Achievements and Process Improvements in Processing Transuranic Waste at the TRU Waste Processing Center– 15488

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ABSTRACT

Wastren Advantage, Inc., (WAI) is the DOE Prime contractor for the TRU Waste Processing Center (TWPC) located in Oak Ridge, TN. This paper highlights the TWPCs specific achievements and process improvements associated with both Contact (CH) and Remote Handled (RH), Transuranic (TRU) waste receipt processing and repackaging for disposal. The five key improvement areas and achievements include:

- The TWPC installed, tested and operated successfully the Drum Venting System (DVS) to vent overpacked CH-TRU waste drums in several configurations including 55-gallon drums overpacked in 79 or 85-gallon drums.
- A new Remote Drum Opener (RDO) system was designed, tested and placed in service to vent drums discovered in overpack boxes in the Box Breakdown Area and to vent overpack configurations that could not be handled in the standard DVS (e.g., 110 gallon overpacks and multiple drum configurations).
- The Cask Processing Enclosure (CPE) approach to repackaging RH-TRU waste contained in concrete casks was developed and implemented
- Hot Cell outage to incorporate planned equipment modifications and improvements to maintain processing rates.
- To improve certification and segregation of CH-TRU from drums that meet Low Level Waste criteria for disposal at Nevada the TWPC added additional equipment/facilities for Non-Destructive Assay (NDA) and Real Time Radiography (RTR).

INTRODUCTION

The TWPC is a continuously improving organization and the specific achievements and process improvements help ensure that the projects mission, the DOE Environmental Management Goals, and State of Tennessee waste disposition requirements are met. These achievements may be incorporated into other TRU waste processing sites across the country and around the world. The TWPC safety basis, CM-R-AD-001, TWPC Documented Safety Analysis [1], was updated and maintained as required by DOE O 420.1C, Facility Safety [2].

DESCRIPTION

The Drum Venting System (DVS)

The TWPC installed, tested and operated successfully the Drum Venting System (DVS) to vent overpacked CH-TRU waste drums in several configurations including 55-gallon drums overpacked in 79 or 85-gallon drums.

The system was installed in a new Drum Vent Building (DVB) which housed the skid-mounted DVS. The DVS was used to install drum filter vents and sample ports on unvented CH waste drums. Sample was collected following after 7 days of aspiration using syringe sampling techniques similar to the transportation flame-gas approach. Drums received at the DVB underwent NDE prior to being staged in the building to allow determination of drum penetrator length to ensure venting of the internal container. It was critical to ensure that the unvented drum within the overpack (i.e., outer container), that a vent of sufficient length was used to penetrate the innermost container to allow for venting and sampling of both the overpack and the innermost drum. Unvented drums received at the DVB were contained within a vented overpack or unvented overpack with a lid restraining device. Lid restraining devices were removed from the drum in the DVB, prior to placement of the drum into the DVS.

The DVS shown below in Figure 1, makes use of a non-sparking, low heat generating process to mitigate the potential for introducing a spark into waste drums during drum filter vent or sample port installation. The DVS enabled the remote installation of hollow-stem, self-drilling filter-vents and sample ports on 55-gal and 85 gal direct loaded drums, and 55 gal, 79 gal, and 85-gal over-pack drums.

