

## **PROGRESS ON THE EAST TENNESSEE TECHNOLOGY PARK (ETTP) THREE BUILDING DECONTAMINATION PROJECT**

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### **ABSTRACT**

The East Tennessee Technology Park (ETTP) Three Building Project is a USDOE-Oak Ridge Operations project to remove all equipment and decontaminate three of the major gaseous diffusion buildings for future use by private industry. It is a major part of a long-term plan to recycle former Oak Ridge facilities into community reuse and industrial development.

BNFL Inc. was awarded a six year fixed price contract for the equipment removal and decontamination effort. Over 360 million pounds of material must be removed and disposed. The buildings, containing over 5 million square feet of floor space, must be decontaminated and capable of being fully released to commercial customers. BNFL had previously dismantled the Capenhurst Diffusion Plant in the United Kingdom.

The three buildings, K-33, K-31, K-29, were constructed in the early 1950's. The primary use of the plants was to produce low enriched uranium for nuclear power plant fuel. Some uranium from recycled reactor fuel was processed through the plants. The primary contaminants are uranium and technetium. Transuranics have been found only in trace amounts. In December 1987, the three buildings were permanently shut down.

Materials leave the site by three paths: survey and unrestricted release, decontamination and unrestricted release, and burial as waste. Survey and unrestricted release is performed for equipment and materials from areas relatively free of contamination. Decontamination and unrestricted release is performed at BNFL's Manufacturing Sciences Division in Oak Ridge, Tennessee. Burial of material is performed at Envirocare in Utah or at the Nevada Test Site.

Of the 360 million pounds to be removed, the to-date progress is:

- |  |                   |
|--|-------------------|
| • Surveyed and Unrestricted Release:     | 9 million pounds  |
| • Shipped to Puducah as usable equipment | 3 million pounds  |
| • Recycled and Free Released             | 12 million pounds |
| • Buried as Waste                        | 18 million pounds |

In addition, over 16 million pounds of equipment has been dismantled, sized, and is awaiting compaction through BNFL's new site supercompactor prior to burial as waste.

In 2001, the project is scheduled to dispose of over 1.5 million pounds a week. Final completion of project is scheduled for completion in Mid-2004.

## **PROJECT OBJECTIVES**

The purpose of the ETTP (formerly the K-25 Site) Three Building D&D and Recycle is to dismantle, remove, decontaminate, and economically maximize the recycle of the process equipment and material within Gaseous Diffusion Plant (GDP) buildings K-29, K-31, and K-33. The interior of the buildings will be cleaned to surface contamination levels acceptable for unconditional release cited in DOE Order 5400.5 supplemented with NRC Regulatory Guide 1.86.

## **PROJECT SCOPE**

The ETTP was originally built as the Oak Ridge Gaseous Diffusion Plant. The two original process buildings (K-25 and K-27) used for producing weapons grade uranium were closed in 1964. K-29, K-31, and K-33 were brought on-line in the early 1950's and utilized for the production of low enriched uranium for nuclear power plant fuel. These three plants were closed at the end of 1987.

In 1996, the site was renamed the East Tennessee Technology Park to reflect its mission of environmental restoration and management, and reindustrialization through leasing to and partnering with private industry. ETTP's goal is to reindustrialize and reuse the site assets such as facilities, equipment, materials, utilities and a trained workforce, by leasing vacated facilities, and incorporating commercial industrial organizations in ongoing work.

BNFL Inc. was awarded a fixed price contract in the fall of 1997 to meet the project objectives and complete the work by mid 2004. The intent of the contract was to recycle as much of the material as possible. Several DOE decisions on recycle have impacted the project and its recycling objectives.

Release of volumetric contaminated materials is now prohibited until the Nuclear Regulatory Commission establishes a national release standard. Release of materials from the Department of Energy facilities within radiological areas is restricted with few exceptions until the current release standard is reviewed and re-released. The latter process is expected in 2001.

