

Advanced Mixed Waste Treatment Project, Design, Construction and Start-up

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ABSTRACT

The Advanced Mixed Waste Treatment Project (AMWTP) was awarded to BNG America in December of 1996. In 2005, following discussions between the United States (US) Department of Energy (DOE) and the United Kingdom (UK) Department of Trade and Industry (DTi) the DOE purchased the facilities. DOE awarded Bechtel B&W Idaho (BBWI) a contract to operate the facilities for one year, commencing 1 May 2005. The handover of AMWTP included the facility to repackage and supercompact waste (Advanced Mixed Waste Treatment Facility) and the retrieval, characterization, storage and Transuranic Package Transporter (TRUPACT) loading facility. This poster updates the progress of AMWTP from the previous presentations to Waste Management (WM) [1 and 2] to completion of the transition to BBWI in May 2005.

INTRODUCTION

AMWTP was awarded in 1996 to BNFL Inc, now BNG America in 1996 as a 'privatization contract' *ie* one where BNG America would be remunerated on the basis of the volume of waste processed and shipped to the Waste Isolation Pilot Plant (WIPP) at a fixed price defined in the 1996 contract. The contract required recovery of waste at the Idaho National Laboratory, Radioactive Waste Management Complex (RWMC) Transuranic Storage Area- Retrieval Enclosure (TSA-RE) and process this, plus *ca* 11,000 m³ already in storage; a total of approximately 65,000 m³ of transuranic waste (TRU). This was to be completed no later than 2018, and target of 2015. The contract also called for the plant to be designed to have the ability to process an additional option quantity of 20,000 m³ *ie* 85,000 m³ without compromising the end date(s) and have the ability to process an additional 100,000 m³ if required. In addition, the contract called for a 65% volume reduction of the TRU waste.

To demonstrate progress, the contract and Settlement Agreement [3] contained a number of milestones, encompassing design, completion of construction, commencement of operations and demonstration of processing (at least 2,000 m³ a year). The first processing/shipping milestone was 6,000 m³ by 31 December 2005.

BACKGROUND

The requirements of the contract resulted in the adoption of a robust design to volume reduce all debris waste (*ca* 70% of the total) by supercompaction and to treat the sludges by incineration: thereby destroying poly chlorinated biphenyls (PCBs) and other organic materials as well as drying the waste to give a low volume free flowing ash to the encapsulation stage. This design was substantially complete, with an advanced development and design program on the incinerator when, in 2000, litigation between Keep Yellowstone Nuclear Free (KYNF) and the DOE resulted in the decision to remove the incinerator. At this stage the permitting process for the facility with the incinerator was virtually complete, as was the conceptual and preliminary design.

The project team responded to this challenge by taking cognizance of the Land Disposal Requirements (LDR) having been removed from the contract and the consequential modification to remove grout from the waste form (to avoid negatively impacting shipments to WIPP). Hence it was possible to introduce a process to send the bulk of the sludge to WIPP, without thermal treatment, using Ten Drum Overpacks (TDOPs). Whilst this removed the immediate need for an incinerator, it placed an additional and heavy burden on characterization and WIPP certification. The residual waste that could not be shipped, estimated at 2% of the total was to be treated, in the future, by a non-incineration technique. This was the subject of a DOE 'Blue Ribbon Panel (BRP), to establish alternatives to incineration [4].

The low volume of metal allowed alternatives to be considered and both BNG America and the DOE in the BRP investigated options to deal with this waste. Technologies included a drum pyrolysis stage coupled with steam reforming process that was relatively low cost. Whilst this technology was not selected, it did allow the potential cost to be bounded and immediately was the subpart of later trials by US DOE, Idaho Operations Office (NE-ID) to move towards a technology solution [5].

In early 2005, discussions between the DOE and Dti, the shareholder of BNFL Inc. (now BNG America), resulted in the purchase of the facility by DOE. The conditions of transfer associated with the sale required, amongst other things, that the facility be fully operational and free from significant defect, completion of a successful WIPP certification audit, submission of Carlsbad Field Office's (CBFO) report recommending certification to the State of New Mexico, and completion of all activities enabling successful transition of the project to BBWI, who were to operate the facilities for one year commencing May 2005.