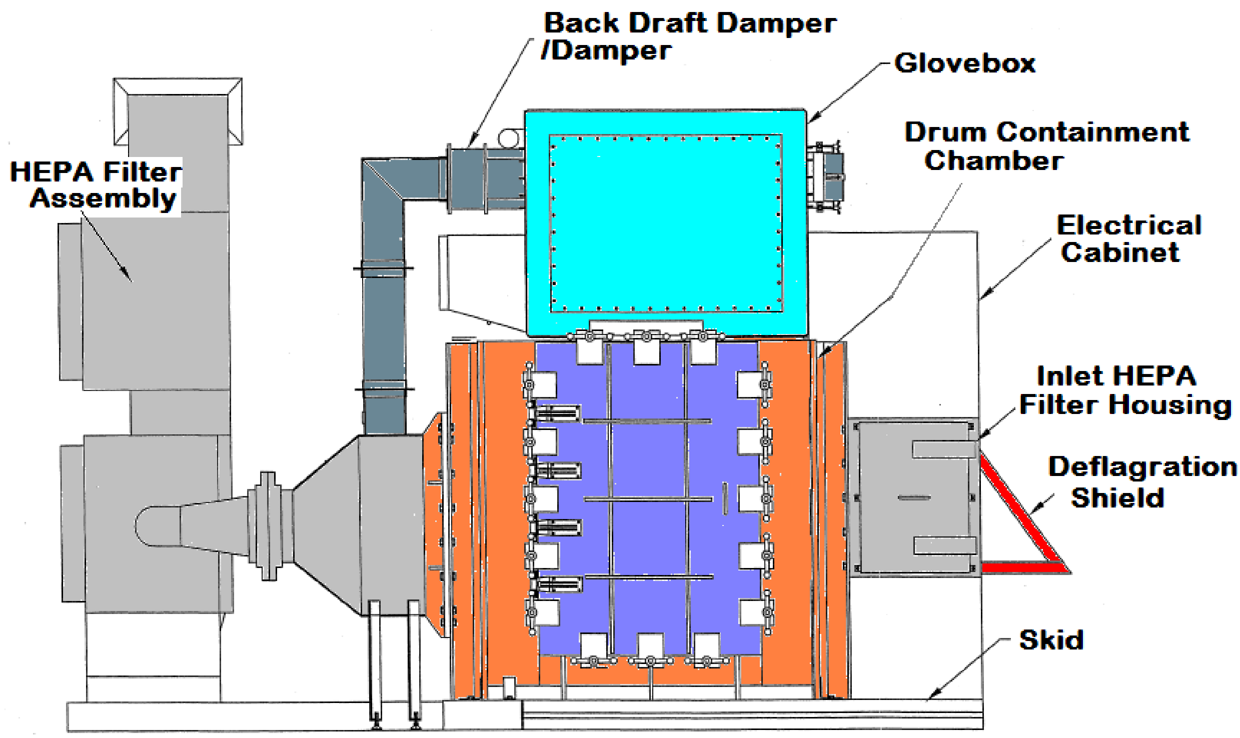

Fig. 1. Drum Vent System

The system automatically penetrates the drum using a specially designed, self-drilling, self-tapping hollow core drum filter vent or sample port. This is a controlled ambient temperature penetration process. The drum filter or sample port is manually inserted into a socket inside the glovebox power head prior to drum venting. A proprietary Programmable Logic Controller (PLC) program commands and controls the process that penetrates the lid, collects a representative headspace gas sample for analysis, and then completes the installation by mechanically sealing the drum filter vent or sample port onto the drum lid. Figure 2, shows an operator inserting overpacked unvented drum into DVS Cabinet.

Fig. 2. Operator Inserting Overpacked Drum into DVS Cabinet

The successful drum venting operations campaign started in September 2010 and the last drum was vented on April 5, 2012. In total 546 overpack containers were vented without incident during the campaign and venting operations were completed five months ahead of schedule. Currently, the DVS has been demobilized at TWPC.

Remote Drum Opener (RDO)

A new Remote Drum Opener (RDO) system was designed, tested and placed in service to vent drums discovered in overpack boxes in the Box Breakdown Area and to vent overpack configurations that could not be handled in the standard DVS (e.g., 110 gallon overpacks and multiple drum configurations).

The RDO System is a drum puncturing device used in the Box Breakdown area (BBA) to breach an unvented drum to provide a vent path for potential flammable gases inside the drum headspace to atmosphere. In excess of 90 overpack drum containers in the inventory have been identified as candidates for the RDO process. Additionally, there are eight waste boxes identified that either are known to have unvented drums or may have unvented drums inside them.

