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BUSINESS CASE ANALYSIS FOR ADVANCED MIXED WASTE TREATMENT PROJECT EXPANDED MISSION

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Concurrences:

Date: 8/28/2018

Mark Senderling, Deputy Assistant Secretary
Office of Waste and Materials Management (EM-4.2)

Date: 8/28/2018

Jack Zimmerman,
Deputy Manager, ID Cleanup Project-EM

Date: 8/28/18

Todd Shrader, Manager, Carlsbad Field Office

Date: 8/28/18

Joe Franco, Deputy Manager
Richland Operations Office

EXECUTIVE SUMMARY

The Department of Energy (DOE) conducted a business case analysis of whether to expand the mission of the Idaho National Laboratory (INL) Advanced Mixed Waste Treatment Project (AMWTP) treatment facility (Appendix 1) to treat contact-handled (CH) transuranic (TRU) waste from other DOE generator sties.[1] The current mission of the AMWTP treatment facility to process on-site legacy waste is scheduled to be completed in December 2018. In recognition of AMWTP's value and unique processing capabilities, DOE thoroughly evaluated potential waste inventories, processing opportunities, approaches, challenges and benefits to extending AMWTP's mission.

The business case analysis indicates that a viable expanded mission for the INL's Advanced Mixed Waste Treatment Project (AMWTP) will be challenging and will not be cost-effective in the short-term nor likely cost-effective in the long-term (Table ES-1). Up to 6,100 cubic meters (m^3) of off-site contact-handled (CH) transuranic (TRU) waste has been identified at Hanford and small quantity sites (SQSs) that could be processed initially at AMWTP under an expanded mission. However, it does not appear to be cost-effective due to packaging and transportation challenges in shipping waste to AMWTP and the irreducible programmatic impacts, risks, and uncertainties of these challenges on a successful business case.

This analysis assumed the priority to ship waste to AMWTP for processing in calendar year (CY) 2019 shortly after AMWTP completes its current mission to avoid placing the facility in a warm standby condition at an estimated cost of $3.5 million (M) per month. However, due to the time needed to develop packaging solutions (1 to 2 years for initial solutions), DOE would first need to ship "non-cost-effective" CH TRU waste (2,500 m^3), which is readily available to ship with no modifications to the available package, to AMWTP during CY 2019-2021 (Phase 1) at a cost deficit of $75.1M. Because this waste requires no further treatment and little characterization to send to the Waste Isolation Pilot Plant (WIPP), it would be more cost-effective to establish an on-site certification capability at Hanford and ship directly to WIPP compared to shipping this waste to AMWTP for super-compaction and certification. If the development of transportation and packaging solutions are successful, DOE could recover much of the cost deficit by processing the "cost-effective" waste (3,600 m^3) at AMWTP during CY 2021-2024 (Phase 2 and Phase 3), resulting in a net cost deficit of $0.6M, provided that both phases are fully successful, i.e., development of packaging solutions is efficient, technically feasible, and accepted by stakeholders. DOE has confidence that technically viable commercial packaging solutions would be available for waste drums and other smaller containers (Phase 2); however, greater uncertainty exists regarding the development of appropriate transportation options for large oversized boxes (Phase 3) to sustain the feed rate to AMWTP (1,225 m^3 per year) necessary to recover much of the Phase 1 cost deficit.

[1] The term "transuranic waste" means waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for (A) high-level radioactive waste; (B) waste that the Secretary has determined, with the concurrence of the Administrator, does not need the degree of isolation required by the disposal regulations; or (C) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with part 10 Code of Federal Regulations Part 61. CH TRU waste is TRU waste for which the dose rate does not exceed 200 millirems per hour at the outside surface.

The business case assumes waste is available to ship to AMWTP beginning mid-CY 2019. This would require acceleration of activities to re-establish waste characterization and pay loading capability at Hanford. This may be difficult to achieve such that AMWTP would likely need to be placed in warm standby status at an estimated cost of $3.5M per month until shipment capability is ready at Hanford. The business case is predicated on reaching an agreement with the State of Idaho to support processing of off-site waste at AMWTP in CY 2019.

The cost analysis in Table ES-1 assumes that there would be no capital cost avoidance at Hanford. This is because fairly comparable modifications to an existing facility would be needed to characterize and prepare waste for shipment to AMWTP or to characterize and certify waste for direct shipment to WIPP. Furthermore, even if AMWTP is fully successful for waste considered in the business case, expanded capabilities will be needed at Hanford to address additional TRU waste at the site, including newly generated CH-TRU from future cleanup and all remote-handled (RH) TRU waste (since AMWTP cannot process RH-TRU). If DOE could avoid incremental capital costs over the life of the Hanford cleanup program by, for example, sending all future CH-TRU waste beyond the business case to AMWTP, the net return on investment shown in Table ES-1 could increase by up to $98M. However, such an increase would depend on the unlikely ability to sustain an economical feed rate to AMWTP over the life of the Hanford cleanup program (projected to be decades) to avoid AMWTP standby costs or increased unit treatment costs, which would offset any capital cost avoidance at Hanford. In addition, the business case does not quantify potential cost savings that could be achieved by reducing footprint costs at generator sites through accelerated processing at AMWTP.

Table ES-1. Cost Summary of Business Case

Business Case Phase	Volume	Processing Duration	Cost Savings or Deficit
1. Carlsbad Field Office Transportation Program Compliant Requiring Minimal Work to Make Road-Ready	2,500 m^3	2 years	($75.1M)
2. Not-Transportation-Compliant Requiring Moderate Work to Make Road-Ready (DOE Type B Certificate of Compliance revision or new Type B package)	1,200 m^3	1 year	$13.5M
3. Not-Transportation-Compliant Requiring Extensive Work to Make Road-Ready (Type B Equivalent package)	2,400 m^3	2 years	$61.0M
Total	**6,100 m^3**	**5 years**	**($0.6M)**

Due to packaging and transportation challenges, the business case assumes a phased approach for processing waste at AMWTP (Appendices 2 and 3).

- Phase 1 (CY 2019-2021): Process up to 2,500 m^3 of Carlsbad Field Office (CBFO) Transportation Program Compliant waste that requires no modifications to the available package and minimal work to make road-ready. Processing this waste at AMWTP would require DOE to assume a cost deficit of approximately $75.1M—compared to the alternative of establishing a certification capability at the generator site and directly shipping this waste to WIPP—with the possibility that this cost deficit could be largely overcome in Phases 2 and 3 (Appendices 3 and 4).

Additional opportunities could be explored during project implementation to reduce the Phase 1 cost deficit, such as accelerating packaging development for Phases 2 and 3 where possible; evaluating whether any waste could be shipped as Type A waste (e.g., surface contaminated objects) in accordance with Department of Transportation requirements; seeking continuous optimization of AMWTP operations to increase processing rates and decrease operational costs where possible; and pursuing any additional Phase 2 and 3 waste volumes that could be treated at AMWTP.

Site	Option	Cost	Cost Deficit
Hanford	a) On-site (2,200 m^3)	$56.9M	($73.6M)
	b) AMWTP (2,200 m^3)	$130.5M	
SQS	a) On-site (300 m^3)	$8.8M	($1.5M)
	b) AMWTP (300 m^3)	$10.3M	
Total	a) On-site (2,500 m^3)	$65.7M	($75.1M)
	b) AMWTP (2,500 m^3)	$140.8M	

- Phase 2 (CY 2021-2022): Process approximately 1,200 m^3 of waste that is currently not transportation compliant and requires moderate work to make road-ready. This requires revisions to DOE Type B packaging certificates of compliance in coordination with stakeholders to ship the waste, as well as procurement of transportation packaging and carrier services. Processing this waste at AMWTP would achieve an estimated cost savings of $13.5M compared to restarting legacy capabilities or building new capabilities at the generator sites to repackage the waste into WIPP compliant containers. Notably, $9.5M of the cost savings is associated with processing small quantities (14 m^3) of challenging SQS waste, particularly Nevada National Security Site (NNSS) spheres; AMWTP offers significant cost savings to process this unique waste over other options.[2] However, Phase 2 does not allow full recovery of the Phase 1 cost deficit (net loss of $62M or more). Furthermore, there is a risk that packaging solutions will not be fully successful to achieve the identified cost savings for Phase 2.

Site	Option	Cost	Cost Savings
Hanford	a) On-site (1,200 m^3)	$156.7M	$4.0M
	b) AMWTP (1,200 m^3)	$152.7M	
SQS	a) On-site (14 m^3)	$14.0M	$9.5M
	b) AMWTP (14 m^3)	$4.5M	
Total	a) On-site (1,214 m^3)	$170.7M	$13.5M
	b) AMWTP (1,214 m^3)	$157.2M	

- Phase 3 (CY 2022-2024): Process approximately 2,400 m^3 of waste contained in 117 large oversized boxes, primarily at Hanford (Appendix 5). This requires extensive work to make the boxes road-ready to include modification of an existing industrial package for licensing as a Type B Equivalent package and development of a new Type B Equivalent package. Processing

[2] DOE is currently evaluating whether the SQS waste at NNSS and the Separations Research Process Unit could be treated at AMWTP within the schedule for completing AMWTP's current mission.

this waste at AMWTP could achieve an estimated cost savings of $61M for Phase 3 compared to developing new capabilities at the generator sites to repackage the waste into WIPP compliant containers.

Site	Option	Cost	Cost Savings
Hanford	a) On-site (2,300 m^3)	$354.4M	$48.2M
	b) AMWTP (2,300 m^3)	$306.2M	
SQS	a) On-site (<120 m3)	$20.3M	$12.8M
	b) AMWTP (<120 m^3)	$7.5M	
Total	a) On-site (2,400 m^3)	$374.7M	$61.0M
	b) AMWTP (2,400 m^3)	$313.7M	

Fully successful implementation of Phases 1, 2, and 3 combined would yield a slight overall cost deficit of $0.6M. There is considerable risk that this deficit could increase if (1) AMWTP must be placed in warm standby condition, at a cost of $3.5M per month, until waste is available to ship or if there are other schedule delays to sustaining an economical feed rate of 1,225 m^3 per year at AMWTP; and (2) packaging solutions are not fully successful due to technical challenges and stakeholder concerns. Conversely, there are inherent technical, cost, and schedule risks in developing new capabilities at generator sites compared to proven capability at AMWTP. Additional waste inventories could also be identified in the future that could benefit from processing at AMWTP, assuming the packaging and transportation approaches for the business case are successful. Processing such waste inventories at AMWTP could increase the return on investment beyond the business case. In addition, super-compaction of the business case inventory would contribute to space preservation at WIPP (up to 12 percent of the remaining capacity in Panel 7 and Panel 8).

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ADVANCED MIXED WASTE TREATMENT PROJECT EXPANDED MISSION

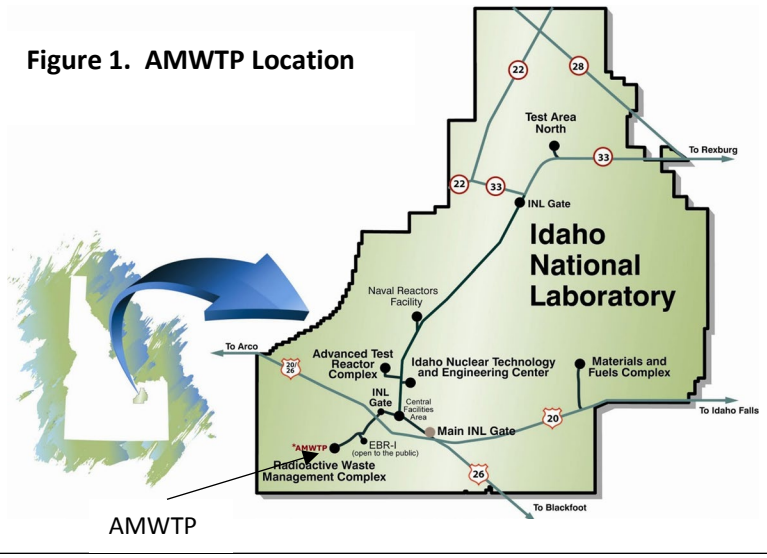
1. PURPOSE

The Idaho National Laboratory (INL) Advanced Mixed Waste Treatment Project (AMWTP) treatment facility is scheduled to complete its current on-site mission in December 2018, at which time the Department of Energy (DOE) will either need to close the treatment facility, place it in cold or warm standby condition, or continue its operation to initially process Hanford and small quantity site (SQS) contact-handled (CH) transuranic (TRU) radioactive waste in above ground storage.[3] In recognition of AMWTP's value and unique processing capabilities, this business case analysis is intended to inform a decision by DOE on whether to continue to operate the AMWTP treatment facility for processing off-site CH TRU waste.

2. BACKGROUND

AMWTP is a 6,280 square-meter CH TRU waste treatment facility located at the INL Radioactive Waste Management Complex (Figure 1). DOE completed construction of AMWTP in 2002 at a total cost of approximately $565M. The highly automated facility re-sizes, sorts, segregates, characterizes, and packages CH TRU waste and mixed-low-level radioactive waste (MLLW) for disposal at the Waste Isolation Pilot Plant (WIPP) and off-site MLLW facilities, respectively (Figures 2 and 3). Specialized equipment includes automated box lines, Brokk robots, a 2,200-ton force super-compactor, and automated band saws. The super-compactor reduces waste volumes by an average of 60 percent (Appendix 1). AMWTP currently employs approximately 700 workers, including waste handlers, operators, engineers, technicians, guards, supervisors, administrators and a variety of other specialists. Historically, AMWTP has processed approximately 700 cubic meters (m^3) of CH TRU waste from 15 DOE sites for disposal at WIPP.

Figure 1. AMWTP Location



[3] Newly generated CH TRU and CH TRU from future cleanup activities could also be considered for processing at AMWTP if DOE proceeds with the expanded mission for the stored inventory analyzed in this business case, provided AMWTP maintains a feed rate of 1,225 m^3 per year.

3. APPROACH

The approach used to develop this business case included the identification, collection, and analysis of the following information:

- AMWTP Capabilities – Information on AMWTP waste processing capabilities, operational cost data, and other relevant information was collected and analyzed, including identification of a conceptual processing rate (1,225 m^3 per year) for an expanded mission.
- Inventory of CH TRU Waste – Waste inventory information was obtained from DOE reports, databases, and waste generator sites. It included stored and projected waste volumes by site, numbers and types of containers, repackaging needs, and other related information.
- Site Baseline Plans for Disposition of CH TRU Waste – Individual site plans for processing CH TRU waste were identified through interviews of responsible DOE and contractor waste management personnel, site visits, and collection and review of relevant documents. The purpose was to identify whether sites had a path forward for all their CH TRU waste processing needs and to identify potential opportunities for shipping waste to AMWTP for processing.
- Transportation Requirements and Approaches – Information was collected on current packaging requirements, shipping assets, and challenges. Proposed transportation approaches were then identified for the various waste inventories consistent with 10 Code of Federal Regulation (CFR) Part 71, Packaging and Transportation of Radioactive Material, and DOE Order 460.1C, Packaging and Transportation Safety.
- Cost Analysis – Cost information was compiled from various sources for each TRU waste disposition option evaluated. Cost data were aggregated and extrapolated to enable a comparison of disposition options in terms of packaging and transportation of waste to AMWTP, capital costs for waste processing facility construction, modification, or re-start; operating costs for waste processing facility, shipments to WIPP, and total combined cost.

Figure 2. Aerial Photo of AMWTP

Figure 3. Remotely-Operated Waste Sorting at AMWTP

4. WASTE INVENTORY OPPORTUNITIES

DOE has made substantial progress in treating, characterizing, certifying, and disposing of legacy TRU waste from sites across the DOE complex. As of August 15, 2018, approximately 94,000 m^3 of TRU waste, comprised of 12,232 shipments, has been disposed of at WIPP since it first opened in 1999.[4] There are approximately 22,000 m^3 of CH TRU waste currently stored at 13 DOE sites, excluding INL.[5] Much of this waste has been, or is being, processed locally using existing capabilities for direct shipment to WIPP, such that it does not present an opportunity for processing at AMWTP.

