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Project Strategy for the Remediation and Disposition of Legacy Transuranic Waste at the Savannah River Site, South Carolina, USA - 11232

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ABSTRACT

This paper discusses the Savannah River Site Accelerated Transuranic (TRU) Waste Project that was initiated in April of 2009 to accelerate the disposition of remaining legacy transuranic waste at the site. An overview of the project execution strategy that was implemented is discussed along with the lessons learned, challenges and improvements to date associated with waste characterization, facility modifications, startup planning, and remediation activities. The legacy waste was generated from approximately 1970 through 1990 and originated both on site as well as at multiple US Department of Energy sites. Approximately two thirds of the waste was previously dispositioned from 2006 to 2008, with the remaining one third being the more hazardous waste due to its activity (curie content) and the plutonium isotope Pu-238 quantities in the waste. The project strategy is a phased approach beginning with the lower activity waste in existing facilities while upgrades are made to support remediation of the higher activity waste. Five waste remediation process lines will be used to support the full remediation efforts which involve receipt of the legacy waste container, removal of prohibited items, venting of containers, and resizing of contents to fit into current approved waste shipping containers. Modifications have been minimized to the extent possible to meet the accelerated goals and involve limited upgrades to address life safety requirements, radiological containment needs, and handling equipment for the larger waste containers. Upgrades are also in progress for implementation of the TRUPACT III for the shipment of Standard Large Boxes to the Waste Isolation Pilot Plant, the US TRU waste repository. The use of this larger shipping container is necessary for approximately 20% of the waste by volume due to limited size reduction capability. To date, approximately 25% of the waste has been dispositioned, and several improvements have been made to the overall processing plan as well as facility processing rates. These lessons learned, challenges, and improvements will be discussed to aid other sites in their efforts to conduct similar activities.

INTRODUCTION

The Accelerate Transuranic (TRU) Waste Disposition Project at the Savannah River Site (SRS) began in April 2009 with the addition of Department of Energy Environmental Management funds directed to accelerate cleanup efforts across the complex. These

funds were intended to reduce the liability both in terms of risk to the environment and the life cycle cost of TRU waste disposition.

An aggressive goal was set for the project to disposition the remaining Savannah River Site legacy TRU waste within the next few years. While previous disposition projects had addressed approximately 62% of the TRU waste by volume, these efforts had focused on the lower hazard, lower activity waste, as shown in Figure 1.

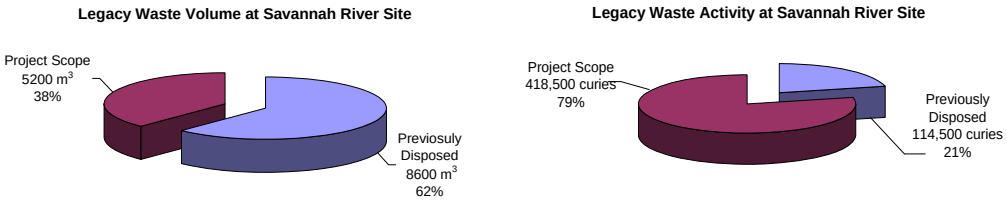

Figure 1. – Savannah River Site Legacy Waste status in April 2009

The waste remediation activities associated with these earlier efforts conducted in the 2006 to 2008 timeframe had been discontinued, and in some cases waste remediation facilities were dismantled due to funding constraints and limitations with these facilities in meeting required nuclear safety controls for higher activity waste. In addition, personnel resources that had performed waste remediation activities had been re assigned to other site work.

The challenges to meet the goal of disposition of all remaining legacy TRU waste within a two to three year timeframe include establishment of multiple waste remediation facilities, development of a trained and qualified work force to safely handle these higher activity wastes, and the certification and use of the Standard Large Box (SLB) and the new TRUPACT III for shipping large waste items that can not be safely sized down into smaller standard waste containers.

PROJECT BASELINE AND EXECUTION STRATEGY

The scope of the Accelerated TRU Waste Disposition Project is the compliant disposition of 5,000 cubic meters of legacy TRU waste either shipped to WIPP or dispositioned as low level waste. After preliminary baseline planning, it was determined that 200 cubic meters of the total 5200 cubic meters of TRU waste exhibits characteristics that present significant challenges to the repackaging and remediation of the waste into compliant shipping containers within the available funding and schedule. This waste volume is considered very difficult by virtue of the plutonium content and highly elevated radiation fields and was removed from the Accelerated TRU Waste Disposition Project scope.

