEALABLE JUDGMENT ON THE	

Number	Milestone	Due Date
	MERITS OF THE LDR STORAGE AND TREATMENT CLAIM IN WASHINGTON V. ABRAHAM, NO. CT-03-5018-AAM, AND AFTER SUCH A JUDGMENT, ONLY AS SET FORTH IN THE ACCOMPANYING SETTLEMENT AGREEMENT. 7. EACH REQUIREMENT OF THIS MILESTONE IS CONSIDERED A DISTINCT WORK REQUIREMENT INDEPENDENTLY SUBJECT TO THE ENFORCEMENT PROVISIONS OF THE AGREEMENT.	
M-91-41	REGARDING THE RETRIEVAL AND DESIGNATION OF REMOTE HANDLED (RH) RSW (ALL RSW RH WASTE REGARDLESS OF PACKAGE SIZE, INCLUDING THE 200 AREA CAISSONS), AND LDR TREATMENT OF SUCH WASTES DETERMINED TO BE MIXED. 1. DOE SHALL INITIATE FULL SCALE RETRIEVAL OF RH RSW BY JANUARY 1, 2011. RETRIEVAL OF NON-CAISSON RH RSW SHALL BE COMPLETED BY DECEMBER 31, 2014. RETRIEVAL THE 200 AREA CAISSON RH RSW IN THE 218-W-4B BURIAL GROUND SHALL BE COMPLETED BY DECEMBER 31, 2018. 2. DOE SHALL DESIGNATE ALL RETRIEVED RH RSW PURSUANT TO WAC 173-303-070 THROUGH 100, WITHIN 90 DAYS OF RETRIEVAL. 1. FOR ALL RETRIEVED RH-RSW DETERMINED TO BE LOW-LEVEL WASTE AND DESIGNATED IN ACCORDANCE WITH WAC 173-303-070 THROUGH 100, AS MIXED AND AS CONTAINING LDR RESTRICTED CONSTITUENTS, DOE SHALL TREAT SUCH WASTE TO MEET LDR REQUIREMENTS IN ACCORDANCE WITH THE SCHEDULE PROVIDED IN MILESTONE M-91-43(3). 2. FOR ALL RETRIEVED RH-RSW DETERMINED TO BE TRANSURANIC WASTE AND DESIGNATED IN ACCORDANCE WITH WAC 173-303-070 THROUGH 100, AS MIXED AND AS CONTAINING LDR RESTRICTED CONSTITUENTS, DOE SHALL TREAT SUCH WASTES TO MEET LDR REQUIREMENTS IN ACCORDANCE WITH THE SCHEDULE PROVIDED IN MILESTONE M-91-44(3). NOTE: THE REQUIREMENTS OF ITEM 4 OF THIS MILESTONE DO NOT APPLY PRIOR TO A FINAL APPEALABLE JUDGMENT ON THE MERITS OF THE LDR STORAGE AND TREATMENT CLAIM IN WASHINGTON V. ABRAHAM, NO. CT-03-5018-AAM, AND AFTER SUCH A JUDGMENT, ONLY AS SET FORTH IN THE ACCOMPANYING SETTLEMENT AGREEMENT. 3. EACH REQUIREMENT OF THIS MILESTONE IS CONSIDERED ADISTINCT WORK REQUIREMENT INDEPENDENTLY SUBJECT TO THEENFORCEMENT PROVISIONS OF THE AGREEMENT.	DUE DATES AS INDICATED IN THE DESCRIPTIVE TEXT OF THIS MILESTONE
M-91-42	REGARDING: (1) NEWLY GENERATED CH WASTE; AND (2) CH WASTE CURRENTLY IN ABOVE-GROUND STORAGE (NOT INCLUDING CH WASTE CURRENTLY IN ABOVE-GROUND STORAGE IN BOXES AND LARGE CONTAINERS).	DUE DATES AS INDICATED IN THE DESCRIPTIV

Number	Milestone	Due Date
	1. DOE SHALL DESIGNATE ALL NEWLY GENERATED CH WASTE AT THE POINT OF GENERATION. SUCH DESIGNATION SHALL COMPLY WITH THE REQUIREMENTS OF WAC 173-303-070 THROUGH 100. 2. THERE ARE 5,066 CUBIC METERS OF CH-MLLW IN PERMITTED STORAGE AT DOE'S CENTRAL WASTE COMPLEX (CWC) AND ELSEWHERE AT HANFORD AS OF 12/31/02 (AS IDENTIFIED IN DOE HFFACO MILESTONE M-26-01 LDR REPORT MLLW TREATABILITY GROUPS MLLW-02 THROUGH MLLW-10, EXCLUDING MLLW-07) THAT HAS NOT BEEN TREATED TO MEET LDR REQUIREMENTS. (THIS VOLUME DOES NOT INCLUDE 600 CUBIC METERS OF WASTE REQUIRING THERMAL TREATMENT, AS THAT WASTE IS REQUIRED TO BE TREATED BY 2006 UNDER HFFACO MILESTONES M-91-12 AND M-91-12A). DOE'S 2002 LDR REPORT ESTIMATES THAT IT WILL GENERATE AN ADDITIONAL ANNUAL VOLUME OF APPROXIMATELY 330 CUBIC METERS OF CH-MLLW (AS WASTE TYPES IDENTIFIED IN DOE HFFACO MILESTONE M-26-01 LDR REPORT MLLW TREATABILITY GROUPS MLLW-02 THROUGH MLLW-10, EXCLUDING MLLW-07). DOE WILL RETRIEVE APPROXIMATELY 800 CUBIC METERS OF CH-MLLW BY 2010. IN ADDITION TO MEETING THE REQUIREMENTS OF M-91-12 AND M-91-12A, DOE SHALL TREAT THE WASTE DESCRIBED ABOVE TO MEET LDR REQUIREMENTS ON A SCHEDULE MEETING, AT MINIMUM, THE FOLLOWING: A. 1630 CUBIC METERS (CUMULATIVE) SHALL BE TREATED BY 12/31/04, B. 3260 CUBIC METERS BY (CUMULATIVE) SHALL BE TREATED BY 12/31/05, C. 4890 CUBIC METERS (CUMULATIVE) SHALL BE TREATED BY 12/31/06, D. 6520 CUBIC METERS (CUMULATIVE) SHALL BE TREATED BY 12/31/07, E. 8150 CUBIC METERS (CUMULATIVE) SHALL BE TREATED BY 12/31/08, AND F. COMPLETE TREATMENT OF ALL CH-MLLW (5066 CUBIC METERS IN STORAGE AS OF 12/31/02 AS DESCRIBED ABOVE, AND RETRIEVED CH-MLLW AND NEWLY GENERATED CH-MLLW IN THE TREATABILITY GROUPS DESCRIBED ABOVE, AS OF 6/30/09) BY 12/31/09 IF CH-MLLW IN THE TREATABILITY GROUPS SUBJECT TO THIS MILESTONE GENERATED DURING THE PERIOD FROM 12/31/02 THROUGH 6/30/09 IS TREATED TO LDR STANDARDS PRIOR TO DELIVERY TO STORAGE OR DISPOSAL, THE ORIGINAL PRE-TREATMENT VOLUME OF THAT WASTE SHALL BE COUNTED TOWARD MEETING THE VOLUME REQUIREMENTS OF THIS MILESTONE. EXCEPT FOR WASTE ALREADY IN PERMITTED STORAGE, TREATMENT OF CERCLA WASTE WILL NOT BE COUNTED TOWARD MEETING THE VOLUME REQUIREMENTS OF THIS MILESTONE. IF THE ACTUAL VOLUME OF NEWLY	E TEXT OF THIS MILESTONE

