

Progress and Lessons Learned in Transuranic Waste Disposition at the Department of Energy's Advanced Mixed Waste Treatment Project

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ABSTRACT

This paper provides an overview of the Department of Energy's (DOE) Advanced Mixed Waste Treatment Project (AMWTP) located at the Idaho National Laboratory (INL) and operated by Bechtel BWXT Idaho, LLC (BBWI). It describes the results to date in meeting the 6,000-cubic-meter Idaho Settlement Agreement milestone that was due December 31, 2005. The paper further describes lessons that have been learned from the project in the area of transuranic (TRU) waste processing and waste certification. Information contained within this paper would be beneficial to others who manage TRU waste for disposal at the Waste Isolation Pilot Plant (WIPP).

INTRODUCTION

In May of 2005, BBWI assumed prime contractor management and operations responsibilities for the AMWTP located outside of Idaho Falls, Idaho. The mission of the facility is to prepare transuranic (TRU) waste for transport to and disposal at the WIPP near Carlsbad, New Mexico. A challenging near-term regulatory milestone under the 1995 Idaho Settlement Agreement was to complete shipment of 6,000m³ of waste out of Idaho by the end of December 2005. As of May 1, 2005, at the time the AMWTP contract was taken over by BBWI, only 625m³ of TRU waste that counted against the milestone had been shipped to WIPP.

Upon assuming operations, BBWI defined seven production lines with a combined output capable of meeting the 6,000m³ milestone. This included two process lines to be operated by the WIPP Central Characterization Project (CCP). All seven lines are now operational. In June 2005, the BBWI TRU Waste Program and Plant Operations hired additional staff to meet increased production needs. The baseline plan included the WIPP CCP becoming certified in mid-July to support AMWTP waste shipments to WIPP.

To meet the 6,000m³ milestone, the AMWTP concentrated on two categories of waste: solids (S3000) and debris (S5000). Debris was contained in and processed from both boxes and drums, and solids were processed only from drums. For the TRU waste processed through December 2005, 55% of the total volume came from debris boxes, 10% came from debris drums, and 35% came from solids drums.

As of December 31, 2005, 4,609m³ of waste that counted against the 6,000m³ Settlement Agreement milestone had been shipped to WIPP from the AMWTP.

1995 SETTLEMENT AGREEMENT

In 1995, the DOE and the State of Idaho reached the Idaho Settlement Agreement, which set methods and a processing schedule for removing TRU waste from Idaho. From this agreement the AMWTP was born. TRU waste milestones associated with the Settlement Agreement included design, construction, and startup of the AMWTP processing facility. After January 1, 2003, a running average of no less than 2,000m³ per year shall be shipped out of the Idaho, measured with a three year running average. A target date for completing waste removal from Idaho in 2015 and a compliance date in 2018 also were agreed to. The first date for measuring the three year running average occurred December 31, 2005.

WASTE INVENTORY DESCRIPTION

The objective of the AMWTP is to process the contact-handled TRU waste that was transported from numerous DOE weapons sites and stored at the DOE site in Idaho. Approximately 65,000m³ of TRU waste had been placed into storage at the Transuranic Storage Area – Retrieval Enclosure (TSA-RE) and Type II waste storage buildings. At the time of the AMWTP contract transition to BBWI in May of 2005, approximately 61,275m³ of waste remained to be processed. From the initial 65,000m³ volume, 3,100m³ had been previously sent to WIPP by BBWI, and 625m³ had been sent to WIPP by BNFL, Inc., since start of operations of the AMWTP.

Storage of waste in the Transuranic Waste Storage Area began in 1971 and concluded in 1988. Over 90% of the TRU waste placed in storage at Idaho came from the Department of Energy Rocky Flats Plant. Other waste came from Mound, Battelle, Argonne, and the Idaho site. During the years that waste was being shipped to Idaho, the DOE made significant changes in the definition of TRU waste. Because of those changes, waste in storage at AMWTP includes waste both below and above 100nCi/g. Although all waste streams were initially classified as TRU waste, it is estimated that as many as 20% of the waste containers will assay <100nCi/g. This waste will not meet today's definition of TRU waste and will need to be managed as mixed low-level waste. At the end of December, 84% of remaining waste remained stored in the TSA-RE, and 16% was stored in the Type II buildings. Over 100,000 containers of waste remain in storage in the TSA-RE today.