The majority of the 5000 cubic meters of legacy TRU waste is currently stored in non-shippable, aged, deteriorating containers that must be repackaged and remediated before shipment to the Waste Isolation Pilot Plant (WIPP) located in Carlsbad, New Mexico or dispositioned as low level waste. The 5,000 cubic meters of TRU waste includes in excess of 1,500 miscellaneous boxed containers and over 1,250 drum type containers stored under earthen cover containing over 400,000 curies of plutonium-238 or plutonium-239. The legacy waste volume is predominantly from SRS, but also includes waste from other DOE complex sites.

To accomplish the disposition of the 5000 cubic meters of waste in the allotted time and minimize project risk, the execution strategy consists of the following:

- Enhance the Solid Waste Facility to accelerate retrieval and characterization of the legacy waste and prepare it for transport to the various remediation facilities on site.

- Utilize multiple facilities to provide maximum flexibility in the remediation activities and mitigate the impacts of downtime in any facility.

- Implement a phased approach that will support initiation of waste handling and remediation activities as soon as possible

- Minimize the size reduction of the waste and utilize the Standard Large Box container and TRUPACT III for shipments of TRU to the Waste Isolation Pilot Plant (WIPP) in New Mexico, U.S.

The majority of the TRU legacy waste is either buried in concrete culverts and boxes or is stored in waste pads in various non standard metal or concrete boxes, see Figures 2 and 3. The waste packages range in size and content from 6 meter x 4 meter x 2 meter large steel boxes containing such items as process vessels, ducts, and large filters to 55 gallon drums containing various waste removed from processing glove-boxes. Within the culverts and boxes are waste drums and/or smaller crates that must be removed for further characterization.

Figure 2. – Legacy TRU waste buried in culverts

Figure 3. – Legacy TRU waste on waste pads

The initial assessment of the Solid Waste Facility waste retrieval capabilities determined that minimal physical upgrades were needed for the lower activity waste containers, but limited upgrades would be needed to support of the higher activity containers. This included the installation of a new tent enclosure large enough to house the crane equipment for retrieval of drums and crates from culverts and refurbishment of existing radiography equipment. Existing non destructive examination systems would be used for preliminary scans of containers to identify prohibited items, evaluate the condition of the containers for transporting across the site and to aid the remediation facilities in pre planning their remediation tasks. Existing facilities were also available for venting and sampling waste containers prior to transporting to other facilities for remediation.

Previous waste remediation efforts had utilized several facilities for the remediation of low activity waste which included the Solid Waste Facility (SWF) for remediation of drums and Standard Waste Boxes, the H-Canyon facility for the repackaging of Large Steel Box contents (crates) into smaller Standard Waste Boxes and the F-Canyon Drum Enclosure for the remediation of drum waste requiring the removal of prohibited items and/or remediation of liquids. The waste remediation facilities at the Savannah River National Laboratory and the F/H Laboratory which had also been used for drum remediation had been dismantled.

An analysis was conducted of the 5000 cubic meters inventory of legacy waste to segregate the waste by container type, container size, and activity level to identify the facilities best suited for the remediation. Table 1 below provides the initial grouping by which the various SRS facilities were then assessed to determine which facilities were best equipped for waste repackaging and remediation with minimal upgrades to the facilities and/or the associated safety basis.

Table I – Preliminary Grouping of Legacy Waste

Activity Level in Plutonium Equivalent Curies	**Container**	**Approximate Container Count**	**Potential Facility**
> 0 and < 2000	Culvert for drum/box retrieval	50	SWF or H-Canyon
> 0 and < 2000	Drum	1200	F-Drum, HB-Line
> 0 and < 500	Standard Large Box	200	F-Canyon, SWF, H-Canyon
> 0 and < 500	Standard Waste Box/B-25	100	F-Canyon, SWF, H-Canyon
> 0 and < 2000	Large Steel Box	35	H-Canyon
> 0 and < 500	Large Misc. Steel Box	32	H-Canyon
> 0 and < 500	Medium Misc. Steel Box	50	F-Canyon or H-Canyon
> 0 and < 500	Small Misc. Steel Box/Container	150	F-Canyon, SWF, H-Canyon, SRNL

