CH and RH Legacy Waste Processing at the WVDP: Utilizing all of your Processing Facilities, "Even the Ones you didn't Think were Processing Facilities" - 11160

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ABSTRACT

When West Valley Environmental Services, LLC (WVES[1]) took over operation of the West Valley Demonstration Project (WVDP) in September of 2007 there was 4,733 cubic meters (167,229 cubic feet) of Legacy Waste in storage. This Legacy Waste had been packaged over many years to differing criteria and degrees of scrutiny as a result of evolving waste packaging guidelines and waste acceptance criteria. Any waste generated after 2001 for low-level waste (LLW) and 2004 for transuranic (TRU) waste was processed in accordance with DOE Order 435.1, Radioactive Waste Management [1].

Re-packaging the Legacy Waste which had been generated and packaged over the life of the Project has resulted in unique challenges. With the varied waste streams, and vastly different levels and types of radiological and chemical contamination, the WVDP has had to develop multiple approaches to managing this waste. Additionally, high dose rates on much of the waste have required employing remote handling strategies to ensure worker dose remains as low as reasonably achievable (ALARA).

Facility capabilities and throughput rates were inadequate to manage the volume of Legacy Waste within the contract period. Therefore the only option was to re-think and challenge the overall process. This led to the development of new facilities in which to process waste, and the development of new ways in which to process the waste within the existing facilities. The application of new technologies and/or use of old technologies applied in new ways were fundamental to improving process efficiencies and productivity. Midway through the contract, the TRU/GTCC (Greater-Than-Class C) waste packaging requirements changed which led to additional facility upgrades and further challenges to the schedule for completion. Overall, the WVES waste processing areas increased from four marginally useful facilities, to seven facilities with improved capabilities.

INTRODUCTION

The West Valley Demonstration Project Act of 1980 authorized the U.S. Department of Energy (DOE) to solidify the high-level liquid radioactive waste (HLW) present at the West Valley site, along with disposing of the low-level and transuranic (TRU) wastes. Since the completion of HLW solidification in 2002, the WVDP has turned its attention to deactivation and decontamination of Project facilities and disposing of the wastes generated throughout performance of the Project. One of the tasks under the current contract is to process all of the 4,733 cubic meters (167,229 cubic feet) of Legacy Waste in storage. There are multiple goals in performing this task. The first goal is to process all of the legacy waste such that it is capable of being shipped and disposed of at an approved disposal facility, provided an approved facility

[1] WVES is a joint venture of URS, Jacobs Engineering, Energy Solutions, and ECC.

exists for that particular type of waste. The second goal is to volume reduce or re-characterize the TRU waste to get the total volume below 799 cubic meters (28,233 cubic feet) with a stretch goal of reducing the volume to 424 cubic meters (15,000 cubic feet).

Preparing wastes generated over the life of the Project for disposal has resulted in unique challenges and equally unique solutions. With the varied composition of waste streams, containing vastly different levels and types of radiological and chemical contamination, the WVDP had to compile an arsenal of tools and facilities that could be utilized to effectively process the legacy waste streams. With high dose rates, much of the waste required remote handling strategies to ensure doses remained ALARA for Project workers.

A strong DOE Order 435.1 program was established in 2001 for LLW and in 2004 this program was expanded for TRU waste generation incorporating the requirements of the Waste Isolation Pilot Plant (WIPP) waste acceptance criteria (WAC). Any waste generated after 2001 for LLW and 2004 for TRU waste was considered processed under DOE Order 435.1 with the exception of potentially needing over-packing or shielding to meet shipping requirements. Previous Project goals focused on decontamination and deactivation of Project facilities and disposal of that newly generated waste, as well as contact handled (CH) waste processing; hence much of the legacy waste generated in the 80s and 90s that were problematic wastes streams remained in storage and unprocessed at the beginning of the current contract. This paper will discuss the challenges and solutions that the WVDP used to safely package Project wastes for ultimate disposal.