The process of AMWTP was represented at WM in 2004 [2]. This poster summarizes the project up to hand-over to BBWI, particularly concentrating on the period from February 2004, onwards.

WASTE

The waste covered by the AMWTP contract is predominantly from Rocky Flats [6]. It consisted of both drummed waste and waste in a variety of boxes. The split of waste by volume is approximately 41% boxes and 59% drummed waste. Of the overall volume *ca* 23% is sludge of which 2% was assessed as being unshippable without treatment by virtue of factors such as hydrogen generation, volatile organic compound (VOC) content, PCB components (a requirement that was subsequently relaxed).

PROCESS

The process chosen, post removal of the incinerator is as shown in Fig. 1. Key factors of the flowsheet were:

- Blending of all waste to achieve the TRU criteria in the primary container (TDOP or puck drum for compacted waste).

- Use of the TDOPs to consolidate sludge waste.
- Opening boxes and supercompaction of the waste to achieve volume reduction.
- Supercompaction of drums of debris waste.
- Extensive characterization prior to processing to build a pool of candidate waste.

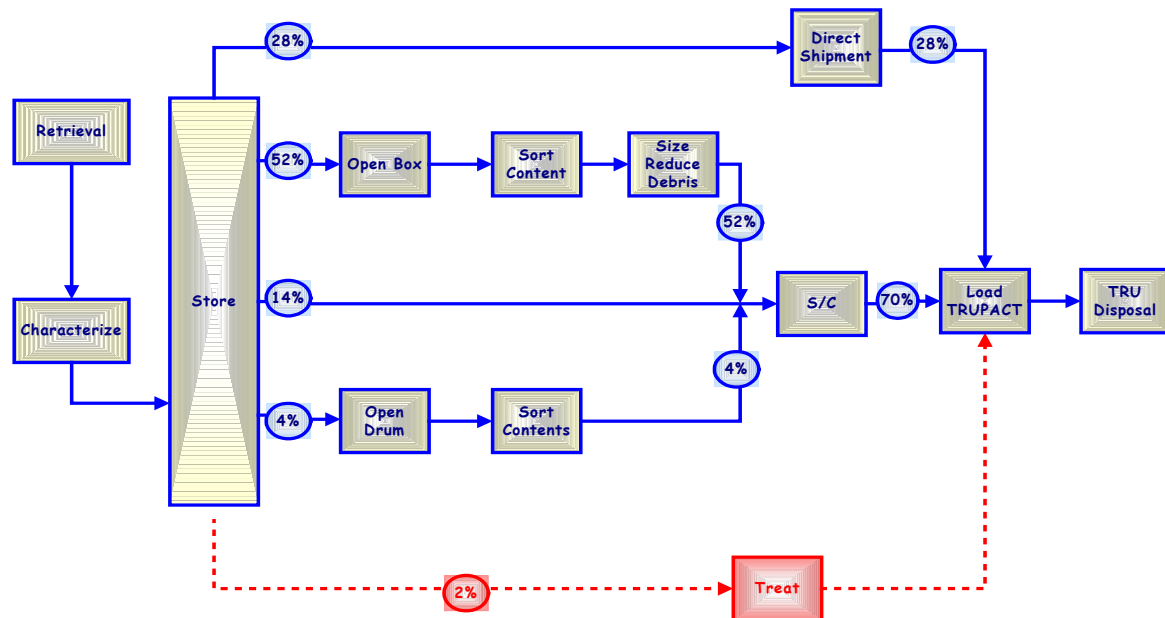


Fig. 1. AMWTP flowsheet

The process was based on a design used in the UK but in this case required a comparatively high throughput (70-140 drum equivalents through the facility per day). To meet the additional potential throughput, the high baseline throughput and the potential to extend the contract to a further 100,000 m³, the design was for a largely remote operation, mechanical plant with features more common in high radiation dose facilities (robot dismantling, low maintenance, low man access *etc.*). The plant is typical of those in the nuclear industry with a design and operating life of 30 years plus.