Waste stored in Idaho included both solids and debris now classified as S3000 and S5000 waste respectively. Approximately 77% of the waste inventory is debris and 23% is solids. Of the total inventory, 55% is stored in various sizes of waste boxes and 45% is stored in drums.

AMWTP FACILITIES

The AMWTP facilities are shown in Figure 1. The AMWTP is located within the 55 acres that make up the Transuranic Storage Area (TSA), and all operations take place within this area. The TSA is located within the Radioactive Waste Management Complex at the southwest corner of the INL site. The nearest site boundary is 3.3 miles to the south, and the nearest public point of access is a public highway 2.2 miles to the northeast.



Fig. 1. Advanced Mixed Waste Treatment Facility

The primary operations facilities within the AMWTP plant are the following.

- *Transuranic Storage Area – Retrieval Enclosure* - The majority of waste received for storage in Idaho was placed on an asphalt pad and then covered with plywood, polyvinyl tarps, and a soil cover that was two to four feet deep. In 1996, a steel weather protection structure was placed over the waste storage pile to further protect the waste from degradation due to weather. This structure covers nearly 313,000ft² (29,000m²). The TSA-RE is covered under the Resource Conservation and Recovery Act (RCRA) Part A interim status.
- *Waste Storage Modules* - Waste is stored in five storage buildings. These are prefabricated corrugated metal buildings each with a space of 28,800 ft². The floor of each is coated with a sealant, and the edges are curbed to contain leaks and spills. The storage modules are included in the RCRA Part B Hazardous Waste Permit for the AMWTP. Waste may also be temporarily stored in the AMWTP characterization and treatment facilities.

- *Waste Characterization Facilities* – Waste is characterized at four buildings at AMWTP. CCP operates characterization equipment in two of the buildings (WMF-610 and WMF-628), and AMWTP operates characterization equipment in the other two (WMF-634 and WMF--635). Characterization operations include drum and box real-time radiography (RTR) units, drum and box radiological assay units, real time as well as SUMMA head space gas sampling and analysis units, and gas generation testing units. Solids coring and visual examination are performed in WMF-634 and debris visual examination is performed in WMF-676. These facilities are contained within the RCRA Part B Hazardous Waste Permit for AMWTP.
- *Treatment Facility* –WMF-676 treatment facility houses the 2,000 ton hydraulic supercompactor, the remote box cutting unit, box tipping and sorting robots, assay units, and bagless transfer units. Most of the facility, including box entry, box sawing, drum handling, box tipping, waste sorting and supercompaction, is operated remotely. Compacted pucks from 55-gallon drums are remotely placed into 100-gallon drums for shipment to WIPP. The facility also has a special-case waste drum repackaging unit, which is used for removal of prohibited items from drums as well as visual examination for RTR confirmation. The facility is permitted under the RCRA Part B Hazardous Waste Permit for the AMWTP.
- *Payload Assembly* – Payload assembly takes place in the WMF-635 building. AMWTP payloads include 14-packs of 55-gallon drums, three- and six-packs of 100-gallon drums, ten-drum overpacks, and standard waste boxes. Two waste assembly platforms supported by gantry cranes are used in WMF-635 for the payload assembly.
- *Waste Shipment Loading Facility* –WMF-618 facility is used for loading the assembled TRU waste payloads into the TRUPACTs and HALFPACTs. This facility has two place loading capability such that two trailers can be loaded concurrently. The facility has operated at a rate of five shipments per day in support of meeting the 6,000m³ milestone.
- *Shipment Inspection Facility* –WMF-602 facility is used for the Idaho State Police (ISP) to inspect vehicles before shipments are released from the AMWTP. The ISP inspects shipments seven days per week, and has performed up to seven inspections in a single day. The WMF-602 facility can house one tractor/trailer combination at a time.

AMWTP facilities are classified as Hazard Category 2 nuclear facilities, and a documented safety analysis has been completed and approved for AMWTP facilities and operations.

AMWTP TRU WASTE PRODUCTION LINES

Seven production lines for preparing TRU waste for disposal at the WIPP were established for the AMWTP to process the S3000 and S5000 waste categories. These included a combination of processing for direct shipment and processing for compacted waste shipment. A description of each process line and capacity is provided as follows.

