

**RECYCLING AND DISPOSAL OF FUSRAP MATERIALS FROM  
THE ASHLAND 1 SITE AT A LICENSED URANIUM MILL**

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**ABSTRACT**

During World War II the Manhattan Engineering District (MED) utilized facilities in the Buffalo, N.Y. area to extract natural uranium from uranium-bearing ores. Some of the sandy byproduct material left from the ores (MED byproduct), containing low levels of uranium, thorium, and radium, was deposited on land currently owned by the Ashland Oil Company. This property is referred to as Ashland 1. As part of a facility expansion between 1974 and 1982, the Ashland Oil Company moved some of the deposited MED byproduct from the first site, now known as Ashland 1, to a new disposal area, now known as Ashland 2. However, the initial placement of the MED byproduct at the Ashland 1 site left a significant area of radiologically contaminated soil. In addition, the mixing of the byproduct with soil as it was moved ultimately increased the volume of radiologically contaminated soil.

Tasked to clean up MED waste sites throughout the United States under the Formerly Utilized Sites Remedial Action Program (FUSRAP), the U.S. Department of Energy (DOE) conducted several site investigations, and evaluated remedial alternatives, during the 1980s and early 1990s. In 1993, the DOE proposed a solution for its Tonawanda, New York sites that involved on-site containment of the radiologically emplaced material. Due to overwhelming public opposition to this plan, it was not implemented and other alternatives were investigated.

In FY 1998, Congress transferred the cleanup management responsibilities to the United States Army Corps of Engineers (USACE, or the Corps) with the charge to commence cleanup promptly. USACE worked with the local community near the Tonawanda site, and after considering public comment, selected the remedy calling for removing soils that exceed the site-specific cleanup standard, and transporting the contaminated material to an off-site location licensed to manage this type of material. The selected remedy is protective of human health and the environment, complies with Federal and State requirements, and meets commitments to the community.

As a rule, the Corps performs a formal Value Engineering (VE) Study on all projects with cost estimates greater than \$2 million. A proposal to consider recycling of FUSRAP 11e.(2)-like uranium byproduct materials, as an option to direct disposal, was proffered in a FUSRAP VE study in 1998; and, consistent with this process, the contractor selected to perform the cleanup activities, IT Corporation (IT), who is the Total Environmental Remediation Contractor (TERC)

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for the USACE in the region, was tasked to provide the best value clean-up results that meet all of the criteria established in the Record of Decision for the site. To this end, rather than focusing solely on disposal-only options, IT also evaluated options that included possible beneficial reuse; effectively reducing cost associated with the disposal as well.

During the solicitation process, International Uranium (USA) Corporation (IUC), the operator of the White Mesa Uranium Mill, a Nuclear Regulatory Commission (NRC)-licensed mill near Blanding, Utah, responded with a proposal to perform uranium extraction on the excavated materials. The Mill's proposal was selected as the best value as it provided beneficial use of the material consistent with the Resource Conservation and Recovery Act (RCRA) intent to encourage recycling and recovery, while also providing the most cost-effective means of material disposal. Such recycling encourages conservation of energy and natural resources, while reaping the benefit of reduced disposal costs.

Remediation of the Ashland 1 site began in June of 1999, and shipment of material is ongoing and is expected to be completed by July of 2000. Recycling of the material will commence in mid- to late 2000, after a majority of the material had been received at the Mill. Challenges being overcome to complete this project include (1) identifying the best-value location to accept the excavated material; (2) meeting regulatory requirements with IUC obtaining an NRC license amendment to accept and process the material as an alternate feed in a licensed uranium mill; (3) excavating and preparing the material for shipment, then shipping the material to the Mill for uranium recovery; and (4) processing the material, followed by disposal of tailings from the process in the Mill's NRC-licensed uranium tailings facility. The program in place is designed to meet these challenges with no lost-time accidents, while gaining the added value of environmental and cost benefits of using recycling as an alternative to direct disposal. In particular, excavation from Ashland 1 and processing of the Ashland 1 material at the White Mesa Mill will result in a cleaner environment at Tonawanda, a cost avoidance of up to \$4M, beneficial recovery of source material, and environmentally protective disposal of byproduct material.