The rapid construction and the change in flowsheet have both been well documented. The permitting and re-permitting were both carried out in rapid, arguably record, time.

ACHIEVEMENTS

The time line for AMWTP is shown in Fig. 2. The award was made in December 1996 and the design and permitting was completed such that construction could start in August 2000, with completion of construction in 2002, despite the changes in flowsheet in November 1999 to January 2000 described above with the consequential permit delay and construction start postponement. Innovation included:

- A winter enclosure
- Stay in place concrete forms
- Modular form work

- Horizontal assembly
- A revised flowsheet that:
 - Consolidates drums of waste for shipment, as < TRU waste, to WIPP
 - Use of the TDOPs
 - Continued to give a volume reduction by supercompaction
- Extensive pre-installation testing of integrated major process units

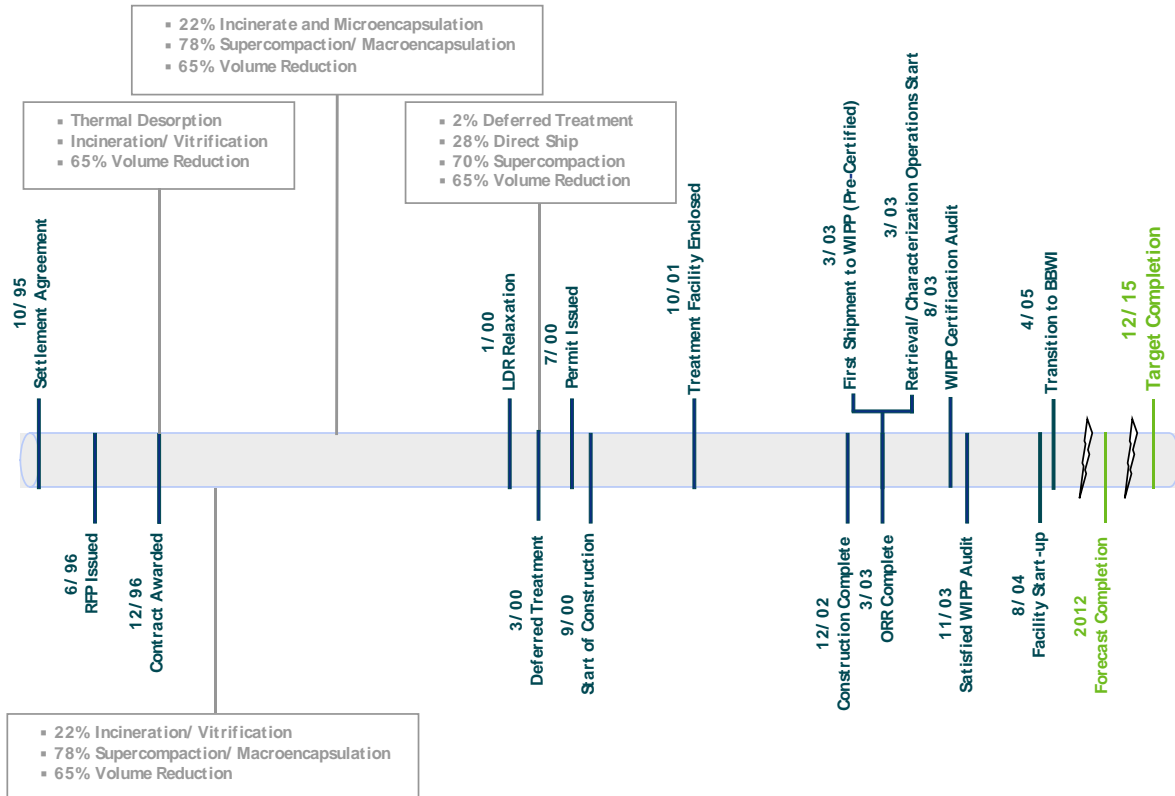


Fig. 2. AMWTP timeline

Major achievements during the period of this update report include:

- Continued outstanding safety performance;
- Facility testing completed faster than originally planned;
- Complete change out of the original Head Space Gas testing equipment;
- Facility WIPP certification achieved within 60 days of the audit;
- Production operations and waste shipping safely ramped up to 10 shipments per week within 12 months of receiving the original certification;
- The sale and transition of AMWTP was completed slightly ahead of schedule.