Within the existing facilities of the SWF, H-Canyon, and F-Canyon Drum Enclosure, the capability to execute the full scope did not exist, but minimal to moderate upgrades could be accomplished within the available funding and project schedule goals to address all but the most extremely difficult waste groups. As mentioned previously, this represented

approximately 200 cubic meters of the inventory and is not part of the project baseline. The safety bases for these facilities at the initiation of the project were limited to low activity waste, but revisions would support the full scope. The biggest challenge facing the project was establishment of additional facilities to support the more intrusive remediation of the waste boxes with higher activity. The only facilities with existing ventilation systems designed for activities involving higher activity waste are the F and H Canyons. H-Canyon is still utilized for other DOE Environmental Management missions, so F-Canyon was chosen for the establishment of a waste box remediation facility. The plan would have H-Canyon concentrate on repackaging the contents of the very large boxes into smaller packages that could then be remediated if necessary in F-Canyon.

SWF will be used to remediate and repackage low content non-compliant containers into shippable box or drum configurations. To accomplish these remediation activities, two locations within SWF will be used. The SWF Pads will procure a new venting system to address sealed waste items that came from dismantled facilities. These containers will be vented, sampled and then repackaged into compliant waste containers. An existing ventilated containment structure within SWF Cells will be modified, staffed and operated to perform the remediation of additional waste boxes that have prohibited items. This activity requires controls due to the high hazards associated with exposure to the principal contaminant of the waste, Pu-238. High airborne concentrations of Pu-238 are anticipated to be generated during hands-on remediation of the waste inside these ventilated enclosures. To address these hazards the facilities will be modified to incorporate controls such as supplemental local ventilation and secondary containment in addition to the three levels of PPE and supplied air workers will don.

The existing F-Canyon Drum Enclosure will be utilized for the remediation and repackaging of higher content non-compliant drums of TRU waste. This waste will be initially characterized in E Area and over packed or properly wrapped to enable on-site transport of the more than 40 year old containers. These containers will be opened in the F-Canyon Drum Enclosure where any non compliant conditions such as prohibited items or free liquids can be addressed, and compliant waste contents repackaged into new waste drums.

F-Canyon is presently partially deactivated and no longer has a mission, so limited areas of the F-Canyon will be modified for a new F-Canyon Box Remediation facility to safely handle the box waste. These modifications will be in the truckwell and truckwell extension where an inner airlock structure and cranes will be erected and localized ventilation provided. The safety basis documentation will be modified to permit the materials to be received into these areas of the canyon with the hands-on remediation conducted including limited size reduction activities using hand tools.

H-Canyon will be employed to repackage the waste within the very large boxes in the TRU waste inventory into other containers via the use of an existing crane and truckwell structure. H-Canyon will also be used to remediate the higher activity waste due to its safety class ventilation. If prohibited items or free liquids are encountered, H-Canyon

will conduct hands-on remediation within the warm shop area. To perform these activities, modifications will be made to this area of the canyon to provide supplemental ventilation controls and improved egress to adhere to the life safety codes. H-Canyon will also procure a new venting system for sealed metal containers that require venting and sampling as part of remediation activities. H-Canyon's primary role is to repackage into smaller boxes and produce feed for the F-Canyon Box Remediation facility.

A portion of the existing TRU waste inventory includes highly (count rates of about 100 million disintegrations per minute for Pu-238) contaminated oversized items. H Canyon and F Canyon will implement size reduction only to the extent necessary to repackage the wastes into an SLB. The amount of waste needing size reduction is not expected to be significant but will include equipment such as steel vessels, large duct work, lathe bases, and glove boxes. This work scope requires more intensive hands-on work, with higher work exposure doses, and a higher probability of contamination spread.

After the facilities were identified, further refinement of the waste grouping was conducted to identify some population that fell within the current safety basis or would require only minor revisions and would require minimal facility upgrades to support early remediation efforts. As shown in Table II, waste retrieval and remediation could begin in several facilities with minimal upgrades and no safety basis revision, therefore a phased approach was developed for each of the operating areas. Project teams were established in each of the facilities and subproject schedules developed that had work begin on lower activity waste until additional modifications and safety basis revisions could be completed.