Number	Milestone	Due Date
	GENERATED OR RETRIEVED CH-MLLW COVERED BY THIS MILESTONE IS LOWER THAN THE ESTIMATED VOLUMES ANTICIPATED BY THESE MILESTONES DOE WILL ONLY BE REQUIRED TO TREAT THE VOLUME OF WASTE GENERATED, RETRIEVED AND/OR IN STORAGE. IF THE ACTUAL VOLUME OF NEWLY GENERATED OR RETRIEVED CH-MLLW COVERED BY THIS MILESTONE IS SIGNIFICANTLY MORE THAN THE ESTIMATED VOLUMES THE PARTIES' MAY AGREE TO REVISE THESE REQUIREMENTS. 3. AFTER JUNE 30, 2009, DOE SHALL TREAT TO MEET LDR TREATMENT REQUIREMENTS ALL NEWLY GENERATED CH-MLLW CONTAINING LDR CONSTITUENTS IN COMPLIANCE WITH WAC 173-303-140 AND BY REFERENCE 40 CFR 268. 4. THERE ARE APPROXIMATELY 440 CUBIC METERS OF CH-TRUM IN PERMITTED STORAGE AT DOE'S CENTRAL WASTE COMPLEX (CWC) AND ELSEWHERE AT HANFORD AS OF 12/31/02. DOE'S 2002 LDR REPORT ESTIMATES THAT IT WILL GENERATE AN ADDITIONAL ANNUAL VOLUME OF APPROXIMATELY 220 CUBIC METERS OF CH-TRUM AND DOE ESTIMATES THEY WILL RETRIEVE APPROXIMATELY 1600 CUBIC METERS OF CH-TRUM BY 2010. CONSIDERING THESE ESTIMATES AND THE CONSIDERABLE UNCERTAINTY ASSOCIATED WITH THEM DOE SHALL TREAT THE WASTE CATEGORIES DESCRIBED ABOVE TO MEET LDR REQUIREMENTS ON THE FOLLOWING SCHEDULE: - 700 CUBIC METERS BY 12/31/04; - 1,800 CUBIC METERS (CUMULATIVE) BY 12/31/05; - 3,000 CUBIC METERS (CUMULATIVE) BY 12/31/06, - 4,200 CUBIC METERS (CUMULATIVE BY 12/31/07 - 5,400 CUBIC METERS (CUMULATIVE BY 12/31/08 - 6,600 CUBIC METERS (CUMULATIVE BY 12/31/09 - 7,600 CUBIC METERS (CUMULATIVE) BY 12/31/10; - 8,600 CUBIC METERS (CUMULATIVE) BY 12/31/11. IF THE ACTUAL VOLUME OF NEWLY GENERATED OR RETRIEVED CH-TRUM COVERED BY THIS MILESTONE IS LOWER THAN THE ESTIMATED VOLUMES ANTICIPATED BY THESE MILESTONES DOE WILL ONLY BE REQUIRED TO TREAT THE VOLUME OF WASTE GENERATED, RETRIEVED AND/OR IN STORAGE. IF THE ACTUAL VOLUME OF NEWLY GENERATED OR RETRIEVED CH-TRUM COVERED BY THIS MILESTONE IS SIGNIFICANTLY MORE THAN THE ESTIMATED VOLUMES THE PARTIES' MAY AGREE TO REVISE THESE REQUIREMENTS. 5. FOR CH TRANSURANIC WASTE NEWLY GENERATED ON OR AFTER 7/1/11 THAT IS DESIGNATED IN ACCORDANCE WITH WAC 173-303-070 THROUGH 100 AS MIXED AND AS CONTAINING LDR RESTRICTED CONSTITUENTS, DOE SHALL TREAT SUCH WASTES TO MEET LDR REQUIREMENTS PURSUANT TO WAC 173-303-140 WITHIN ONE YEAR OF GENERATION.	

Number	Milestone	Due Date
	DOE MAY CHOOSE TO COMPLETE CERTIFICATION OF CH TRANSURANIC WASTE FOR DISPOSAL AT WIPP IN LIEU OF LDR TREATMENT, PROVIDED THAT ECOLOGY IS NOTIFIED IN WRITING OF SUCH COMPLETION OF CERTIFICATION, AND ONLY IF, AS OF THE TIME OF CERTIFICATION OR BY VIRTUE OF CERTIFICATION, SUCH WASTE IS EXEMPT FROM LDR TREATMENT REQUIREMENTS. IF DOE CHOOSES TO CERTIFY IN LIEU OF TREATMENT, IT MAY MEET THE VOLUME REQUIREMENTS SPECIFIED IN THIS MILESTONE FOR ANY GIVEN YEAR BY CERTIFYING CH TRU OR CH TRUM, PROVIDED THAT 1) ALL CH TRUM IN PERMITTED STORAGE AS OF 12/31/02 IS TREATED TO MEET LDR REQUIREMENTS OR CERTIFIED BY 12/31/2006 AND 2) ALL CH TRUM IN PERMITTED STORAGE AS OF 7/1/11 IS TREATED TO MEET LDR REQUIREMENTS OR IS CERTIFIED BY 12/31/2011. NOTE: THE REQUIREMENTS OF ITEMS 4 AND 5 OF THIS MILESTONE DO NOT APPLY PRIOR TO A FINAL APPEALABLE JUDGMENT ON THE MERITS OF THE LDR STORAGE AND TREATMENT CLAIM IN WASHINGTON V. ABRAHAM, NO. CT-03-5018-AAM, AND AFTER SUCH A JUDGMENT, ONLY AS SET FORTH IN THE ACCOMPANYING SETTLEMENT AGREEMENT. IN THE EVENT THAT ITEMS 4 OR 5 BECOME APPLICABLE, AMOUNTS OF CH TRUM CERTIFIED BETWEEN THE EFFECTIVE DATE OF THIS CHANGE PACKAGE AND THE DATE ON WHICH ITEMS 4 OR 5 BECOME APPLICABLE SHALL COUNT TOWARDS SATISFACTION OF THE OBLIGATIONS IN ITEMS 4 AND 5. 6. EACH REQUIREMENT OF THIS MILESTONE IS CONSIDERED A DISTINCT WORK REQUIREMENT INDEPENDENTLY SUBJECT TO THE ENFORCEMENT PROVISIONS OF THE AGREEMENT.	
M-91-43	REGARDING: (1) NEWLY GENERATED RH LOW-LEVEL WASTE; (2) NEWLY GENERATED BOXES AND LARGE CONTAINERS OF CH LOW-LEVEL WASTE; (3) RH LOW-LEVEL WASTE CURRENTLY IN ABOVE-GROUND STORAGE; AND (4) BOXES AND LARGE CONTAINERS OF CH LOW-LEVEL WASTE CURRENTLY IN ABOVE-GROUND STORAGE. THERE ARE 81 CUBIC METERS OF RH-MLLW IN PERMITTED STORAGE AT DOE'S CENTRAL WASTE STORAGE COMPLEX (CWC) AND ELSEWHERE AT HANFORD AS OF 12/31/02 (AS IDENTIFIED IN DOE HFFACO MILESTONE M-26-01 LDR REPORT MLLW TREATABILITY GROUPS MLLW-07) THAT HAS NOT BEEN TREATED TO MEET LDR REQUIREMENTS. DOE'S 2002 LDR REPORT CURRENTLY ESTIMATES THAT DOE WILL GENERATE AN ADDITIONAL YEARLY VOLUME OF 280 CUBIC METERS OF WASTE IN THIS TREATABILITY GROUP. IN ADDITION, DOE WILL RETRIEVE APPROXIMATELY 800 CUBIC METERS BY 2010. THIS INCLUDES VOLUMES OF RETRIEVED RSW. 1. DOE SHALL DESIGNATE ALL RH LOW-LEVEL WASTE AND BOXES AND LARGE CONTAINERS OF CH LOW-LEVEL WASTE CURRENTLY IN ABOVE-GROUND PERMITTED STORAGE (AS OF JUNE 30, 2003) ACCORDING TO THE REQUIREMENTS OF WAC 173-303-070 THROUGH 100, BY DECEMBER 31, 2008.	DUE DATES AS INDICATED IN THE DESCRIPTIVE TEXT OF THIS MILESTONE