Drum puncturing in the BBA involves the use of a stand-alone compressed air-driven portable drum puncturing device (See Figure 3). One key feature to safety for the RDO process is the remote operation.

The RDO Assembly consists of a steel frame, an air cylinder with a piston rod threaded on one end, a clamp and interchangeable drum penetrator cylinder heads. Pneumatic Air supply lines with a flow control valve (FCV-890) provide the motive force.

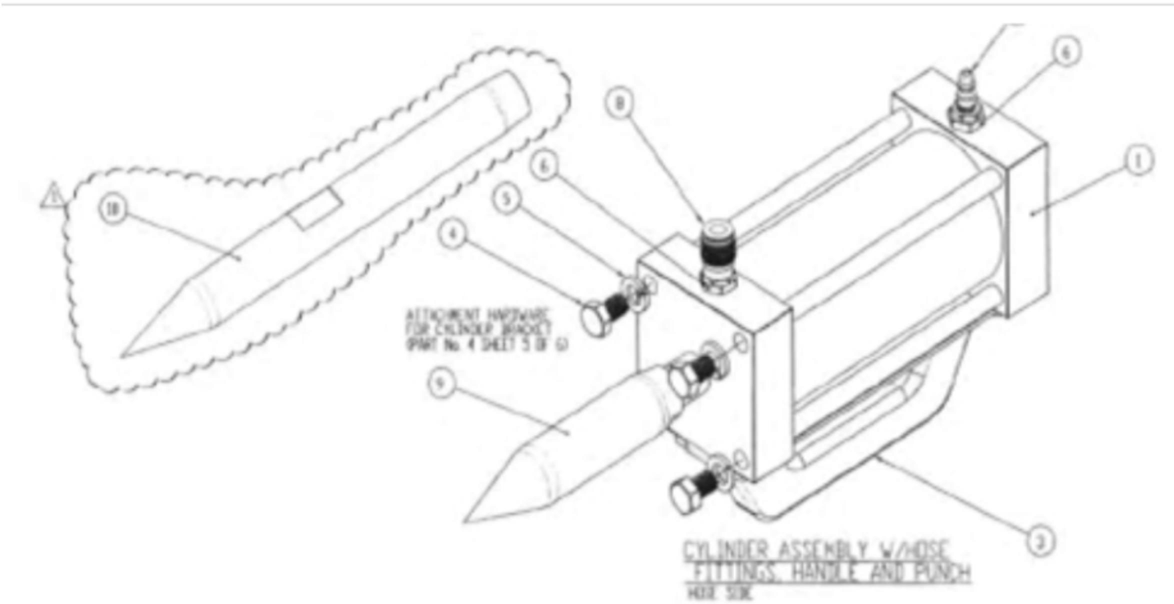

Fig. 3. Cylinder Assembly for RDO

The Drum Penetrator Cylinder Head is a passive SSC and is constructed of non-sparking material such as nickel, aluminum, and bronze alloy. The Drum Penetrator Cylinder Head provides a vent path for flammable gases trapped inside the drum headspace to the atmosphere. Heads of varying lengths can be attached to the threaded end of the air cylinder piston rod to be driven into the drum lid(s). The RDO assembly is shown below in Figure 4.

