

## **Reusing Property Resulting from Analytical Laboratory Closure**

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### **ABSTRACT**

The U.S. Department of Energy Office of Legacy Management (DOE-LM) site in Grand Junction, Colorado, faced the problem of reusing an extensive assortment of laboratory equipment and supplies when its on-site analytical chemistry laboratory closed. This challenge, undertaken as part of the Grand Junction site's pollution prevention program, prioritized reuse of as much of the laboratory equipment and supplies as possible during a 9-month period in fiscal year 2004. Reuse remedies were found for approximately \$3 million worth of instrumentation, equipment, chemicals, precious metals, and other laboratory items through other Grand Junction site projects, Federal Government databases, and extensive contact with other DOE facilities, universities, and colleges. In 2005, the DOE-LM Grand Junction site received two prestigious DOE pollution prevention awards for reuse of the laboratory's equipment and supplies.

### **INTRODUCTION**

During fiscal year 2004, the U.S. Department of Energy Office of Legacy Management (DOE-LM) site in Grand Junction, Colorado, found reuse remedies for approximately \$3 million worth of instruments, equipment, and supplies that remained after the site's analytical chemistry laboratory (ACL) was permanently closed. ACL items were reused by other DOE facilities, universities and colleges, and projects funded through the DOE-LM Grand Junction site. The Grand Junction site received two prestigious DOE pollution prevention (P2) awards in 2005 for this effort: the DOE-LM Best-in-Class Award and a DOE P2 Star Award.

### **ANALYTICAL CHEMISTRY LABORATORY CLOSURE**

The DOE-LM site in Grand Junction, Colorado, has had numerous missions since 1943. These include participating in the Manhattan Project in the early 1940s and the National Uranium Resource Evaluation (NURE) Program in the 1970s and 1980s, managing the Uranium Mill Tailings Remedial Action (UMTRA) Program in the 1980s and 1990s, and its current mission of long-term management of sites for DOE-LM.

DOE privatized the Grand Junction site in 2000. Once privatized, DOE began to lease buildings from the site owner (Riverview Technology Corporation), including the structures that housed the on-site ACL. As a result of changing missions and diminishing service requests, the ACL was permanently closed on December 31, 2003.

The ACL (Fig. 1) operated for more than 40 years and, at one time, performed more than 10,000 analyses annually. It was a fully equipped, full-service laboratory capable of providing comprehensive analyses of multiple environmental media and was considered one of the top radiochemistry facilities in the United States. In addition to supporting site mission projects, the laboratory periodically provided analytical services for other DOE sites, such as Los Alamos National Laboratory, the Waste Isolation Pilot Plant, and the Rocky Flats Environmental Technology Site.



Fig. 1. DOE Grand Junction Analytical Chemistry Laboratory

The terms of the lease agreement required DOE to dismantle and remediate the ACL once it ceased operations. In preparation for demolition of the ACL, efforts began in January 2004 to remove instrumentation, equipment, chemicals, miscellaneous supplies, and wastes associated with laboratory operations. Removal of the majority of the laboratory contents was required by September 30, 2004. Table I lists the types of items that required removal from the ACL.

Table I. Items Requiring Removal from the DOE Grand Junction Site ACL

Category	Example
Instrumentation	Gas chromatographs, spectrometers (alpha, dual, inductively coupled plasma, and mass), germanium detectors, energy analyzers, mass detectors, microscopes, and instrument software
Sample management equipment	Temperature-controlled sample storage units, centrifuges, scales, hotplates, stirrers, burners, thermometers, drying ovens, ultrasonic cleaners, chillers, heaters, glassware, utensils, and racks
Building systems	Deionized water systems, water purification systems, and ventilation hood systems
Radioactive standards and sources	Cesium-137, barium-133, carbon-14, tritium, americium-243, cobalt-60, plutonium-236, nickel-63, uranium-232 and -233, and strontium-90

Hazardous chemicals	Acids (acetic, hydrochloric, perchloric, sulfuric, nitric), bases (sodium, ammonium, and potassium hydroxides), methanol, titanium trichloride, potassium cyanide, sodium cyanide, arsenic trioxide, and many others
Miscellaneous	Computers, office furniture, compressed gas cylinders, pumps, stainless steel work tables, storage cabinets, and carts

## REUSE PATHWAYS

The Grand Junction site's P2 program prioritized reuse of as much of the ACL equipment and supplies as possible prior to the September 30, 2004, deadline. Both high- and low-value items were targeted for reuse. Numerous pathways were employed to locate opportunities for reusing the laboratory's equipment and supplies.

### Projects Funded Through the Grand Junction Site

As an internal cost saving measure, projects funded through the Grand Junction site, listed below, were given the first opportunity to reuse excess ACL materials.