WASTE PROCESSING FACILITIES

The WVES contract started out with four buildings which were marginally useful for waste reprocessing and repackaging. These facilities included the Remote Handled Waste Facility (RHWF), Vitrification Facility (VF), Waste Packaging Area (WPA), and Container Sorting and Packaging Facility (CSPF).

These facilities were upgraded or modified, and three others were modified or newly established to process the remaining complex waste streams to increase the Projects' waste processing throughput on both remote handled (RH) and CH wastes. Application of new technologies and/or use of old technologies applied in new ways were fundamental to improving process efficiencies and productivity. Through the use of these technologies, the WVDP was able to increase productivity, reduce dose and ultimately reduce the overall volume of TRU/GTCC waste that will need to be disposed of in the future leading to overall cost savings to the DOE. Midway through the contract, the TRU/GTCC waste packaging requirements changed, which led to additional facility upgrades and further challenges to the schedule for completion.

The RHWF is a building which was specially designed for packaging RH-TRU waste. However, during periods of heavy processing of RH-TRU and RH-LLW throughout the first few years of the project, several design issues were identified. The first issue involved the PaR (power manipulator) arms that are used to do the work in the cell.

These arms are used for everything from size reduction to decontamination, to sampling and packaging. These arms were not meant for continuous use in downsizing waste. Using saws and other tools exposes the PaR arms to repeated vibrations which can damage the arms. Also, the two arms are mounted on the same bridge trolley, so whenever one arm is removed from service and into the repair area, the second arm is unusable as well. This means that to repair one arm, both arms have to be decontaminated prior to being taken into the repair area. This also means that operations are often continued with only one operable arm, delaying repairs to the first arm until the second arm fails as well. This facility was designed with all of the manipulator windows on the second floor, so to work on them, the material has to be placed on tables mounted on the walls. If an item falls off the table, the manipulators are unable to reach the item.

The facility also has a stainless steel liner, with a floor drain that leads to a collection tank. This design would have been perfect for periodically washing down the cell between waste streams, and for decontaminating waste items. However, due to the site's efforts to avoid generating contaminated water, the drain was previously taken out of service and the system was never used as designed. This caused two issues. First it meant that decontamination between waste-streams was much more difficult due to the use of vacuums and sweepers. Second, the level of decontamination was not as effective, which led to material not being able to be decontaminated to LLW levels.

The VF has been adapted from its original purpose – to conduct the vitrification process from 1996-2002 - to an RH waste processing facility. The VF is essentially the Vitrification Cell with all of the vessels and piping stripped out. There are protrusions from the floors and walls where the vessels and piping were cut off. The facility is highly contaminated, particularly the floor. This creates a challenge in processing the waste as items can pick up contamination from the floor and become "hotter" than they were when they were put into the cell. Like the RHWF, this facility also has the manipulator windows on the second floor with tables mounted to the walls. Early in the project there was a BROKK® 330 unit inside the cell for size reduction during VF dismantlement, but this was an old unit which no longer operated properly. This facility is much older than the RHWF and has had reliability issues with the in-cell crane, transfer cart, and shield doors which are used to move material in and out of the cell.

Both the WPA and CSPF are processing areas within a facility. Both are small containment structures within the LSA-4 Waste Storage Building. Localized portable HEPA filtration units are used to provide ventilation for processing and packaging CH-TRU waste and CH-LLW, as well as Mixed LLW (MLLW). The CSPF is also used for managing Asbestos Containing Material (ACM).

TIME-SAVING IMPROVEMENTS

One of the most significant time-saving improvements WVES implemented involved processing RH-LLW. During the first two years of the project there were numerous containers of RH-LLW which were taken into the RHWF to be processed. Although this waste did not require the audio and video recordings required for RH-TRU waste, processing was slowed by the limited speed of the in-cell equipment and the requirements in handling waste containers within the facility. These containers were considered RH-LLW because the dose rates exceeded 200 mR/hr somewhere on the surface of the containers. In many instances however, it was only a single spot or two on the container which exceeded this limit. Early on these would be sent into the RHWF to be processed, but this could take several weeks.