Table II – Revised Waste Groups for Developing Project Execution Strategy

Activity Level in Plutonium Equivalent Curies	Container	Approximate Container Count	Facility	Required Modifications	Safety Basis Revision
> 0 and < 200	Culvert for drum/box retrieval	13	E-Area	None	No
> 200 and < 2000	Culvert for drum/box retrieval	30	E-Area	None	Yes
> 2000 and < 8500	Culvert for drum/box retrieval	31	E-Area	None	Yes
> 0 and < 2000	Culvert for drum/box retrieval	15	H-Canyon	New Venting System	Yes
> 0 and < 1200	Drum	700	F-Drum	Minor upgrades	No
> 1200 and < 2000	Drum	500	F-Drum	Minor upgrades	Yes
> 0 and < 500	Standard Large Box or Standard Waste Box	70	F-Canyon	Moderate Upgrades - New Enclosure	Yes
> 0 and < 500	Medium Misc. Steel Box	50			
> 0 and < 500	Small Misc. Steel Box/Container	50			
> 0 and < 4	Standard Large Box	130	E-Area (Cells)	Moderate Upgrades	No
> 0 and < 4	Standard Waste Box/B-25	100	E-Area (Pads)	Minor upgrades	No
> 0 and < 4	Small Misc. Steel Box/Container	100	E-Area (Pads)	New Venting System	No
> 0 and < 160	Large Steel Box	25	H-Canyon	Minor upgrades	No
> 160 and < 2000	Large Steel Box	10	H-Canyon	New Venting System	Yes
> 0 and < 500	Large Misc. Steel Box	32			

MINIMIZE SIZE REDUCTION

At the beginning of the project planning phase, it was recognized that not all legacy waste would fit into the Standard Waste Box (SWB), the predominant package used for currently generated TRU waste. To get all large waste box contents into the smaller SWB, over 95% would require some level of size reduction; however, less then 10% of these large waste boxes contain items which will require size reduction to fit into a SLB.

Automated and/or robotic size reduction capability was deemed impractical both from a cost and schedule perspective, therefore, it was proposed that there would be very limited size reduction of waste, and the use of the SLB and new TRUPACT III shipping container would be implemented at WIPP.

The DOE reviewed this strategy and supported implementation of the SLB and TRUPACT III at the WIPP facility and is responsible for providing this capability to meet the project schedule.

PROJECT STATUS

Since the initiation of the project in April 2009, all planned facilities are operational with the exception of the F-Canyon Box Remediation facility which is in final startup preparations. The planned operations rates have been met in most cases and been exceeded in H-Canyon through the implementation of a number of process improvements.

Of the original 5000 cubic meters, approximately 50 % by volume has been preliminarily remediated with a rejection rate averaging 15% of this volume. The majority of rejected containers come from the H-Canyon facility as expected where limited resizing is performed and no RTR is available to aid the workers in identifying prohibited items. Approximately 25% of the 5000 cubic meters has been dispositioned to date with the majority of this waste shipped to WIPP. Currently the TRUPACT II shipping container is being used with plans to begin using the TRUPACT III by July 2011. The TRUPACT III has been certified for shipping, and six new TRUPACT III are in fabrication. Upgrades at the WIPP are in progress to support receipt of a TRUPACT III and the unloading and storage of SLB. In addition, non destructive assay equipment at SRS has been upgraded and undergoing certification for the SLB.

LESSONS LEARNED AND IMPROVEMENTS

Several lessons learned have been identified for both the facility modification and waste remediation phases of the project. Resultant recommendations have been implemented where applicable to help the project meet both cost and schedule objectives.

All of the facilities required some level of modifications, and the most significant lessons learned are listed below.

- Increase early engagement with critical vendors to track and validate delivery dates.

  All of the operating areas required procurement of critical equipment to include new fire mister systems, new venting systems, cranes, and airlock panels. In many cases, delays were encountered due to the complexity of the specifications or issues by the vendors with obtaining components. It was also found that some vendor suppliers had limited parts in stock or did not

have the ability to put on multiple shifts to accelerate fabrication, which also delayed final assembly and delivery of the equipment. A thorough, early and regular review of vendor capability should be done to assess risk of delays and identify risk handling strategies.

- Acquire trained and qualified technical resources sooner in the project.

  Trained and qualified technical resources are required to adequately support development of requirements, design reviews, safety basis revisions, procedure and training development and detailed waste processing plans. The majority of the early technical resources assigned to the project were new subcontractors not familiar with facilities or the Department of Energy requirements for design and modification to nuclear facilities. In addition, training and qualification durations for some engineering staff positions can be up to one year. For those facilities that required more extensive upgrades, particularly the F-Canyon Box Remediation facility, project delays were encountered very early on. Site engineering resources were ultimately reassigned to the project teams to address this issue. Initial project planning should have better addressed engineering resource needs and obtained them early on.