The business case analysis identified approximately 6,100 m^3 of CH TRU waste in above ground storage at Hanford (5,700 m^3) and SQS (400 m^3)[6] for potential processing at AMWTP. Most of this waste is comprised of debris (e.g., contaminated protective clothing, equipment, tools, metal, wood, etc.) generated during former facility operations, decontamination and decommissioning of excess facilities, and environmental cleanup activities. These quantities are summarized in Table 1 based on their readiness to ship to AMWTP.

Table 1. CH TRU Inventory in Business Case Analysis (m^3)

Site	Carlsbad Field Office Transportation Program Compliant Requiring Minimal Work to Make Road-Ready		Not-Transportation-Compliant Requiring Moderate Work to Make Road-Ready		Not-Transportation-Compliant Requiring Extensive Work to Make Road-Ready		*Total Volume	*Total # of Containers
	Volume	# of Containers	Volume	# of Containers	Volume	# of Containers		
Hanford	2,200	4,500 drums/ Standard Waste Boxes (SWB)	1,200	2,400 drums/ boxes	2,300	92 large boxes	5,700	7,000
SQSs	300	1,100 drums/ SWBs	14	7 misc.	<120	<25	430	1,100
*Total	*2,500*	*5,600*	*1,200*	*2,400*	*2,400*	*120*	*6,100*	*8,100*

*Totals rounded to two significant digits. Therefore, some totals may not correspond with the sum of the separate figures.

Examples of CH TRU waste inventories not included in the business case analysis are listed below.

- 3,500 m^3 in above grade storage at Hanford, which can be treated at an adjacent commercial facility (treatment ongoing).
- 3,000 m^3 in below ground storage at Hanford, which is currently not anticipated to be retrieved until the 2022-2026 timeframe (i.e., does not present immediate availability for processing at

[4] http://wipp.energy.gov/shipment-information.asp
[5] Annual Transuranic Waste Inventory Report – 2017, DOE/TRU-17-3425, Rev. 0, December 2017
[6] Includes Lawrence Livermore National Laboratory, Separations Process Research Unit, Nevada National Security Site, and several other sites.

AMWTP but could be considered later if AMWTP operates for the business case inventory and packaging and transportation solutions are available).

- 3,400 m^3 in above and below grade storage at Los Alamos National Laboratory (LANL), for which LANL is proceeding with existing baselines to treat this waste on-site (most of the waste is in below grade storage and is not anticipated to be retrieved until the 2023 timeframe).
- 1,300 m^3 in above ground storage at Oak Ridge National Laboratory, which has been or is in the process of being certified on-site for direct shipment to WIPP.
- 750 m^3 in above ground storage at Savannah River Site, which has been or is in the process of being certified on-site for direct shipment to WIPP.

In addition, the business case excludes newly generated waste (31,800 m^3) from potential future DOE mission programs and environmental cleanup because the waste is not currently available for processing at AMWTP and there are inherent uncertainties on the volume and timing of waste generation. Furthermore, newly generated waste can often be packaged into WIPP certifiable containers at or near the point-of-generation. The business case also does not consider RH-TRU waste because AMWTP does not have capability to process this type of waste.

5. PACKAGING AND TRANSPORTATION REQUIREMENTS

DOE's agreement with the Western Governors Association (WGA) and the associated protocol require that TRU waste shipments to WIPP and between other DOE sites be packaged in a U.S. Nuclear Regulatory Commission (NRC)-approved Type B package, such as a Transuranic Packaging Transporter-Model II or Model III (TRUPACT-II or -III). The agreement and protocol allow DOE to use alternative packaging for inter-site shipments (excluding shipments to WIPP) if impacted states agree to the packaging. Alternatives would include transportation packages that DOE can approve under its existing authorities. The specifications (physical, chemical, and radiological) for the waste content that can be shipped in a Type B package are defined by its certificate of compliance (CoC), which in turn is based on the packaging design and safety basis. For example, the current TRUPACT-II CoC prohibits pay loads containing compressed gases (e.g., unpunctured aerosol cans), residual liquids > 1 percent by volume, and ≥ 200 Fissile Gram Equivalent (FGE).[7] The waste inventory analyzed in this business case can be grouped into three categories based on whether it presently meets the NRC-approved Type B CoCs.

- **Carlsbad Field Office (CBFO) Transportation Program Compliant Requiring Minimal Work to Make Road-Ready (<1 year) (Phase 1)** – These are waste containers that have been packaged to meet the WIPP WAC and, therefore, are expected to meet existing Type B CoCs. The waste requires final characterization and certification to meet the WIPP CH Transuranic Waste Authorized Methods for Payload Control (TRAMPAC), which are very similar to the WIPP waste acceptance criteria (WAC).
- **Not-Transportation-Compliant Requiring Moderate Work to Make Road-Ready (1 to 2 years) (Phase 2)** – These are drums, standard waste boxes (SWBs) and other waste containers that can fit into a Type B package but contain prohibited items or that are not the right type of container

[7] The <200 FGE limit is for standard drums. Criticality control overpacks and pipe overpacks have a <380 FGE limit.

allowed by the Type B CoC. The Office of Environmental Management (EM) would need to conduct a safety analysis to determine if the CoC could be revised by DOE such that DOE-approved Type B packages could safely transport this waste. This would require DOE CoC revisions to several different Type B packages (e.g., TRUPACT-II, TRUPACT-III, etc.) or new Type B packages given the multiple waste streams involved and the range of content. These type of packages would need to be acquired by INL and would not be part of the CBFO National TRU Program (NTP) fleet licensed by NRC to ship TRU waste to WIPP (i.e., there would be no changes to the NRC-approved CoC used to ship waste to WIPP; DOE would use dedicated Type B packages approved by DOE to ship waste to AMWTP for treatment). EM has successful precedent in shipping waste to AMWTP using this approach but not on the scale required for the AMWTP expanded mission.[8] EM has confidence that technically viable commercial packaging solutions could be available for Phase 2 waste. In addition, stakeholders may be more likely to accept this approach, as compared to the Type B Equivalent solution below, because this approach would largely be consistent with existing transportation protocols in that the waste would still be shipped in a Type B package (e.g., TRUPACT-II or -III), though not under an NRC certificate.

- **Not-Transportation-Compliant Requiring Extensive Work to Make Road-Ready (2 to 5 years) (Phase 3)** – This solution would be used for large boxes that are too big to fit into an existing Type B package. It would require in-depth safety analysis, design, manufacturing, and testing (including drop tests as appropriate), which are initially estimated to take 2 to 5 years. The vast majority of the oversized boxes are at Hanford and they vary in physical dimensions. Approximately 83 boxes have dimensions that could fit into an existing industrial package (e.g., TL-1800), which would be modified (e.g., added structural reinforcement) to Type B equivalency. The other 34 boxes (containing 27 percent of the total business case volume) would require design, manufacture, and testing of a new Type B Equivalent Package, and it is uncertain whether or not these boxes could even be transported by truck or rail due to their physical dimensions. Although packaging solutions would need to meet DOE and Department of Transportation requirements, stakeholders may not be amenable to this solution because the waste would not be shipped in a standard Type B package (e.g., TRUPACT). It would not be cost-effective to repackage the large boxes on-site in order to be shipped to AMWTP in a Type B package. Although the ability to process oversized boxes at AMWTP offers a significant return on investment, greater uncertainty exists regarding the development of appropriate packaging and transportation options for the boxes and the ability to gain stakeholder acceptance to sustain the defined feed rate to AMWTP (1,225 m^3 per year).

6. BUSINESS CASE

This section presents the requirements, assumptions, operations scenario, relative cost comparison of processing the waste on-site compared to processing at AMWTP, and associated cost estimating

[8] The successful precedent included 10 shipments (26 m^3) from LANL in a DOE Type B 10-160B package. Approximately 457 shipments (1,200 m^3) would be required to ship the "Not-Transportation-Compliant Requiring Moderate Work to Make Road-Ready" in the business case.

methodology, preliminary funding needs, and programmatic risks for processing 6,100 m^3 of waste from Hanford and SQSs at AMWTP.

6.1 Requirements

- **1995 Idaho Settlement Agreement** – DOE would need a temporary waiver from the Idaho Settlement Agreement Paragraph E.2. requirement that off-site waste be shipped outside the state of Idaho within 6 months following its treatment.
- **WGA Agreement** – EM would need agreement from WGA and the states through which the waste would be transported on the alternative packaging to ship approximately 60 percent of the CH TRU waste analyzed in the business case to AMWTP.
- **Generator Pay Loading Capability** – Hanford currently has no readily available characterization, loading, and shipping capabilities for CH TRU waste. The Waste Receiving and Processing Facility (WRAP), which has been in cold standby since 2011, may be restarted to ship drums and SWBs. This would require hiring and training personnel, updating operations and maintenance procedures, upgrading computer software, performing preventive and corrective maintenance, replacing the facility's roof, performing readiness activities, and obtaining contractor management and DOE approval for restart.
- **Transportation Carrier Resources** – The CBFO NTP would ship the "CBFO Transportation Program Compliant Requiring Minimal Work to Make Road-Ready" waste (Phase 1) to AMWTP because the waste meets current contractor carrier requirements (i.e., it can be shipped in a NRC-approved Type B package). However, CBFO NTP would need to modify its existing contract to increase shipping resources (e.g., crews, trailers, etc.) to support shipments to AMWTP (anticipated at 3 to 4 shipments per week to support a feed rate of 1,225 m^3 per year). For the waste that is "Not-Transportation-Compliant Requiring Moderate Work to Make Road-Ready" and "Not-Transportation-Compliant Requiring Extensive Work to Make Road-Ready" (Phases 2 and 3), INL would need to obtain additional carrier service and dedicated packages to support shipments to AMWTP.
- **Funding** – EM would need to identify funding to support the AMWTP expanded mission. The budget planning cases for Idaho Site and Hanford currently do not include funds to ship waste to AMWTP. Estimated funding needs are identified in Section 6.6.

6.2 Key Assumptions

- The AMWTP treatment facility will complete its current mission in December 2018, thereby making the facility available to process off-site waste in mid-calendar year (CY) 2019, after AMWTP completes work force realignment to the expanded mission in early CY 2019.[9]

[9] There may be small quantities of newly generated on-site waste and legacy re-work waste that may require treatment at AMWTP in early CY 2019.

- AMWTP will economically process off-site waste at a rate of 1,225 m^3 per year, compared to the current legacy mission processing rate of approximately 3,000 m^3 per year[10].
- The State of Idaho will temporarily waive the "6 months out" requirement for off-site waste treated at AMWTP. If an agreement is not reached to support waste processing by May 2019, there will be a day-for-day slip in the schedule for processing off-site waste, which would incur costs of approximately $3.5 million (M) per month to maintain the facility in warm standby condition.
- Adequate funding is provided to support and sustain the expanded mission (Section 6.6). It is assumed that no additional appropriations will be available; thus, funds will need to be drawn from existing budgets.
- For "CBFO Transportation Program Compliant Requiring Minimal Work to Make Road-Ready" waste (Phase 1), activities to restart waste characterization, pay loading, and shipping activity at Hanford and augment NTP carrier services to certify for transportation and ship Phase 1 waste to AMWTP can be accelerated to support waste shipments beginning in mid-CY 2019. Currently, it is estimated that restart activities at Hanford could take 18 months to complete and it may not be possible to accelerate this schedule. AMWTP would incur $3.5M in standby costs for each month waste is unavailable to ship.
- For "Not-Transportation-Compliant Requiring Moderate Work to Make Road-Ready" and "Not-Transportation-Compliant Requiring Extensive Work to Make Road-Ready" (Phases 2 and 3), needed packaging development will be adequately funded, supported by safety analysis, accepted by stakeholders, and be available no later than:
    - CY 2021 – Revised DOE Type B CoC packaging or new Type B packaging; this would be a new DOE CoC versus revising the CoC to NRC Type B packaging (some revised CoC activities have been initiated to support inter-site shipment of SQS waste)
    - CY 2022 – Modification and licensing of existing industrial packaging to Type B Equivalency.
    - CY 2023 – Design, licensing, manufacturing, and testing of new Type B Equivalent packaging (this requires work to be completed 1 to 2 years ahead of the preliminary schedule provided by Savannah River National Laboratory subject matter expert).

6.3 Operating Scenario

The operating scenario for the business case is based on a phased approach (Figure 4).

- Phase 1 (CY 2019-2021): Process up to 2,500 m^3 of CBFO Transportation Program Compliant waste that requires minimal work to make road-ready. Processing this waste at AMWTP would require DOE to assume a cost deficit of approximately $75.1M compared to the alternative of standing up certification capability at the generator site and directly shipping this waste to WIPP with the expectation that this cost deficit could be largely recovered in Phases 2 and 3. The alternative to processing Phase 1 waste at AMWTP would be to place the facility in warm standby status ($3.5M per month) until Phases 2 and 3 waste is available to ship. However, it is

[10] Based on operating under a one 10-hour/4-days-per-week shift as compared to legacy level of operating a one 24-hour/seven-days-per-week shift, which included above ground waste retrievals.

likely that the total standby costs would be on the same order of the Phase 1 cost deficit without the added benefit of waste super-compaction and certification. To reduce the Phase 1 cost deficit, the project could pursue the following actions: (1) accelerating packaging development for Phases 2 and 3 to reduce Phase 1 waste processing; (2) evaluating whether any waste could be shipped as Type A waste (e.g., surface contaminated objects) in accordance with Department of Transportation requirements; (3) seeking continuous opportunities to further optimize AMWTP operations, e.g., increase processing rates and decrease operational costs; and (4) pursue any additional Phase 2 and 3 waste volumes that could be treated at AMWTP.

Site	Option	Cost	Cost Deficit
Hanford	a) On-site (2,200 m^3)	$56.9M	($73.6M)
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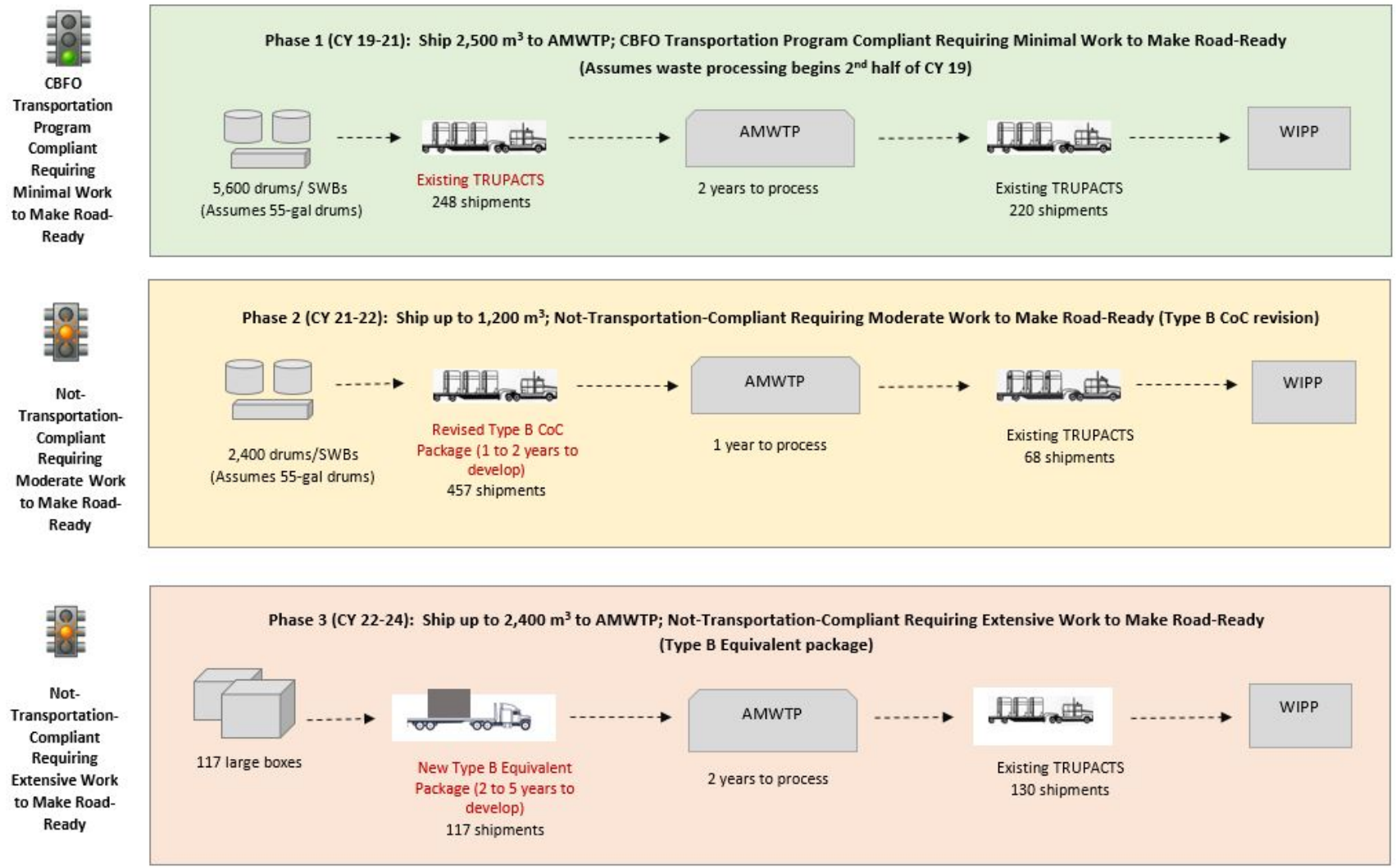
Total	a) On-site (2,500 m^3)	$65.7M	($75.1M)
	b) AMWTP (2,500 m^3)	$140.8M	

Phase 2 (CY 2021-2022): Process approximately 1,200 m^3 of waste that is currently not transportation compliant but requires moderate work to make road-ready. This requires revisions to DOE Type B packaging CoC (versus a revision to the NRC Type B CoC) or a new Type B packaging in coordination with stakeholders to ship the waste, as well as procurement of transportation packages and carrier services. Processing this waste at AMWTP would achieve an estimated cost savings of $13.5M compared to restarting legacy capabilities or developing new capabilities at the generator sites to repackage the waste into WIPP compliant containers. Notably, $9.5M of the cost savings is associated with processing small quantities (14 m^3) of challenging SQS waste, particularly Nevada National Security Site (NNSS) spheres; AMWTP offers significant cost savings to process this unique waste over other options. However, Phase 2 does not allow full recovery of Phase 1 cost deficit (i.e., $75.1M deficit in Phase 1 plus $13.5M cost savings in Phase 2 equals a net loss of $61.6M). Furthermore, there is a risk that packaging solutions will not be fully successful to achieve the identified cost savings.