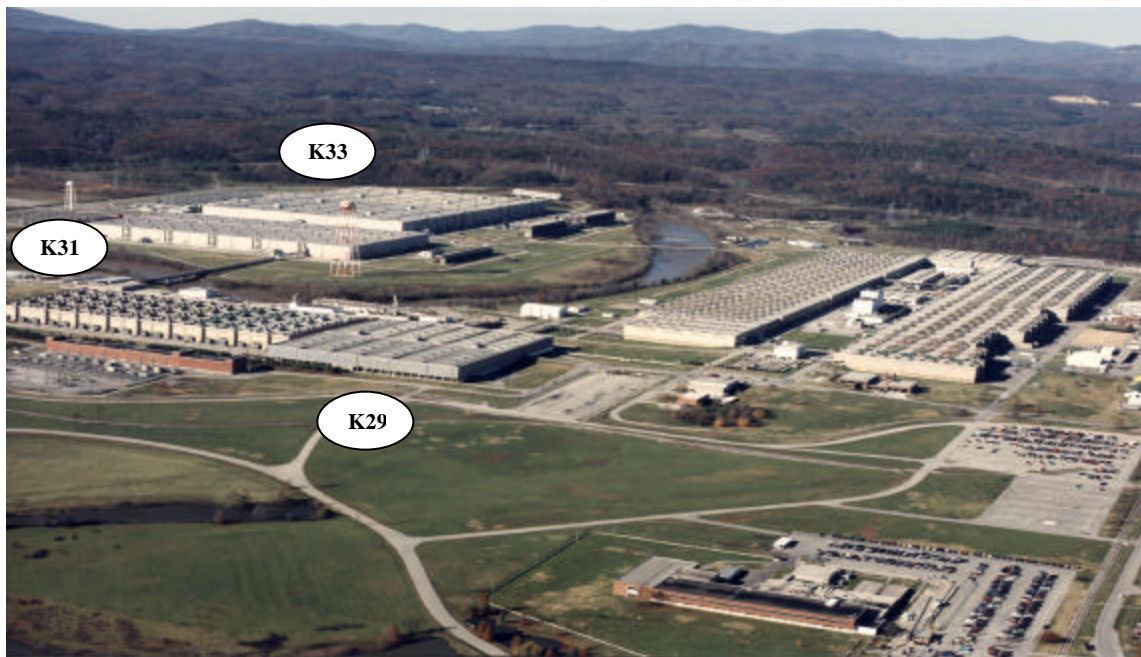


Fig. 1. East Tennessee Technology Park (ETTP), Former K Gaseous Diffusion Plant Site

## PROJECT ORGANIZATION

### Department of Energy

#### *Oak Ridge Operations*

The BNFL contract with the Department is a prime contract. The physical area, which is BNFL's responsibility covers the three process buildings as well as the immediate grounds surrounding the structures including the electrical switch yards that provided power for the former operations. Previously this area was the responsibility of the Maintenance and Operations (M&O) contractor; however, once the BNFL contract was signed, the responsibility was shifted to BNFL. The area was completely fenced to further help delineate the borders of responsibility between BNFL and the M&O. About the same time, DOE changed from a M&O contract to a Management and Integrator (M&I) contract to accomplish the Environmental Restoration mission. The difference between the M&O and M&I methodology is to a large extent to allow more subcontracting as opposed to performing the work with direct or captive forces.

Due to the physical separation of the capital equipment and real property, the oversight as well as Project Management responsibility for the project fell to DOE -ORO (as opposed to the traditional method of subcontracts under the M&O/ M&I).

DOE-ORO recognized the challenge associated with the fixed price nature of the BNFL contract compared to the traditional cost plus award fee-based contracts utilized for the M&O and M&I contractors. This challenge was to ensure that the assumption of risk taken by BNFL on a fixed price basis was not inadvertently shifted back to the DOE by providing day-to day direction or management from federal employees. Conversely, the

government must likewise maintain arm's length so as not to interfere or inadvertently add scope beyond the contract basis. A formal board was established within DOE to consider changes and approve those that were additional scope or the result of a government action. Basically, the Department attempted to structure the contract as close as possible to industrial standards, yet maintain the intent of the DOE's safety and health criteria. An important government function is to ensure that the principles of integrated safety management are continuously understood and applied by BNFL throughout the execution of the project.