- **Process Line #1** – This line is for characterization of S5000 debris waste contained in drums. This line is operated by CCP in buildings WMF-610 and WMF-628. CCP operates both fixed and mobile equipment for WIPP characterization analysis including RTR, radiological assay, headspace gas sampling and analysis, and gas generation testing. Waste is certified by CCP, then assembled and shipped through AMWTP operations. Debris waste streams processed through this line include combustibles, rashig rings, and graphite. The payload efficiency of this line is 2.1m^3 per payload. The capacity of this line is approximately 160 drums per week.
- **Process Line #2** – This line is also for characterization of S5000 debris waste contained in drums. This line is operated by AMWTP personnel in building WMF-634. AMWTP operates fixed equipment for WIPP characterization analysis including RTR, radiological assay and headspace gas sampling. Approved debris waste streams processed through this line include metals, filters and insulation, leaded rubber gloves and aprons, glass, and firebrick all from Rocky Flats, and debris waste received from Mound. The payload efficiency of this line is 2.1m^3 per payload. The capacity of this line is approximately 60 drums per week.
- **Process Line #3** – This line is for repackaging and visual examination of S5000 debris drums with prohibited items. One the prohibited item is removed and the waste is visually examined to WIPP requirements and repackaged, the drums process through assay, super-compaction and headspace gas sampling. With exception of the headspace gas sampling, the work is performed by AMWTP personnel in the WMF-676 treatment facility. S5000 visual examination for RTR confirmation is also performed within this unit. The payload efficiency of this line is 3.8m^3 per payload. The capacity of this line is approximately 35 drums per week. This process line has primarily been used for visual examination for RTR confirmation to date.
- **Process Line #4** – This line is for characterization of S3000 solids waste contained in drums. This line is operated by CCP in buildings WMF-610 and WMF-628. CCP operates both fixed and mobile equipment for WIPP characterization analysis including RTR, radiological assay, headspace gas sampling and analysis, and gas generation testing. Waste is certified by CCP, then assembled and shipped through AMWTP operations. Solids waste streams processed through this line include the organic sludge solids received from the Rocky Flats Plant. The payload efficiency of this line is 2.1m^3 per payload. The capacity of this line is approximately 40 drums per week, currently limited by the gas generation testing required for transportation.
- **Process Line #5** – This line is for repackaging boxes containing S5000 debris. This process line is operated by AMWTP personnel in the WMF-676 treatment facility. The boxes are first measured for fissile content then screened through a box RTR unit for treatment facility compatibility. The boxes are then brought into the facility where the lids are remotely cut off. The box then proceeds to one of three boxline waste troughs where the box is emptied and waste contents are sorted and visually examined per WIPP requirements. Drums are then remotely loaded with the waste and sent for assay to WIPP requirements. Following successful assay, the drums are compacted in the AMWTP

supercompactor. Following super-compaction the pucks are loaded into 100-gallon drums and a head space gas sample is taken and analyzed to WIPP requirements. The capacity of this line is 28 boxes per week (roughly equal to 420 drums per week).

- Process Line #6** – This line is for characterization of S3000 solids waste contained in drums. This line is operated by AMWTP personnel in building WMF-634. AMWTP operates WIPP characterization analysis processes including RTR, radiological assay, and headspace gas sampling and analysis. All venting of drums for all process lines is also performed in WMF-634. Sample coring of solids drums and visual examination of solids drums are performed also performed in WMF-634. Solids waste streams processed through this line include the first and second stage sludge, building 374 sludge, special set-up and sludge, all from the Rocky Flats Plant. Sludge waste received from the Mound plant is also processed through this line. The payload efficiency of this line is 2.1m³ per payload. The capacity of this line is approximately 110 drums per week.
- Process Line #7** – This line is for the direct supercompaction of drums containing S5000 debris waste. This process line is operated by AMWTP personnel in the WMF-634 and WMF-676 characterization and treatment facilities. Waste is characterized through RTR, assay and headspace gas analysis before entering the treatment facility. The waste drums are directly compacted in the super-compactor then the pucks are placed into 100-gallon drums for shipment to WIPP. The payload efficiency of this line is 3.8m³ per payload. After start-up, testing and preliminary runs of this process line it was decided to focus the super-compactor on feed from the boxlines. This was because volume would be maximized due to higher throughput and better payload yields.

A block diagram of each of the seven processes is shown in Figure 2.