Within the remediation phases, a number of lessons learned and improvements have been identified from the areas that were started early and been applied to the facilities with later startups. These include the follow:

- Minimize multiple handling of the waste in the overall waste remediation plan.

  The original plan was to use H-Canyon to place large crates predominantly into Standard Large Boxes. These would then be transported back to E Area for characterization. A large majority were expected to fail waste acceptance criteria, so they would then be sent to the F-Canyon Box Remediation facility. This would required multiple handling of waste containers and delay its availability for final characterization and disposition. After H-Canyon had repackaged large crates from several of the Large Standard Boxes into Standard Large Boxes, the decision was made to begin opening crates, inspecting waste packages, and repackaging into Standard Waste Boxes to the maximum extent possible. This reduced to some extent the multi handling of waste and produced waste containers that can be shipped in the TRUPAC II earlier in the project.

- Develop formal training and qualifications commensurate with the work.

  The Accelerate TRU Disposition project is predominantly an operations activity and relies on trained and qualified personnel to conduct the work just as other nuclear processing activities on site do. Project resources for waste

remediation were obtained predominantly from the site's construction craft organization or through staff augmentation contracts with personnel experienced in nuclear industry work. Typically, these groups are provided minimal training due to their work being identified as skill of the craft, but it was recognized early on that formal training specific to waste remediation work would be required. Training programs for each of the subproject processing areas were developed to include classroom instruction, exams, job performance evaluations and drills. This proved critical to ensuring safe and compliant execution of work.

- Implement Sustained Disciplined Operations Programs.

  One of the biggest traps to guard against for high hazard work activities is worker complacency. Management oversight, continuing training, drills, worker engagement in pre and post job reviews and periodic refocus sessions are key elements to an overall program that helps keep the work force focused on safe and disciplined operations. The waste remediation activities that were part of existing operating facilities with mature Sustained Disciplined Operations Programs have maintained good safety performance while becoming more efficient. These Sustained Disciplined Operations Programs have been implemented across all waste remediation facilities to ensure safe disciplined operations through the remainder of the project.

REMAINING CHALLENGES

As the project progresses, several challenges still remain to bring all waste remediation processing areas on line and up to maximum efficiency and to address the necessary higher shipping rates for the last year of the project. All processing areas and in particular the SWF Cells which began remediation of SLB in early January 2011 are implementing process improvements to reduce cycle time and rework. The F-Canyon Box Remediation facility, which will be used for the more intrusive remediation work, is the final waste remediation facility to be brought on line. Its upgrades have been the most extensive because the F-Canyon facility has been deactivated and many systems are no longer in service. The upgrades include installation of new airlocks, cranes, a glovebag enclosure, localized ventilation, lighting and support systems such as power, air monitors, and fire detection. The final readiness preparations include the training and qualification of the waste remediation operators, facility reviews and a DOE review.

The current plans are for approximately half of the waste to be characterized and made ready for shipment in the final year of the project, thus characterization processes need to be streamlined and shipping rates need to be almost double what they have been the first two years of the project. This presents a significant challenge to both SRS and the shipping contractor. In addition, a new shipping container for the WIPP, the TRUPACT III, will be put into service later in 2011 which requires some physical modifications to both sites as well as revisions to the waste certification program for these larger

containers. Efforts by both SRS and the shipping contractor are underway to develop an integrated schedule to successfully manage this through project completion.

SUMMARY

The Savannah River Site is accelerating the disposition of 5000 cubic meters of legacy Transuranic Waste over a three and a half year project. To date, after the first 18 months, its has successfully started up four of the five planned remediation facilities, performed preliminary remediation of approximately 50% of the waste volume, and completed final disposition of approximately 25 % of the waste volume.

Utilization of the multiple facilities has been necessary to deal with the broad range of waste container sizes and activity levels and has helped the project take some early starts on waste remediation activities. Lessons learned have been gained from all the facilities and applied across the board to improve facility modification planning, safety and disciplined operations, operating rates, and build schedule contingency. Remaining challenges include implementing additional efficiencies in all operating areas, the startup of the final remediation facility which will deal with some of the higher activity waste boxes, beginning shipments in the new TRUPACT III shipping container, and increasing the characterization and off site shipping capability for the final year of the project.