## **INTRODUCTION**

During World War II the Manhattan Engineering District (MED) utilized facilities in the Buffalo, N.Y. area to extract natural uranium from uranium-bearing ores. Some of the sandy byproduct material left from the ores (MED byproduct), containing low levels of radioactivity, was deposited on land currently owned by the Ashland Oil Company. As part of a facility expansion between 1974 and 1982, the Ashland Oil Company moved approximately 6,000 cubic yards of the deposited MED byproduct, containing thorium, uranium, and radium, from the first site, now known as Ashland 1, to a new disposal area, now known as Ashland 2. However, the placement of MED byproduct at the Ashland 1 site left an area of radiological contamination to be removed from the site. In addition, other construction activities were accomplished over the intervening years further mixing of the byproduct with soil. These activities ultimately increased the volume of radiologically contaminated soil significantly.

The U.S. Department of Energy (DOE) was tasked to clean up MED waste sites throughout the United States under the Formerly Utilized Sites Remedial Action Program (FUSRAP). During

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the 1980s and early 1990s, the DOE conducted several site investigations and evaluated remedial alternatives. In 1993, the DOE proposed a solution for its Tonawanda, New York sites that involved on-site containment of the radiologically emplaced material. Due to overwhelming public opposition to this plan, it was not implemented and other alternatives were investigated. In FY 1998, Congress transferred the cleanup management responsibilities to the United States Army Corps of Engineers (USACE, or the Corps) with the charge to commence cleanup promptly.

### **PROJECT OVERVIEW**

USACE worked with the local community near the Tonawanda site, and after considering public comment, selected the remedy known as Alternative 2A in the Proposed Plan. A Record of Decision (ROD) for the Ashland 1 and 2 sites was signed on April 20, 1998. The chosen remedy calls for the removal of soils that exceed 40-picocuries/gram (pCi/g) thorium. The soil exceeding the cleanup standard was to be transported to an off-site location that was licensed to manage this type of material. The selected remedy is protective of human health and the environment, complies with Federal and State requirements, and meets commitments to the community.

As a rule, the Corps performs a formal Value Engineering (VE) Study on all projects with cost estimates greater than \$2 million. A proposal to consider recycling of FUSRAP 11e.(2)-like uranium byproduct materials, as an option to direct disposal, was proffered in a FUSRAP VE study in March of 1998. Consistent with this process, the contractor selected to perform the cleanup activities, IT Corporation (IT), who is the Total Environmental Remediation Contractor (TERC) for the USACE in the region, was tasked to provide the best value clean-up results that meet all the criteria established in the ROD. To this end, rather than focusing solely on disposal-only options, ICFKE also evaluated options that included possible beneficial reuse; effectively reducing cost associated with the disposal as well.

During the solicitation process, International Uranium (USA) Corporation (IUC), the operator of the White Mesa Uranium Mill, a Nuclear Regulatory Commission (NRC)-licensed mill near Blanding, Utah, responded with a proposal to perform uranium extraction on the excavated materials. The Mill's proposal was selected as the best value as it provided beneficial use of the material consistent with the Resource Conservation and Recovery Act (RCRA) intent to encourage recycling and recovery, while also providing the most cost-effective means of material disposal. Such recycling encourages conservation of energy and natural resources, while reaping the benefit of reduced disposal costs.

Remediation of the Ashland 1 site began in June of 1999, with excavation of the soil commencing on 14 June. On 22 June, the first flatbed rail car left the Ashland 1 site bound for the Mill, carrying 88 tons of MED-contaminated soils in four intermodal containers. Excavation and shipment of material from the Ashland 1 site is ongoing, with over 76,000 tons of material shipped by 12 January 2000. Shipments are expected to continue through July 2000 and recycling of the material will commence in mid- to late 2000, after a majority of the material had been received at the Mill.

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Details of this uranium recycling and byproduct disposal project include (1) identifying the best-value location to accept the excavated material; (2) meeting regulatory requirements with IUC obtaining an NRC license amendment to accept and process the material as an alternate feed in a licensed uranium mill; (3) excavating and preparing the material for shipment, then shipping the material to the Mill for uranium recovery; and (4) processing the material, followed by disposal of tailings from the process in the Mill's NRC-licensed uranium tailings facility. Conclusions revisit the environmental and cost benefits of recycling vs. direct disposal. In particular, processing of the Ashland 1 material at the White Mesa Mill is expected to result in substantial cost avoidance, beneficial recovery of source material, and environmentally protective disposal of byproduct material.