Number	Milestone	Due Date
	2. DOE SHALL DESIGNATE ALL NEWLY GENERATED RH LOW-LEVEL WASTE AND TRANSURANIC WASTE AND NEWLY GENERATED BOXES AND LARGE CONTAINERS OF CH-LOW-LEVEL WASTE AT THE POINT OF GENERATION. SUCH DESIGNATION SHALL COMPLY WITH THE REQUIREMENTS OF WAC 173-303-070 THROUGH 100. 3. DOE SHALL BEGIN TREATING RH MLLW AND BOXES AND LARGE CONTAINERS OF CH MLLW TO MEET LDR TREATMENT REQUIREMENTS AT A MINIMUM RATE OF 300 CUBIC METERS PER YEAR BEGINNING NO LATER THAN JUNE 30, OF 2008. IF THERE ARE NOT 300 CUBIC METERS OF RH MLLW AND BOXES AND LARGE CONTAINERS OF CH MLLW IN STORAGE IN ANY GIVEN YEAR, THIS MILESTONE REQUIRES THAT DOE TREAT ONLY THAT AMOUNT THAT IS IN STORAGE. IF RH-MLLW IN THE TREATABILITY GROUPS SUBJECT TO THIS MILESTONE GENERATED DURING THE PERIOD FROM 12/31/02 THROUGH 6/30/09 IS TREATED TO LDR STANDARDS PRIOR TO DELIVERY TO STORAGE OR DISPOSAL, THE ORIGINAL PRE-TREATMENT VOLUME OF THAT WASTE SHALL BE COUNTED TOWARD MEETING THE VOLUME REQUIREMENTS OF THIS MILESTONE. EXCEPT FOR WASTE ALREADY IN PERMITTED STORAGE, TREATMENT OF CERCLA WASTE WILL NOT BE COUNTED TOWARD MEETING THE VOLUME REQUIREMENTS OF THIS MILESTONE. IF ACTUAL VOLUMES OF NEWLY GENERATED OR RETRIEVED RH AND BOXES AND LARGE CONTAINER MLLW ARE SIGNIFICANTLY MORE THAN THE ESTIMATED VOLUMES, THIS MILESTONE WILL BE REVISED TO REFLECT ACTUAL VOLUMES. 4. EACH ELEMENT OF THIS MILESTONE IS CONSIDERED A DISTINCT WORK REQUIREMENT INDEPENDENTLY SUBJECT TO THE ENFORCEMENT PROVISIONS OF THE AGREEMENT.	
M-91-44	REGARDING: (1) NEWLY GENERATED RH TRANSURANIC WASTE; (2) NEWLY GENERATED BOXES AND LARGE CONTAINERS OF CH-TRANSURANIC WASTE; (3) RH TRANSURANIC WASTE CURRENTLY IN ABOVE GROUND STORAGE; AND (4) BOXES AND LARGE CONTAINERS OF CH TRANSURANIC WASTE CURRENTLY IN ABOVE-GROUND STORAGE. 1. DOE SHALL DESIGNATE ALL RH TRANSURANIC WASTE AND BOXES AND LARGE CONTAINERS OF CH TRANSURANIC WASTE CURRENTLY IN ABOVE- GROUND STORAGE (AS OF JUNE 30, 2003) ACCORDING TO THE REQUIREMENTS OF WAC 173-303-070 THROUGH 100, BYDECEMBER 31, 2012. 2. DOE SHALL DESIGNATE ALL NEWLY GENERATED RH TRANSURANIC WASTE AND BOXES AND LARGE CONTAINERS OF TRANSURANIC WASTE AT THE POINT OF GENERATION. SUCH DESIGNATION SHALL COMPLY WITH THE REQUIREMENTS OF WAC 173-303-070 THROUGH 100. 3. DOE SHALL BEGIN TREATING RH TRUM AND BOXES AND LARGE CONTAINERS OF CH TRUM TO MEET LDR TREATMENT REQUIREMENTS AT A MINIMUM RATE OF 300 CUBIC METERS	DUE DATES AS INDICATED IN THE DESCRIPTIVE TEXT OF THIS MILESTONE