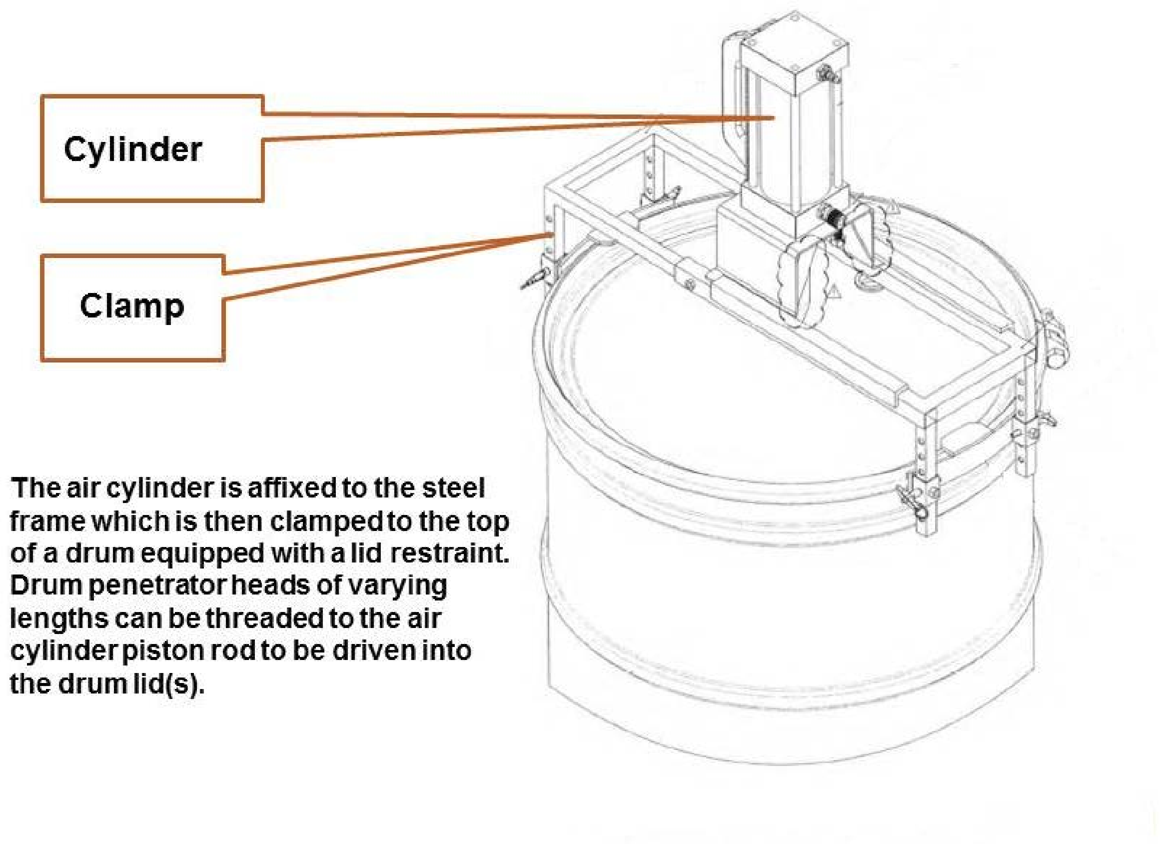

Fig. 4. RDO Assembly

To date, the RDO operations have been very successful, and continue to safely vent the previously unvented containers to allow the processing and final disposition as CH-TRU and LLW.

Cask Processing Enclosure (CPE)

At the TRU Waste Processing Center (TWPC), waste initially characterized as Remote Handled is received in thick walled concrete casks (10-cm, 15-cm and 30-cm thick walls). The concrete casks are normally connected to the Hot Cell to allow waste removal using a remote powered manipulator (provided by PaR Systems, Inc.) and the waste is then sorted and processed using standard through-the-wall master-slave manipulators (provided by Central Research Laboratories). The Hot Cell was designed for processing remotely handled radioactive waste exhibiting contact dose rates in excess of 2.0 mSv/hr.

Dose rates on individual waste items contained in the casks have shown to exceed 1.0 mSv/hr and some of the waste exhibits neutron dose rates in combination with the gamma component. It has been shown to date that a high percentage (if not all) of the contents in the casks are less than 2.0 mSv/hr (i.e., waste consists of Contact Handled -TRU or Low Level Waste), resulting in longer time delays due to the waste being moved from the RH container to the Contact Handled waste drum out station.