### **ORIGIN AND HISTORY OF THE ASHLAND 2 MATERIAL**

During World War II the Manhattan Engineering District (MED) utilized the Linde facility in Tonawanda, N.Y. to extract natural uranium from uranium-bearing ores. Some of the sandy MED byproduct material left from the ores, containing low levels of radioactivity, was deposited on land currently owned by the Ashland Oil Company. As part of a facility expansion between 1974 and 1982, the Ashland Oil Company moved approximately 6,000 cubic yards of the deposited MED byproduct, containing low levels of thorium, uranium, and radium, from the first site known now as Ashland 1 to a new disposal area now known as Ashland 2. However, the placement of MED byproduct at the Ashland 1 site left an area of radiological contamination to be removed from the site. In addition, the mixing of the byproduct with soil as it was moved ultimately increased the volume of radiologically contaminated soil.

### **DESCRIPTION OF THE MATERIAL**

The material was a predominately granular soil situated above the native clay soil and the water table. Radioisotopes, including thorium at levels up to 16,750 pCi/g and uranium at levels up to 1,575 pCi/g, were distributed throughout a six-acre site at depths as great as 12 feet. Interspersed throughout the thorium- and uranium-contaminated material was radium at levels averaging about 225 pCi/g. In order to both expedite and enhance the precision of excavation, the decision was made to use radium as a surrogate, as it was more identifiable using real-time field instruments, and to follow up with analytical tests. The total volume of soil expected to be excavated and shipped will be approximately 80,000 to 100,000 CY.

### **COST CONSIDERATIONS**

IT was challenged by USACE to develop a cost-effective and timely disposal option as part of the site cleanup. The first step was to identify licensed disposal locations in the U.S., along with their disposal criteria. During this solicitation process, the idea to look at innovative locations or methods was pursued. The material to be removed at Ashland 1 had several limiting characteristics. The first was that the soil could not be treated at the site, so any treatment, if it were to be performed, would have to take place elsewhere. Second, the range of thorium contamination varied from levels as low as 35 pCi/g to as high as 16,750 pCi/g, which, when combined with the added content of lower levels of uranium and radium, limited the number of sites in the United States capable of accepting the material. Through interaction with

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International Uranium Corporation (IUC), it was discovered that they could process the waste stream for the purpose of uranium recovery, and then dispose of the byproduct in their fully lined, NRC-licensed disposal facility. IT requested proposals from five vendors in the U.S., and IUC provided the best value. Also, the opportunity to reduce the overall radioactive constituents in the final disposal location was considered to provide an alternative that is better for the environment.

After all the materials are transported to IUC for processing, the savings associated with IUC's ability to accept different categories of material for this option will be tabulated. The cost avoidance to the government is expected to range from \$3 to \$4M when compared to the direct-disposal options.

### **REGULATORY CONSIDERATIONS**

Regulatory issues included amendment of the Mill's NRC license to accept the alternate feed material, and a review of the data on hazardous constituents potentially in the material.

#### NRC Guidance for Acceptance of Alternate Feed at Licensed Uranium Mills

On August 15, 1997, the NRC issued its "Final Position and Guidance on the Use of Uranium Mill Feed Material Other Than Natural Ores" ("Alternate Feed Guidance"). Under this policy the NRC permits licensees to process alternate feed material (material other than natural ore) in uranium mills as long as the following procedures are followed:

1. Consideration of the NRC definition of "ore" as "a natural or native matter that may be mined and treated for the extraction of any of its constituents or any other matter from which source material is extracted in a licensed uranium or thorium mill". This would include processing ores that have been previously beneficiated for other minerals and which are now outside of the owner's legal or technical ability to further process.
2. A determination of whether the feed material contains hazardous waste. Environmental Protection Agency (EPA) regulations that implemented RCRA exempt those potential alternate feed materials that exhibit only a characteristic of hazardous waste (ignitable, corrosive, reactive, toxic) from hazardous waste classifications by providing that byproducts that are being reclaimed are not regulated as hazardous waste (40 CFR 261.2c(3)).
3. A determination of whether the ore is being processed primarily for its source material content. This determination may be based on a variety of criteria, including the uranium content; other economic considerations; the physical or chemical similarity of the material to 11e.(2) byproduct material; or other grounds.