Number	Milestone	Due Date
	PER YEAR BEGINNING NO LATER THAN JUNE 30, 2012. IF THERE ARE NOT 300 CUBIC METERS OF RH TRUM AND BOXES AND LARGE CONTAINERS OF CH TRUM IN STORAGE IN ANY GIVEN YEAR, THIS MILESTONE REQUIRES THAT DOE TREAT ONLY THAT AMOUNT THAT IS IN STORAGE. IF ACTUAL VOLUMES OF NEWLY GENERATED OR RETRIEVED RH TRUM AND BOXES AND LARGE CONTAINER TRUM ARE SIGNIFICANTLY MORE THAN THE ESTIMATED VOLUMES, THIS MILESTONE WILL BE REVISED TO REFLECT ACTUAL VOLUMES. 4. AS TO NEWLY GENERATED RH TRUM GENERATED AFTER 12/31/18 THAT IS DESIGNATED IN ACCORDANCE WITH WAC 173-303-070 THROUGH -100 AS MIXED AND AS CONTAINING LDR RESTRICTED CONSTITUENTS, DOE SHALL TREAT TO MEET LDR REQUIREMENTS WITHIN ONE YEAR OF GENERATION. DOE MAY CHOOSE TO COMPLETE CERTIFICATION OF SUCH WASTES FOR DISPOSAL AT WIPP IN LIEU OF LDR TREATMENT, PROVIDED THAT ECOLOGY IS NOTIFIED IN WRITING OF SUCH COMPLETION OF CERTIFICATION AND ONLY IF, AS OF THE TIME OF CERTIFICATION OR BY VIRTUE OF CERTIFICATION, SUCH WASTE IS EXEMPT FROM LDR TREATMENT REQUIREMENTS. NOTE: THE REQUIREMENTS OF ITEMS 3 AND 4 OF THIS MILESTONE DO NOT APPLY PRIOR TO A FINAL APPEALABLE JUDGMENT ON THE MERITS OF THE LDR STORAGE AND TREATMENT CLAIM IN WASHINGTON V. ABRAHAM, NO. CT-03-5018-AAM, AND AFTER SUCH A JUDGMENT, ONLY AS SET FORTH IN THE ACCOMPANYING SETTLEMENT AGREEMENT. 5. EACH REQUIREMENT OF THIS MILESTONE IS CONSIDERED ADISTINCT WORK REQUIREMENT INDEPENDENTLY SUBJECT TO THE ENFORCEMENT PROVISIONS OF THE AGREEMENT.	
M-91-45	BY SEPTEMBER 30 OF EACH YEAR, DOE SHALL SUBMIT TO ECOLOGY A REPORT DESCRIBING COMPLETED AND SCHEDULED WORK RELATING TO RH WASTE AND BOXES AND LARGE CONTAINERS OF RH AND CH WASTE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF THIS MILESTONE SERIES. DOE'S REPORTS WILL DOCUMENT WORK COMPLETED DURING THE PREVIOUS FEDERAL FISCAL YEAR AND WORK SCHEDULED FOR THE COMING FISCAL YEAR. DOE'S REPORTS SHALL IDENTIFY BY CITATION ALL PUBLICLY AVAILABLE REPORTS DESCRIBING PERTINENT PROJECT ISSUES AND ACCOMPLISHMENTS, AND SHALL IDENTIFY ANTICIPATED PROJECTS FOR THE COMING YEAR.	09/30/2004 AND ANNUALLY THEREAFTER

Appendix C

Container Sizes in SWITS

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Appendix C

Container Sizes in SWITS

Several different types and sizes of waste containers were used to package the mixed low-level and transuranic waste to be processed. A list of the number of containers as recorded in the Solid Waste Information Tracking System and Solid Waste Integrated Forecast Technical Report along with the volume (m^3) by location is shown in the following table. Dimensions shown in the container field are shown in feet.

Waste Type	Container	Storage	Post-1970 LLBGs	Forecast	Total
CH_MLLW	17.7*9.7*13.6	66			66
	10.5*7.9*7.6	18			18
	9.7*8.6*6.2	15			15
	8*8*7.5	14			14
	12*6*6	12			12
	8*8*6	11			11
CH_MLLW Total		135			35
RH_MLLW	8*7.8*7.5	13			13
	9.2*8.2*5.7	12			12
	9*8*5.7	12			12
	9.3*6.5*5.6	10			10
	9.7*5.7*5.6	8.7			8.7
	10.67*6.6*3.75	7.5			7.5
	9*5*5	25			25
	8.5*4.5*4.9	5.3			5.3
	8*5*4	4.6			4.6
	8*4*4	6.8			6.8
	6*4*4	2.7			2.7
	6*3*3	3.1			3.1
	7.7*2.6*2.4	1.1			1.1
	6.4*2.4*2.6	1.1			1.1
	6*2*2	2.0			2.0
	85 GALLON	1.6			1.6
	208 L Drum (1A2)			304	304
	208 L Drum (lead-lined)			0.5	0.5
	208 LITER	0.42			0.42
	55 GALLON	2.5			2.5
RH_MLLW Total		119		304	423
CH_TRU(M)	Concrete Monolith			90	90
	20*12.7*9		452		452
	20*11.6*9		393		393
	15.5*16.8*7.8	44			44
	20*10.67*9		925		925
	19.6*10.6*8.3		48		48
	16*10.67*9		965		965
	12.7*12*9		39		39
	12*10.7*10.5		190		190

Waste Type	Container	Storage	Post-1970 LLBGs	Forecast	Total
	16*10*8		184		184
	20*8*8		73		73
	1250 CU FT		35		35
	12*10.7*9		555		555
	12*9.9*9.5		32		32
	16*10*7		32		32
	17.7*11.3*5.4	31			31
	18.5*8*6.5		81		81
	16.1*9.7*5.3	24			24
	14.6*8*6.5		194		194
	9.3*15.2*5.3	21			21
	14.7*8*6.3		22		22
	10.7*8*8		39		39
	13*10*5		18		18
	16.5*7.1*5.2		90		90
	10.8*9.7*5.7	17			17
	17*7*5	17	17		34
	8.75*8.75	15			15
	9.2*10.7*5.3	15			15
	16*8*4		14		14
	12*7.1*6		43		43
	12*7*6	57			57
	10.7*8.1*5.7	14			14
	16*6*5		14		14
	5.6*7.4*11.3		26		26
	7*12	13	13		26
	12.7*8.8*4.1	15			15
	11*7.7*5.4	26	39		65
	10.1*7.3*5.6		152		152
	15.6*6.2*4.2		11		11
	11*7.8*4.7		79		79
	16.5*6*4		11		11
	10*7.1*5.5	55	33		88
	10.5*7.1*5.2		99		99
	9.3*9.7*4.2	19			19
	15*6*4		20		20
	10.6*5.8*5.8		20		20
	16*5.5*4		10		10
	9.6*6.1*6		10		10
	11.2*5.7*5.5		29		29
	9*6.2*6.2		34		34
	9.3*5.7*6.4	272			272
	9.3*6.5*5.6	48			48
	11*6*5	19			19
	9.6*5.8*5.8		64		64
	10*8*4		9.1		9.1
	13.2*6.5*3.7		8.8		8.8
	Ion exchange module			35	35
	9.8*5.7*5.3		50		50
	7.2*5.8*6.7		16		16
	11.8*5.1*4.6		7.8		7.8

