The Design and Construction of the Advanced Mixed Waste Treatment Facility

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ABSTRACT

The Advanced Mixed Treatment Project (AMWTP) privatized contract was awarded to BNFL Inc. in December 1996 and construction of the main facility commenced in August 2000. The purpose of the advanced mixed waste treatment facility is to safely treat plutonium contaminated waste, currently stored in drums and boxes, for final disposal at the Waste Isolation Pilot Plant (WIPP). The plant is being built at the Idaho National Engineering and Environmental Laboratory.

Construction was completed in 28 months, to satisfy the Settlement Agreement milestone of December 2002. Commissioning of the related retrieval and characterization facilities is currently underway. The first shipment of pre-characterized waste is scheduled for March 2003, with AMWTP characterized and certified waste shipments from June 2003. To accommodate these challenging delivery targets BNFL adopted a systematic and focused construction program that included the use of a temporary structure to allow winter working, proven design and engineering principles and international procurement policies to help achieve quality and schedule.

The technology involved in achieving the AMWTP functional requirements is primarily based upon a BNFL established pedigree of plant and equipment; applied in a manner that suits the process and waste. This technology includes the use of remotely controlled floor mounted and overhead power manipulators, a high power shredder and a 2000-ton force supercompactor with the attendant glove box suite, interconnections and automated material handling. The characterization equipment includes real-time radiography (RTR) units, drum and box assay measurement systems, drum head space gas sampling / analysis and drum venting, drum coring and sampling capabilities.

The project adopted a particularly stringent and intensive pre-installation testing philosophy to ensure that equipment would work safely and reliably at the required throughput. This testing included the complete off site integration of functional components or glove boxes, with the attendant integrated control system and undertaking continuous, non-stop, operational effectiveness proof tests.

This paper describes the process, plant and technology used within the AMWTP and provides an outline of the associated design, procurement, fabrication, testing and construction.

Introduction

In the early 1970’s, DOE began retrievably storing transuranic (TRU; >100nC/gm) mixed waste and low level alpha (i.e. 10 – 100 nCi/gm) mixed waste at the INEEL in Idaho. This process continued until the mid 1980’s, by which time approximately 65,000 m$^3$ of total waste had accumulated: 40,000 m$^3$ of mixed TRU and 25,000 m$^3$ of mixed alpha low level waste. The waste is stored at the Radioactive Waste Management Complex (RWMC) of the INEEL in either an above ground earthen covered berm or in Type II storage modules. The wastes are mainly packaged in 55-gallon steel drums, fiberglass reinforced plywood boxes or metal boxes.

The 1995 Settlement Agreement (sometimes referred to as the “Governor’s Agreement”) between the State of Idaho, the DOE and the U.S. Navy requires that this 65,000 m$^3$ of waste be shipped out of Idaho. The target date for completion of shipments is 2015 and no later than 2018.
In 1995, the DOE Idaho Operations Office began the procurement process for a privatized facility to treat this waste to the standards required for shipment and disposal. The majority of the waste will be shipped to the WIPP in New Mexico and therefore treatment must satisfy the WIPP waste acceptance criteria.

BNFL Inc. was awarded the competitively procured AMWTP privatization contract by the DOE in December 1996. The AMWTP contract is fixed price and spans the project lifecycle from conceptual design to Resource Conservation Recovery Act (RCRA) closure. The project is divided into three phases:

- Phase I, initiated on January 20th 1997, consisted of completing the necessary permits and approvals, including the RCRA Part B Permit, the AMWTP Environment, Safety, and Health (ES&H) authorization process, submitting data to DOE to support National Environmental Policy Act (NEPA) analysis, and managing public involvement activities. This phase has been successfully completed.

- The current project phase (II) consists of the detailed design, equipment development, manufacture of equipment, and construction of a new facility at the INEEL RWMC. Phase II also includes completing all final permit or license requirements, and other obligations established during the AMWTP authorization process. Although phase I costs were covered by a series of deliverable payments, the phase II finance responsibility is solely with BNFL Inc.

- Phase III, operations will consist of waste retrieval from the RWMC; pretreatment characterization of waste needed for storage and/or treatment; storage; treatment; post-treatment characterization as needed to certify the final waste form; waste preparation for shipment; loading TRUPACT II containers; loading containers on approved transport carriers; and RCRA closure of the facility. During phase III operation payments are received as the waste is treated, to the final waste form specifications.