WVES decided to re-think RH work altogether. WVES decided to utilize the Equipment Decontamination Room (EDR) and the Fuel Receiving Storage (FRS) building high-bay as processing areas where RH-LLW containers could be shielded on specific locations which were greater than 200 mR/hr to be able to process them as if they were contact handled. This made it possible to move about 35 percent of the remaining RH-LLW from the RHWF schedule to be performed in either the EDR or FRS. This approach to processing was obviously much faster and made it possible to reduce the RHWF schedule by removing containers entirely from that facility's run plan. This also made it possible to increase production by speeding up the processing rates and providing parallel processing paths with in-cell work.

Besides removing some of the RH-LLW from the RHWF run plan, additional measures were implemented or are currently being implemented to improve processing rates within the RHWF. WVES purchased and modified a BROKK® 180 unit for remote operations within the RHWF. This unit has saws, shears, and combination tools for use in the size reduction of waste. The expectation is using the BROKK® for size reduction instead of the PaR arms will reduce the wear and tear on the PaRs, thereby reducing down time.

A portable Nitrocision® unit was borrowed from Hanford for deployment in the RHWF. Nitrocision® is similar to carbon dioxide (CO_2) blasting, but uses nitrogen instead of CO_2. The unit was received, upgraded, and personnel were trained in its use. The unit will be deployed for testing in the EDR where it will be used to decontaminate areas of fixed contamination to reduce general area dose rates and allow for longer entries by the workers. After testing, it will be deployed to the RHWF where it will be used to decontaminate items currently characterized as TRU to LLW whenever possible to reduce the amount of size reduction required. It will also be utilized to decontaminate the general area as needed.

Several improvements were made in the VF. First, the defunct BROKK® 330 was removed from the area and was replaced with a spare unit (Fig. 1). Another unit was procured to serve as a backup to this unit and backup units for each of the tools/end effectors for this unit were procured, including saws, shears, and combination tools. These units were used to either replace units that might break or as an immediate part supply for a quick repair . This method allowed time to order replacements on the spare unit.

A cutting table that could be reconfigured to hold different sized and shaped items which were being cut with the BROKK® 330 was added. This cutting table stabilized the item being cut to minimize the likelihood of breaking the saw

Fig. 1. Spare BROKK 330 being modified for remote operation within the VF.

blade during size reduction. The table greatly reduced the number of broken blades and the resulting downtime involved with removing and decontaminating the saw so that the blade could be changed.

Fig. 2. Floor plates within the VF to make space usable. BROKK® 330 in the foreground, and cutting table in lower left corner.

There were numerous protrusions on the VF floor from removing piping and vessels during dismantlement of the Vitrification processing equipment. These protrusions made it very difficult to place items on the floor or clean the floor, greatly reducing the area available as useful floor space. WVES had interlocking raised floor plates designed and built to raise the floor above the level of the protrusions (Fig. 2). In addition to providing more usable floor space, the floor was much easier to clean because it was a flat surface.

Fig. 3. Nitrocision® unit at the Nitrocision® facility in Idaho Falls, ID.

There was a Nitrocision unit (Fig. 3) in use elsewhere within the Main Plant Processing Building, so WVES is taking advantage of that fact by piping lines into the Vitrification Cell for use in there as well. This unit will be deployed within the VF where it will be used to decontaminate items from TRU to LLW whenever possible to reduce the amount of size reduction required. It will also be utilized to decontaminate the general area as needed.

Additional size reduction capabilities are being added to the VF in the form of a plasma cutting unit. This unit will be used in conjunction with a downdraft table with inline filtration and a modified in cell filtration design. The downdraft table will draw smoke and fumes away from the cutting operation where it will pass through the first set of filters. This filter is made up of a 30.48 meters (100 feet) continuous roll of filter material which passes through the filter housing.