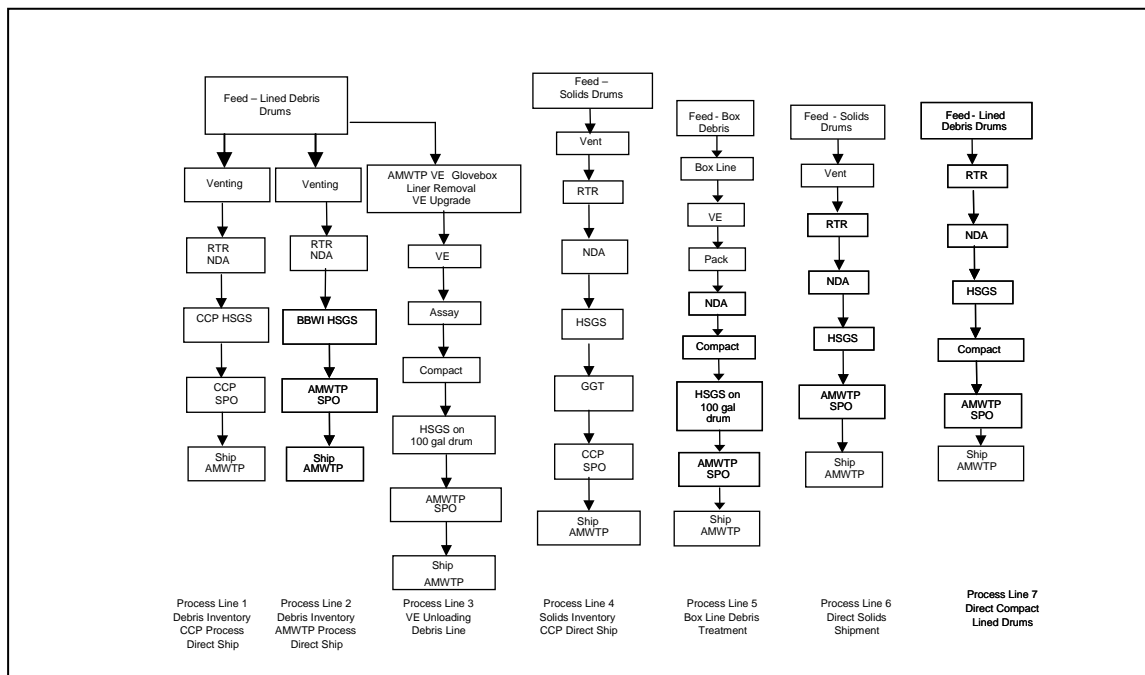


Fig. 2. AMWTP process lines unit operations.

DATA VALIDATION AND WASTE CERTIFICATION

The AMWTP TRU Programs group manages and performs the waste data validation as well as waste and transportation certification functions at the AMWTP. TRU Programs operates under the WIPP-approved Waste Certification Plan for the AMWTP. Data validation and waste certification functions operate using two crews who provide coverage seven days per week, twelve hours per day. Data validation and waste certification personnel are primarily located at the BBWI Energy Drive Facility in Idaho Falls. Management responsibilities include both production and compliance. The certified positions of the Site Project Manager, Waste Certification Official, Transportation Certification Official, and Site Quality Assurance Officer reside within TRU Programs. In August 2005, AMWTP completed a CBFO recertification audit of S3000 solids waste with only two findings, which were immediately corrected and closed. The recertification audit of S5000 debris and an EPA baseline reassessment are scheduled for March 2006.

PERFORMANCE TO DATE

Through the end of 2005, the AMWTP had shipped 4,609m³ of TRU waste to WIPP. An additional 734m³ of TRU waste had been certified but had not yet been shipped to WIPP. It is anticipated that the 6,000m³ milestone will be met in mid-February 2006. Figure 3 shows the cumulative volume of waste shipped to WIPP from the AMWTP from the first shipment in March of 2003 through December 2005.