Safety Standards

Within the AMWTP contract there are a number of Environmental, Safety and Health requirements specified. Part of those requirements included a commitment by BNFL Inc. to develop a definitive and comprehensive set of requirements that would become the Program Operating Plan for the Project. Not only Nuclear Safety Management requirements were to be agreed upon and specified, but also all other relevant requirements in support of Design, Construction, Procurement and ultimately Operations. The Plan thus addressed radiological, criticality, nuclear, industrial and environmental safety requirements as well as conduct of operations, facility start up, emergency planning and many other aspects of the project safety basis. Specifically for nuclear safety management, the Project was required to have an approved Preliminary Safety Analysis Report (PSAR). This document was written in accordance with DOE Order 5480.23 using DOE Standard 3009-94. DOE approval of these two documents was required before BNFL Inc. could begin construction of the Treatment Facility in August 2000.

After 10CFR830: subpart B Nuclear Safety Management, became federal law in the spring of 2001, AMWTP had to reconsider the path forward and assess the impact of any new requirements on the project. BNFL Inc. elected to produce one safety basis document for the entire project, utilizing and building upon existing safety programs and integrating this into all phases of the project. Throughout, industrial safety and health programs have had to be maintained in accordance with OSHA.

Quality Assurance

From the start, BNFL Inc. was committed to establishing and implementing a Quality Assurance Program at the AMWTP that met all regulatory requirements of Title 10, Code of Federal Regulations (CFR), Part 830, commonly referred to as The Price Anderson Amendment Act. Through the establishment of a QA Program, BNFL Inc. strives to provide effective, compliant and efficient services to the Idaho Operations Office to ensure
safe and efficient management and operation of the AMWTP. The provisions of the AMWTP QA Program Plan (QAPP) apply to all BNFL Inc. activities that may affect radiological, nuclear, or process safety within the scope of work for all phases of the contract.

The objective of the AMWTP QAPP is to establish planned and systematic processes necessary to provide adequate confidence that safety related activities for the contract are satisfactorily conducted to meet nuclear safety requirements, thereby minimizing potential hazards to the public, site or facility workers, and the environment. The management processes established by the AMWTP QAPP are fundamentally integrated with the principles of an integrated safety management system to ensure safe management of BNFL Inc. products and services. These principles are essential to ensure continuous protection of BNFL Inc. employees, the public and the environment.

Management’s policy is to promote self-identification through rigorous Management Self Assessments with the objective of identifying weaknesses before they become self-disclosing events, and targeting areas for improved management and productivity. This also aligns with BNFL Inc.’s responsibilities under the Price-Anderson Amendment Act.

The AMWTP Process Throughput

The basic outline process flow sheet is shown schematically as Figure 1, which indicates the volumetric percentage routing of waste material through the process stages.

![AMWTP Simplified Process Flow Diagram](image)

Fig. 1, AMWTP Simplified Process Flow Diagram.

The overall throughput must be adequate to allow the treatment of 65,000 m³ of (baseline) waste and an additional 20,000 m³ of (optional) waste by the target year of 2015 and the contractual deadline of 2018. A total
of 85,000 m$^3$, between the years 2003 and 2015, gives an average operational throughput of approximately 7,000 m$^3$ per year, with reduced throughput at startup and an allowance for plant shutdown(s). BNFL Inc has however adopted an approach whereby at least 98% of the first 65,000 m$^3$ should be completed by early 2013; five years ahead of schedule.

**Retrieval**

The INEEL baseline (existing) waste to be treated has a volume of 65,000 m$^3$, approximately 11,700 m$^3$ of which is in storage within INEEL Type II Storage Modules and 53,300 m$^3$ currently stored under an earthen covered berm.

Retrieval of the Type II stored material is straightforward. Access to the majority of the other 53,300 m$^3$ of drums or boxes requires that the soil burden be removed. This involves soil sampling and earth removal or excavation and vacuum ‘finishing’ and controlled, but generally conventional, means of tarpaulin and plywood cover removal. Retrieval operations have to be safely conducted at a rate that matches the treatment facility throughput requirements and operations are subject to the necessary protections and precautions.

**Characterization and Storage**

Following retrieval, waste is characterized using real-time radiography (RTR) units, drum and box non-destructive assay measurement systems, head space gas sampling / analysis and drum coring capabilities.