Site	Option	Cost	Cost Savings
Hanford	a) On-site (1,200 m^3)	$156.7M	$4.0M
	b) AMWTP (1,200 m^3)	$152.7M	
SQS	a) On-site (14 m^3)	$14.0M	$9.5M
	b) AMWTP (14 m^3)	$4.5M	
Total	a) On-site (1,214 m^3)	$170.7M	$13.5M
	b) AMWTP (1,214 m^3)	$157.2M	

Figure 4. Business Case Phased Approach



Shipments to WIPP assume 100-gallon overpack/5 pucks per overpack for debris waste with a 40 percent reduction for debris waste. Some incoming drums in Phase 1-3 are assumed to contain sludge, which will result in an increase in shipments after treatment (Phase 2 and 3). Phase 2 incoming shipments include 393 oversized boxes, which are assumed to be packaged in a TRUPACT-III with one box per shipment. AMWTP processing duration is based on a processing rate of 1,225 m^3 per year.

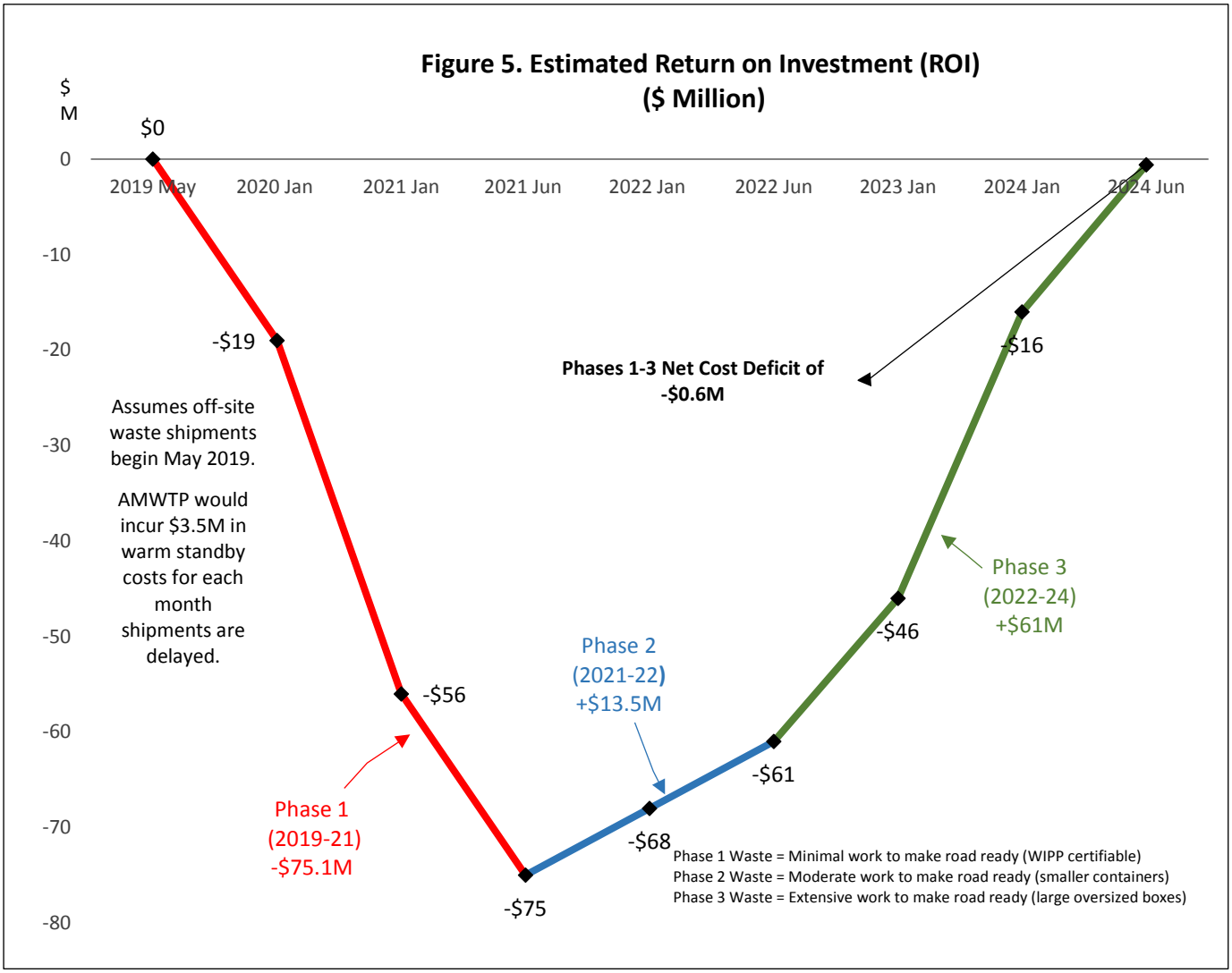
- Phase 3 (CY 2022-2024): Process approximately 2,400 m^3 of waste contained in 117 large oversized boxes, primarily at Hanford (Appendix 5). This requires extensive work to make the boxes road-ready to include modification of an existing industrial package for licensing as a Type B Equivalent package and development of a new Type B Equivalent package. Processing this waste at AMWTP could achieve an estimated cost savings of up to $61M compared to restarting legacy capabilities or building new capabilities at the generator sites to repackage the waste into WIPP compliant containers. However, there is a risk that packaging solutions will not be entirely successful due to technical challenges and potential stakeholder concerns. Repackaging these large boxes into smaller containers that could then be shipped to AMWTP would not be cost effective due to upfront costs, even to minimally repackage the waste (e.g., preparation of safety analysis documentation, establishment of a hazard category 2 facility, readiness assessments, etc.). It would be more advantageous to complete the repackaging on-site to meet the WIPP WAC.

Site	Option	Cost	Cost Savings
Hanford	a) On-site (2,300 m^3)	$354.4M	$48.2M
	b) AMWTP (2,300 m^3)	$306.2M	
SQS	a) On-site (<120 m3)	$20.3M	$12.8M
	b) AMWTP (<120 m^3)	$7.5M	
Total	a) On-site (2,420 m^3)	$374.7M	$61.0M
	b) AMWTP (2,420 m^3)	$313.7M	

In sum, this phased approach would require careful planning and scheduling (Appendix 2), an acceleration of packaging and transportation solutions for Phases 2 and 3, and commitment to resources to sustain a feed rate of 1,225 m^3 per year. It carries uncertainty that packaging and transportation solutions can be developed for Phases 2 and 3 and that stakeholders will accept those solutions. The business case would require DOE to initially assume a $75.1M cost deficit for CY 2019-2020 (Phase 1), which could largely be recovered by Phases 2 and 3, yielding a slight net cost deficit of $0.6M (Table 2 and Figure 5). This loss could be counterbalanced to some extent by more difficult-to-quantify benefits to processing the waste inventory analyzed in this business case at AMWTP including preservation of up to about 1 room at WIPP (roughly 12 percent of the remaining disposal space in Panel 7 and Panel 8). In addition, AMWTP is a proven capability whereas there would inherent technical, cost, and schedule risks in developing new capability at generator sites. Conversely, reallocation of existing funds at INL and Hanford, in particular, to support an expanded AMWTP mission could affect prioritization of activities with implications for completion of other mission-relevant tasks. Possible reallocation of WIPP shipments from other generator sites such as OR, LANL, or Savannah River Site to support an AMWTP expanded mission, could have programmatic implications at those sites.

Table 2. Cost Summary of Business Case

* Business Case	Volume	Processing Duration	Cost Savings or Deficit
1. CBFO Transportation Program Compliant Requiring Minimal Work to Make Road-Ready	2,500 m^3	2 years	($75.1M)
2. Not-Transportation-Compliant Requiring Moderate Work to Make Road-Ready (DOE Type B CoC revision or new Type B packaging)	1,200 m^3	1 year	$13.5M
3. Not-Transportation-Compliant Requiring Extensive Work to Make Road-Ready (Type B Equivalent package)	2,400 m^3	2 years	$61.0M
Total	**6,100 m^3**	**5 years**	**($0.6M)**



6.4 Standby Scenarios

DOE could place AMWTP in cold or warm standby condition upon the completion of the Idaho mission based on an expectation to operate the facility in the future for processing of off-site waste. The facility could also be placed in standby condition if there are delays in shipping waste that impact the ability to sustain a 1,225 m^3/yr. processing rate at AMWTP.

Under a warm standby scenario, the facility is maintained in a state of readiness to process off-site waste. DOE estimates that the warm standby scenario would cost approximately $42M per year assuming a one shift for 10 hours, four days a week. The personnel would maintain proficiency in characterization, treatment, certification, and shipping operations without actually processing off-site waste.

For the cold standby scenario, the facility is placed into a configuration that reduces the resources needed to the bare minimum. Surveillance of the facilities and equipment is conducted and minimal maintenance is performed to prevent significant degradation of confinement, ventilation, and other systems and key facility infrastructure. This scenario does not maintain any personnel to operate the characterization, treatment, packaging, or loading equipment and systems. DOE estimates the cold standby scenario would cost approximately $3M per year, but restart costs would be significant (perhaps on the order of $100M).

6.5 Cost Estimating Methodology

Appendix 4 presents the detailed cost analysis for the business case. Variables, input parameters, uncertainties, and assumptions are summarized below. Many of the costs presented are a rough order of magnitude estimate appropriate for the purposes of conducting a relative comparison of the processing options (i.e., the estimated costs are not definitive).

6.5.1 Phase 1 Cost Estimating Methodology, Uncertainties, and Assumptions

The Phase 1 cost estimating methodology is primarily based on historical costs and therefore has a higher degree of certainty compared to Phases 2 and 3. The main uncertainties are associated with the extent of acceptable knowledge (AK) documentation and waste characterization and generator support costs to ship waste to AMWTP or WIPP. The cost estimate makes the following assumptions:

- The waste (2,500 m^3) will meet TRAMPAC. TRAMPAC is largely equivalent to the WIPP WAC in terms of waste characterization and requirements to ship to AMWTP in a NRC-approved Type B package. Hanford has indicated there is a possibility that some waste containers may contain prohibited items, which would make them non-TRAMPAC compliant. DOE will evaluate the waste inventory to ensure the waste in Phase 1 meets the TRAMPAC; any waste containers that do not meet the TRAMPAC would be considered for shipment under Phase 2.
- Many of the Central Characterization Project (CCP), AK development, and generator support activities to certify waste for shipment to WIPP would also be required to ship waste to AMWTP. If less characterization is required to ensure compliance with TRAMPAC and AMWTP WAC (i.e., can demonstrate based on existing characterization and records), then the cost to ship waste to

AMWTP would decrease. The CCP costs for shipment to WIPP or AMWTP are based off historical information provided by CBFO NTP.

- Hanford will need to prepare AK packages for 15 waste streams for shipment to WIPP or AMWTP at an estimated cost of $350,000 per waste stream. This cost could increase or decrease depending on the final number of AK packages.
- Hanford operators will perform drum handling, nondestructive assay, nondestructive examination, and pay loading. These responsibilities and estimated cost ($20M) are consistent with 2010-2011 shipments to AMWTP.
- NTP CCP costs for shipment to AMWTP or WIPP do not include cost activities that would be conducted by Hanford.
- AMWTP costs to process SQS waste assumes a reduced base operations cost because the facility would primarily operate to process Hanford waste.
- Drums could be directly loaded into the AMWTP super-compactor without being processed in box lines.

6.5.2 Phases 2 and 3 Cost Estimating Methodology, Uncertainties, and Assumptions

The cost estimating methodology for Phases 2 and 3 is a mix of historical (AMWTP costs and commercial treatment costs), subject matter expert opinion (packaging and transportation development), and extrapolation of planning data (Hanford on-site composite costs). Key uncertainties and assumptions include:

Treatment Options

- Hanford on-site composite unit treatment cost ($54.75/$m^3$) is based on funding profiles to complete TRU disposition milestone activities through 2030, which includes the CH waste inventories analyzed in this business case. The cost estimates were derived by subtracting activities that were not related to CH TRU repackaging. The unit treatment cost may increase or decrease depending upon final repackaging strategies. A preliminary estimate of $98M to modify WRAP for CH TRU small and large packages is also considered in the Business Case for purposes of sensitivity analysis. The business case assumes that Hanford will require on-site TRU repackaging capability to complete legacy cleanup regardless of whether the business case inventory is sent to AMWTP. If DOE could avoid these capital costs over the life of the Hanford cleanup program by sending all future CH-TRU waste to AMWTP, the net return on investment could increase by $98M. However, such an increase would depend on the unlikely ability to sustain an economical feed rate to AMWTP over the life of Hanford cleanup program (projected to be decades) to avoid AMWTP standby costs, which could offset any capital cost avoidance at Hanford.
- Commercial unit treatment cost ($40/$m^3$), which includes Hanford activities, is based on the historical annual funding for this activity ($20M) divided by an average processing rate of 500 m^3 per year for fiscal years 2015-2016. This unit treatment cost may fluctuate depending upon process efficiencies and the mix of containers being processed (e.g., drum vs. large box).

- AMWTP treatment costs are based on 2013 actual cost data[11] escalated to 2017 dollars and assumes a processing efficiency of 1,225 m^3 per year with the majority of waste being debris versus sludge. The treatment cost may fluctuate based on operating efficiencies, actual volume of waste processed, and actual mix of waste processed (e.g., debris vs. sludge and drums vs. large boxes).
- Lawrence Livermore National Laboratory on-site costs assume capital costs ($12M) to construct a Permacon facility to repackage large oversized boxes plus operating costs, as extrapolated from costs to construct and operate the LANL 375 Box Line facility.
- NNSS "on-site" costs to disposition research and development spheres assume $9.3M to treat the spheres at another DOE site and certify the waste for disposal at WIPP.
- Separations Process Research Unit "on-site" costs to disposition its remaining five CH TRU waste containers assume shipment of the containers to a commercial facility for treatment and then shipment to another DOE site for waste certification followed by disposal at WIPP.
- Hanford preliminary estimated cost ($20M) to restart WRAP and to transfer and operate the TRUPACT-III mobile loading facility from Savannah River Site to Hanford is included in the Hanford on-site composite cost.