In addition, the high variability in the waste with respect to actual dose rates (predominately CH-TRU), changes in waste form and types of waste, groundwater intrusion into the cask and waste matrix characteristics created equipment handling and maintenance problems. Processing these items presented issues and stressed the delicate Hot Cell equipment to the point of premature and frequent failure. Master-slave manipulators (each costing nearly EUR 100 000) fail at a rate of one every other shift and the large bridge mounted crane experienced extended periods of down-time (several days each event) to repair wrist functions, cameras, motor brakes and belt drives.

The Cask Processing Enclosure (CPE) approach to repackaging RH-TRU waste contained in concrete casks was developed and implemented. A general layout of the CPE is shown in Figure 5. The CPE was constructed adjacent to the existing 30-Ton Crane Bay. A 3-D view of the CPE is shown in Figure 6.

Hands-on processing in the CPE will be significantly faster and more predictable. Additionally, hands-on processing helps to achieve higher drum loading efficiency (hand-load verses manipulator). Another advantage gained in the CPE compared to Hot Cell processing is the capability to load waste designated as low level waste into emptied cask. This option was not readily available for casks that are removed after processing from the Hot Cell. It is projected that for the same waste types the CPE will be at least 50% faster and with the increased efficiency will reduce project costs. CPE operations cut approximately 2 years off of the base-line schedule for the Hot Cell and results in 16.42 million EUR ($20M USD) in savings to the Client – US DOE.