The White Mesa Mill, for example, processes "natural" (i.e., mined, native) uranium ores, and uranium-bearing "alternate feed materials" for recovery of uranium, often followed by recovery of additional minerals. These alternate feed materials are generally processing byproducts from other extraction procedures. For the Ashland 1 material, the NRC granted IUC an amendment to

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the Mill's NRC license for this particular alternate feed on February 3, 1999. This approach is being revised to a more flexible, performance-based acceptance standard. This will eliminate the need for individual amendments such as the one obtained for the Ashland 1 material.

### Review of Hazardous Constituent Data

Extensive testing was conducted and historical documents were reviewed to determine if the Ashland 1 material had the potential to be a listed or characteristic waste under the Resource Conservation and Recovery Act (RCRA). The results, which were coordinated with both the New York State Department of Environmental Conservation and the Utah Department of Environmental Quality, resulted in a determination that no RCRA regulated material was shipped to IUC. While Environmental Protection Agency (EPA) regulations that implement RCRA would have allowed characteristic waste to be processed at the Mill (RCRA allows for processed byproduct material to be exempt from hazardous waste requirements because it is being recycled or reclaimed) the determination that the Ashland 1 material did not fall into this category was further evidence of the environmental protectiveness of this disposal option.

### **EXCAVATION, TRANSPORTATION, RECEIVING, AND STORAGE**

Upon receipt of the NRC license, the shipping and manifesting requirements were modified. As the material was classified as an alternate feed source, the transportation requirements followed where those in 29 CFR. The shipping requirements were streamlined to meet the needs of 29 CFR and IUC. Both needs were met using less paperwork with fine-tuned data, thus saving many man-hours on the project, while still ensuring safe transport of the material. In addition to transportation requirements, operations at the Ashland 1 site had to meet all water and air emission standards. Full time air monitoring stations were established, and soil and erosion control measures were undertaken to preclude any runoff problems. A half-acre decontamination area was established in the work zone to clean equipment. Most importantly, all aspects of human health and safety requirements were established and enforced.

Workers involved in excavation wore radiation monitors. In addition, the entire site was surrounded by full-time air monitoring equipment to confirm that the construction process generated no off-site exposures. A decontamination trailer was established for access and egress onto the site. Also, the site was secured by a guard force and an eight-foot chain link fence. The job is expected to be completed with no lost time accidents and all regulatory requirements will be met.

The excavation task at the Ashland 1 site is straightforward. First, the site was radiologically surveyed, and as per the SAP, an additional 15 surface soil samples were taken to confirm the field survey findings and the absence of listed hazardous chemical contamination. Construction of soil and erosion control structures, a haul road, a perimeter air sampling system, a load out pad, and a decontamination pad were completed. Excavation then began in lifts using rough terrain excavators and off-road dump trucks. The soil was segregated into "clean" and "dirty" piles, based upon field screening and observation of apparent oily staining.

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After scanning confirmed no external contamination, the soil was transported using off-road dump trucks via a constructed haul road to the rail site approximately one-half of a mile away. A concrete and asphalt rail siding was constructed to speed the loading and unloading of intermodal containers. The siding was a spur off the main CSX line and was dedicated to construction activities. Prior to loading each intermodal container, a radiation analysis of the soil was conducted by the on site field laboratory and a bill of lading for each container was developed in accordance with 29 CFR. As noted above, the soil was shipped beginning 22 June 1999, as alternate feed material rather than waste. The designation of alternate feed material allows for a simpler streamlined shipping documentation system that results in secondary cost savings, while still ensuring safe transport of the material.

The soil is being transported by rail to an off-load site near Cisco, Utah and trucked to the White Mesa Mill near Blanding, Utah for processing. A round trip per rail car averages 28 days. An added benefit of this rail transport scenario is that no demurrage results due to the quick off-load and reload of intermodal containers at the Utah site.

The SAP includes confirmatory sampling of each 500 CY of excavated soil to ensure that the material contains no listed hazardous wastes. IUC also conducts confirmatory sampling of the material received at the Mill to confirm the absence of listed hazardous wastes, at a frequency of one sample per 100 CY for the first 1,000 CY, and thereafter at a rate of one sample per 500 CY.