Packaging and Transportation Development

- CBFO NTP will not provide CCP, packaging, and carrier services for Phases 2 and 3.
- INL is responsible for developing and procuring transportation packaging for Phases 2 and 3 and for establishing contractor carrier services for these phases (CBFO NTP will provide these services for Phase 1).
- For Phase 2, packaging development costs are estimated at $17M, including safety analysis, CoC revisions, and procurement of Type B packages, as based on subject matter expert opinion.
- For Phase 3, packaging development costs assume $13M, including safety analysis and design, modification, procurement, and testing of Type B Equivalent packages, as based on subject matter expert opinion (Savannah River National Laboratory).

Waste Preparation for Shipment

- For shipment to AMWTP, Hanford and SQS operators will perform drum handling, nondestructive assay, nondestructive examination, and pay loading. These activities are assumed to cost $34M total for Phases 2 and 3 based on historical Hanford cost activities. SQS costs are assumed to be $3.8M for similar type activities for Phases 1, 2, and 3 based on a Lawrence Livermore National Laboratory cost estimate.
- INL will be responsible for certifying that waste shipments to AMWTP meet the packaging CoC and AMWTP WAC. It is assumed that these activities will be similar to what NTP CCP will perform for Phase 1 shipments to AMWTP using cost information provided by CBFO NTP.

[11] 2013 cost data was the last data available that included a full year of waste shipments from AMWTP to WIPP (WIPP shipments for the complex were suspended in February 2014 and resumed in April 2017). 2017 and 2018 cost data were reviewed and found to be consistent with the cost data used in the Business case.

- For Phases 2 and 3, Hanford will prepare AK packages for 15 waste streams per phase for shipment to WIPP or AMWTP at an estimated cost of $350,000 per waste stream. SQS will prepare one AK package per phase for one waste steam at an estimated cost of $350,000.
- NTP CCP costs for shipment to WIPP do not include cost activities that would be conducted by Hanford, SQSs, and AMWTP for drum handling, nondestructive assay, nondestructive examination, and pay loading.

6.5.3 Sensitivity Analysis

The following variables have the greatest impact on the cost analysis:

- Hanford composite unit treatment cost ($54.75/$m^3$) – decreasing this variable will shift the cost favorability for Phases 2 and 3 from the AMWTP option to the Hanford on-site option whereas increasing the variable will have the opposite effect.
- Hanford capital costs to modify WRAP for small and large packaging processing systems – the business case assumes no capital cost avoidance because it is likely Hanford would require these systems to serve long-term needs regardless of whether Phase 1-3 waste is sent to AMWTP. If credit is taken for capital cost avoidance (assumes $98M), the estimated net return on investment for the business case would increase from a negative $0.6M to a positive $97.4M. The capital cost avoidance would require DOE to assume that waste shipments from Hanford to AMWTP could be sustained at 1,225 m^3/yr. even though future waste generation at Hanford may not sustain such a processing rate. If the processing rate is not sustained, the unit cost to treat waste at AMWTP would increase or AMWTP would need to be placed into warm standby at an estimated cost of $3.5M/month, which would offset any capital cost avoidance at Hanford.
- AMWTP operations – decreasing the operating efficiency below 1,225 m^3/yr. will increase unit treatment costs and/or require placing the facility in warm standby condition ($3.5M/month) and further increase the Phase 1 cost deficit and/or, for Phases 2 and 3, shift favorability from the AMWTP option to the Hanford on-site option.
- Characterization for shipment to AMWTP – the cost estimate assumes that many of the CCP, AK development, and generator support activities to certify waste for shipment to WIPP would also be required to ship waste to AMWTP. If less characterization is required, then the cost to ship waste to AMWTP would decrease.

6.6 Preliminary Funding Needs

The budget planning cases for the INL, CBFO NTP, Hanford, and SQSs currently do not include funds to ship waste to AMWTP. Rough order of magnitude funding needs are identified in Table 3, which exclude CBFO NTP costs to ship processed waste from AMWTP to WIPP and associated WIPP disposal costs. An important distinction is that CBFO NTP would provide CCP, Type B packaging, and carrier services for shipments to AMWTP during Phase 1 up until the shipment rate to WIPP reaches 17 shipments per week. At that point, all CBFO resources would be needed to support the WIPP mission; ID would provide these services for Phases 2 and 3, including packaging development and procurement.

Table 3. Rough Order of Magnitude Funding Requirements $M (excluding shipments to WIPP)

Site	Activity	FY18	FY19	FY20	FY21-24	Total
INL	1. Develop/procure packaging and carrier services (Phases 2/3)	*$5.0	*$10.0	*$10.0	$5.0	$30.0
	2. AMWTP Certification Program (Phases 2/3 incoming shipments)	$0	$0	$0	$22.2	$22.2
	3. Ship waste from Generator to AMWTP (Phases 2/3)	$0	$0	$0	$16.9	$16.9
	4. Operate AMWTP for expanded mission (Phases 1-3)	$0	$36.0	$47.5	$159.0	$242.5
	Subtotal	$5.0	$46.0	$57.5	$203.1	$311.6
RL	5. Restart WRAP for Phase 1 characterization and pay loading (Phases 1/2)	$0	$20.0	$0	$0	$20.0
	6. Generator shipping support (Phases 1-3)	$0	$5.0	$10.0	**$39.0	$54.0
	7. AK package development (Phases 1-3)	$0	$3.4	$1.7	$15.9	$21.0
	Subtotal	$0	$28.4	$11.7	$54.9	$95.0
CBFO	8. CCP for shipment to AMWTP (Phase 1)	$0	$3.8	$7.7	$3.8	$15.3
	9. Ship waste to AMWTP (Phase 1)	$0	$1.8	$3.7	$1.8	$7.3
	Subtotal	$0	$5.6	$11.4	$5.6	$22.6
SQS	10. Generator shipping support (Phases 1-3)	$0	$0.9	$1.9	$8.6	$11.4
	11. AK package development (Phases 1-3)	$0	$0.4	$0.4	$0.4	$1.2
	Subtotal	$0	$1.3	$2.3	$9.0	$12.6
	Total	$5.0	$81.3	$82.9	$272.6	$441.8

*These funding needs are for Phase 2 and 3 packaging development.

**Prorated value based on number of containers that would go to AMWTP in Phase 2 and 3.

6.7 Programmatic Risks

Key programmatic risks with potential negative impacts and proposed mitigating actions are presented in Table 4. Opportunities with potential positive benefits include, but are not limited to, accelerating packaging development, identifying additional Phase 2 and 3 type waste volumes for treatment at AMWTP, and potential further optimization of AMWTP operations to reduce operating costs, increase processing rates, etc.

Table 4. Key Programmatic Risks

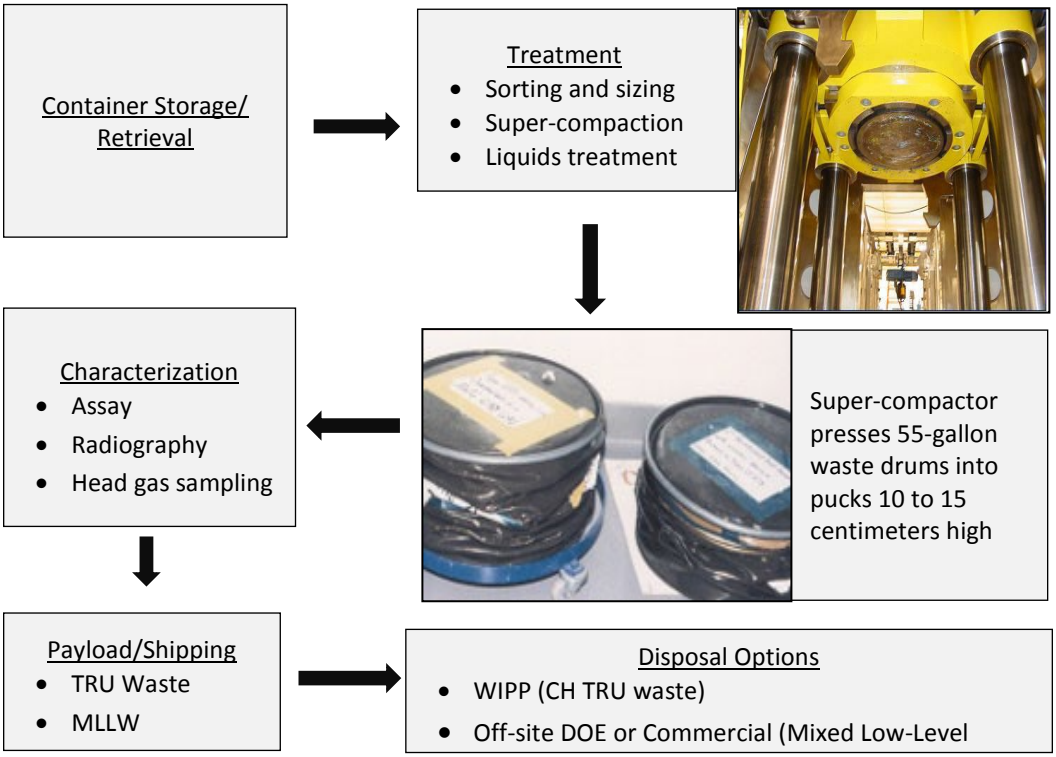
#	Risk Event	Likelihood of Occurrence	Risk Impact	Mitigating Actions
1.	State of Idaho and DOE do not agree on waiver of the Paragraph E.2. requirement (Phases 1-3)	Mod-High	No AMWTP expanded mission	Negotiate temporary waiver with State
2.	Stakeholders do not accept revised DOE Type B CoC approach (Phase 2)	Low-Mod	Cost savings from Phase 2 are reduced; higher net loss considering $75.1M deficit from Phase 1	Early coordination with stakeholders
3.	Revised DOE Type B CoC revisions and underlying safety basis do not support shipment of all Phase 2 waste	Mod	Reduced waste inventory for Phase 2; higher net loss considering $75.1M deficit from Phase 1	Obtain subject matter experts for technical analysis
4.	Stakeholders do not accept Type B Equivalent packaging approach or the approach is not technically feasible for all or some of the inventory (Phase 3)	Mod-High	$61M cost savings for Phase 3 is not realized; net deficit from earlier phases not recovered increasing overall cost loss	Coordination with stakeholders and robust technical safety basis for packaging
5.	Packaging solutions are not developed in time to support continuous AMWTP operations (Phases 2 and 3)	Mod	Increased unit costs to process waste at AMWTP or premature shutdown if lengthy delay in packaging; net deficit from earlier phases is not recovered increasing overall cost loss	Establish/monitor integrated baseline and adequately fund packaging development
6.	Establishment of Hanford and SQS characterization and pay loading capabilities are delayed (Phase 1)	Mod	Unavailability of waste inventory resulting in AMWTP operating gaps, warm standby, or premature shutdown	Establish/monitor integrated baseline

Likelihood of Occurrence: Low < 25 percent chance; Mod 25-75 percent chance; High >75 percent chance of occurrence as judged by subject matter experts.

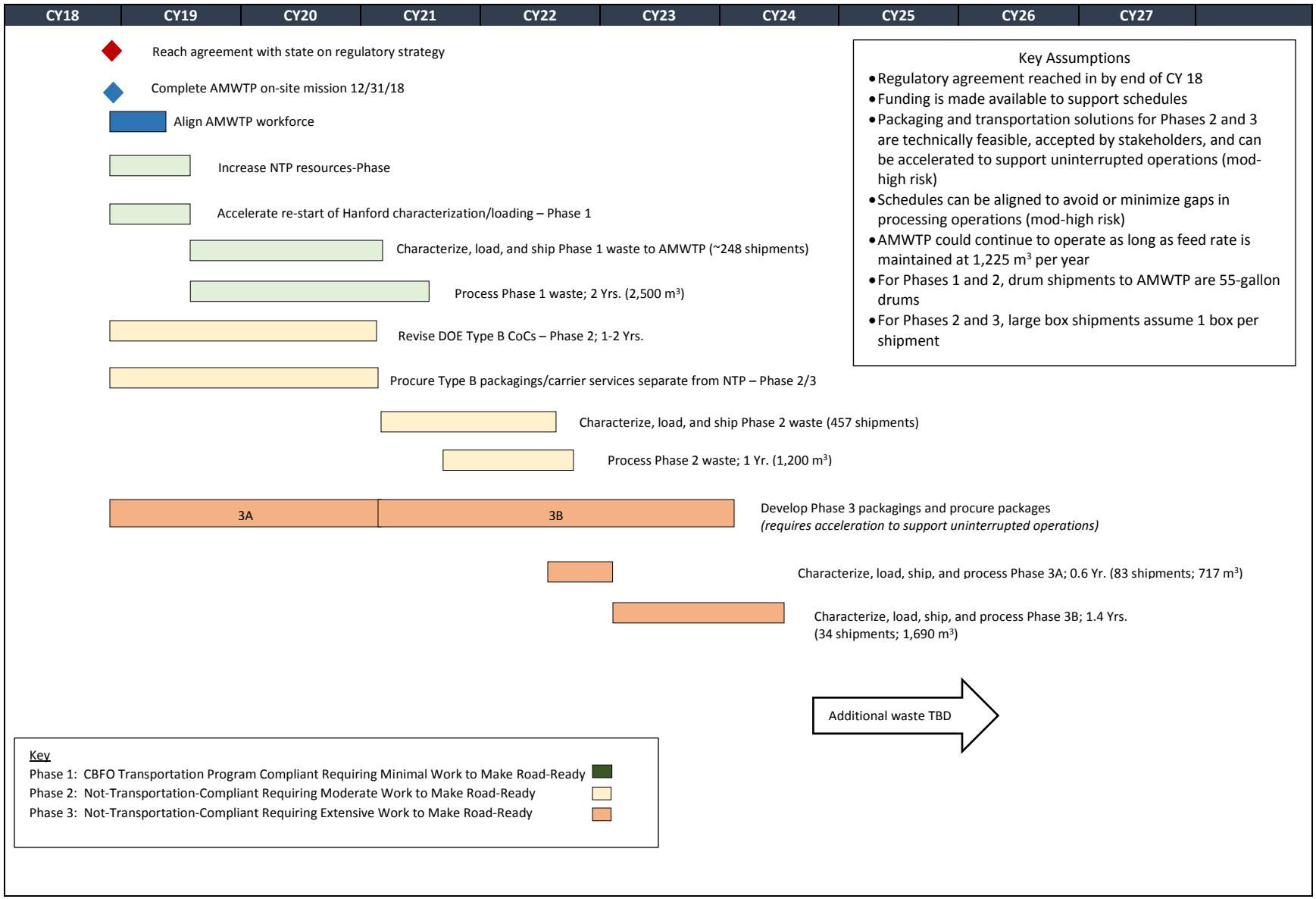
7. CONCLUSION

Extending AMWTP's mission to process off-site waste, primarily from Hanford, will be challenging and will not be cost-effective in the short-term nor likely cost-effective in the long-term. EM would incur significant costs (as compared to processing at the generator site) during Phase 1 of the expanded mission, which could largely be recovered if packaging solutions are fully effective for Phase 2 and Phase 3. However there is considerable uncertainty that the packaging approaches can be fully successful, especially for large oversized boxes which comprise approximately 40 percent of the total business case inventory. Significant schedule challenges, such as re-establishing characterization and pay loading capability at Hanford and developing packaging solutions, could also contribute to standby costs ($3.5M/month) decreasing the cost-effectiveness of an extended mission. While cost is an important consideration, other factors should be considered including (1) AMWTP's proven capability to treat challenging radioactive waste compared to substantial technical, cost, and schedule risks in developing new capabilities at generator sites; and (2) space preservation at WIPP from super-compaction at AMWTP (up to 12 percent of the remaining capacity in Panel 7 and Panel 8).