All equipment was fully tested against rigorous specifications, and then assembled as operable units off-site, for testing as complete units (eg the supercompactor, the ancillary equipment and glovebox). These

tests were to assure the availability of the equipment and confirm assumptions used in the Operation Research (OR) model, which underpinned the throughput projections.

The plan was to begin shipping in advance of facility operation by sending sludge to WIPP in TDOPs. During the period of facility construction and commissioning the project retrieved 12,919 m³ and characterized 7,940 m³ of sludge and debris waste. Of this, 7,304 m³ of sludge completed data validation and 643 m³ was certified in WIPP Waste Information System (WWIS). At the time of handover 624 m³ of sludge waste had been shipped. The main facility was commissioned at the time of hand-over and sufficient waste had been processed through the facility to satisfy the fully operational criteria of the sale. Facility commissioning and the Operational Readiness Review (ORR) were completed slightly ahead of schedule, enabling the permission to commence treatment facility operations to be received ahead of the baseline target of September 2004.

Some areas did require a higher than planned level of effort to bring them on line. For example to cope with the multiple waste streams (incineration produced only one) associated with sludge a much more complex and manual process to meet WIPP certification was required. The project had moved from a two product process (compacted debris and incinerator ash) to multiple categories for sludge waste. This in turn moved sludge from a 'production line' concept to something more akin to a disposition by drum approach.

Some of the areas associated with characterization of these drums, notably head gas sampling, required on most drums required an extensive investment in both additional equipment and effort to achieve the needed throughput.

The various delays moved the focus of the project from completion by 2012 (65,000 m³) *ie ca* 9,000 m³ per annum (pa) to the target based on 2,000 m³ pa *ie* 6,000 m³ by 31 December 2005. The focus automatically became ramp up rather than peak and steady production rate.

At the time of turnover, the production had been ramped to *ca* 10 shipments per week. On several occasions drum retrieval rates exceeded 200 drums per day (this is more than double the design capacity). Additionally, 7,940 m³ of sludge and debris waste had been characterized. This included enough debris boxes to supply the treatment facility for over a year without further characterization.

Notable events over the period of ramp up included retrieval and remediation of severely damaged buried containers, a very small fire in a venting operation of a bulged drum, which although not in itself a significant incident did lead to significant design and procedural changes to venting 'bulged' drums, and perhaps most significant, a non compliance associated with certification of the waste.

OTHER CHALLENGES

One of the most difficult challenges was dealing with the uncertainty created by the sale of AMWTP during this project start up period, which had its own significant pressures created by the need to achieve various WIPP certifications and ramp up production. Labor attrition rates grew but in particular a number of key staff left the project. Recruitment of replacement staff and maintaining the planned build up of technical and operations supervisory staff during the latter half of 2004 proved extremely difficult. Primary focus was maintaining safe and quality operations and continued motivation of the work force. It was essential to ensure the staff transitioned to BBWI, without losing motivation and momentum. This was only achieved by excellent cooperation and close working between the contractor, DOE, at both NE-ID and CBFO, and BBWI to ensure all the conditions of transfer were fully met in a timely manner. Ultimately the staff were successfully transitioned to BBWI along with all information, documentation, business systems and equipment as required. The handover was as close to 'seamless' as makes no matter.

A further challenge was the contract itself, which was essentially a privatization. This enabled the DOE to plan against a fixed and firm price for the waste. Given the lead time for projects of this type, the firm

commitment removed doubt about cost was not the best vehicle for dealing with unforeseen circumstances and evolving changes in approach to waste management in general, for example arising from the successful practices on the Rocky Flats contract.