Chemical and radiological data collected are provided to IUC and to the State of Utah. The total amount of soil to be excavated shipped is estimated to range from 80,000 to 100,000 CY, with the last of the soil expected to be excavated and shipped by July 2000. The site will be sampled to confirm its adherence to the ROD, and then be backfilled and seeded. The State of New York Department of Environmental Control (NYSDEC) is provided split samples for their independent analysis of the excavated area. The Corps is a joint participant in the final status survey using the Multi-Agency Radiation Survey and Site Investigation Manual (MARSIMMS) method prior to backfill activities. After the contract, IT completes their initial walk-over and MARSIMMS analysis and the Corps also performs a QA check. The multiple reviews and checks ensure that the site meets the ROD requirements and a final status survey report is then made.

Intermodal containers received at the White Mesa Mill are weighed and stockpiled into 500 CY lots for sampling and analysis. Containers are lined with a 3-mil plastic liner to aid in containment of the soil and assist in protection of the container shell, which ultimately makes decontamination of the container easier. This plastic liner is separated from the soil as it is stockpiled. In addition to the confirmatory sampling described above to ensure that the material contains no listed hazardous waste, individual 500 CY lots are sampled and analyzed for constituents that could pose unforeseen problems in the milling process. Samples are also obtained to conduct amenability tests to fix processing conditions.

### **MILL PROCESS**

The White Mesa Mill was permitted and constructed in the early 1980s, originally to process uranium and vanadium ores from the historical Colorado Plateau mining district, and later from

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the high-grade breccia pipe mines in northern Arizona. Throughout its operating history, the Mill has demonstrated the flexibility to adapt to wide variations in ore grades and processing parameters, resulting in exceptional recoveries of uranium and vanadium values from over three and one-half million tons of native ores. The Mill circuit can operate at leach temperatures up to 90 degrees centigrade and pH levels as low as 0.5, utilizing sulfuric acid. More recently, the Mill has demonstrated recoveries of 90 percent of contained tantalum/niobium values using a combination of sulfuric and hydrochloric acid leach. The Mill has eight high capacity thickeners, which are capable of being configured into groups or series of parallel stages. Three separate solvent extraction (liquid ion exchange) circuits are capable of handling aqueous flows up to 800 gallons per minute. Final products can be dewatered, dried, or calcined at temperatures up to 650 degrees centigrade. The Mill is operated by a seasoned professional and operations staff, some of whom have been at the facility since its startup in spring of 1980. The metallurgical staff has the experience and background to evaluate options and process for the recovery of a wide variety of minerals.

### Amenability Testing

Soil samples will be tested to determine the optimum processing conditions for recovery of uranium values. The samples will also be tested to determine the presence or absence of other valuable minerals that could be recoverable in the milling process. Based on IUC's prior experience with processing material from the Ashland 2 site, it is likely that the amenability testing will confirm the need to use a sulfuric acid leach with moderate heat. Leach solutions will be tested for processing through liquid solvent extraction (SX) or resin ion exchange (IX).

### Process Description

The soil (ore) material will be introduced into the milling process by use of a semi-autogenous grinding (SAG) mill that reduces the ore to a slurry form at 35-50% solids by weight. The ore slurry will then be leached for approximately 18-24 hours in an atmospheric leach utilizing sulfuric acid and steam. The slurry will then be transferred to liquid/solid separation where the solids are washed and discharged to the tailings ponds at 30-40% density. The solution bearing the uranium values is clarified and then fed to the IX circuit, where the uranium values are further concentrated and purified. The concentrated strip solution from the IX circuit is neutralized with anhydrous ammonia to precipitate the uranium values. The precipitated uranium is then dewatered and calcined to make a  $U_3O_8$  product.

### Byproduct Management

Waste streams that result from the ore processing will be discharged from the washing circuit in the form of a 30-40% solid/liquid slurry. The slurry is pumped to the Tailing Management System where the solids are allowed to settle and the liquids are evaporated or recycled back to the Mill for use as wash water. Liquid tailings from the solvent extraction circuit are also pumped to the tailings system and evaporated or recycled.