Retrieved containers undergo RTR examination to determine waste material parameters (e.g., metals/alloys, cellulosics, rubber, plastics, soil, sludge, etc.) and detect prohibited items and unexpected conditions such as liquids or material that could adversely affect assay measurements. The containers of the retrieved waste are radioassayed to determine the amount and isotopic composition of the radionuclides contaminating the waste. The box and drum assay units use this information to estimate the fissile gram equivalent, Pu 239 equivalent activity, for the individual waste containers. Assay measurements help determine or confirm criticality limits.

![Fig. 2. An AMWTP Real Time Radiography Unit.](image)

![Fig. 3. An RTR image.](image)

For wastes that are direct shipment or processed directly through the supercompactor, these examinations and measurements are used to certify the waste for disposal: Therefore, the equipment and procedures for radiography and drummed waste nuclear assay must conform to the requirements specified in the WIPP Quality Assurance Program Plan for characterization.
Figure 2 above shows an AMWTP real time radiography unit in test prior to delivery to Idaho. The tests undertaken included operational effectiveness trials to positively confirm that the specified throughput could be achieved. This was accomplished by running the units in pseudo operational mode to generate hundreds of container radiographic images whilst ensuring that the units operated reliably with no significant failures. Figure 3 is an image generated during this testing period and shows a light bulb surrounded by waste. This image is of waste that is in a 55g drum, within an 83 g drum, overpacked by a 100g drum; and the bulb filaments are clearly visible.

### Waste Processing Routes

The characterization processes and information gathered dictate the subsequent interim storage and processing requirements for the waste. Boxed waste that satisfies the AMWTP waste acceptance criteria (e.g. has an acceptable fissile content) will be routed to one of the main facility box lines. Drummed waste will fall into the following categories, see figure 1:

- Suitable for direct shipment to WIPP – no processing required (28% by volume)
- To be routed to supercompaction for volume reduction in the facility (14% by volume)
- Need treating as special case waste within the facility (4% by volume)

Drummed waste identified as suitable for direct shipment, after full characterization and certification, is placed into ten-drum over packs that are then loaded into TRUPACT - II containers. The other boxed and drummed waste is transported using flatbed trailers to the receiving and staging area within the main facility.

### The Box Lines

All boxes of waste (52% of the baseline volume) need to be opened, in the AMWTF box lines, and the waste sorted. Within the facility there are two radiological cells equipped with remotely operated mechanical equipment. These box lines facilitate the opening of waste boxes, sorting and size reducing the box contents and then loading the waste into drums, in preparation for supercompaction.

![Fig. 4, Box line in construction, showing overhead and floor mounted power manipulators.](image)

These operations are accomplished using a variety of remote handling equipment, including overhead gantry cranes, gantry robots, floor mounted power manipulators for the main size reduction tasks, overhead power manipulators for the tasks requiring a finer level of dexterity and Master Slave Manipulators (MSMs).
The drums produced from the box lines are assayed. Dependent on the drum contents the waste is either fed forward to supercompaction (majority), or treated as special case waste. A box of waste will typically fill up to fifteen 55-gallon drums. Each of these drums must then be assayed, prior to transportation to supercompaction. This is necessary for both WIPP certification requirements and to satisfy facility criticality conditions. Adjacent to one box line is a large, twin auger, shredder to allow the shredding of the empty wooden or metal boxes prior to their disposal as low-level waste.

**Supercompaction**

The supercompaction area receives feed material from either the box lines or the drums from characterization identified as suitable for direct feed to supercompaction. This 60-ton weight supercompactor exerts a 2,000-ton force and will compress a loaded 55-gallon drum to a ‘puck’ of approximately 6 inches height (a height basically determined by the drum content), with minor increase in diameter. After supercompaction typically six pucks are placed in specialist 100-gallon drums for subsequent transportation to WIPP.

![Figure 5, the AMWTP supercompaction suite](image1)

![Figure 6, the supercompactor infeed venturi.](image2)

The facility will process approximately four boxes per day and the supercompactor will compress over eighty drums per day. After storage, the drums of waste are assembled into payload assemblies for shipment to WIPP. Prior to transportation the waste data is authorized by WIPP personnel and checks undertaken to confirm the payload meets transportation regulations. There are a number of limits (primarily weight and fissile content) that may limit both puck to drum contents and puck drum to payload assemblies for off site shipping.