The Project Management plus the environmental and safety oversight is especially complex due to provisions of the contract that calls upon BNFL to make unilateral decisions. The Department does not want to accept the risk for these decisions nor add difficulty to the BNFL decision-making process, but at the same time to assure that the job is done safely and with no danger to the public or environment. A prime example of this complexity deals with recycling materials. The decision to recycle material or bury the material as waste is a BNFL decision. Clearly that decision is dependant upon economics. The Department must not interfere with this decision, yet must assure itself that if materials are recycled it is done so without endangering the public or the environment. The oversight of the decision likewise must be done with minimal interference to BNFL so as not to skew the economics such that it undermines the decision. This particular example's solution by the Department was to hire an Independent Verification Contractor (IVO) who performs an independent verification that the material is clean and can be recycled or returned to BNFL for additional clean-up or disposal

To-date the IVO process has been extremely successful and has allowed work to continue on a non-inference basis yet at the same time assure that safety and environmental standards are met.

The project execution responsibility is that of the Assistant Manager of Asset Utilization (AMAU) with the federal project manager reporting directly to the AMAU. Support resources are provided from the ORO offices of procurement, legal, environmental management, and safety and quality. The department currently has two full time facility representatives stationed at the project and two additional contract construction personnel reporting to the Project Manager.

#### **Headquarters (Hqs) - Washington, D.C.**

Responsibility for policy, budget and deployment rests with the Environmental Management (EM) program in Hqs. Programmatic reviews are held formally on a quarterly basis as well as informal reviews with ORO. Site visits are made to validate integrated safety, progress, and functional clean up and oversight of the ORO management on a frequent basis.

## **BNFL Inc., Executing Contractor**

The Vice President, BNFL Inc. Oak Ridge Operations is responsible for all company activities in support of the ETTP Project. All support functions report directly to the Vice President including Human Resources, Public Affairs, Administration, Support Services, and Compliance Support.

Operations are divided into three business groups:

- *Removal Operations*

Removal Operations is responsible for all dismantlement, disassembly, and sizing. In turn, Removal Operations is subdivided into total systems responsibility: Major Components, Piping, HVAC, and Electrical and Subcontracted Tasks. All removal activities are performed by craft personnel from the Building Trades with primary representation being laborers, boilermakers, operating engineers, and electricians.

- *Waste Management Operations*

Waste Management Operations has the responsibility for release of all materials from the project including radiological survey of materials, waste treatment, compaction, transportation, and interfaces with Envirocare, Nevada Test Site, Manufacturing Sciences Corporation and the United States Enrichment Corporation. Members of the International Association of Machinists and Aerospace Workers perform survey activities.

- *Recycle (Manufacturing Sciences Corporation).*

Manufacturing Sciences Corporation (MSC) is a BNFL Inc. wholly owned corporation located in Oak Ridge and is fourteen miles from the ETTP site. Manufacturing Sciences Corporation decontaminates and releases materials for unrestricted release. All materials are released under license from the State of Tennessee. The company also processes contaminated materials from DOD and the nuclear utilities as well as performs specialty metals operations. The International Association of Machinists and Aerospace Workers represents the workforce.

A number of functions are outsourced to subcontractors including project controls, security and safeguards, information systems, and capital construction. The project currently employs between 900 and 1000 personnel.

## **MATERIALS DISPOSITION**

### **Task**

The buildings each contain two floors. The ground floor, called the operating floor, contains primarily the electrical control equipment and lubricating oil storage for the

process equipment. All process equipment for the gaseous diffusion process is located on the upper floor, called the cell floor.

The gaseous diffusion process involves the pumping of heated uranium hexafluoride gas through a nickel barrier, which preferentially separates the lighter uranium-235 molecules from the heavier uranium-238 molecules. By repeating this process through a large number of successive barriers (or stages), the natural uranium is enriched in the uranium-235 isotope to the desired percentage for its end use.