Once the filter material loads up to maximum capacity, it can simply be rolled through the housing to put fresh filter material within the housing. After passing through the first filter, it is passed through a diffuser to slow the air movement into the cell. This diffuser exhausts into the bottom of the pit which is the low point in the cell farthest away from the main HEPA filters. By slowing the exhaust of the downdraft table in the lowest part of the cell away from the main filtration intake, particulates may settle out into the pit instead of getting drawn up and into the main ventilation. However, if this does happen, as a precaution additional pre-filters are being installed in front of the existing HEPA filters and pre-filters.

There were a large number of oversized containers of CH-TRU waste scheduled to be managed in the WPA, but it was determined that these containers were going to be too large to manage within that facility in any effective manner. WVES considered other facilities on site where waste containers of this size could be managed. Besides the RHWF and VF, both of which were not viable due to contamination levels being higher than the waste to be processed, there was only the Container Size Reduction Facility (CSRF).

The CSRF required a complete upgrade of ventilation, access points, crane rails and hoists, etc. to make it a viable facility for this purpose. The ventilation upgrades included the installation of a scrubber unit to remove the particulates created by the plasma cutting unit that was installed in the CSRF to improve size reduction capabilities. Three Plymovent® arms were also installed (Fig. 4). These are point source capture ventilation arms that can be moved around and positioned as needed based on where the intake of the ventilation needs to be placed. The CSRF was used only to size reduce CH-TRU waste, and size reduce and process CH-LLW and MLLW. CH-TRU waste was transferred to the WPA for packaging after size reduction in the CSRF. This area was also set up to support bubble suit usage if contamination levels warranted a higher level of protection.

Fig. 4. CSRF cutting room. Note flexible exhaust Plymovent® arms in the top center of the photo.

The WPA ventilation was upgraded to increase the ventilation flow to allow work with higher contamination levels. The WPA was also set up to support bubble suit usage for those waste-streams with much higher levels of alpha contamination requiring a higher level of protection. Additionally, this area was set up with an ISOCS ™ unit for use in segregating CH-LLW from CH-TRU waste to speed up the packaging and reduce the volume of CH-TRU to be managed.

Ventilation upgrades were installed in the CSPF and a glovebox was installed to increase the ventilation flow and provide a ventilated containment within which to process various materials.

WVES also implemented process improvements which increased processing abilities. WVES developed a graded approach to TRU waste processing including:

- Non-intrusive techniques such as ISOCS™ technology and refined characterization);
- Targeted invasive processing such as ISOCS™ processing to map and isolate areas of TRU waste that, when removed, reduced the box to LLW; and