Waste Type	Container	Storage	Post-1970 LLBGs	Forecast	Total
	10*6*4.5		7.6		7.6
	269 CU. FT.		7.6		7.6
	6.1*6.1*7	15			15
	13*4*5	7.4			7.4
	252 CU FT	21	21		43
	7*6*6	370	161		531
	9*7*4		14		14
	10*6*4	14	27		41
	6.9*6.7*5.1	6.7			6.7
	12.1*4.7*4.1	6.6			6.6
	12.1*4.6*4.1	6.4			6.4
	9*5*5	55	25		80
	7.3*5.7*5.3		19		19
	216 CU FT		12		12
	6*6*6		47		47
	6.8*5.6*5.4	53	18		70
	8*5*5	5.7			5.7
	197 CU FT		11		11
	8*5*4.83		11		11
	6.3*5.5*5.5		91		91
	9*5*4		5.1		5.1
	8.3*5*4.25	5.0			5.0
	7*5*5	39			39
	8*6*3.5		4.8		4.8
	10.3*5*3.17		4.6		4.6
	156 CU FT		13		13
	149 CU FT	4.2	4.2		8.4
	7.33*4.5*4.5	21			21
	7.3*4.5*4.5	25			25
	8*4*4	13	7.3		20
	MB-V (4x4x8)			6.9	6.9
	5.3*5.8	4.0			4.0
	5.7*4.7*4.7	3.7			3.7
	5*5*5		3.5		3.5
	121 CU FT		14		14
	10*4*3		6.8		6.8
	6*5*4	53	116		169
	8*5*3		6.8		6.8
	115 CU FT		3.3		3.3
	7*4*4	61	107		169
	108 CU FT		3.1		3.1
	4*8	11			11
	6.7*4.5*3.2		2.7		2.7
	15*3*2		2.5		2.5
	3.08*5.92*4.54	14			14
	5.9*3.08*4.54	17			17
	5.9*4.5*3.1	78			78
	5.7*4.5*3.2	2.3			2.3
	6*4.5*3	34			34
	80.8 CU FT		2.3		2.3
	5*4*4		4.5		4.5

Waste Type	Container	Storage	Post-1970 LLBGs	Forecast	Total
	5.7*4.3*3.1	8.2			8.2
	5.73*4.32*3.06	12			12
	6*4*3	1.9			1.9
	5.9*4*2.9	1.9			1.9
	4*4*4		18		18
	5*4*3	15			15
	6*3*3	1.5			1.5
	4*4	15			15
	4*3*3		4.1		4.1
	5.7*2.3*2.3	5.0			5.0
	4.3*2.6*2.6		2.5		2.5
	3*3*3		7.8		7.8
	2.8*4.1	0.5			0.5
	4*2.5*2.5		18		18
	4*5	8.9			8.9
	6*2*2		0.68		0.68
	2.5*2.5*2.5		2.3		2.3
	2*2*3		6.2		6.2
	1.5*5		0.23		0.23
	1.8*1.38*0.94	18			18
	2 CU FT		0.06		0.06
	UNKNOWN		288		288
	(blank)	10	3		14
CH_TRU(M) Total		1,768	6,335	132	8,235
RH_TRU(M)	9*5	27			27
	6.3*5.5*5.5		5.3		5.3
	Large Diameter Container			22	22
	SWDB			4.5	4.5
	8.3*5*4.25	45			45
	Metal box, Shielded, 4x4x8			305	305
	7*4*4		22		22
	7*4*3		2.4		2.4
	5*4*4		6.8		6.8
	SWB			79	79
	4*4*4		27		27
	HN-200 liner			17	17
	3*3*3		10		10
	2.8*4.1	1.0			1.0
	2.5*4.75		0.10		0.10
	1.5*5		1.8		1.8
	208 L Drum (1A1)			41	41
	208 L Drum (1A2)			32	32
	208 L Drum (concrete-lined)			2.3	2.3
	208 L Drum (lead-lined)			0.57	0.57
	55 GALLON	4.2	26		30
	30 GALLON		0.3		0.3
	1.37*1.52	50			50
	5 GALLON		1.5		1.5
	2 GALLON		0.03		0.03
	1 GALLON		22		22
	UNKNOWN		82		82

Waste Type	Container	Storage	Post-1970 LLBGs	Forecast	Total
	(blank)		0.49		0.49
RH_TRU(M) Total		127	208	503	838
Grand Total		2,150	6,543	939	9,633

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Appendix D

Remote Manipulator and Gantry Systems

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Appendix D

Remote Manipulator and Gantry Systems

D.1 Hydraulic Manipulators

Hydraulic manipulators (Figure D.1) are complex and expensive but have a high payload capacity (typically 200 to 250 lb) and considerable dexterity. Hydraulic manipulators require a hydraulic power unit (HPU). The fluid must be kept relatively clean (no particulates larger than 3 microns). These systems require product-specific trained operators, of which there will be only few, if any, onsite.

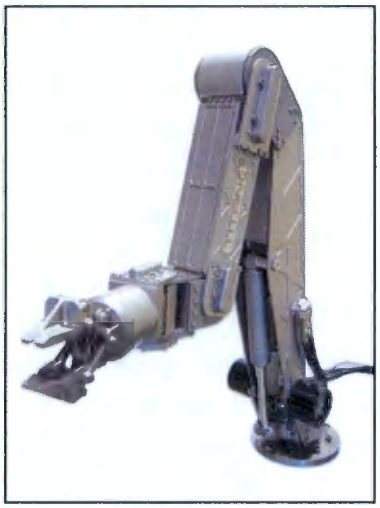

Figure D.1. Hydraulic Manipulator

6-DOF Hydraulic Manipulator – General Information regarding maintenance for hydraulic manipulators (based on one manufacturer's recommendations):

- Daily – check for collision damage, loose screws, hydraulic leaks, damaged hoses, loose connectors, etc.
- 100 hr – retorque all external fasteners (could avoid by applying lock-tite before initial deployment), check hydraulic reservoir for particulates (replace if contaminated).
- 500 hr – check HPU fluid level, clean/replace HPU filters (upper slave arm filter too; should not need cleaning unless your post filter indicates problems).
- 2000 hr – replace worn/damaged actuator pins and bushings, drain and replace fluid.
- 3 yr/2000 hr – replace all actuator O-rings and seals, replace all slave arm O-rings and seals, clean all O-ring grooves and surfaces (involves complete dismantlement of the manipulator).

Parts – A company that has 1000 or more manipulators in service will usually have good availability of spare parts at all times.

Critical Failure Points – Generally seem to be the servos and resolvers. Servo failure rates can be reduced by maintaining good fluid filtration/cleaning. Replacement of these items would require pulling the arm out of service and dismantling a portion of it (usually a single joint).

Uses

- Gross positioning, tool positioning and handling, handling up to 200 lb pieces of material.
- Not suited well for working within small space requirements.