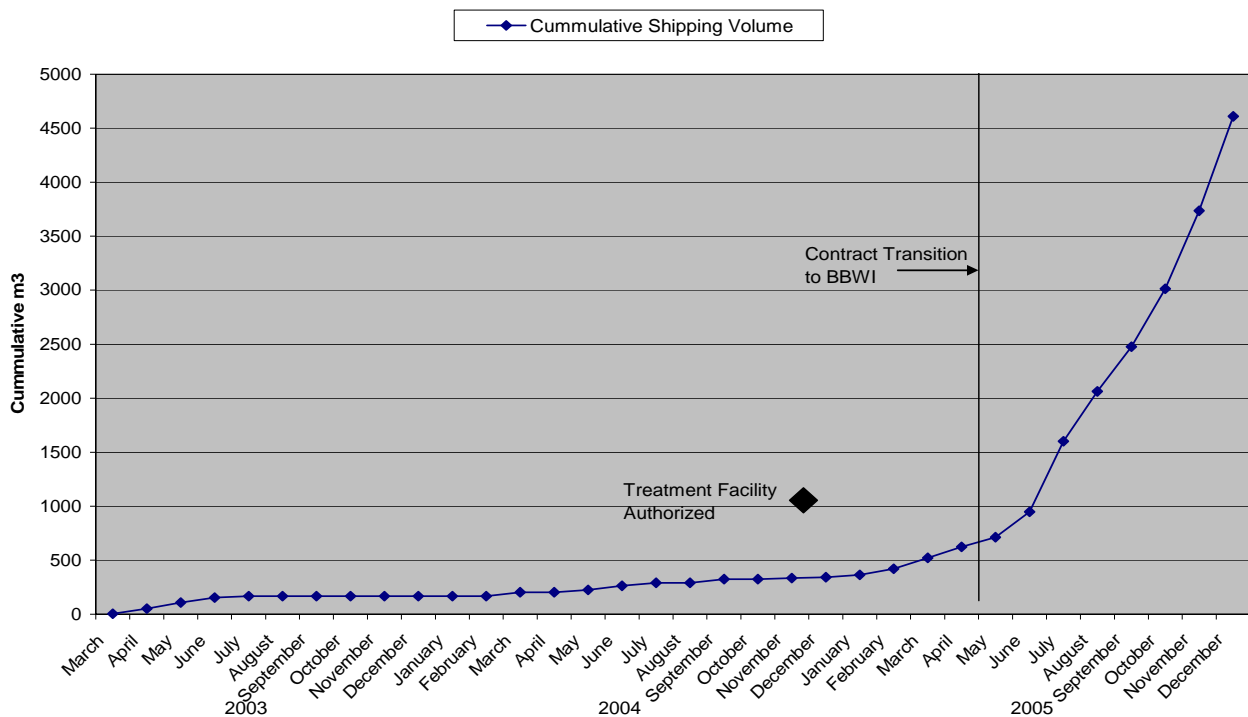


Fig. 3. Cumulative volume of AMWTP shipments to WIPP.

Comparing May 2005 performance against December 2005 performance shows that performance increases were achieved in several key areas. The following performance increases were the result of significant efforts as noted:

- Treatment Facility Boxline Production* – Treatment facility boxline production increased from an average of 1.6 boxes per day in May 2005 to an average of 6.0 boxes per day in December 2005 — a 275% improvement. Since October 2005, production performance has exceeded the facility production design basis. Performance of the boxlines and the treatment facility was the highest priority and absolutely key to achieving the 6,000m³ milestone due to processing volume and payload efficiency. Improvements in the boxline and treatment facility production were due to stabilizing facility equipment performance and reliability, replacing defective equipment and minimizing single points of failure, increasing operator proficiency in boxline operations, and waste feedstock optimization. Figure 4 shows the increase in boxline production since May 1, 2005.