Appendix 1. AMWTP Process Diagram



Appendix 2. Notional Schedule for Business Case



Appendix 3. Comparison of Processing Options for Business Case

Waste Type	Container Type	# of Containers	Volume m^3	Onsite $M	AMWTP $M	Delta Onsite Minus AMWTP $M	AMWTP Processing Duration (Yrs.)
Phase 1 CBFO Transportation Program Compliant Requiring Minimal Work to Make Road-Ready							
*Hanford Above Ground	Drums/SWBs	4,500	2,200	$56.9	$130.5	($73.6)	1.8
SQS	Drums/SWBs	1,100	300	$8.8	$10.3	($1.5)	0.2
	**Total Phase1	5,600	2,500	$65.7	$140.8	($75.1)	2.0
Phase 2: Not-Transportation-Compliant Requiring Moderate Work to Make Road-Ready							
Hanford Above Ground	Drums/SWBs	2,000	700	$156.7	$152.7	$4.0	0.6
Hanford Above Ground	Large Box 1	390	500				0.4
SQS (NNSS and SPRU-CH)	Misc.	7	14	$14.0	$4.5	$9.5	<0.1
	**Total Phase 2	2,400	1,200	$170.7	$157.2	$13.5	1.0
Phase 3A. Not-Transportation-Compliant Requiring Extensive Work to Make Road-Ready (Industrial Package Modified to Type B Equiv.)							
Hanford Above Ground	Large Box 2	58	600	$119.6	$107.6	$12.0	0.5
SQS (LLNL)	Large Box 2	25	120	$20.3	$7.5	$12.8	0.1
	**Total	83	720	$139.9	$115.1	$24.8	0.6
Phase 3B. Not-Transportation-Compliant Requiring Extensive Work to Make Road-Ready (New Type B Equivalent Package)							
Hanford Above Ground	Large Box 3	34	1,700	$234.8	$198.6	$36.2	1.4
**Grand Total		8,100	6,100	$611.1	$611.7	($0.6)	5.0

*Inventory for Hanford large boxes current as of 8/2017, Hanford drums/SWBs 6/2016; and SQS containers 12/2015.

** The number of containers and volume have been rounded to two significant digits. Due to rounding, some totals may not correspond with the sum of the separate figures.

Appendix 4. Basis of Estimate for Business Case Analysis

Inventories Analyzed in Business Case

Site	Waste Stream Category	Existing TRAMPAC Compliant	Description	% Debris	Inventory								
					Drums			SWB		Other		Total Stored Containers	Total Stored Waste Volume m3
					Type	#	m3	#	m3	#	m3		
Hanford	Phase 1	Yes	Repackaged, meets existing TRUPACT CoCs	82%	Unk	3,700	749	800	1,451	0	0	4,500	2,200
Hanford	Phase 2 -Total PFNW and Non-PFNW Compatible	No	Requires DOE Revised Type B CoC to ship to AMWTP	97%	Unk	2,800	701	104	196	541	1,140	3,445	2,037
Hanford	Phase 2 - Non-PFNW Compatible	No	Requires DOE Revised Type B CoC to ship to AMWTP (waste does not meet PFNW WAC)	97%		1,900	512	100	188	393	530	2,393	1,230
Hanford	Phase 2: PFNW Compatible	No	Requires DOE Revised Type B CoC to ship to AMWTP (waste meets PFNW WAC)	97%		900	189	4	8	148	610	1,052	807
Hanford	Phase 3A: PFNW and Non-PFNW Compatible	No	Requires design and modified industrial Package licensed to Type B Equivalent	97%		0	0	0	0	121	1,603	121	1,603
Hanford	Phase 3A: Non-PFNW Compatible	No	Requires design and modified industrial Package licensed to Type B Equivalent (waste does not meet PFNW WAC)	97%		0	0	0	0	58	597	58	597
Hanford	Phase 3A: PFNW Compatible	No	Requires design and modified industrial Package licensed to Type B Equivalent (waste meets PFNW WAC)	97%		0	0	0	0	63	1,006	63	1,006
Hanford	Phase 3B: PFNW and Non-PFNW Compatible	No	Ship in new Type B Equivalent package (boxes too big to fit in existing industrial package)	97%		0	0	0	0	72	3,382	72	3,382
Hanford	Phase 3B: Non-PFNW Compatible	No	Ship in new Type B Equivalent package (boxes too big to fit in existing industrial package)(waste does not meet PFNW WAC)	97%		0	0	0	0	34	1,692	34	1,692
Hanford	Phase 3B: PFNW Compatible	No	Ship in new Type B Equivalent package (boxes too big to fit in existing industrial package) (waste meets PFNW WAC)	97%		0	0	0	0	38	1,690	38	1,690
SQS	Phase 1	Yes	Repackaged, meets existing TRUPACT CoCs	100%		1,109	302					1,109	302
SQS	Phase 2	No	Requires DOE Revised Type B CoC to ship to AMWTP	100%		7	14					7	14
SQS	Phase 3A	No	Requires design and modified industrial Package licensed to Type B Equivalent	100%						25	120	25	120

Key Variables

Category	Variable	Range Name	Value	Units	Source	Comments
AMWTP	AMWTP Capacity - Base Ops	AMWTP_Cap_Base	2,450.0	M3/yr		
AMWTP	AMWTP Capacity - Box Line	AMWTP_Cap_Box	2,450.0	M3/yr		
AMWTP	AMWTP Capacity - M/LLW Disposition	AMWTP_Cap_MLLW	2,450.0	M3/yr		
AMWTP	AMWTP Capacity - Compaction	AMWTP_Cap_Comp	4,900.0	M3/yr		
AMWTP	AMWTP Capacity - CCP	AMWTP_Cap_CCP	4,900.0	M3/yr		
AMWTP	AMWTP Capacity - Shipping Preparation	AMWTP_Cap_Ship	4,900.0	M3/yr		
AMWTP	Base Ops Unit Cost	AMWTP_BaseOps	30.72	FY17$K/M3	FY13 AMWTP actual costs	
AMWTP	SQS Reduced Base Ops Unit Cost	AMWTP_SQSBaseOps	5.16	FY17$K/M3	FY13 AMWTP actual costs	
AMWTP	Box-Line Unit Cost	AMWTP_Repack	3.96	FY17$K/M3	FY13 AMWTP actual costs	
AMWTP	Compaction Unit Cost	AMWTP_Compaction	1.11	FY17$K/M3	FY13 AMWTP actual costs	
AMWTP	M/LLW Unit Cost	AMWTP_MLLW	5.48	FY17$K/M3	FY13 AMWTP actual costs	
AMWTP	Non-Debris Treatment Unit Cost	ARPV_Sludge	41.02	FY17$K/M3	FY13 AMWTP actual costs	
AMWTP	CCP Unit Cost	AMWTP_CCP	1.10	FY17$K/M3	FY13 AMWTP actual costs	
AMWTP	Transportation Prep Unit Cost	AMWTP_TransPrep	0.92	FY17$K/M3	FY13 AMWTP actual costs	
Characterization	LQS CCP Cost to AMWTP (GFE)	CCP_LQS_AMWTP	5.93	FY17$K/M3	Per email from Tom Carver (CBFO) on 11/22/16 to Jamie Joyce	Assumed 90 55-gal drums/week and 50 weeks/year
Characterization	LQS CCP Cost to WIPP (GFE)	CCP_LQS_WIPP	9.75	FY17$K/M3	Per email from Tom Carver (CBFO) on 11/22/16 to Jamie Joyce (EM-4)	Assumed 90 55-gal drums/week and 50 weeks/year
Characterization	SQS CCP Cost to AMWTP (Lease)	CCP_SQS_AMWTP	7.53	FY17$K/M3	Per email from Tom Carver (CBFO) on 11/22/16 to Jamie Joyce (EM-4)	Assumed 60 55-gal drums/week and 50 weeks/year
Characterization	SQS CCP Cost to WIPP (Lease)	CCP_SQS_WIPP	11.21	FY17$K/M3	Per email from Tom Carver (CBFO) on 11/22/16 to Jamie Joyce (EM-4)	Assumed 60 55-gal drums/week and 50 weeks/year
Characterization	Richland Generator Acceptable Knowledge Documentation	RL_Gen_AK	5,250.00	FY17$K	3/22/18 telecon with RL personnel (Linda Maiden, et al)	$350k per waste stream, assume 15 waste streams per phase
Characterization	SQS Generator Acceptable Knowledge Documentation	SQS_Gen_AK	350.00	FY17$K	See Comments	$350k per waste stream, assume 1 waste streams per phase
Containers	Drum (100 gal) Internal Volume	Drum100_Vol_Int	0.378	M3	Reference Value	
Containers	Drum (100 gal) WIPP Volume	Drum100_Vol_WIPP	0.778	M3	3 pack configuration	72 in diameter, 35 in height
Containers	Drum (55 gal) Internal Volume	Drum55_Vol_Int	0.21	M3	Reference Value	
Containers	Drum (55 gal) WIPP Volume	Drum55_Vol_WIPP	0.334	M3	7 pack configuration	72 in diameter, 35 in height
Containers	SLB2 Internal Volume	SLB2_Vol_Int	7.39	M3	Reference Value	
Containers	SWB Internal Volume	SWB_Vol_Int	1.88	M3	Reference Value	
Containers	SWB WIPP Volume	SWB_Vol_WIPP	2.34	M3	Reference Value	
M/LLW	Commercial Disposal	Comm_Disposal	1.83	FY17$K/M3	Class A - based on Contract DE-EM0002406 (MLLW drums by truck)	
M/LLW	Commercial Macroencapsulation	Comm_Macro	3.49	FY17$K/M3	Email from Ben Leake (DOE-ID) to Jamie Joyce (EM-4) on 9/19/16 - Class A MLLW treatment (Macro)	
M/LLW	ERDF Disposal Costs	ERDF_Disposal	0.14	FY17$K/M3	http://www.wmsym.org/archives/1998/html/sess19/19-06/19-06.htm	Per source cost was $2.59/ft3 in 1998

Category	Variable	Range Name	Value	Units	Source	Comments
Repack	Hanford RH TRU Difficulity Correction Factor	RL_RHDifficulty	75%	Percent	Assumed that CH is less costly than the CH/RH composite	
Repack	Hanford TRU Unit Repack Cost (CH/RH Composite)	RL_Repack_Ops	73	FY17$K/M3	Calculated based on HNF-19169 Rev 18 and CHPRC-02916 Rev 0 (see RL_Costs worksheet)	
Repack	Repackaging Vol Reduction	Repack_PctNonTRU	33%	% that is LLW/MLLW	Hanford value per Jaime Joyce (EM-4) Hanford trip notes (3/3 - 3/4/15)	
Repack	SQS Permacon Capital	SQS_Repack_Cap	12,000	FY17$K	LANL Box Line 375 estimate per V. Rhodes, LANL	
Repack	SQS Permacon Operating	SQS_Repack_Ops	24	FY17$K/M3	LANL Box Line 375 cost estimate	$6.9M for 35 boxes. Used 8.2 M3 per box per LANL De-Inventory Plan (EP2012-5025, Page 35)
Repack	NNSS Repack for Spheres	NNSS_Repack_Ops_Spheres	9,300	FY17$K	DOE Idaho	Feasibility Study for the Disposition of Two Confinement Vessels from Nevada National Security Site at Los Alamos National Laboratory (LA-CP-16-20247). Issued 5/23/16
RL TRU Disposition	Hanford TRU Unit Disposition Cost (CH/RH Composite)	RL_TRUDisp_Ops	13	FY17$K/M3	Calculated based on HNF-19169 Rev 18 and CHPRC-02916 Rev 0 (see RL_Costs worksheet)	
Transportation	AMWTP 100 gal Drums/Shipment	Ship_Cap_100gal	15	100 gal drums/shipment	Talley Jenkins, DOE-ID	
Transportation	Distance - AMWTP to WIPP	Distance_AMWTP_WIPP	1,088	Miles	Google Search	
Transportation	Distance - Hanford to AMWTP	Distance_RL_AMWTP	572	Miles	Google Search	
Transportation	Distance - Hanford to WIPP	Distance_RL_WIPP	1,504	Miles	Google Search	
Transportation	Distance - LANL to AMWTP	Distance_LANL_AMWTP	806	Miles	Google Search	
Transportation	Distance - LANL to WIPP	Distance_LANL_WIPP	308	Miles	Google Search	
Transportation	Distance - LLNL to AMWTP	Distance_LLNL_AMWTP	829	Miles	Google Search	
Transportation	Distance - LLNL to WIPP	Distance_LLNL_WIPP	1,300	Miles	Google Search	
Transportation	Drums/SWB w/Prohibitive Items	TypeB_CoC	2,000	FY17$K	Jeff England, SRNL	Cost to license new content in Type B DOE CoC (TRUPACT-II, TRUPACT-III and/or HalfPact)
Transportation	Large Boxes Type B Equivalent Exemption (3A)	TYpeB_Equivalency	2,000	FY17$K	Jeff England, SRNL	Equivalent safety demonstration
	Large Box New Type B Equiv. Exemption (3B)	TypeB_3B Equivalency	9,000	$k		
Transportation	Large/Over-Sized Boxes per Shipment	Ship_Cap_LargeBox	1	Box/Shipment		
Transportation	Procure Type B Equivalent Packaging for Large Boxes	TypeB_Enhance	1,000	FY17$K	Jeff England, SRNL	Assumes TL-1800 packaging would be structurally re-inforced to meet 10 CFR 71 criteria
Transportation	Procure Type B Packaging and Stand Up AMWTP Transportation Program	AMWTP_TransProgram	17,000	$k	Jeff England, SRNL; V. Rhodes, LANL	Assumes purchasing/lease of Type B packages

Category	Variable	Range Name	Value	Units	Source	Comments
Transportation	Shipping - Hanford to AMWTP	Ship_RL_AMWTP	29.40	FY17 $k/Shipment	Carlsbad FY13 EV Reporting	Based on 20 shipments/wk, 52 wk/yr (Reduced by difference in distance from Hanford to WIPP and Hanford to AMWTP at $5.50/mile round trip)
Transportation	Shipping - LANL to AMWTP	Ship_LANL_AMWTP	31.79	FY17 $k/Shipment	Carlsbad FY13 EV Reporting	Based on 20 shipments/wk, 52 wk/yr (Reduced by difference in distance from LANL to WIPP and LANL to AMWTP at $5.50/mile round trip)
Transportation	Shipping - LLNL to AMWTP	Ship_LLNL_AMWTP	31.93	FY17 $k/Shipment	Carlsbad FY13 EV Reporting	Based on 20 shipments/wk, 52 wk/yr (Reduced by difference in distance from LLNL to WIPP and LLNL to AMWTP at $5.50/mile round trip)
Transportation	Shipping to AMWTP Based on WIPP PBS-90	Ship_AMWTP	34.53	FY17 $k/Shipment	Carlsbad FY13 EV Reporting	Based on 20 shipments/wk, 52 wk/yr
Transportation	Shipping to WIPP Full PBS-90	Ship_WIPP	35.52	FY17 $k/Shipment	Carlsbad FY13 EV Reporting	
Transportation	Tractor/Trailer Capacity	TRUPACT2_PerTruck	3	TRUPACT-II/Truck	Reference Value	
Transportation	Tractor/Trailer Capacity	TRUPACT3_PerTruck	1	TRUPACT-III/Truck	Reference Value	
Transportation	TRUPACT-II Capacity - 55 gal drums	TRUPACT2_Cap_55gal	14	55 gal drums/TRUPACT-II	Reference Value	
Transportation	TRUPACT-II Capacity - SWB	TRUPACT2_Cap_SWB	2	SWB/TRUPACT-II	Reference Value	
Transportation	TRUPACT-III Capacity	TRUPACT3_Cap_SLB2	1	SLB2/TRUPACT-III	Reference Value	
Transportation	Generator Site Payloading	Generating_Payloading	0.42	FY17$K/M3	FY13 AMWTP actual costs	
Transportation	WRAP Restart for Characterization/Payloading	WRAP_Restart	20,000	$K	DOE-RL to J. Joyce (EM-4) 3/8/18 VTC and 8/7/18 Telecon	
Transportation	RL Shipping Support	RL_Ship_Support	20,000	FY17$K	Email from Linda Maiden (Hanford) on 3/22/18	It is assumed that the CBFO NTP CCP costs for shipment to AMWTP or WIPP do not include costs that would be borne by Hanford for its work force for drum handling, nondestructive assay, nondestructive evaluation, and pay loading ($20M). Assumed to apply to Phase 1, 2, and 3
Transportation	SQS Shipping Support	SQS_Ship_Support	3,800	FY17$K	See Comments	Based off NNSA estimate for LLNL Phase 1
Treatment	AMWTP Compaction Vol Reduction	Compact_PctVol_Reduce	60%	% Vol Reduction	Talley Jenkins, DOE-ID	4 to 5 55 gal drums into a 100 gal product drum, per 11-16-16 call with AMWTP Report team
Treatment	Non-Debris Volume Increase	NonDebris_PctVol_Increase	50%	%Increase	Assumed	Volume increase due to treatment of sludges/non-debris