Gantry Robots – Gantry robots, also referred to as Cartesian robots, provide flexible and efficient solutions for a wide range of applications including pick and place, machine loading and unloading, stacking, unitizing, and palletizing. Gantry robots typically have three degrees of freedom (DOF) along the X, Y, and Z coordinate system. Most gantry robots allow teach and repeat motions to allow them to perform repetitive tasks efficiently. End-effectors may be designed to be interchangeable to allow the use of different tools from a single gantry robot. The use of tool change plates are encouraged when utilizing multiple tools.

Gantry robots may also be used as the base platform for deploying other manipulators. The gantry acts as a gross positioning system and the manipulator can perform the fine work. Several companies, most notably PaR Systems Inc., have developed combined gantry robot and manipulator systems that are used in module environments. Gantry systems may be driven electrically or hydraulically; electrically driven systems are the most common commercial systems.

To return to a specific point in space, the system must have precision orientation sensors. These sensors may require special maintenance to keep them free of debris and from damage.

Other Manipulator Systems Considered but Likely Not Applicable

Mechanical – Mechanical master slave manipulators are simple and fairly inexpensive systems (Figure D.2). They have a high component failure rate, and their payload/lifting ability is limited to operator strength, typically no more than 40 pounds. Some newer mechanical manipulators are power assisted. Mechanical manipulators have limited DOF and work envelopes. There are many personnel trained to use these types of manipulators onsite.

Electric – Electric manipulators are y less expensive than hydraulic manipulators, have good dexterity, and usually have mid-level payload ranges (20 to 100 lb). These systems require product-specific trained operators; there will be few, if any, onsite. Electric manipulators are used in manufacturing industries where high precision and repeatability are important (Figure D.3).

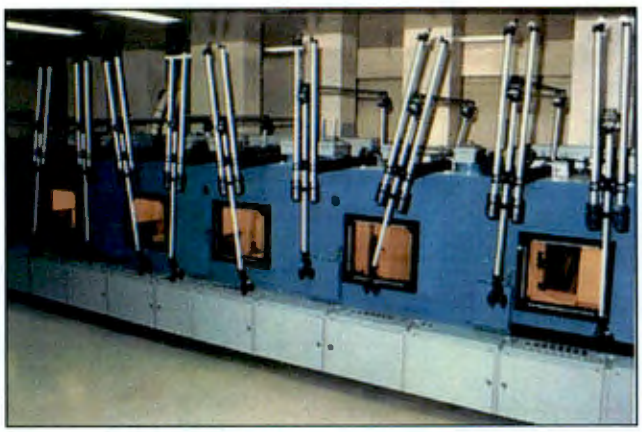

Figure D.2. Mechanical Master Slave Manipulators

Figure D.3. Electric Manipulator

Electric manipulators are generally not suited for tele-operation (man in the loop) and generally are not set up for the types of tasks that may be done in a nuclear waste handling and repackaging facility. Installation and programming of electric systems can be expensive (three times the price of the hardware).

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Appendix E

General Remote Systems Process Information

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General Remote Systems Process Information

E.1 Vision and Lighting

Vision systems are key aspects of remote operations. Correctly located and selected cameras and appropriate lighting are essential for successful remote operations. Conventional camera views do not provide the depth of field information required for efficient remote operations. While stereoscopic vision systems can provide this information, all of the display methods available have shortcomings. A remote system of this type will require a large number of cameras, some in fixed locations and others mounted to moving elements of the systems such as the gantry and articulated manipulators. Managing the information from all of these cameras becomes a task-loading issue for the operator.

Camera location is a key determinant of camera usefulness. Cameras need to be situated where they provide useful information to the operators. It is important to have a view that is perpendicular to the direction of motion as a manipulator attempts to pick up an object. To aid in picking up objects from the sorting table, for example, it will be necessary to have a camera that looks out across the table. As the manipulator moves down to acquire an object, the camera will be able to present a view that allows the operator to judge the distance between the gripper and the object. In some cases, it will be desirable to have cameras that can be relocated (moved up and down or back and forth along a rail).

Stereoscopic vision systems can provide the depth of field information that operators need when picking up and placing objects. However the displays used pose a number of human factors issues. Goggles that display one camera image to each eye are a common approach. These goggles generally preclude use of other video displays and obscure the operators' view of the system controls. In addition, spatial disorientation often results in operator nausea. Systems that use a double-scanned image to alternate display of the left and right cameras on a display are also used. These work in conjunction with liquid crystal display (LCD) glasses that alternately block the left and right eyes so that each eye sees the appropriate image. The glasses are expensive and fragile, and the viewing angle is limited. Operator headaches can result from extended use of this system. Some newer displays promise to produce the three-dimensional effect without these issues. These displays may hold substantial promise for this type of application.

It may be possible to mount some of the cameras outside the containment enclosure. These cameras can view the enclosure through small view port windows. They may still be subjected to a high dose from the waste material, but they should remain uncontaminated. When they fail, repair or replacement should be relatively straightforward. Other cameras will need to be mounted inside the enclosure. Appropriate shielding and camera- and waste-management

methods can be used to reduce exposure to the cameras, but the cameras will be considered disposable items. Some provision for replacing them remotely will be required.

Managing the images from multiple cameras is also an issue. The operator requires a few high-quality views of the work he is performing, but will need to be able to easily select those from perhaps dozens of available camera views. It is important to design this system so that it does not overwhelm the operator.

Strategically placed lighting will also be required; the ability to move, dim, aim, and turn individual lights on and off is important. This will allow the lighting to be customized to accommodate the work flow. Again, it is important that the operator be able to manage the lighting without distraction from the main task.

We have found that having operators work in pairs can be of substantial benefit. One operator can drive the manipulator and remain focused on the detail task of picking up objects, cutting things, opening things, etc. The other operator can select and adjust camera views so that they evolve appropriately as the task progresses. This operator can also watch the overall environment for potential collisions between the machines and the work and for other potential issues.

E.2 Remote Use of Standard Tools and Equipment

A number of commercially available standard tools will be used in the module to perform various operations. Examples are listed in the sidebar. These tools are already proved in commercial use for exactly the types of tasks required. However, they are not often used in remote applications and the tools must be modified to allow them to function properly in this environment.

Candidate Remotable Tools

- Bolt cutters
- Concrete saw
- Nibbler
- Plasma torch
- Liquid nitrogen cutter
- Clamshell
- Vacuum
- Scoop
- Shear
- Shredder
- Jackhammer

Areas of modification include grasping, power source control, and maintenance. Another issue that must be dealt with is the services required by the tooling. It is not practical to provide all services required by all tools to the end of the manipulator arm, where they are needed.

Many tools that are ordinarily hand-held (such as a nibbler or vacuum cleaner) can be readily modified for remote use by adding a T-handle or other grip designed for use by a manipulator gripper. Others (such as a plasma torch) may be more easily dealt with by a near-complete redesign of the tool. Much of the grip of a plasma torch is designed for operator comfort and convenience and (for remote use) can be replaced by a simple fixture. Another class of tool would include the bolt cutter. Here it is probably best to design almost a completely new tool, although parts from a commercial tool could (and likely would) be used. The remote bolt cutter would probably be built on a quick-change plate. In use, it would replace the gripper and be powered by the manipulator hydraulic system.