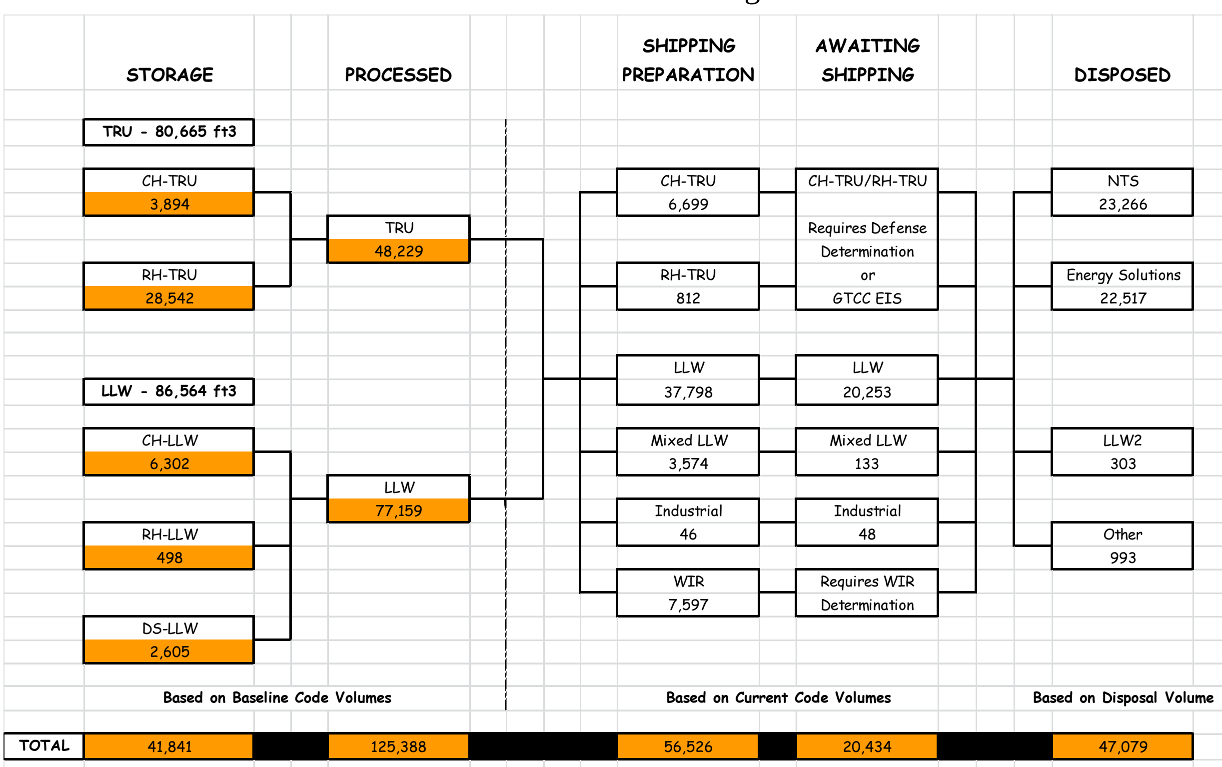
- Full processing, including size reduction and repackaging.

Through non-intrusive techniques, approximately 40 percent of the stored TRU waste inventory was determined to be LLW. In these cases, the resulting LLW packages are further characterized, inspected and prepared for transportation and disposal as LLW at an offsite disposal facility.

Targeted invasive processing also has proven effective for waste packages that have areas of concentrated activity that can be removed from the remainder of the waste in the container. The removed waste is managed as TRU while the remaining waste container and contents are classified as LLW. WVES has employed waste characterization and measurement techniques to map the locations of the highest concentrations of radionuclides in or on a component, and has successfully cut or isolated the TRU sections of the component from the LLW sections of the component. Using these techniques, another 10 percent of the stored TRU waste inventory was classified as LLW.

Full processing capabilities for both CH-TRU and RH-TRU waste were also developed. Many of the tools and techniques used for the processing of RH-TRU waste are developed specifically for individual waste streams and often utilize specialized tooling. For example, 36 boxes of radioactively-contaminated filters posed a waste processing dilemma due to their unyielding composition and high contamination levels. WVES engineers modified a drum crusher to remotely process these filters. Using the filter crusher, operators size reduced 149 filters and were able to package two to three size-reduced filters into a single waste package, achieving a size reduction factor of 4-6 times. Other examples of size-reduction technology employed by WVES in its contact- and remote-handled processing areas include plasma cutting, crushing and mechanical size reduction. See Table I for results of processing efforts through September 2010.

Table I. Waste Processing Results



If WVES had not recognized the shortcomings of existing processing areas and the initial approach to processing the waste, the needed changes might not have happened in time to make a difference. Many of the changes are completed and others are still being made, but WVES is currently on track to meet all of the goals discussed earlier.

This will be used as a lessons learned for this project and future projects. Every aspect of waste processing facilities plays into how productive they can be. Everything from shield door and crane speeds, to in-cell decontamination capabilities, to equipment reliability, etc. have an effect on your production rates. Obviously, any time work can be conducted hands-on (as opposed to remotely) chances of success improve. Also, redundant systems also improve chances, provided the systems are not interrelated such that taking one out of service requires the other to be taken out as well.

REFERENCES

1. DOE Order 435.1, Radioactive Waste Management.