Category	Variable	Range Name	Value	Units	Source	Comments
WIPP	WIPP Mining Costs	Mining_Costs	656	FY17 $k/room	GTCC LLW EIS, Pre-Closure Assessment Data Package, October 2008, Section 7.1.1 (2008$)	
WIPP	WIPP Mining post-accident operating cost	WIPP_Increase	61%	% increase	Based on FY18 IPL, excluding Line Items ($239,774), relative to pre-accident operational baseline $149,085k (IPABS FY13 CB-0080 actuals, escalated to FY17$)	
WIPP	WIPP Utilization	WIPP_M3_Room	2,278	M3 Waste/Room	Waste Isolation Pilot Plant Hazardous Waste Permit, October 2016, Permit Part 4, Page 4-2 of 16	

Cost Analysis Results – Business Case

Waste/Disposition Alternatives				Processing/Disposition Volumes (M3)						On Site/Commercial Repackaging		CBFO CCP for Shipment to AMWTP or Direct to WIPP	AMWTP CCP for Shipment to AMWTP (Phases 2/3)	Generator Shipping Support (Phase 1/2/3)	Generator AK Prep.	Shipment to AMWTP			AMWTP Costs							WIPP Disposal				
Site	Waste Category		Disposition Alternative	Segregated TRU Debris	Non-Debris TRU	M/LLW	WIPP Waste Volume	WIPP Emplacement Volume	WIPP Rooms	Capital/ Re-start	Operating					#	Package Development/ Procurement/ Maintenance	Transport Cost	Base Ops	Box Line/ Repack	Compac-tion	Non-Debris Treatment	M/LLW	CCP	TRU Ship Prep	# Shipments	Shipment Cost	Capacity Cost	Total Cost	AMWTP Alternative Minus Onsite Alternative
Hanford	Phase 1 (Onsite)	1	Total 2,200 m3 Onsite CCP/WIPP	1,802	398	0	2,200	3,105	1.36	$20,000	$0	$21,453	$0	$20,000	$5,250	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	221	$8,792	$1,439	$76,934	
Hanford	Phase 1 (AMWTP) (Existing TRUPACTs)	2	Total 2,200 m3 AMWTP	1,802	398	0	1,126	2,320	1.02	$20,000	$0	$13,044	$0	$20,000	$5,250	221	$0	$6,510	$67,584	$5,744	$2,000	$0	$0	$1,239	$1,036	199	$7,056	$1,075	$150,538	**$73,604**
Hanford	Phase 2 (Onsite)	1	807 m3 Commercial Trtmnt/ Onsite CCP/WIPP	524	24	259	560	697	0.31	$0	$32,261	$5,465				0	$0	$0	$0	$0	$0	$0	$0	$0	$0	50	$2,001	$323	$40,050	
		1	1,230 m3 New Onsite Trtmnt/ WIPP	799	37	394	855	1,063	0.47	$0	$79,506	$8,335				0	$0	$0	$0	$0	$0	$0	$0	$0	$0	76	$3,051	$493	$91,385	
		1	Total 2,037 m3 Commercial/New Onsite Composite	1,324	61	653	1,415	1,760	0.77	$0	$111,767	$13,800	$0	$20,000	$5,250	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	125	$5,052	$816	$156,685	
Hanford	Phase 2 (AMWTP) (Revised Type B CoC)	2a	Total 2,037 m3 AMWTP	1,330	51	655	614	1,265	0.56	$0	$0	$0	$12,075	$20,000	$5,250	625	$17,000	$18,374	$62,562	$7,861	$2,203	$2,108	$1,450	$676	$565	108	$3,849	$587	$154,562	**-$2,123**
		2b	807 m3 Commercial Trtmnt/ Onsite CCP/WIPP	524	24	259	560	697	0.31	$0	$32,261	$5,465	$0			0	$0	$0	$0	$0	$0	$0	$0	$0	$0	50	$2,001	$323	$40,050	
		2b	1,230 m3 AMWTP	799	37	394	378	779	0.34	$0	$0	$0	$7,293			455	$17,000	$13,374	$37,786	$4,725	$1,324	$1,514	$872	$416	$348	67	$2,370	$361	$87,382	
		2b	Total 2,037 m3 Commercial/AMWTP Combo	1,324	61	653	939	1,476	0.65	$0	$32,261	$5,465	$7,293	20,000	$5,250	455	$17,000	$13,374	$37,786	$4,725	$1,324	$1,514	$872	$416	$348	116	$4,371	$684	$152,682	**-$4,003**
Hanford	Phase 3A (Onsite)	1	1,006 m3 Commercial Trtmnt/ Onsite CCP/WIPP	654	30	322	699	869	0.38	$0	$40,240	$6,817				0	$0	$0	$0	$0	$0	$0	$0	$0	$0	62	$2,496	$403	$49,956	
		1	597 m3 New Onsite Trtmnt/ WIPP	388	18	191	415	516	0.23	$0	$38,590	$4,045				0	$0	$0	$0	$0	$0	$0	$0	$0	$0	37	$1,481	$239	$44,355	
		1	Total 1,603 m3 Commercial/New Onsite Composite	1,042	48	513	1,114	1,385	0.61	$0	$78,830	$10,862	$0	$20,000	$5,250	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	99	$3,977	$642	$119,561	
Hanford	Phase 3A (AMWTP) (Modified Type B Equiv)	2a	1,603 m3 AMWTP	1,042	48	513	493	1,015	0.45	$0	$0	$0	$9,504	$20,000	$5,250	121	$3,000	$3,557	$49,244	$6,157	$1,726	$1,973	$1,136	$542	$454	87	$3,089	$471	$106,103	**-$13,457**
		2b	1,006 m3 Commercial Trtmnt/ Onsite CCP/WIPP	654	30	322	699	869	0.38	$0	$40,240	$6,817				0	$0	$0	$0	$0	$0	$0	$0	$0	$0	62	$2,496	$403	$49,956	
		2b	597 m3 AMWTP	388	18	191	184	378	0.17	$0	$0	$0	$3,540			58	$3,000	$1,705	$18,340	$2,293	$643	$735	$423	$202	$169	32	$1,150	$175	$32,375	
		2b	Total 1,603 m3 Commercial/AMWTP Combo	1,042	48	513	883	1,248	0.55	$0	$40,240	$6,817	$3,540	$20,000	$5,250	58	$3,000	$1,705	$18,340	$2,293	$643	$735	$423	$202	$169	94	$3,646	$578	$107,581	**-$11,980**
Hanford	Phase 3B (Onsite)	1	1,690 m3 Commercial Trtmnt/ Onsite CCP/WIPP	1,098	51	541	1,174	1,461	0.64	$0	$67,600	$11,452				0	$0	$0	$0	$0	$0	$0	$0	$0	$0	104	$4,193	$677	$83,921	
		1	1,692 m3 New Onsite Trtmnt/WIPP	1,100	51	542	1,176	1,462	0.64	$0	$109,369	$11,465				0	$0	$0	$0	$0	$0	$0	$0	$0	$0	104	$4,198	$678	$125,710	
		1	Total 3,382 m3 Commercial/Onsite Composite	2,198	101	1,083	2,350	2,923	1.28	$0	$176,969	$22,917	$0	$20,000	$5,250	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	208	$8,390	$1,355	$234,882	
Hanford	Phase 3B (AMWTP) (New Type B Equiv)	2a	3,382 m3 AMWTP	2,198	101	1,083	1,040	2,142	0.94	$0	$0	$0	$20,052	$20,000	$5,250	72	$10,000	$2,117	$103,895	$12,991	$3,641	$4,162	$2,397	$1,144	$957	183	$6,516	$993	$194,116	**-$40,765**
		2b	1,690 m3 Commercial Trtmnt/ Onsite CCP/WIPP	1,098	51	541	1,174	1,461	0.64	$0	$67,600	$11,452				0	$0	$0	$0	$0	$0	$0	$0	$0	$0	104	$4,193	$677	$83,921	
		2b	1,692 m3 AMWTP	1,100	51	542	520	1,072	0.47	$0	$0	$0	$10,032			34	$10,000	$1,000	$51,978	$6,499	$1,822	$2,082	$1,199	$572	$479	92	$3,260	$497	$89,421	
		2b	Total 3,382 m3 Commercial/AMWTP Combo	2,198	101	1,083	1,695	2,532	1.11	$0	$67,600	$11,452	$10,032	$20,000	$5,250	34	$10,000	$1,000	$51,978	$6,499	$1,822	$2,082	$1,199	$572	$479	196	$7,453	$1,174	$198,592	**-$36,289**

Waste/Disposition Alternatives				Processing/Disposition Volumes (M3)						On Site/Commercial Repackaging		CBFO CCP for Shipment to AMWTP or Direct to WIPP	AMWTP CCP for Shipment to AMWTP (Phases 2/3)	Generator Shipping Support (Phase 1/2/3)	Generator AK Prep.	Shipment to AMWTP			AMWTP Costs							WIPP Disposal				
Site	Waste Category		Disposition Alternative	Segregated TRU Debris	Non-Debris TRU	M/LLW	WIPP Waste Volume	WIPP Emplacement Volume	WIPP Rooms	Capital/ Re-start	Operating					#	Package Development/ Procurement/ Maintenance	Transport Cost	Base Ops	Box Line/ Repack	Compac-tion	Non-Debris Treatment	M/LLW	CCP	TRU Ship Prep	# Shipments	Shipment Cost	Capacity Cost	Total Cost	AMWTP Alternative Minus Onsite Alternative
SQS	Phase1 (Onsite)	1	302 m3 Onsite CCP/WIPP	302	0	0	302	370	0.16	$0	$0	$3,385	$0	$3,800	$350	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	26	$1,065	$171	$8,771	
	Phase 1 (AMWTP)	2	Ship 302 m3 to AMWTP	302	0	0	122	251	0.11	$0	$0	$2,273	$0	$3,800	$350	26	$0	$843	$1,558	$0	$335	$0	$0	$134	$112	22	$764	$116	$10,287	**$1,515**
SQS	Phase 2 (Onsite)	1	14 m3 Treated at LANL and Commerical Facility/WIPP [Shipment to AMWTP Cells are for shipment to LANL/Commercial]	9	0	5	9	12	0.01	$0	$9,540	$105	$0	$3,800	$350	4	$0	$128	$0	$0	$0	$0	$0	$0	$0	2	$75	$5	$14,003	
	Phase 2 (AMWTP)	2	14 m3 Treated at AMWTP	9	0	5	4	8	0.00	$0	$0	$0	$105	$3,800	$350	2	$0	$64	$72	$55	$16	$0	$10	$4	$3	1	$24	$4	$4,508	**-$9,496**
SQS	Phase 3A (Onsite)	1	120 m3 Treated at New Onsite/WIPP	80	0	40	80	100	0.04	$12,000	$2,885	$901	$0	$3,800	$350	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	7	$287	$46	$20,270	
	Phase 3 A (AMWTP)	2	120 m3 Treated at AMTWP	80	0	40	32	67	0.03	$0	$0	$0	$903	$3,800	$350	25	$0	$798	$619	$475	$133	$0	$88	$36	$30	6	$203	$31	$7,467	**-$12,803**

Notes:

- WIPP shipments for on-site options assume waste is packaged in a standard waste box.
- Shipments from AMWTP to WIPP assume 100-gallon overpacks/5 pucks for over pack.
- WIPP Rooms are dependent on actual waste form and packaging.
- Hanford Phase 2 shipments to AMWTP assume oversized boxes are transported in TRUPACT-III, which accounts for the relatively large number of shipments.

Hanford On-Site Composite Cost Basis

Source: M-091 Transuranic Mixed/Mixed Low-Level Waste Project Management Plan (HNF-19169, Rev 18) - Figure 8-1

		Current $k														
WBS- Scope	Total	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
013.01 - PBS RL-13-Project Management	**310,551**	16,938	16,435	17,036	24,886	26,102	27,284	28,863	29,446	30,612	32,914	20,776	9,136	9,631	9,998	10,494
013.04 - Treatment MLLW	**5,304**	0	0	0	0	0	0	483	491	511	549	589	623	653	686	719
013.05 - TRU Retrieval	**264,289**	0	0	0	0	0	0	0	0	31,968	60,350	61,500	98,987	11,484	0	0
013.06 - TRU Repackaging	**647,296**	20,000	20,460	20,920	21,380	28,392	28,990	29,588	30,186	30,784	31,382	75,030	76,433	77,836	79,239	76,676
013.07 - WRAP	**98,321**	4,831	4,948	3,472	3,473	3,630	2,753	5,690	8,127	8,288	8,449	8,610	8,771	8,932	9,093	9,254
013.08 - T Plant	**799,311**	16,691	18,373	16,189	18,173	37,128	44,600	45,520	142,803	146,816	161,738	68,880	20,048	20,416	20,784	21,152
013.09 - CWC	**167,164**	12,695	10,729	11,298	12,701	12,535	13,412	13,410	13,495	14,065	7,511	8,552	8,525	8,945	9,420	9,871
013.10 - ERDF	**37,439**	0	0	0	3	1	1	145	145	152	163	13,921	8,191	8,584	5,920	213
013.12 - IDF	**104,136**	1,111	352	360	464	503	526	4,022	4,098	7,244	22,368	38,867	7,197	5,408	5,699	5,917
013.15 - TRU Disposition	**218,184**	0	0	0	0	0	0	0	0	11,840	12,070	31,980	37,590	40,832	41,568	42,304
013.21 - Mixed Waste Disposal Trenches	**5,337**	594	607	620	574	603	597	569	581	592	0	0	0	0	0	0
Total	**2,657,332**	**72,860**	**71,904**	**69,895**	**81,654**	**108,894**	**118,163**	**128,290**	**229,372**	**282,872**	**337,494**	**328,705**	**275,501**	**192,721**	**182,407**	**176,600**
Current $k (13.01 Pro-rated across other WBS Elements)																
013.04 - Treatment MLLW	**5,819**	0	0	0	0	0	0	623	563	573	608	629	644	687	726	764
013.05 - TRU Retrieval	**282,839**	0	0	0	0	0	0	0	0	35,847	66,872	65,649	102,382	12,088	0	0
013.06 - TRU Repackaging	**734,565**	26,058	26,522	27,662	30,753	37,343	37,693	38,177	34,632	34,520	34,773	80,092	79,055	81,930	83,834	81,520
013.07 - WRAP	**113,094**	6,294	6,414	4,591	4,995	4,774	3,580	7,342	9,324	9,294	9,362	9,191	9,072	9,402	9,620	9,839
013.08 - T Plant	**926,581**	21,746	23,817	21,407	26,140	48,833	57,990	58,734	163,836	164,632	179,216	73,527	20,736	21,490	21,989	22,488
013.09 - CWC	**202,284**	16,540	13,908	14,939	18,269	16,487	17,439	17,303	15,483	15,772	8,323	9,129	8,817	9,416	9,966	10,495
013.10 - ERDF	**39,569**	0	0	0	4	1	1	187	166	170	181	14,860	8,472	9,036	6,263	226
013.12 - IDF	**114,138**	1,448	456	476	667	662	684	5,190	4,702	8,123	24,785	41,489	7,444	5,692	6,029	6,291
013.15 - TRU Disposition	**231,603**	0	0	0	0	0	0	0	0	13,277	13,374	34,138	38,879	42,980	43,979	44,977
013.21 - Mixed Waste Disposal Trenches	**6,840**	774	787	820	826	793	776	734	667	664	0	0	0	0	0	0
Total	**2,657,332**	**72,860**	**71,904**	**69,895**	**81,654**	**108,894**	**118,163**	**128,290**	**229,372**	**282,872**	**337,494**	**328,705**	**275,501**	**192,721**	**182,407**	**176,600**
FY17$k (13.01 Pro-rated across other WBS Elements)																
013.04 - Treatment MLLW	**4,726**	0	0	0	0	0	0	556	491	489	507	512	513	535	552	569
013.05 - TRU Retrieval	**230,792**	0	0	0	0	0	0	0	0	30,572	55,749	53,500	81,558	9,413	0	0
013.06 - TRU Repackaging	**618,135**	26,657	26,522	27,040	29,385	34,881	34,416	34,074	30,215	29,440	28,989	65,269	62,975	63,799	63,814	60,657
013.07 - WRAP	**96,942**	6,439	6,414	4,488	4,773	4,460	3,268	6,553	8,135	7,926	7,805	7,490	7,227	7,321	7,323	7,321
013.08 - T Plant TRU Above Base Ops	**482,715**	22,247	23,817	20,925	24,978	45,613	52,948	52,422	142,940	140,406	149,407	59,919	16,518	16,734	16,738	16,733
013.09 - CWC (Excluded)	**180,741**	16,921	13,908	14,603	17,457	15,400	15,922	15,443	13,508	13,451	6,938	7,439	7,024	7,332	7,586	7,809
013.10 - ERDF	**31,445**	0	0	0	4	1	1	167	145	145	151	12,110	6,749	7,036	4,768	169
013.12 - IDF	**94,051**	1,481	456	465	638	618	624	4,632	4,102	6,928	20,663	33,811	5,930	4,433	4,590	4,681
013.15 - TRU Disposition	**181,674**	0	0	0	0	0	0	0	0	11,323	11,150	27,820	30,971	33,468	33,476	33,466
013.21 - Mixed Waste Disposal Trenches	**6,421**	792	787	801	789	741	709	655	582	566	0	0	0	0	0	0
Total	**1,927,643**	**74,536**	**71,904**	**68,324**	**78,024**	**101,713**	**107,889**	**114,502**	**200,118**	**241,246**	**281,359**	**267,871**	**219,466**	**150,071**	**138,846**	**131,404**