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### Long-Term Care and Monitoring

The tailings or wastes generated during the process will be disposed of in 11e.(2) byproduct material impoundments which are subject to stringent regulatory criteria set forth in 10 CFR Part 40, Appendix A, which conform to EPA's active mill tailings site regulations set forth at 40 CFR Part 192. The Appendix A criteria impose soil and groundwater protection standards for radioactive and nonradioactive (hazardous) waste constituents that provide protection equivalent to that provided by RCRA. Indeed, with respect to potential impacts of byproduct material to groundwater, the White Mesa Mill tailings facility offers an exceptional degree of protection in that these uranium mill tailings impoundments are separated from the nearest aquifers by at least 1,000 feet of impermeable rock. In addition, the long-term management and monitoring of uranium mill tailings facilities is regulated under the Uranium Mill Tailings Radiation Control Act (UMTRCA), which requires measures sufficient to provide reasonable assurance of stability without active ongoing maintenance for at least 200 years and as long as 1,000 years, far beyond the regulatory horizon of RCRA. UMTRCA requires that upon closure, custody of the 11e.(2) byproduct material impoundments is transferred to the DOE (or the State) which, in turn, becomes an NRC licensee with the primary responsibility for perpetual maintenance and surveillance of such sites. As of this time, no State has expressed any interest in accepting custody to 11e.(2) tailings sites, so it is highly likely that the DOE will become the long-term custodian and licensee of such sites. Post-closure funds will be transferred from the NRC to the DOE at the time of the license transfer, providing a long-term surveillance fund for perpetual management and monitoring, at no cost to the Government.

### **EMPLOYEE RADIATION SAFETY**

Because the level of radiological components in the ore appears to be no greater than the conventional uranium/vanadium ores the Mill processes, there are likely to be no extraordinary health and safety precautions beyond the existing Radiation Health and Safety Program followed by the Mill operators. The normal programs include monitoring and control of dust on the ore pad and continuous monitoring of employees for exposures throughout the milling process.

### **SUMMARY AND CONCLUSIONS**

After experiencing overwhelming public opposition to the 1993 proposed plan for on-site containment of the radiologically emplaced material at the Tonawanda sites, other alternatives were investigated. Working with the public, the USACE selected a remedy that gained public support and positive involvement by the local community, and that is protective of human health and the environment, complies with Federal and State requirements, and meets commitments to the community. This commitment required that that the soil not be treated at the site, so any treatment, if it were to be performed, would have to take place elsewhere. However, the large range of radionuclide contamination levels limited the number of sites in the United States capable of accepting the material.

The Corps performs a formal Value Engineering Study as a rule, on all projects with cost estimated greater than \$2 million. A proposal to recycle FUSRAP 11e.(2)-like uranium byproduct material was proffered in a FUSRAP VE study in March 1998. Consistent with this

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process, alternatives to direct disposal were investigated by IT and the Buffalo District for this project. IT was tasked to provide the best value clean-up results that meet all the criteria established for the site. IT met this objective by not focusing solely on disposal-only options, but by also evaluating options that included possible beneficial reuse; effectively reducing cost associated with the disposal as well. By exploring options, IT located a means by which to process the waste stream at a licensed uranium mill for the purpose of uranium recovery, and then dispose of the byproduct in the Mill's fully lined, NRC-licensed disposal facility. Recycling the material through a licensed uranium mill was selected as the best value as it provided beneficial use of the material consistent with RCRA's intent to encourage recycling and recovery, while also providing the most cost-effective means of material disposal. Such recycling encouraged conservation of energy and natural resources, and will reap the benefit of reduced disposal costs. Use of the VE concept is expected to save \$3 to \$4M in Federal taxpayer costs on Ashland 1 while reducing the radioactivity of the byproduct requiring disposal, and providing for environmentally protective disposal of such byproduct.

Challenges that are being overcome to complete this project include (1) identifying the best-value location to accept the excavated material; (2) meeting regulatory requirements with IUC obtaining an NRC license amendment to accept and process the material as an alternate feed in a licensed uranium mill; (3) excavating and preparing the material for shipment, then shipping the material to the Mill for uranium recovery; and (4) processing the material, followed by disposal of tailings from the process in the Mill's NRC-licensed uranium tailings facility. These challenges are expected to be met with no lost-time accidents, while gaining the added value of environmental and cost benefits of using recycling as an alternative to direct disposal. In particular, excavation from Ashland 1 and processing of the Ashland 1 material at the White Mesa Mill will result in a cleaner environment at Tonawanda, a cost avoidance of up to \$3 to \$4M, beneficial recovery of source material, and environmentally protective disposal of byproduct material.