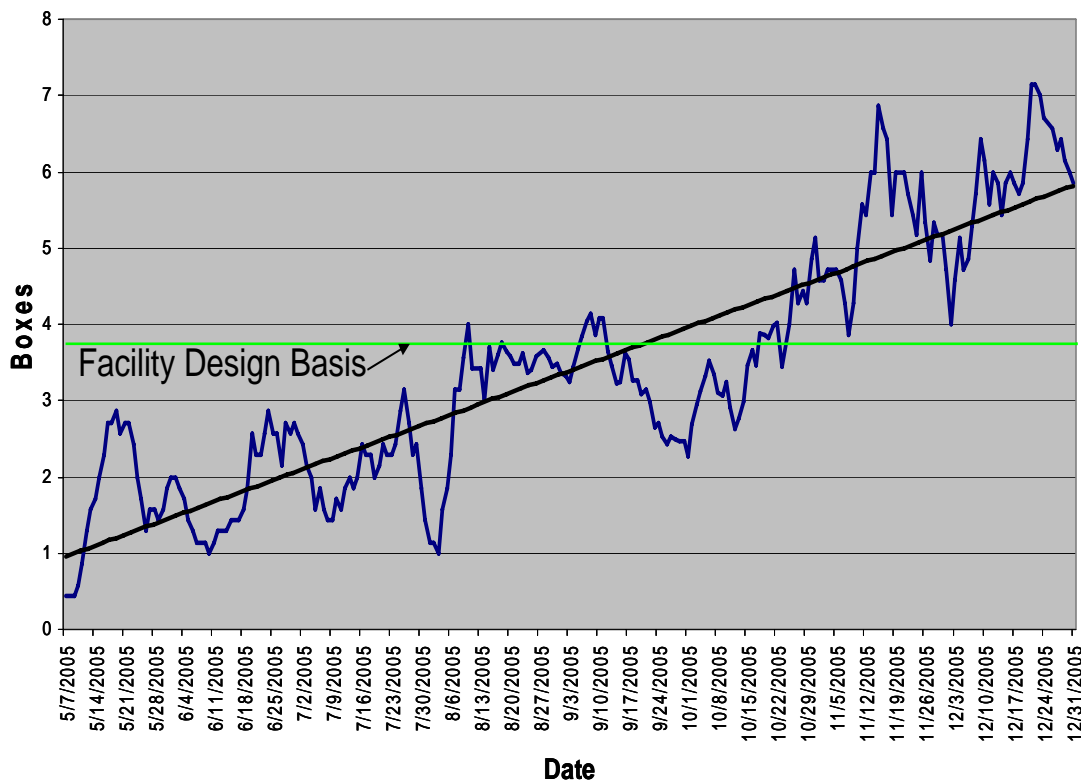


Fig. 4. AMWTP treatment facility boxline production.

- Headspace Gas Sampling Production* – Headspace gas sampling and analysis increased from an average of 12.2 samples per day in May to an average of 73.8 samples per day in December. This is an increase of over 500%. These increases were due to making efficiency improvements in the equipment to increase operational reliability, chemist proficiency, and bringing the fourth unit into certified operation.
- Shipment Efficiency* – Shipment efficiency increased by 20% based upon total shipment weight. The average shipment weight prior to May 2005 was 63,830 pounds per

shipment, and for November and December 2005 the average had increased to 76,860 pounds per shipment, an improvement of over 13,000 pounds of waste per shipment. Deviation around the mean also decreased significantly. From the period May 1, 2005 through December 31, 2005 the following performance was achieved in shipments to WIPP.

- TRU Waste Shipments to WIPP – 516
- 55-gallon drums shipped to WIPP- 8,598
- 100-gallon drums shipped to WIPP- 2,400
- Puck drums shipped to WIPP – 12,203

TRU Programs Waste Validation and Certification – Beginning in May 2005, through December 2005, the AMWTP data validation and waste certification functions continued to improve as a result implementing improved data tracking tools, establishing a production planning function within TRU Programs, improving worker proficiency and multiple qualifications, relocation of workers from the AMWTP plant to town, implementing a production philosophy, and staffing to meet production needs. This is apparent in measurement of the average cycle times for batch data report (BDR) processing. The processing time for headspace gas BDRs at the beginning of May 2005 was an average of 86.2 days. By December, that average had been reduced to 8.2 days. Assay validation processing time improved from 38.6 days to 2.6 days, and RTR was similarly improved from 118.1 days to 27.3 days. These improvements enabled TRU Programs to increase the amount of waste certified by 500% and to complete certification of 12,500 containers into the WIPP database in eight months of operation. Cost per cubic meter certified was reduced by 30% between May and December.

MIXED WASTE DISPOSITION

In addition to disposition of the TRU waste to WIPP, work began in shipping the mixed low-level waste fraction of waste stored at the AMWTP to Envirocare of Utah for treatment to land disposal requirements, followed by land disposal in a RCRA subtitle C landfill. Shipments of waste characterized to RCRA requirements and certified to meet the Envirocare of Utah waste acceptance criteria were initiated in November 2005. At the end of December, 41 shipments totaling 544m³ of mixed waste had been shipped to Envirocare of Utah.