Figure 5 shows the supercompaction suite during installation on site. The large post compaction glovebox assembly shown allows for the handling, staging and export of pucks. It has been the experience of BNFL Sellafield, and elsewhere in Europe, that pucks can be prone to reassertion and deformation to a degree that will not permit insertion into the puck drum. The puck recovery glovebox portion of the supercompaction suite allows these deformations to be worked without immediate stoppage of the main supercompaction line.

Figure 6 shows a venturi feed unit. This allows drums to be safely fed forward into the compactor (or box line) in a controlled manner that provides assurance of radiological / contamination boundary conditions: The venturi has been engineered and qualified so that the (ventilation) airflow prevents back diffusion or contamination.

**Drum Repack System**

The AMWTP facility is equipped with a Drummed Waste Handling Enclosure (DWHE) and a Drummed Waste Packaging Glovebox (DWPG). The DWPG is designed for the processing of low levels of debris waste (in bags) and ‘container in container’ waste. These packages and containers will be removed from a 55-gallon drum,
characterized, subjected to WIPP Hazardous Waste Analysis Permit (WAP) - required visual examination, and repacked into new 55-gallon drums.

**Special Case Waste (SCW)**

The SCW area is designed to handle a wide range of materials brought to or generated within the plant. This large glovebox system can receive either debris or non-debris waste in transfer baskets/containers from the box line, or that that is transferred into the glovebox through the bag ports. It is required to track individual SCW item(s) back to the original drum or campaign. The appropriate information is linked via the data management system (DMS) to the transfer basket / container. All packages and containers being presented to the special case waste station must carry with them (via the data management system) assay value for fissile material and a radiological dose measurement.

**The Central Control Room**

A significant proportion of in plant operations are controlled local to the machine and operation, such as the floor mounted or overhead power manipulators in the box lines. This allows the operator clear visual view of the waste and task at hand, supplemented by closed circuit television (CCTV) images.

For remote operations and monitoring, the plant is equipped with a central control room (CCR), complete with three operator consoles and standby panels.

![Figure 7, the general layout of the central control room and adjacent offices](image)

During normal operations, all of the information required to successfully control and monitor the plant is available from the CCR consoles. Each console houses four to six visual display unit (VDU) workstations, a total of 14, two CCTV workstations, plus communication facilities. The console assigned to Ventilation and Services also accommodates the radiological surveillance and Criticality Incident Detection (CID) workstations. The console allocated to production management contains the independent fissile tracking system.

The CCR has hardwired shutdown panels dedicated to separate plant areas, a standby and shutdown panel for the ventilation and fire damper systems, and the radiological panel. In the event of the loss of the computer-based control system the plant will be shutdown, and the panels provide instrumentation sufficient to monitor that the shutdown has been effective and that the plant remains in a safe state with ventilation operative.
A large plasma screen display on the wall directly in front of the production management console will assist in the planning, monitoring and controlling of the plant throughput across the entire AMWTP. The operators have the freedom to select any of the control system displays (e.g. the alarm list during a fault condition to aid fault diagnosis) and portray it on the large screen.

The facility is also equipped with a backup monitoring room (BMR) used to confirm safe shutdown and plant state in the unlikely event of an unavailable control room. If, for example, a localized fire prompted evacuation of the control room the BMR would be used to confirm or initiate safe plant shutdown. Situated in a different location in the facility building the BMR contains an independently hardwired replica of all the CCR hardwired shutdown and standby panels, two control and data management system VDU workstations, one CCTV workstation and a radiological surveillance workstation.

The Integrated Control System

The main Integrated Control System (ICS) uses distributed programmable logic controllers and redundant servers in a ‘Factory Link’ SCADA manner to provide sequence and interlock control and overview monitoring for the plant operators. Over 250 mimic displays are applied with the VDU-based control system interface. The mimics were kept relatively simple, but are very well structured in terms of the content, presentation of information and navigation through the system.

![Sample ICS mimic display](image)

Figure 8  Sample ICS mimic display

The ICS hardware was systemized on a process basis that in the majority of cases matches the physical room layout of the facility. The Integrated Control System consists of 19 Modicon Quantum programmable logic controllers (PLC’s) encompassing some 4500 input / output (I/O) points. With a few exceptions, all the I/O is marshaled into the PLC’s utilizing remotely located Momentum I/O units. This has greatly reduced the number of control signal cables and glovebox penetrations in the facility, reduced the total number of termination and therefore provides significant construction schedule advantages.