Total Processing Costs	**1,202,518**	(Treatment MLLW, TRU Repackaging, WRAP, and T Plant)
RH/Large Box Capital Costs	**192,677**	(original capital costs)
Processing Costs (Excluding Capital)	**1,009,841**	
Unit Processing Costs (Excluding Capital)	**73**	
Unit TRU Disposition Costs	**13**	

Source: M-091 Transuranic Mixed/Mixed Low-Level Waste Project Management Plan (HNF-19169, Rev 18) - Figure 8-1

AMWTP Operating Costs

Title	Function:	Base Ops	SQS Base Ops	Box Line/ Repack	M/LLW	Compaction	CCP	TRU Ship Prep	Gen Payloading	Resource	FY13	Burdened	FY17$
Characterization Management	AMWTP CCP	X	X							Labor	1,196,844	1,573,341	1,723,159
Characterization Management	AMWTP CCP	X	X							Materials	2,341	3,077	3,370
Characterization Management	AMWTP CCP	X	X							Service Subcontracts	45,302	59,553	65,224
Characterization Management	AMWTP CCP	X	X							Subcontracts	34,338	45,140	49,438
Characterization Management	AMWTP CCP	X	X							Travel	1,377	1,810	1,983
Characterization Other TRU	AMWTP CCP						X			Labor	484,081	636,361	696,957
Characterization Other TRU	AMWTP CCP						X			Travel	70	92	101
Operations RTR	AMWTP CCP	X	X							Labor	888,510	1,168,013	1,279,234
Operations RTR	AMWTP CCP	X	X							Materials	25,909	34,059	37,303
Operations RTR	AMWTP CCP	X	X							Service Subcontracts	-2,279	-2,996	-3,281
Operations NDA	AMWTP CCP	X	X							Labor	2,687,169	3,532,484	3,868,858
Operations NDA	AMWTP CCP	X	X							Materials	761	1,000	1,096
Operations NDA	AMWTP CCP	X	X							Service Subcontracts	1,905,664	2,505,138	2,743,684
Operations NDA	AMWTP CCP	X	X							Subcontracts	441,829	580,817	636,124
Drum Venting & HSG	AMWTP CCP	X	X							Labor	157,085	206,500	226,164
Drum Venting & HSG	AMWTP CCP	X	X							Materials	103,244	135,722	148,646
Drum Venting & HSG	AMWTP CCP	X	X							Service Subcontracts	519,103	682,400	747,380
Solids Coring	AMWTP CCP	X	X							Labor	41,074	53,995	59,136
Solids Coring	AMWTP CCP	X	X							Materials	24,359	32,022	35,071
TRU Validation - Level I	AMWTP CCP						X			Labor	726,652	955,238	1,046,199
TRU Validation - Level I	AMWTP CCP						X			Materials	2,504	3,292	3,605
TRU Validation - Level I	AMWTP CCP						X			Travel	0	0	0
TRU Validation - Level II	AMWTP CCP						X			Labor	525,472	690,772	756,550
TRU Validation - Level II	AMWTP CCP						X			Materials	112	147	161
TRU Validation - Level II	AMWTP CCP						X			Subcontracts	0	0	0
TRU Validation - Level II	AMWTP CCP						X			Training		0	0
TRU Validation - Level II	AMWTP CCP						X			Travel	3,341	4,392	4,810
Recon/TRU Certification	AMWTP CCP						X			Labor	272,657	358,428	392,559
Recon/TRU Certification	AMWTP CCP						X			Materials		0	0
Recon/TRU Certification	AMWTP CCP						X			Service Subcontracts	1,741,581	2,289,438	2,507,445
Recon/TRU Certification	AMWTP CCP						X			Travel	2,958	3,889	4,259
Source Term Development	AMWTP CCP				X					Labor	23,103	30,371	33,263
Source Term Development	AMWTP CCP				X					Subcontracts	334,251	439,398	481,239
Characterization Maintenance	AMWTP CCP	X								Labor	345,966	454,798	498,105
Characterization Maintenance	AMWTP CCP	X								Materials	478,415	628,912	688,799
Characterization Maintenance	AMWTP CCP	X								Service Subcontracts	114,298	150,253	164,561
Characterization Maintenance	AMWTP CCP	X								Travel		0	0
Acceptable Knowledge	AMWTP CCP	X	X							Labor	434,830	571,617	626,048
Acceptable Knowledge	AMWTP CCP	X	X							Subcontracts	273,809	359,942	394,217
Acceptable Knowledge	AMWTP CCP	X	X							Travel	1,905	2,504	2,743
Production Planning	Base Ops	X								Labor	1,356,099	1,782,693	1,952,447
Production Planning	Base Ops	X								Materials	0	0	0
Production Planning	Base Ops	X								Service Subcontracts		0	0
Production Planning	Base Ops	X								Subcontracts		0	0
Production Planning	Base Ops	X								Travel		0	0
Treatment Facility General	Base Ops	X								Labor	2,665,042	3,503,397	3,837,001
Treatment Facility General	Base Ops	X								Materials	25,380	33,364	36,541
Treatment Facility General	Base Ops	X								Subcontracts		0	0
Treatment Facility General	Base Ops	X								Travel	770	1,012	1,109

Title	Function:	Base Ops	SQS Base Ops	Box Line/ Repack	M/LLW	Compaction	CCP	TRU Ship Prep	Gen Payloading	Resource	FY13	Burdened	FY17$
Treatment Facility Maintenance	Base Ops	X								Equipment	30,617	40,248	44,081
Treatment Facility Maintenance	Base Ops	X								Labor	1,605,393	2,110,409	2,311,368
Treatment Facility Maintenance	Base Ops	X								Materials	1,538,052	2,021,884	2,214,414
Treatment Facility Maintenance	Base Ops	X								Service Subcontracts	79,579	104,613	114,574
Treatment Facility Maintenance	Base Ops	X								Subcontracts	1,235	1,623	1,778
Treatment Facility Maintenance	Base Ops	X								Travel	175	230	252
Payload Assembly	Base Ops							X		Labor	189,786	249,488	273,245
Payload Assembly	Base Ops							X		Materials	7,252	9,533	10,441
Payload Assembly	Base Ops							X		Travel	2,695	3,543	3,880
TRUPACT Operations	Base Ops							X		Labor	625,314	822,022	900,297
TRUPACT Operations	Base Ops							X		Materials	28,178	37,042	40,569
TRUPACT Operations	Base Ops							X		Service Subcontracts	30,059	39,515	43,278
TRU Payload Assembly	Base Ops							X	X	Labor	413,560	543,656	595,424
TRU Payload Assembly	Base Ops							X	X	Materials	1,008,163	1,325,306	1,451,505
TRU Payload Assembly	Base Ops							X	X	Service Subcontracts	10,154	13,348	14,619
TRU Payload Assembly	Base Ops							X	X	Subcontracts		0	0
TRU Payload Assembly	Base Ops							X	X	Travel	1,730	2,274	2,491
TRU Transportation/Shipping	Base Ops							X		Equipment	354	465	510
TRU Transportation/Shipping	Base Ops							X		Labor	599,570	788,180	863,232
TRU Transportation/Shipping	Base Ops							X		Materials	10,327	13,576	14,868
TRU Transportation/Shipping	Base Ops							X		Service Subcontracts	284	373	409
TRU Transportation/Shipping	Base Ops							X		Training	2,290	3,010	3,297
TRU Transportation/Shipping	Base Ops							X		Travel	8,920	11,726	12,843
Other Transportation/Shipping	Base Ops							X		Labor	44,020	57,868	63,378
Other Transportation/Shipping	Base Ops							X		Materials	42	55	60
Other Transportation/Shipping	Base Ops							X		Service Subcontracts		0	0
Maintenance Transportation/Shipping	Base Ops							X		Equipment		0	0
Maintenance Transportation/Shipping	Base Ops							X		Labor	126,493	166,285	182,119
Maintenance Transportation/Shipping	Base Ops							X		Materials	29,475	38,747	42,437
Nuclear Assurance	Base Ops	X								Labor	311,436	409,406	448,391
Nuclear Assurance	Base Ops	X								Materials	2,093	2,751	3,013
Nuclear Assurance	Base Ops	X								Service Subcontracts		0	0
Nuclear Assurance	Base Ops	X								Subcontracts	126,981	166,926	182,821
Nuclear Assurance	Base Ops	X								Travel	1,676	2,203	2,413
Project Management	Base Ops	X								Labor	628,977	826,837	905,571
Project Management	Base Ops	X								Materials	2,589	3,403	3,728
Project Management	Base Ops	X								Other Direct Costs	2,350	3,089	3,383
Project Management	Base Ops	X								Service Subcontracts	64,887	85,299	93,421
Project Management	Base Ops	X								Subcontracts	1,190,496	1,564,996	1,714,019
Project Management	Base Ops	X								Training	156,941	206,311	225,956
Project Management	Base Ops	X								Travel	46,632	61,301	67,139
Legal	Base Ops	X								Service Subcontracts	40,058	52,659	57,674
Legal	Base Ops	X								Training		0	0
Legal	Base Ops	X								Travel		0	0
Human Resources	Base Ops	X								Labor	492,768	647,780	709,464
Human Resources	Base Ops	X								Materials	22	29	32
Human Resources	Base Ops	X								Other Direct Costs		0	0
Human Resources	Base Ops	X								Service Subcontracts	103,598	136,187	149,155
Human Resources	Base Ops	X								Training	970	1,275	1,397
Human Resources	Base Ops	X								Travel	872	1,146	1,255
Project Controls	Base Ops	X								Labor	627,750	825,224	903,805
Project Controls	Base Ops	X								Materials	796	1,046	1,146
Project Controls	Base Ops	X								Service Subcontracts		0	0
Project Controls	Base Ops	X								Subcontracts	178,410	234,533	256,866
Project Controls	Base Ops	X								Training	7,834	10,298	11,279
Project Controls	Base Ops	X								Travel	12,347	16,231	17,777

Title	Function:	Base Ops	SQS Base Ops	Box Line/ Repack	M/LLW	Compaction	CCP	TRU Ship Prep	Gen Payloading	Resource	FY13	Burdened	FY17$
Procurement	Base Ops	X								Labor	991,532	1,303,443	1,427,561
Procurement	Base Ops	X								Materials	318,219	418,323	458,157
Procurement	Base Ops	X								Other Direct Costs	121	159	174
Procurement	Base Ops	X								Service Subcontracts	5,398,240	7,096,390	7,772,129
Procurement	Base Ops	X								Training	498	655	717
Procurement	Base Ops	X								Travel	30,913	40,637	44,507
Financial / Accounting	Base Ops	X								Labor	415,452	546,143	598,148
Financial / Accounting	Base Ops	X								Materials	569	748	819
Financial / Accounting	Base Ops	X								Service Subcontracts	101,253	133,105	145,779
Financial / Accounting	Base Ops	X								Subcontracts	36,587	48,096	52,676
Financial / Accounting	Base Ops	X								Training	500	657	720
Financial / Accounting	Base Ops	X								Travel	847	1,113	1,219
Internal Audit/PA	Base Ops	X								Labor	263,436	346,306	379,283
Internal Audit/PA	Base Ops	X								Subcontracts	59,170	77,783	85,190
Internal Audit/PA	Base Ops	X								Training	255	335	367
Internal Audit/PA	Base Ops	X								Travel	4,363	5,735	6,282
Central Engineering Management	Base Ops	X								Equipment	2,067	2,717	2,976
Central Engineering Management	Base Ops	X								Labor	202,621	266,360	291,724
Central Engineering Management	Base Ops	X								Service Subcontracts	-77	-101	-111
Central Engineering Management	Base Ops	X								Subcontracts	-197,586	-259,742	-284,475
Central Engineering Management	Base Ops	X								Training	145	191	209
Central Engineering Management	Base Ops	X								Travel	4,807	6,319	6,921
System Engineering	Base Ops	X								Labor	1,561,819	2,053,128	2,248,633
System Engineering	Base Ops	X								Materials	71,325	93,762	102,690
System Engineering	Base Ops	X								Service Subcontracts	41,373	54,388	59,567
System Engineering	Base Ops	X								Subcontracts	1,573,521	2,068,511	2,265,481
System Engineering	Base Ops	X								Training	2,037	2,678	2,933
System Engineering	Base Ops	X								Travel	7,850	10,319	11,302
Nuc Safety	Base Ops	X								Labor	421,666	554,311	607,095
Nuc Safety	Base Ops	X								Materials		0	0
Nuc Safety	Base Ops	X								Service Subcontracts	7,000	9,202	10,078
Nuc Safety	Base Ops	X								Subcontracts	717,767	943,558	1,033,407
Nuc Safety	Base Ops	X								Training		0	0
Nuc Safety	Base Ops	X								Travel	3,292	4,328	4,740
Work Control	Base Ops	X								Labor	631,313	829,908	908,934
Work Control	Base Ops	X								Materials	6,577	8,646	9,469
Work Control	Base Ops	X								Subcontracts	1,085,379	1,426,812	1,562,677
Work Control	Base Ops	X								Training	4,018	5,282	5,785
Work Control	Base Ops	X								Travel	3,577	4,702	5,150
Information Technology	Base Ops	X								Labor	2,298,501	3,021,551	3,309,272
Information Technology	Base Ops	X								Materials	709,635	932,868	1,021,699
Information Technology	Base Ops	X								Service Subcontracts	347,087	456,272	499,719
Information Technology	Base Ops	X								Subcontracts	-2,474	-3,252	-3,562
Information Technology	Base Ops	X								Training	5,902	7,759	8,497
Information Technology	Base Ops	X								Travel	6,638	8,726	9,557
ISIH	Base Ops	X								Labor	278,625	366,273	401,151
ISIH	Base Ops	X								Materials	361,571	475,312	520,573
ISIH	Base Ops	X								Service Subcontracts	10,817	14,220	15,574
ISIH	Base Ops	X								Subcontracts	380,870	500,682	548,358
ISIH	Base Ops	X								Training	4,250	5,587	6,119
ISIH	Base Ops	X								Travel	11,400	14,986	16,413