Within, the K-33 building, there are 640 stages. Each stage consists of a converter containing the barrier material, a compressor for maintaining the uranium hexafluoride gas flow, a compressor motor, and the associated piping and valves. The average stage contains 83 tons of metal including a 33-ton converter, 20-ton compressor and a 2500 hp motor weighing 10 tons. The remaining material is contained in piping, valves, and structural steel.

The equipment in the other two buildings is smaller in size. The overall building area for the three buildings is approximately 5 million square feet. Over 360 million pounds of material, primarily metals, must be processed and disposed from the site. Materials are categorized and tracked by 120 material groups. The disposition route of each group, whether by survey, decontamination, compaction, disposal as waste, is subject to cost measurement and economic decision making on a continuous basis.

## **HEALTH AND SAFETY PROGRAM**

A strong and vigorous safety program has been initiated at the site. While management has responsibility for worker safety, the safety program is directed through a joint Management/Union Safety Committee that is fully empowered. Stop Work Authority for every individual on the site has been constantly emphasized. A full time Nurse Practitioner is on duty at the site.

The project's Recordable Accident Case Rate for the year 2000 was 2.31 with two day-away cases for of an on-site work force of over 800. The Lost Time Accident Rate was 0.71. Including all subcontractors, there were only 15 days of worker-restricted activities and 16 days away from work for injuries.

All of the buildings have low-level uranium contamination. The average annual dose is less than one millirem. The primary radiological hazard is internal through cutting operations. A major HEPA system was installed for workshop sizing operations. Portable HEPA units are used extensively for field cutting operations. An active Industrial Hygiene monitoring program is in place and full-face respirators are used in all operations involving cutting or dust generation.

As there are extensive deposits of enriched uranium compounds in the process systems, a full criticality control program is in place. Deposits are removed from components and placed in secure storage until final disposition.

## DISMANTLEMENT

Dismantlement activities include removing of all uranium enrichment equipment and it's supporting systems. As the building is to remain in place, care must be exercised to protect building components.

Cell Floor Process Components: Cell Floor Process Components include Converters, Compressors, Electric Motors, Fifty Four inch process Pipe, and Process Valves. Converters and Compressors are sent to a disassembly/sizing workshop on the cell floor of K-33. There they are disassembled into individual components.



Fig. 2. Rigging K-33 Converter, One of 640 K-33 Converters, for Movement to Workshop and sizing.

The United States Enrichment Corporation has requested some of the salvaged components. This has been primarily a limited number of electric motors. All other motors will be buried fully assembled.

Valves and process pipe are stockpiled for compaction and burial. In addition, HVAC ducting, structural steel, and Stage Enclosure panels are stockpiled for compaction and burial. Freon and Cooling Water piping are sent to the workshop for sizing and eventual decontamination.

Operating Floor Equipment: The operating floor of K-33 is almost free of contamination. Control panels transformers, HVAC Inlet ducts, electrical cabling and other components are processed through a survey center on the operating floor and released for unrestricted use. Contaminated material is stockpiled for processing through the compactor. The operating floors of K-31 and K-29 are contaminated and extensive compaction and burial of the equipment is expected.

D&D Workshop: A major processing workshop was constructed on the cell floor of K-33. The shop has a variety of heavy lift capacities ranging from the existing 40 ton building overhead crane to small cranes for sized components. The entire shop is ventilated through a HEPA system that includes downdraft-cutting tables to eliminate smoke. Cutting is done primarily through both automatic and hand held 200 amp plasma arc metal cutters.

The 34-ton converters are brought by cart into a fully enclosed processing section. Due to the classified nature of some of the components, the disassembly work force must have secret clearances. The converters are rotated on the cart while plasma cutters cut off the end cap. The tube bundle is removed and taken to a disassemble area for recovery of the nickel barrier material. The other end cap is removed through a similar operation. The endcaps and converter shell is moved to sizing station. After sizing, the converter shell components are sent to Manufacturing Sciences Corporation in Oak Ridge for decontamination, survey, and unrestricted release.