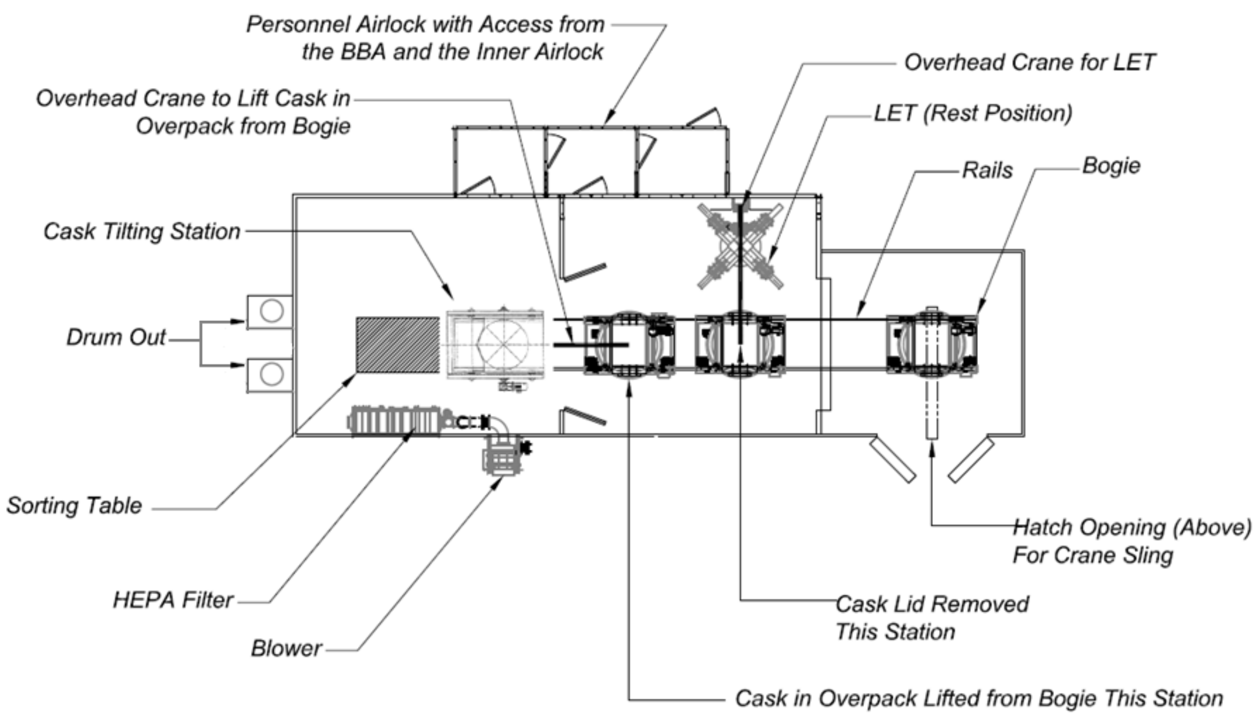

Fig. 5. General Layout of the Cask Processing Enclosure

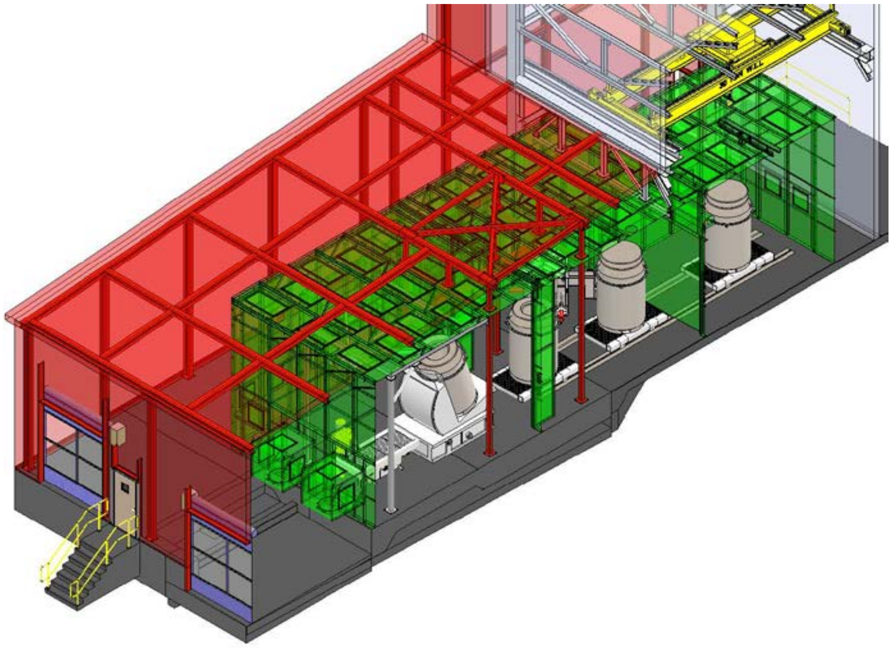

Fig. 6. Cask Processing Enclosure

Several key pieces of equipment enable cask handling, including the new Cask Tilting Station (CTS) which is an electric driven machine that inherently secures the load in any position on loss of power. See Figure 7. The tilt cycle can move the cask/overpack 1.57 radians (90 degrees) from vertical to horizontal. The CTS is capable of returning a fully loaded cask to the upright position in the event a cask needs to be removed from the CPE.