Title	Function:	Base Ops	SQS Base Ops	Box Line/ Repack	M/LLW	Compaction	CCP	TRU Ship Prep	Gen Payloading	Resource	FY13	Burdened	FY17$
ES/H	Base Ops	X								Labor	1,873,794	2,463,242	2,697,799
ES/H	Base Ops	X								Materials	674,345	886,477	970,890
ES/H	Base Ops	X								Service Subcontracts	1,974,834	2,596,067	2,843,272
ES/H	Base Ops	X								Subcontracts	468,093	615,343	673,938
ES/H	Base Ops	X								Training	9,471	12,450	13,636
ES/H	Base Ops	X								Travel	23,700	31,155	34,122
Quality Assurance	Base Ops	X								Labor	739,050	971,536	1,064,049
Quality Assurance	Base Ops	X								Materials	580	762	835
Quality Assurance	Base Ops	X								Subcontracts	35,853	47,131	51,619
Quality Assurance	Base Ops	X								Training	300	394	432
Quality Assurance	Base Ops	X								Travel	689	906	992
Training	Base Ops	X								Labor	509,878	670,273	734,098
Training	Base Ops	X								Materials	17,903	23,535	25,776
Training	Base Ops	X								Service Subcontracts	25,531	33,562	36,758
Training	Base Ops	X								Subcontracts	355,073	466,770	511,217
Training	Base Ops	X								Travel	2,254	2,963	3,245
Env Comp Program	Base Ops	X								Labor	569,318	748,411	819,677
Env Comp Program	Base Ops	X								Materials	3,801	4,997	5,472
Env Comp Program	Base Ops	X								Service Subcontracts	12,342	16,224	17,769
Env Comp Program	Base Ops	X								Subcontracts	-4,810	-6,323	-6,925
Env Comp Program	Base Ops	X								Training	1,325	1,742	1,908
Env Comp Program	Base Ops	X								Travel	5,986	7,869	8,618
AMWTP Facility Permits	Base Ops	X								Labor	379,434	498,794	546,291
AMWTP Facility Permits	Base Ops	X								Materials	2,552	3,355	3,674
AMWTP Facility Permits	Base Ops	X								Service Subcontracts	2,128	2,797	3,064
AMWTP Facility Permits	Base Ops	X								Subcontracts	90,005	118,318	129,585
AMWTP Facility Permits	Base Ops	X								Training	35	46	50
AMWTP Facility Permits	Base Ops	X								Travel		0	0
Analytical Laboratory	Base Ops	X								Labor	680,983	895,203	980,447
Analytical Laboratory	Base Ops	X								Materials	103,644	136,248	149,222
Analytical Laboratory	Base Ops	X								Service Subcontracts	12,861	16,907	18,517
Analytical Laboratory	Base Ops	X								Subcontracts	97,582	128,279	140,494
Facility/Maint	Base Ops	X								Equipment	43,694	57,439	62,909
Facility/Maint	Base Ops	X								Labor	2,099,178	2,759,526	3,022,297
Facility/Maint	Base Ops	X								Materials	329,669	433,375	474,642
Facility/Maint	Base Ops	X								Service Subcontracts	369,737	486,047	532,330
Facility/Maint	Base Ops	X								Subcontracts	103,651	136,257	149,232
Facility/Maint	Base Ops	X								Training	1,185	1,558	1,706
Facility/Maint	Base Ops	X								Travel	0	0	0
Facility Improv/Upgrades	Base Ops	X								Labor	307,312	403,985	442,453
Records Management	Base Ops	X								Labor	142,284	187,043	204,854
Records Management	Base Ops	X								Materials	932	1,225	1,342
Records Management	Base Ops	X								Subcontracts		0	0
Document Services	Base Ops	X								Labor	302,794	398,045	435,948
Document Services	Base Ops	X								Materials		0	0
Document Services	Base Ops	X								Subcontracts	163,220	214,565	234,996
Safeguards/Security/CI	Base Ops	X								Equipment	250	329	360
Safeguards/Security/CI	Base Ops	X								Labor	480,043	631,052	691,143
Safeguards/Security/CI	Base Ops	X								Materials	3,950	5,193	5,687
Safeguards/Security/CI	Base Ops	X								Service Subcontracts	3,780	4,969	5,442
Safeguards/Security/CI	Base Ops	X								Subcontracts	50,000	65,729	71,988
Safeguards/Security/CI	Base Ops	X								Training	520	684	749
Safeguards/Security/CI	Base Ops	X								Travel	3,216	4,228	4,630

Title	Function:	Base Ops	SQS Base Ops	Box Line/ Repack	M/LLW	Compaction	CCP	TRU Ship Prep	Gen Payloading	Resource	FY13	Burdened	FY17$
Boxline Operations	Boxline Ops			X						Equipment	23,944	31,476	34,473
Boxline Operations	Boxline Ops			X						Labor	4,357,971	5,728,879	6,274,399
Boxline Operations	Boxline Ops			X						Materials	1,142,285	1,501,619	1,644,608
Boxline Operations	Boxline Ops			X						Service Subcontracts	4,122	5,419	5,935
Boxline Operations	Boxline Ops			X						Subcontracts		0	0
Boxline Operations	Boxline Ops			X						Travel	9,127	11,998	13,141
Supercompactor Operations	Compaction					X				Equipment	3,303	4,342	4,756
Supercompactor Operations	Compaction					X				Labor	1,567,767	2,060,947	2,257,196
Supercompactor Operations	Compaction					X				Materials	2,192,813	2,882,617	3,157,108
Supercompactor Operations	Compaction					X				Travel	105	138	151
LLW/MLLW - TVS I and II	M/LLW Management				X					Labor	269,602	354,412	388,160
LLW/MLLW - TVS I and II	M/LLW Management				X					Subcontracts	52,352	68,821	75,374
MLLW/LLW Operations	M/LLW Management				X					Equipment		0	0
MLLW/LLW Operations	M/LLW Management				X					Labor	563,637	740,943	811,498
MLLW/LLW Operations	M/LLW Management				X					Materials	4,077	5,360	5,870
MLLW/LLW Operations	M/LLW Management				X					Service Subcontracts		0	0
MLLW Transportation/Shipping	M/LLW Management				X					Labor	488,894	642,688	703,886
MLLW Transportation/Shipping	M/LLW Management				X					Materials	2,547	3,348	3,667
MLLW Transportation/Shipping	M/LLW Management				X					Service Subcontracts	600,506	789,410	864,580
MLLW Transportation/Shipping	M/LLW Management				X					Training		0	0
MLLW Transportation/Shipping	M/LLW Management				X					Travel	820	1,078	1,181
Management Disposal	M/LLW Management				X					Labor	-533	-701	-767
Management Disposal	M/LLW Management				X					Materials	-9,832	-12,925	-14,156
Management Disposal	M/LLW Management				X					Service Subcontracts	48,586	63,870	69,952
Management Disposal	M/LLW Management				X					Subcontracts	131,129	172,379	188,793
Management Disposal	M/LLW Management				X					Training	365	480	526
Management Disposal	M/LLW Management				X					Travel	5,164	6,788	7,435
Offsite MLLW Disposal	M/LLW Management				X					Equipment		0	0
Offsite MLLW Disposal	M/LLW Management				X					Labor	118,793	156,162	171,033
Offsite MLLW Disposal	M/LLW Management				X					Materials	1,025	1,347	1,476
Offsite MLLW Disposal	M/LLW Management				X					Service Subcontracts	4,632	6,089	6,669
Offsite MLLW Disposal	M/LLW Management				X					Subcontracts	2,127,489	2,796,743	3,063,057
Offsite LLW Disposal	M/LLW Management				X					Labor	252,025	331,306	362,854
Offsite LLW Disposal	M/LLW Management				X					Materials	11,368	14,944	16,367
Offsite LLW Disposal	M/LLW Management				X					Service Subcontracts	938	1,233	1,350
Offsite LLW Disposal	M/LLW Management				X					Subcontracts	113,169	148,769	162,935
Offsite LLW Disposal	M/LLW Management				X					Training	485	638	698
Onsite MLLW Treatment (Macroencaps	M/LLW Management				X					Labor	338,642	445,170	487,561
Onsite MLLW Treatment (Macroencaps	M/LLW Management				X					Materials	1,316,518	1,730,661	1,895,460
Onsite MLLW Treatment (Macroencaps	M/LLW Management				X					Service Subcontracts		0	0
Onsite MLLW Treatment (Macroencaps	M/LLW Management				X					Subcontracts	63,409	83,356	91,293
Offsite MLLW Treatment	M/LLW Management				X					Equipment		0	0
Offsite MLLW Treatment	M/LLW Management				X					Labor	183,806	241,627	264,635
Offsite MLLW Treatment	M/LLW Management				X					Materials	14	18	20
Offsite MLLW Treatment	M/LLW Management				X					Service Subcontracts		0	0
Offsite MLLW Treatment	M/LLW Management				X					Subcontracts	2,282,954	3,001,114	3,286,889

Title	Function:	Base Ops	SQS Base Ops	Box Line/ Repack	M/LLW	Compaction	CCP	TRU Ship Prep	Gen Payloading	Resource	FY13	Burdened	FY17$
628 Tent Operations	Repack			X						Equipment	6,678	8,779	9,615
629 Tent Operations	Repack			X						Labor	37,413	49,182	53,865
630 Tent Operations	Repack			X						Materials	18,169	23,885	26,159
631 Tent Operations	Repack			X						Travel	35	46	50
635 Tent Operations	Repack			X						Equipment	4,206	5,529	6,056
636 Tent Operations	Repack			X						Labor	1,055,408	1,387,413	1,519,526
637 Tent Operations	Repack			X						Materials	56,679	74,509	81,604
638 Tent Operations	Repack			X						Subcontracts	16,254	21,367	23,402
Box Retrieval Operations	Retrieval									Equipment	35,000	46,010	50,391
Box Retrieval Operations	Retrieval									Labor	883,114	1,160,919	1,271,466
Box Retrieval Operations	Retrieval									Materials	640,740	842,301	922,507
Box Retrieval Operations	Retrieval									Service Subcontracts	7,787	10,237	11,211
Box Retrieval Operations	Retrieval									Subcontracts	39,365	51,748	56,676
Box Retrieval Operations	Retrieval									Travel		0	0
Drum Retrieval Operations	Retrieval									Equipment	154,441	203,024	222,357
Drum Retrieval Operations	Retrieval									Labor	1,677,869	2,205,684	2,415,716
Drum Retrieval Operations	Retrieval									Materials	1,307,690	1,719,056	1,882,750
Drum Retrieval Operations	Retrieval									Service Subcontracts	13,025	17,122	18,753
Drum Retrieval Operations	Retrieval									Subcontracts	405,159	532,612	583,329
Drum Retrieval Operations	Retrieval									Travel	3,273	4,303	4,712
Soil Removal Operations	Retrieval									Labor	2,270	2,984	3,268
Soil Removal Operations	Retrieval									Materials	71,010	93,348	102,237
Retrieval Maintenance	Retrieval									Equipment	-1,000	-1,315	-1,440
Retrieval Maintenance	Retrieval									Labor	763,748	1,004,004	1,099,608
Retrieval Maintenance	Retrieval									Materials	167,200	219,797	240,727
Retrieval Maintenance	Retrieval									Service Subcontracts	10,459	13,749	15,058
Retrieval Maintenance	Retrieval									Travel	175	230	252
Grand Total											**85,189,528**	**111,988,000**	**122,651,827**

Cost Analysis Key

Category	Element	Calculation	Comments/Notes
Processing/Disposition Volumes	Segregated TRU Debris	Total Stored Volume * % Debris - M/LLW Volume	▪ For WIPP-compliant waste M/LLW Volume is zero ▪ For waste requiring repackaging, M/LLW Volume assumed to be 33% of Total Stored Volume after sorting/segregation
	Non-Debris TRU	Total Stored Volume * (1 - %Debris)	
	M/LLW	Total Stored Volume * %Debris * %Non-TRU	▪ For WIPP-compliant waste M/LLW Volume is zero ▪ For waste requiring repackaging, %Non-TRU assumed to be 33% of Total Stored Volume after sorting/segregation
	WIPP Waste Volume	Segregated TRU Debris * (1 - %Vol Reduction Compaction) + Non-Debris TRU * (1 + %Vol Increase Stabilization)	▪ For WIPP-compliant waste %Vol Increase Stabilization is zero (i.e., Non-Debris TRU is already stabilized) ▪ For Non-AMWTP options, %Vol Reduction Compaction is zero
	WIPP Emplacement Volume	# Containers to WIPP * Container Emplacement Volume	▪ All AMWTP waste assumed to be packaged in 100 gal drums ▪ For 55 gal drums, Container Emplacement Volume based on 7-pack configuration of drums ▪ For 100 gal drums, Container Emplacement Volume based on 3-pack configuration of drums ▪ Container Emplacement Volume for boxes based on box outer dimensions
	WIPP Rooms	WIPP Emplacement Volume / WIPP m3 per room	
On Site/Commercial Repackaging	Capital/Re-start	See Comments/Notes	▪ Not applicable for WIPP-compliant waste ▪ Not applicable to alternatives that would employ AMWTP for repackaging ▪ Excluded from Hanford options using new on site capability as assumed to be needed for life-cycle cleanup program
	Operating	Total Stored Volume * Repackaging Unit Operating Costs	▪ Not applicable for WIPP-compliant waste
On Site CCP for Shipment to AMWTP or WIPP	On Site CCP for Shipment to AMWTP or WIPP	**Shipping to WIPP** WIPP Waste Volume * CCP Costs **Shipping to AMWTP** Total Stored Volume * CCP Costs	▪ For Shipping to AMWTP, the volume increase due to stabilization of non-debris is included in the Total Stored Volume if stabilization is done at the shipping site ▪ Costs assumed to be included in repackaging operating costs for Hanford alternatives that employ the new on site processing capability
Shipment to AMWTP	# Shipments	# Containers Shipped / Containers Per Shipment	▪ 55 gal drums - 42/shipment ▪ SWB - 6/shipment ▪ Large boxes = 1/shipment
	Package Development/Procurement/Maintenance	NA	
	Packaging & Transport Cost	# Shipments * Cost per Shipment	
AMWTP Costs	Base Ops	Total Volume to AMWTP * Base Ops Unit Cost	▪ The volume increase due to stabilization of non-debris is included if stabilization is done at the shipping site
	Box-Line/Repack	Total Box Volume to AMWTP * Box-Line Unit Cost	▪ All non-compliant debris assumed to go through Box Line ▪ All waste from commercial repack at Hanford assumed to be in SWBs
	Compaction	(Segregated TRU Debris + M/LLW) * Compaction Unit Cost	▪ M/LLW volume only included if waste is re-packed at AMWTP
	Non-Debris Treatment	Non-Debris TRU * Sludge Treatment Unit Cost	▪ Not applicable to WIPP-compliant waste
	M/LLW	M/LLW Volume * (1 - %Vol Reduction Compaction) * M/LLW Unit Cost	▪ Not applicable to WIPP-compliant waste ▪ M/LLW assumed compacted at AMWTP
	CCP	WIPP Waste Volume * CCP Unit Cost	
	TRU Ship Prep	WIPP Waste Volume * Transportation Prep Unit Cost	
WIPP Disposal	# Shipments	# Containers Shipped / Containers Per Shipment	▪ 55 gal drums - 42/shipment ▪ SWB - 6/shipment ▪ Large boxes = 1/shipment ▪ 100 gal drums (AMWTP) - 15/shipment
	Shipment Cost	# Shipments # * Cost per Shipment	
	Capacity Cost	WIPP Rooms * WIPP Mining Costs * (1 + WIPP Post Accident Cost Increase)	
Segregated M/LLW Disposal	Segregated M/LLW Disposal	M/LLW Volume * Commercial Treatment/Disposal Unit Cost	
Summary	Total Cost	Sum of all the cost elements for the disposition alternative	
	Alternative Minus Reference (Alternative 1)	Total Alternative Cost - Total Reference Cost	▪ Disposition Alternative #1 is the Reference Alternative

Appendix 5. Aerial Photo of CH TRU Large Boxes at Hanford Central Waste Complex