LESSONS LEARNED

- **Safe, Compliant Production** – “Safe, compliant production” has been the mantra of the project. Attaining the increased production has not been at a sacrifice to safety or quality. At the end of December, the AMWTP had an OSHA Total Recordable Incident Rate of 0.53, had worked over two years without a lost-time injury, and were closing in on three million man-hours without a lost-time injury. The strength of the AMWTP safety program rests with its employee safety team, management leadership, and full worker involvement. Improvements in this area included using more durable Type B personal

protective equipment, implementing a senior supervisory watch program, implementing a strong conduct of operations program, staffing backshifts with industrial hygiene and industrial safety personnel, and making safety a precursor to any of the management and employee incentives.

- **Payload and Shipment Efficiency** – Beginning in May, efforts were made to maximize the efficiency of waste loads in the shipments to WIPP. With different weights of payloads coming from the seven production lines, an opportunity to mix types of payloads within the shipments presented itself. Correctly balancing to maximize weight allowed use of three payloads for all shipments. The maximum gross weight per shipment established by the Department of Transportation is 80,000 lb. Before May 1, 2005, the average weight per shipment was 63,830 lb. After improving production from the seven process lines, the average for the last two months of 2005 was 76,860 lb, an improvement of over 20%.
- **Incentives** – A variety of incentives were used to motivate the workforce to safely and compliantly hit production targets. These included financial payouts to all AMWTP BBWI employees for 1,000m³, 2,000m³, 3,000m³, 4,000m³, 5,000m³ and 6,000m³; award of gift certificates for boxline, characterization, and payload assembly performance; and award of gift certificates for production challenges. All incentives were awarded only if work was performed safely and compliantly. Celebrations were also held for meeting safety, compliance and production milestones. Lunch celebrations were held for working two million man-hours without a lost time accident, and cakes were supplied at every thousand-meter mark. A large western-style celebration is currently being planned by an AMWTP employee team for meeting the 6,000m³ milestone. Although these incentives and celebrations were not large financially, they did have a very positive impact in meeting the AMWTP goals and increasing job satisfaction.
- **Goals and Production Reporting** – BBWI developed daily goals for each of the unit operations based upon the production demands to meet 6,000m³. Goals were established for unit operations within retrieval, treatment, characterization, payload assembly, shipments, data validation and waste certification. Daily production reports were then generated by both plant operations and TRU Programs against these production goals.
- **DOE Oversight and Support** - The DOE, both the Idaho Field Office (DOE-ID) and the CBFO, provided significant support and enhancements to AMWTP. Three examples among many are the following. First, a mandatory daily phone call was established between DOE-ID, AMWTP, DOE-HQ, CCP and BBWI personnel. In this call, daily performance was reviewed as were issues and project support needs. At the end of the call all were on board with the project. Next, an electronic web-based document review system was put in place for review and approval of AMWTP document changes. In this, the revised document could be put into a web-meeting system, and all from different sites could have access to the document via the web network. This allows everyone to review the document, make changes, and approve the document in the review meeting. This saved significant time and cost in the review process and allowed changes to be efficiently implemented to the field. Lastly CBFO supported numerous site visits to

AMWTP with the purpose of providing additional expertise for streamlining and further enhancing AMWTP processes. Without this support from the DOE, AMWTP would not have achieved the performance to date.

OUTLOOK AND FORECAST

The future for the AMWTP appears bright. Through the 6,000m³ campaign, the process line capacities were proven and the production outputs of processing systems were stabilized. As with any new plant, the period of startup provided challenges associated with equipment failures, increased maintenance, and optimizing operator efficiency. Production systems were put in place in the area of data validation and waste certification to be able to match plant production outputs. That high-production work, in many cases above design capacities, could be performed safely and compliantly was clearly demonstrated. Last, cost-per-unit price for TRU waste disposition at AMWTP is among the lowest in the DOE complex.

Challenges facing the AMWTP include the efficient supercompaction of direct debris drums, safe and efficient retrieval of the stored waste in the TSA-RE, and sizing and supercompacting more difficult boxed debris waste.

Although the 6,000m³ milestone was not met at the end of December, it will be met in the first quarter of 2006. The expected date for AMWTP to have 6,000m³ certified is January 24, 2005, and the expected date to have 6,000m³ shipped from the state of Idaho to the WIPP disposal facility is February 15, 2005. AMWTP will continue to process TRU waste post-6,000m³ and ship approximately twenty shipments per week to the WIPP disposal facility, and be the primary supplier of TRU waste to WIPP for years to come.