Compressors are disassembled and compressor blades are removed. Compressor stators and rotors are stockpiled for compaction. The blades are packaged for burial. Piping is processed through pipe cutting machines that have the capability to section fifty-four inch diameter pipe at a rate of one foot per minute.

The dismantlement effort is a major materials movement process that requires careful planning and coordination. Currently, over 1.5 million pounds of material is being dismantled and process weekly.

## **WASTE MANAGEMENT**

### **Survey for Unrestricted Release**

The first choice for removal of material from the ETTP Three Building D&D Project is the survey for unrestricted release path. This path involves the assessment and subsequent surface radiological survey of items contained in the three buildings that were not impacted by the gaseous diffusion process operations that took place in the buildings. In each building this involves the majority of the lower or "operations floor" that contains electrical switchgear, transformers, electrical cable and other non-impacted support equipment. Over 40,000 tons of material is projected to be processed for unrestricted release.

The unrestricted release program is a Multi-Agency Radiation Survey and Site Investigations Manual (MARSSIM) and DOE Order 5400.5 based process that is reviewed and approved by the Department of Energy Oak Ridge Office.

The program involves the tracking and classification of various components into four general categories:

- Class 1- Those materials that are known to be impacted by the facility operations and radiologically contaminated beyond recovery. Radiological surveys on this material are utilized for waste characterization.
- Class 2 – Those materials that may have been slightly radiologically contaminated by facility operations, but below the specified surface contamination release limits.



- Class 3 – Those materials that may contain some residual radiological contamination, but only a percentage of the specified surface contamination release limits.
- Non-Impacted – Those materials that are not expected to contain residual radiological contamination.

In each classification a specific radiological survey methodology is defined.

After initial survey by BNFL Inc. personnel, the material is then subject to two separate and distinct quality assurance checks. In the first verification step, BNFL Inc. quality assurance survey technicians verify the initial surveys and paperwork. This verification step is designed to allow constant feedback to the Survey Operations Group and can include up to 100% of the surface of the object(s).

As a second line of verification and independent of the BNFL Inc. operations, the Department of Energy-Oak Ridge Operations has hired the Oak Ridge Institute of Science and Education (ORISE) to verify the results of the BNFL Inc. program. ORISE reviews and verifies the radiological results for all releases from the BNFL Inc. program. ORISE approval must be received, in writing, prior to the release of any materials destined for unrestricted release.

### **Waste Disposal/Transportation**

The second path for removal of material from the ETTP Three Building D&D Project is the waste disposal path. This path primarily consists of the packaging, characterization and transportation of low-level radioactive waste to Envirocare of Utah and the Nevada Test Site (NTS) disposal sites. However, the ETTP project does characterize and transport electrical transformers contaminated with polychlorinatedbiphenyls (PCB) for treatment, PCB remediation waste for disposal, and Resource and Conservation Recovery Act (RCRA) regulated wastes for treatment and/or disposal. In total, all waste streams are projected to exceed 70,000 tons or 1,300,000 cubic feet of disposal.

Low-level radioactive waste is packaged in 675 cubic foot (ft<sup>3</sup>) inter-modal containers, 96 ft<sup>3</sup> boxes and 1080 ft<sup>3</sup> cargo containers for transport to Envirocare of Utah. Inter-modal containers are loaded onto articulating 177 ton capacity rail cars for transport via Norfolk Southern and Union Pacific railroads to Envirocare. Cargo containers and boxes are transported by truck to both the Nevada Test Site and Envirocare of Utah.

Characterization of the low-level radioactive waste to meet both Envirocare and NTS requirements is vital to the Project. In order to provide real time characterization of the low-level radioactive waste stream, BNFL Inc. installed a passive neutron counter designed and built by BNFL Instruments Inc. The counter is designed to count and analyze:

- Full size (8' X 8' X 20') cargo containers.
- Inter-modal containers (8' X 6.5' X 20').

- Standard waste boxes (4' X 4' X 6') up to 12 at one time.
- Down to 10 grams of Uranium-235 in a 1080 ft<sup>3</sup> container that contains up to 45,000 pounds of waste materials. The count time (excluding background) specified for this iteration is 30 minutes.