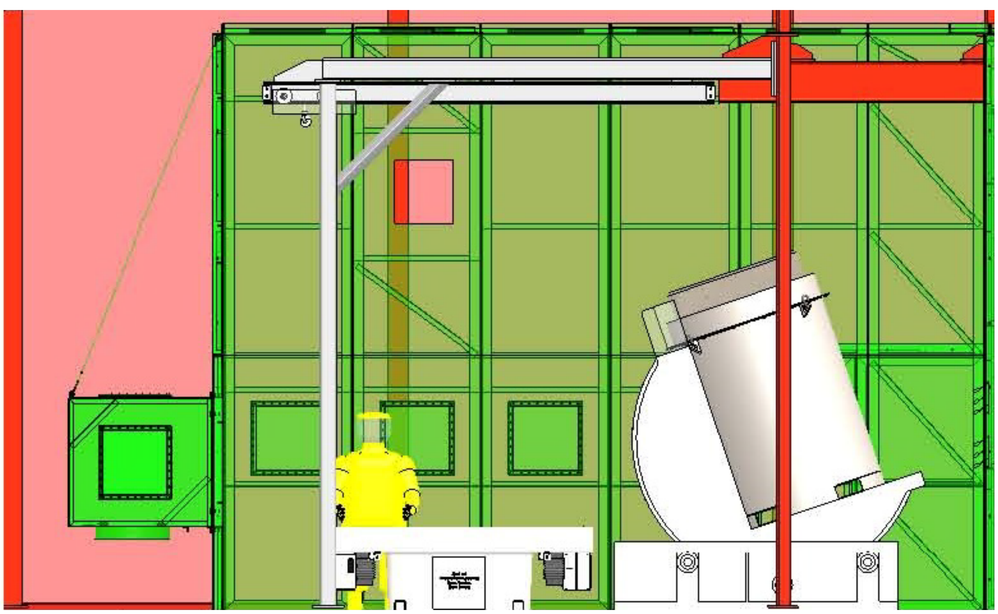

Fig. 7. Cask Tilt Station and Sorting Table in Process Area

Another key feature of the CPE is the sorting table enclosure which works in conjunction with the downdraft through the surface of the sorting table which is shown in Figure 8. This design maximizes the flow of air away from the worker through the table and into the ventilation system. The enclosure allows for the worker to open only that portion of the enclosure needed to access the waste at any given time, thereby maximizing the efficacy of the downdraft feature and minimizing the spread of contamination in the area around the sorting table. By minimizing the contamination on the worker's air supplied (a.k.a. bubble) suit the potential for a skin contamination event during the doffing of the suit and subsequent CPE egress is greatly reduced.

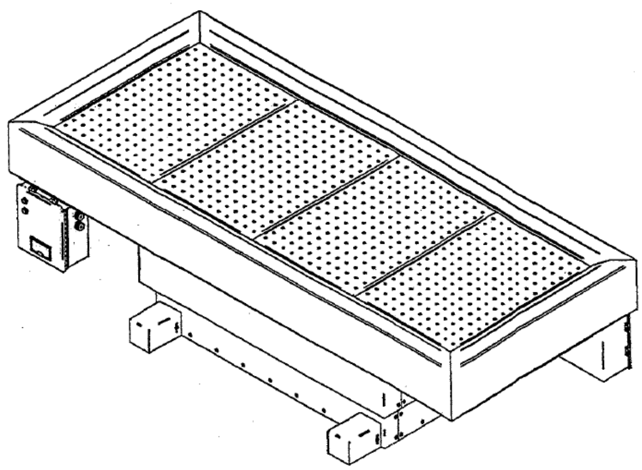

Fig. 8. Cask Processing Area Sorting Table

The results expected by implementing the CPE waste processing approach for RH waste casks include:

- Higher throughput rates for waste.
- Reduce waste processing costs
- Higher loading rates per drum
- Cost savings in Hot Cell equipment upkeep and maintenance
- Reduce down time in the Hot Cell
- Reduction in repairs and maintenance time
- Implement capability to load non RCRA Low Level Waste into empty cask (option not available for Hot Cell)
- Frees Hot Cell for actual high dose rate waste and special operations that must be done in Hot Cell

Hot Cell Outage – Equipment Upgrades and Modifications

As a result of Hot Cell equipment reliability in the Hot Cell a planned outage was performed to rebuild the key equipment, install new hoists, work table tools and modify the liquids transfer system. Multiple other enhancements such as the addition of an equipment pass-through, upgrades to the camera system, lighting, dose rate monitoring system, and most notably the key modification to the PaR Manipulator were completed. Hot Cell manned entry which is inherently difficult, was managed through effective planning and decontamination efforts (full air-supplied air suits) prior to performing the outage tasks. Maintenance personnel were able to perform work in less restrictive Powered Air Respirators (PAPR) increasing productivity and improving execution of Hot Cell improvements.