An issue with these remote tools is the logic of powering them on and off. Tools powered by draped cables are connected to their power source continuously, and it is possible to (potentially inadvertently) turn them on when they are in a storage area. Other tools powered by end-of-arm services may turn on and off in different ways, as they may use different services. A relatively simple system would use a series of toggle switches to turn different tools on and off. However, this allows the operator to turn on tools that are not currently in the gripper. It also makes it difficult to distinguish between two tools that use the same end-of-arm service. Significant design work needs to be done in this area to ensure that appropriate safety interlocks are in place and that the operator can easily and accurately activate the desired tool.

Some services (such as hydraulic power) may be readily available at the gripper end of the manipulator arm. Other services (such as vacuum or electrical power as required by the plasma arc cutter) are unlikely to be available at end-of-arm. These kinds of services are often best dealt with by draping the required service lines to the tool from a wall- or ceiling-mounted fixture. While this requires the operator to manage the lines without having them damaged or interfere with the task, this is not too onerous compared with permanently routing these lines along the manipulator arm. Routing heavy, bulky lines along the manipulator reduces the range of motion and payload and adds unacceptably to the bulk of the arm.

Some kinds of tools lend themselves to remote operation. Largely, these are non-contact tools such as water jet or plasma arc cutters. These tools are tolerant of slight misalignment and do not bind up when slightly out of alignment with the cut. Contact cutting tools are, in contrast, substantially more difficult to operate remotely. Generally, tools with a long contact with the material being cut (such as rotary saws) are not tolerant of misalignment. To prevent tool failure, the tooling must be designed with compliance that can allow the tool to align itself correctly. Alternatively, force feedback can be incorporated into the system (manipulator) to prevent misalignment. This is a challenging and not necessarily effective approach. Other types of contact cutting tools, such as reciprocating saws, share this issue but to a lesser degree.

E.3 Tool Staging and Acquisition

A very time-consuming aspect of remote work is acquisition of objects in an unstructured environment. An operator may make several attempts to pick up an object that has dropped to the work table surface. Remote tooling must be picked up in much the same way as other objects, although it is more difficult due to the precise orientation requirements. Acquisition of tooling constructed on a quick-change plate is somewhat different, but substantially similar to gripper held tooling. To avoid the potentially large consumption of time associated with tool acquisition, tools should be stored in fixed, known locations. This will allow pre-programmed algorithms to be used for tool acquisition and replacement. Each tool will be stored in a specific location on a tool rack that is fixed in the module. This will allow the manipulator to move directly to the required tool storage location without time wasted in trying to locate and acquire the tool.

An important aspect of this interchangeable tooling concept is the use of quick-change tool plates. This system consists of mating pairs of plates, one permanently mounted to the manipulator, and the other permanently mounted to the tool. A latching mechanism allows the manipulator to acquire a plate (and hence the tool mounted to it), while service pass-throughs and electrical connections allow hydraulic, pneumatic, and electrical signals to pass between the manipulator and the tool. The tool may be quite complex, possessing multiple degrees of freedom and passing sensor information back through the manipulator to the operator.

E.4 Problematic Waste Forms

It is possible that some of the inventory consists of intractably challenging waste forms. An example would be a TRU-contaminated air filter encased in concrete. Such a filter might be too large to fit into a Waste Isolation Pilot Plant-approved container and not amenable to size reduction due to the likely release of highly mobile contamination. It may be possible to minimize the contamination release by using a concrete saw or other cutter to minimize the number of resulting pieces. Another approach would be to perform the size reduction underwater or in some other entraining fluid that would capture any particles released by the size reduction process. Problematic waste forms will be dealt with on a case-by-case basis.

E.5 Maintenance/Repair/Upset Recovery

All remote systems will have maintenance issues. Remote maintenance is very difficult and time consuming. Remote problem identification is even more difficult. If there are ways to decontaminate a process module well enough to allow personnel entry, then maintenance and repair becomes easier. Another option is to make replacement of equipment easy such that the broken equipment can be replaced, decontaminated, and moved to another area, either outside the process module or in a designated low hazard area for repair. Once the equipment is repaired, it can be held in the repair area until needed as a service replacement. The approach for maintenance/repair of remote systems is something that will need to be carefully planned for.

One method to alleviate the challenge of remote equipment repair is to treat small equipment as disposable. To facilitate replacement, use quick change plates where possible. These quick change plates would include all necessary utility contacts/connections required to power and operate the equipment. When equipment fails, it will be processed as waste (or sent to a repair module/facility), and a replacement will be sent into the module for quick remote installation.

Large equipment such as the gantry, shredder, and conveyers require advance recovery design. The module may require access to facilitate replacement of the entire piece of equipment if catastrophic failure occurs. Additionally, large equipment should be as modular as possible so that components can be replaced more easily. For example, the conveyor system should be divided into sections such that a failed section can be easily replaced.

Vision system components should be mounted within enclosures that are easily decontaminated and changed remotely. Additionally camera change out should be regularly scheduled to avoid burn out of all vision components simultaneously (thus leaving you blind for camera change out).

Provisions for upset recovery must be present within the module. Any time there is an inspection (welding inspection, radiological survey, leak tests, etc), there is a possibility of a need for rework. Additional instances might come after preliminary size reduction (i.e., if size reduced, but not quite enough to get the piece into the waste container). Additionally, upset recovery may be required due to the failure of process equipment, such as a jammed shredder or broken conveyor system.

E.6 Technology Trade-Offs

An important issue to be decided when dealing with remote equipment is the trade-off between having expanded capability through new technologies versus the maintenance or replacement problems required to keep them operational. This process line should be designed either in the traditional way with no intelligence (all mechanical hardware using optics for vision) or to try to update waste processing with new technologies (computer controlled equipment and digital vision systems).

For example, gantry systems exist that have less precision positioning feedback and depend solely on operator vision. These systems lack the capability to automate certain tasks, such as "Go to X position for tool change out" or "Take this part to the shredder," which may greatly increase productivity. However, the lack of positioning feedback results in fewer components that may fail and need replacement. Replacing linear encoder positioning systems within the module will be a very difficult and time intensive task.

One way to help alleviate maintenance/repair problems would be to have redundant process lines. In the event of a catastrophic failure, waste streams could be diverted to the redundant line while the original process equipment was decontaminated and repaired.

E.7 Staging Areas

Staging areas are required for numerous objects within this process line. Staging and insertion areas will be needed for bagless transfer blanks waiting to be filled, final containers (55-gallon drum, WIPP SWB, 5 × 5 × 9 ft, Big Box, etc.), payload canisters for WIPP containers, the WIPP inner vessel and lid, the WIPP outer vessel and lid, as well as all the tools and survey equipment required to certify containers prior to release from the module. Staging may also be required for waste items prior to container loading and for output containers awaiting release.