The 19 PLC’s are further subdivided into 4 process areas. Each area has duty / standby SCADA servers providing >99.98% availability of the system. Communication links between PLC’s and servers utilize Ethernet of 100 MB bandwidth.
With regards to the ICS software, a modular approach to all aspects of the PLC (Concept 2.5) and SCADA (Factory Link 7 ++) code was adopted. This manifests itself as a library of software for PLC, SCADA and simulation to support common plant devices such as valves, drives and cylinders. Any new devices encountered were coded in a manner consistent with the library devices. A rigorous testing regime was put in place utilizing a ‘PICS’ simulation tool to emulate plant equipment feedback and product movement.

BNFL adopted a staged approach to testing:

Stage 1  System Tests
Stage 2  Area Tests
Stage 3  Integrated Test.

Each stage of testing proved specific functionality whilst progressing toward the final objective of an Integrated Test, simulating normal process operations and justifying or verifying the fundamental assumptions of the operational research model. Working in this systematic manner provided the required confidence that the installed system, and plant, would perform as designed.

The Data Management System (DMS)

The scale of operations, the amount and the range of waste to be handled, the applicable regulatory conditions and consequent magnitude of data demand that the AMWTP use a data management system (DMS). The waste tracking part of the DMS, for example, needs to manage information in relation to:

- Acceptance and inspection of the containers.
- Characterization of the waste material inside the containers.
- Assignment of processing/treatment of the waste material to meet shipping requirements.
- Payload assembly, storage, and preparation for shipment to the storage facility.
- Shipment of the containers to their final destination.

The system provides a unified and searchable database of information covering container history, characterization, disposition, waste movement and current location. To accomplish this the DMS interfaces with barcode readers, radiography units, assay equipment, analyzer stations and plant automation software. In doing so, the DMS provides a centralized data management system for the entire waste management process and facilitates auditable operator and managerial approvals.

A security/logon component is utilized to allow authorized users entry into the DMS and access security is enforced via the user name and password. Users are restricted to specific areas. An electronic signature component is used by qualified supervisors to certify final results of analyses performed by operators throughout the system. The DMS allows for multiple levels of data validation with checklists at each level of processing. Authorization using electronic signature is required at each level, thereby assuring result verification occurs throughout processing.

The system includes an alarm component that monitors time-sensitive processes within the facility. Electronic alarms are created to send messages to specific users to remind operators of time-based events. Non-conformance reports may be generated that typically indicate a problem, concern, or simply some anomaly that has occurred during processing.

The software was specifically and custom developed for AMWTP using Oracle 8i database, and primarily using Oracle Forms (version 6i), in client-server mode. The complete AMWTP DMS was designed to support the WAP and WIPP certification requirements.

Equipment, Technology & Testing
The technology involved in achieving the AMWTP functional requirements is primarily based upon a BNFL established pedigree of plant and equipment; applied in a manner that suits the process and waste.

The philosophy of technology selection by the AMWTP team was to select, where possible, processes and equipment that have an established track record. This resulted in minimizing uncertainties and any development work to resolve uncertainties was targeted at demonstration and increasing confidence rather than the more risky business of invention.

Characterization of the drums and boxes is conducted by radiography, radioassay or chemically, as appropriate. The radiography and radioassay detection principles chosen were well established, but technology and system advancements were applied to improve AMWTP detection limits. Advantage was taken of the experience gained at BNFL’s Waste Treatment Complex (WTC) at Sellafield or the DOE Waste Receiving and Packaging facility at Hanford. The box assay supplier is BNFL Instruments. The real time radiography of containers has also been applied at WTC in Sellafield but AMWTP uses a USA manufacturer, namely V J Technologies of NY.

The main facility box lines use equipment and tools with proven track records. The floor-mounted manipulators are of the same manufacture (Brokk) as applied in the Sellafield Waste Treatment, Monitoring and Compaction Plant (WAMAC). The overhead power manipulators, manufactured by PaR, have been applied and proven previously and the master slave manipulators are as used throughout Sellafield, including the vitrification lines. These MSM’s are manufactured by Forward Industries, UK.

Supercompaction has been used worldwide at places such as the Waste Receiving and Packaging facility at Hanford, and the Sellafield site for volume-reduction of wastes ranging from low-level to transuranic waste. The applicable Sellafield plants include Sellafield Drypack Plant (SDP) and WTC, and the AMWTP has taken advantage of the improvements made through operational experience. The AMWTP supercompactor manufacturer is Fontijne of Holland, the same supplier used for the Sellafield plants listed.