Improve Certification and Segregation of CH-TRU

One area that has improved the most is streamlining the time to complete and receive confirmation of Batch Data Reports (BDR's) from NDA. Previously it required weeks and even months for final BDR receipt. This time has been reduced to 10 days.

To become more efficient the TWPC has set-up and implemented new waste staging and disposition strategies, including:

- Examination and section of alternatives for waste disposition (for example 30 gallon RH 'cask')
- Effective strategic planning in early 2014 for Central Characterization Project (CCP) operations
- Performing and implementing outputs from Shielding/ALARA review of material movement/storage activities
- Determination of location-based optimization for wastes at the TWPC
- Implementation of disposition path for 'hot' wastes and RH-TRU wastes with neutron dose rate.

The TWPC worked closely with vendors to bring in an additional RTR unit and a second NDA measurement system. For the second NDA system, an In Situ Object Counting System (ISOCS) unit was selected to maximize identification of radionuclides considering the counting limitations of the existing Segmented Gamma Scanning (SGS) system. The new systems worked were placed in service using additional staff and backshift support as necessary to meet the increased throughput requirements.

The additional equipment/facilities for Non-Destructive Assay and Real Time Radiography added to the site capabilities and improved certification and segregation of CH-TRU from drums that meet Low Level Waste criteria for disposal at Nevada.

DISCUSSION

The TWPC identified several processes as critical to providing the conditions required for continuous waste throughput and good capacity utilization. One of the key improvements has been in the area of ensuring continuous and, reliable feedstock to TWPC unit operations. This includes efficient set-up and implementation of waste staging and disposition strategies.

Feedstock to TWPC processes had been identified as a constraint to waste processing activities and throughput. TWPC waste processing areas are fed by three critical units: Non-Destructive Examination (NDE), Non-Destructive Assay (NDA) and the Drum Venting System (DVS). These units are for analytical purposes and are the direct upstream components for many of the TWPC waste operations. These units were under control of a separate contractor (CCP) until May 2011 when DOE funding constraint's pulled certification support from the site.

The TWPC assumed management of the operations, scheduling and utilization of NDE and NDA processes, as well as, optimization of DVS to ensure adequate feedstock was available for processing. Figure 9 below shows an example of material handling activity at the TWPC.

Fig. 9. Example of Material Handling Activity at the TWPC

Process improvement in and capabilities included the installation, tested and operations of the Drum Venting System (DVS) to vent overpacked CH-TRU waste drums in several configurations including 55-gallon drums overpacked in 79 or 85-gallon drums. Current problem drum configurations (drums discovered in overpack boxes in the Box Breakdown Area and to vent overpack configurations that could not be handled in the standard DVS) required the design, testing and placement in service of the new Remote Drum Opener (RDO) system. The CPE approach to repackaging RH-TRU waste contained in concrete casks was developed and implemented to process concrete casks that were originally processed in the hot cell saving 2 years of schedule and 20 M dollars.

Additionally, the planned outage in the hot cell enabled the project to implement equipment modifications and improvements to maintain RH waste processing rates following resumption of operations. Finally, additional equipment/facilities for Non-Destructive Assay and Real Time Radiography were added to the site capabilities to improve certification and segregation of CH-TRU from drums that meet Low Level Waste criteria for disposal at Nevada.

CONCLUSION

The TWPC is a continuously improving organization and the specific achievements and process improvements described above help ensure that the projects mission, the DOE Environmental Managements Goals, and State of Tennessee waste disposition requirements are met. These achievements may be incorporated into other TRU waste processing sites across the country and around the world.

REFERENCES

1. CM-R-AD-001, TWPC Documented Safety Analysis
2. DOE O 420.1C, Facility Safety, , U.S. Department of Energy, Washington, D.C., 12-4-2012

ACKNOWLEDGEMENTS

- Kevin East, TWPC RH Process Manager
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