E.8 Decontamination

Remote decontamination may be required to keep the process modules as clean as possible. High contamination levels will affect the ability to survey, maintain, and operate equipment within the module. Good housekeeping habits will reduce the spread of contamination.

Appendix F

Potential Remote Equipment by Process Function

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Function	Tool	Level of Confidence	Testing Requirements
		Successful Task Completion Confidence - H = high, M = medium, L = not confident	1 = Post Install Acceptance Test/Training, 2 = Mockup Functional Testing (integration, interfaces, etc), 3 = Individual Equipment Functional Testing (buy equipment, remotize it, & test it), 4 = Equipment Design/Develop (not currently off the shelf)
Feed Container Handling (SWH)			
	Heavy lift	M	1
Load into SWPM			
	Conveyors	H	1
	Airlock & crane	H	2
Container Opening			
Fixture to hold any container smaller than 4x4x4 box	Two or three arms (clamshell) to handle all shapes	H	4
Fixed automation systems to open common container types (set of fixtures used by manipulator or gantry for 55-gallon drums, SWB, 4x4x8 boxes, etc):	Cut ring off drums, unbolt box lids, etc, Lid cutter, concrete saw, nibbler	H	4, (3 - individual tools)
Other:	Bolt cutter	M	3
	Plasma torch or other hot cutter	H	3
	Liquid nitrogen cutter	L	3
Container & Shielding Removal/Container Emptying			
Removing items	Gripper	H	1-2
	Hook	H	1-2
	Clamshell	H	3
	Vacuum	H	3
	Scoop	M	3
Empty container & shielding handling/transfer	Conveyor	H	1
	Heavy lift	H	1
Lead blankets	Manipulators	H	2
Sorting			
Liquids, contained and loose	Vacuum post absorb	H	3
	Sweep/scoop post absorb	H	3
Dirt, absorbents	Vacuum	H	3
	Sweep/scoop	H	3
Non-conforming waste	Manipulator	H	2
Conveyor size waste	Conveyors	H	1
	Roller devices	H	2
Large items	Heavy lift	H	1
Heavy items	Heavy lift	H	1
Paint cans	Paint can opener station	H	4
	Manipulators & tools	H	3
Fuel rod hulls, fuel pieces	Vacuum	H	3
	Scoop/sweep	H	3
Biological	Manipulators & tools	H	3
	Scoop/sweep	H	3
	Vacuum	H	3
Bagged items	Manipulators & tools	H	3
	Sharp spike attached to manip table	H	2
	Utility knife	H	2

Function	Tool	Level of Confidence	Testing Requirements
Waste Item Size Reduction			
Plastic sheeting	Sharp knife or paper cutter/shear device	H	2
Jumpers, pipes, ducting, well casings, flanges, telescoping pipes, coil assemblies, tube bundles, conductivity probes	Shear	H	3
	Shredder	H	3
Paint cans	Shredder	H	3
Combustibles (paper, wood, cloth), foam, plastic, rubber, glass, small tools, construction debris, heaters	Shredder if necessary	H	3
Duct encased in concrete	Shredder	H	3
	Concrete saw	M	3
	Jack hammer	H	3
Concrete containers	Jackhammer	H	3
	Shredder	M	3
Concrete tank w/ steel liner	Jackhammer	M	3
	Shredder	H	3
	Plasma cutter	M	3
Pump assemblies, centrifuges, agitators	Plasma cutter	H	3
	Manipulator & tools	M	3
	Shredder	M	3
Process vessels, dissolvers, condensers, feed waste containers	Shredder	H	3
	Plasma cutter	H	3
Lead blankets	Shredder	H	3
Assay/Survey			
	Fixed automation stations	H	4
	Manipulator portable instruments	H	4
Waste Container Loading **RH-TRU Waste Container Loading**			
Empty RH payload cannister loading into SWPMs	Conveyor	H	1
	Manipulator	H	2
	Heavy lift	H	1
Move & manipulate empty RH payload cannister	Automated transport system	H	4
Fill RH payload cannister	Conveyor	H	1
	Heavy lift	H	1
	Gantry/manipulator	H	2-3
	Clamshell	H	3
Item removal (too much material, too much dose, etc)	Gantry/manipulator	H	2-3
	Vacuum	H	3
	Clamshell	H	3
Weld lid onto payload cannister	Automated weld station	M	4
Inspect weld	Inspection station	H	4
Move & manipulate empty inner vessel into cell	Fixed automation	H	4
Load payload into inner vessel	Fixed automation	H	4
Place gaskets and lid on inner vessel	Fixed automation, w/ alignment tools	M	4
Secure lid to inner vessel	Fixed automation	H	4
Leak test inner vessel	Fixed automation, w/ special leak test tool	M	4
Move & manipulate empty outer vessel into cell	Fixed automation	H	4
Load payload into outer vessel	Fixed automation	H	4
Place gaskets and lid on outer vessel	Fixed automation, w/ alignment tools	M	4
Secure lid to outer vessel	Fixed automation	H	4
Leak test outer vessel	Fixed automation, w/ special leak test tool	M	4

Function	Tool	Level of Confidence	Testing Requirements
SWB Container Loading			
Load empty SWB into cell	Fixed automation	H	4
Move & manipulate empty SWB	Fixed automation	H	4
Fill SWB	Conveyor	H	1
	Heavy lift	H	1
	Gantry/manipulator	H	2-3
	Clamshell	H	3
Item removal (too much material, too much dose, etc)	Gantry/manipulator	H	2-3
	Vacuum	H	3
	Clamshell	H	3
Put on & secure lid	Fixed automation	H	4
(Shielded & Unshielded) MLLW Container Loading			
Load empty container into cell	Fixed automation	H	4
Move & manipulate empty container	Fixed automation	H	4
Fill container	Conveyor	H	1
	Heavy lift	H	1
	Gantry/manipulator	H	2-3
	Clamshell	H	3
Item removal (too much material, too much dose, etc)	Gantry/manipulator	H	2-3
	Vacuum	H	3
	Clamshell	H	3
Put on & secure lid	Fixed automation	H	4
55 Gallon Drum Loading			
Load empty drum into cell	Fixed automation	H	4
Move & manipulate empty drums	Fixed automation	H	4
Fill drum	Conveyor	H	1
	Heavy lift	H	1
	Gantry/manipulator	H	2-3
	Clamshell	H	3
Item removal (too much material, too much dose, etc)	Gantry/manipulator	H	2-3
	Vacuum	H	3
	Clamshell	H	3
Put on & secure lid	Fixed automation	H	4
Output container handling			
	Conveyor	H	1
	Heavy lift	H	1
	Forklift	H	1
	Drum dolly	H	1
Container Transfer			
	Trucks	H	1
Component			
Vision systems		H	4
Deconamination systems		L	4
Lighting		H	4
Tool change plates		H	4

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