The project adopted a particularly stringent and intensive pre-installation testing philosophy to ensure that equipment would reliably work at the required throughput. This testing included the complete off site integration of functional components or glove boxes, with the attendant integrated control system and undertaking continuous, non-stop, operational effectiveness proof tests.

These effectiveness trials generally translated to a demonstration of the reliable operation of equipment through the equivalent of one-week operation; without failure. For supercompaction this meant that hundreds of drums were compacted at both the manufacture’s works in Holland and again at the glove box supplier and integration point in Tennessee.

The supercompactor maximum throughput of almost 100 drums per day is a continued rate of treating one drum every 15 minutes. This demands high utilization, system availability and reliability - through the application of proven technology with a high degree of automation.

Throughout the project, risks and challenges were managed by a structured, systematic and formalized approach that allows graduation and quantification of the risks and tracking of the mitigating actions or progress towards resolution.

**Construction**

At contract award, BNFL had already established a teaming arrangement with Morrison Knudsen (MK), a company later to change title to Washington Group International or WGI. WGI undertook the architectural and
structural design and had been chosen to act as the construction management contractor. This organizational arrangement had several advantages including the assignment of the intended Construction Manager to the design team very early in the Project. This ensured that designs were appropriately considered within construction and constructability review frameworks.

Ground breaking was initiated in August 2000 with an excavation of 16,500 cubic yards and a backfill of 25,000 cubic yards, setting the floor for concrete mat pour(s) of 7,000 cubic yards. The total size of the building is 128,000 square feet comprised of 57,000 sq. ft. on the 1st floor, 56,000 sq. ft. on the 2nd floor and a 15,500 sq. ft. penthouse.

Staged completion of the mat allowed the commencement of construction of the cast in place (CIP) walls. Crucial to the Project schedule was the planning and preparation for the winter of 2000. An INEEL Idaho winter is extreme with snow expected from early November to late March and outside temperatures well below freezing: Conditions that are not at all conducive to outside working or concrete pours.

To allow construction to proceed throughout the winter the Project therefore rented an immense and robust ‘tent’. The tent was prefabricated, constructed on site and with heat sources allowed work through the winter with craftsmen in shirtsleeves. Had winter working not been applied there would have been significant loss of productivity and it would not have been possible to finish the building sufficiently prior to the next, 2001, winter: Hence the schedule would have suffered in a compound manner.

The main building structure was complete by mid October 2001, with large construction openings left to allow entry of the plant and equipment that continued to arrive, mainly through the first quarter of 2002.

Through the summer of 2002 the setting of plant & equipment, the installation of pipework, ventilation, cable tray and rack, continued as the blockwork / CMU walls were completed. As summer drew to a close efforts were intensified to complete the electrical, critical path, activities.

By November 2002 the craft resource level was at 900, over half of which were electricians, working two shifts and weekends. The electrical statistics include approximately one million linear feet of cable and 70,000 terminations (excluding lighting & small power).
Construction completion was achieved on time, on December 27th 2002; four days prior to the end of December 2002 Settlement Agreement milestone and twenty-eight months after breaking ground.

Summary & Conclusions

At the first AMWTP Team Meeting in January 2000 the following mission statement was produced: “As a responsible member of the community the BNFL Team is committed to the safe, timely, profitable and efficient management of the Advanced Mixed Waste Treatment Project which will prepare waste for shipment from the INEEL.” The spirit and intent of this mission, to remove the waste, has been sustained throughout the Project.

The AMWTP privatized contract was awarded to BNFL Inc. in December 1996 and construction of the main facility commenced in August 2000. This construction was completed on time in December 2002. This type of schedule challenge has not been seen in the industry for several decades. The focused and innovative construction program included the use of a temporary structure to allow (first) winter working and massive resource loading towards the end of construction.

The technology involved in achieving the AMWTP functional requirements is primarily based upon a BNFL established pedigree of plant and equipment and the project adopted a particularly stringent and intensive pre-installation testing philosophy to ensure that equipment would work reliably at the required throughput.

Commissioning of the related retrieval and characterization facilities is currently underway: The first shipment of pre-characterized waste is scheduled for March 2003, with AMWTP characterized and certified waste shipments from June 2003 and facility operation and shipments commencing in early 2004.

Fig 11 Construction August 2000

Fig 12 Facility construction August 2002