LESSONS LEARNED

At the time of hand over, a first-rate facility was passed on to BBWI a first-rate facility for processing waste and volume reducing it by supercompaction. Waste is flowing to WIPP at a rate that will ultimately meet the project goals. There are however a number of lessons learned. The project showed some of the difficulties of a 'privatization contract' for waste processing. It was a serious constraint on BNG America to attempt to keep costs down to match the price defined in the contract. This was a particular problem as the process moved from one waste stream from the incineration process to multiple waste streams for the anticipated sludge streams. The impact of this change on the work required for waste characterization and certification was underestimated and in hindsight it is fair to say that work scope and demands of implementation of the TRU Waste Program in total were significantly underestimated initially. Changes in requirements only served to exacerbate this situation. Similarly the drive towards volume reduction and its impact on shipping was not well understood and proved to be a constraint when called upon to achieve the 6,000 m³ target *eg* it was not possible to direct ship debris drums, without compromising the contractual volume reduction. The scenario against which the contract was let was not entirely stable, as evidenced by the impact of litigation. At the time the contract was let the ultimate disposition route, WIPP, was not open and operating. BNG America was constrained by its fixed price for waste processing that no longer reflected the task. Price redetermination would not occur until 25,000 m³ had been shipped; *ca* 2008 or 12 years after the contract had been let. These constraints hampered flexibility on the part of both the contractor and DOE.

A further lesson was to always challenge conventional wisdom *eg* working through the winter by the use of a weather enclosure. Conventional wisdom has a cessation of external construction over the winter in Idaho. Other areas that were subject to innovation included use of TDOPs.

By using available technology, rather than developing new techniques, BNG America was able to reduce the design, construction and ramp up period. Many of the unit operations were applied or developed from operational plants such as the Waste Treatment Complex (WTC) in the UK.

A strong link in the project between design, technology, operations, safety and regulators was essential for the rapid move into and the completion of construction.

Finally a good professional working relationship with the regulators ensured rapid permitting of the project and facilities.

SAFETY

It would be wrong to ignore the aspect of safety. The project between March 2004 and hand over in April 2005 operated under an entirely different, unplanned focus leading up to the sale and transition of AMWTP. As previously stated this created great uncertainty in the work force whilst going through the process of ramping up operations on a project; which is often a time when safety is challenged. None-the-less, BNG America completed its work of commissioning and 2 years of hot operations with the following excellent safety record

- Days Away Case Rates (DACR) = 0.0, with only one lost time accident in 9 years including construction, commissioning and hot operations.
- Total Recordable Incidence Rate (TRIR) = 0.9

- No personal skin or other contamination
- All radiation exposure below the BNG America internal limits (10% of Federal limits).
- No measurable exposures of employees to hazardous materials.

CONCLUSION

Despite the difficulties of working a fixed priced contract where litigation changed the initial flowsheet and design concepts at a crucial stage, and the challenges of undertaking and completing a major start up while the facility sale was being negotiated, BNG America has delivered a major plant to allow NE-ID to meet its clean-up obligations. The plant and associated services is currently operating at, or in excess, of its design capacity.

REFERENCES

1. Harrop G, 2003 *The Design and Construction of the Advanced Mixed Waste Treatment Facility*; WM-03
2. Holmes RGG, Robbins RA, 2004. *Progress at the Advanced Mixed Waste Treatment Project*; WM-04-4443
3. Lodge EJ, 1995, Settlement Agreement between *Public Co. of Colorado v. Batt*, No. CV91-00350SOEJL (D.Id.) and *United States v. Bart*, No. CV-91-0054-S-EJL (D.Id.) Consent Order signed October 17, 1995, by Edward J. Lodge
4. Secretary of Energy Advisory Board, U.S. Department of Energy, 2000. *Report to the Secretary of Energy Advisory Board's Panel on Emerging Technological Alternatives to Incineration*
5. Department of Energy, *Action Plan for Emerging Technological Alternatives to Incineration*, June 2001
6. Ravio BD, 1995. *Waste Description Information for Transuranically Contaminated Wastes Stored at Idaho National Engineering Laboratory (INEL)*, INEL-95/0412