The counter is housed in a shield that was constructed during early 2000 and utilizes an existing ETTP site building for additional shielding. This configuration allows for the lower detection limit and the short count time. The counter was commissioned and began operations in July 2000.

### **Compaction Facility**

The third path for removal of material from the ETTP Three Building D&D Project is the compaction (volume reduction) and disposal path. As indicated in pathway two, the project anticipated over 70,000 tons of material would ultimately end up as waste. Since both Envirocare of Utah and the Nevada Test Site (NTS) charge for disposal on a cubic foot (ft<sup>3</sup>) basis, volume reduction of the physically large waste stream is of primary importance from a project cost standpoint. Additionally, waste acceptance criteria at Envirocare of Utah requires that at least one dimension be less than ten inches. Based upon existing practices, this would necessitate the need for manual cutting to meet the dimensional requirement or shipment of the "oversize" waste stream to Envirocare at an increased cost in disposal and transportation.

The combination of these issues led BNFL Inc. to propose a super-compaction facility for the ETTP project. Working with the Department of Energy, Oak Ridge Operations Office, BNFL Inc. was able to take the facility from the BNFL Inc. board approval stage to operation in less than fifteen months. The facility is tied directly to the K-33 building (a DOE Category 2 nuclear facility) and contains a criticality monitoring system, a nuclear grade (HEPA) ventilation system, internal air monitoring system, exhaust monitoring system, material handling systems, rail spur, fire suppression system and control room. Central to the facility is the super-compactor itself.

Designed and built by Harris Waste Management, Inc. the super-compactor is a compactor-shear designed to reach the ten inch dimensional requirement through compaction, or if necessary, through shearing of the compacted material at eight to ten inch intervals. The Harris super-compactor was selected because of its standard design and the reliability of the Harris machines that are currently operating in American scrap yards and Russian naval shipyards.

Only slightly modified, the super-compactor general operational parameters are:

- Ability to receive materials up to 26' long, 14' wide and 6' long when fully open.
- 300 tons of compressive force in the "folding" phase.
- 1100 tons of compaction force under the "clamp"
- Shear force of 2200 tons

- Computer controlled and remotely accessible (maintenance) control system
- Throughput rates in excess of 40 tons per hour

The super-compactor was manufactured, assembled, and tested at the manufacturer with actual materials (decontaminated) from the ETTP project in March of 2000. The ETTP machine successfully volume reduced the material and sheared a 6 ½ inch, 58 inch wide, steel plate and a 10 inch round bar. Additional performance tests were performed for the commissioning phase of the facility. The facility commenced operation in January 2001.

### **Other Disposal Paths**

Other material, primarily converter shells, Freon piping, and Recirculating Cooling Water piping is sent to BNFL's recycling subsidiary, Manufacturing Sciences Corporation, for decontamination and sale. Some components, primarily compressor motors, have been sent to the United States Enrichment Corporation for use in their diffusion plants.

### **DECONTAMINATION/RECYCLE**

Materials for recycle are sectioned at the site to expose all internal surfaces. The materials are shipped in 20-foot sea-vans to the Manufacturing Sciences Co. It is processed through four possible mechanical decontamination paths. The processes utilize a variety of abrasive grit or shot that is projected by air blast or centrifugal force to abrade the surface of the components. The four paths are:

- Large Component Blaster with a component capacity of up to 13 feet in diameter and over 6 feet in length.
- A Structural Steel Blaster for pipe up 12 feet in length.
- Tumble Blast Machine for miscellaneous pieces of metal less than 2 feet in length.
- A Manual Blast Booth for odd shaped pieces.

A 100% surface survey validates that the metal is clean and meets NRC Regulatory Guide 1.86

### **PROJECT COMPLETION**

After equipment removal has progressed to the point to isolate areas of K-31, building decontamination will commence. The last activity will be the D&D of the project workshop and removal of the compactor. The project will be completed in Mid-2004.