- Office of Legacy Management (ground water monitoring activities)
- Environmental Sciences Laboratory (analytical services)
- Office of Environmental Management (Moab, Utah, UMTRA Project)

### Federal Government Databases

Most of the equipment in the ACL was controlled property. Government property management procedures require that DOE controlled property, if no longer needed (i.e., excess), must be offered first to DOE entities, then to universities and colleges, and last to other government entities before being offered to the public (see Figure 2). ACL controlled-property items were offered to these parties using the databases below (listed in the order they were used).

- The Energy Asset Disposal System (EADS), a database used to make excess DOE property available to other DOE entities.
- The Energy Related Laboratory Equipment (ERLE) Grant Program, a database used to make excess DOE laboratory equipment available to universities and colleges.
- The Federal Equipment Disposal System (FEDS), a database used to make excess federal government property available to other government entities, including federal, state, and the Bureau of Indian Affairs.

The database associated with the DOE Material Exchange Program was also used to offer excess ACL ultra-pure and reagent-grade chemicals, which were uncontrolled property, to other DOE entities.

***Property Must Be Dispositioned in the Following Order***

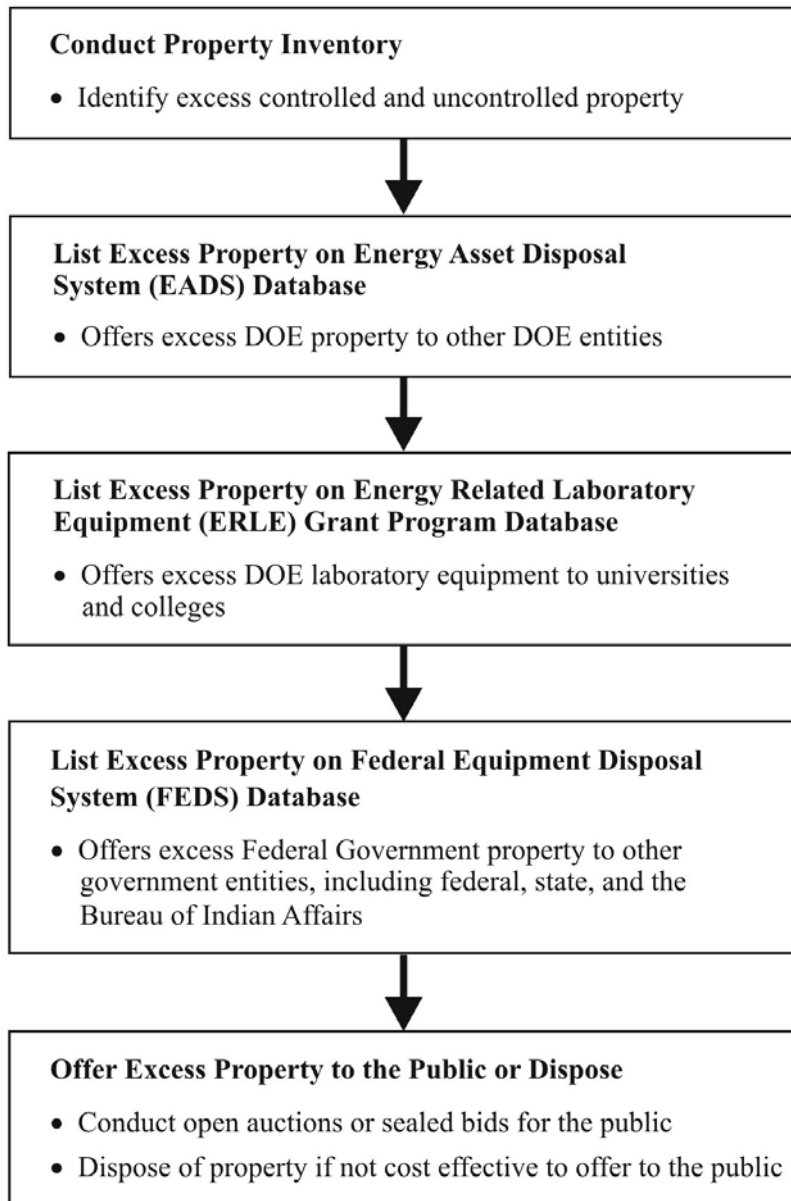


Fig. 2. Procedure for disposition of excess DOE property

**DOE Metal Recycling Programs**

The following DOE programs were used to disposition various ACL recyclable metals:

- The DOE Business Center for Precious Metals Sales and Recovery for recycling laboratory items constructed of precious metals, such as gold and platinum.
- The DOE National Center of Excellence for Metals Recycling for recycling radioactively contaminated and uncontaminated lead shielding.

## **Manufacturers**

Manufacturers were contacted to reuse materials that might otherwise have been managed as regulated waste or would likely have been of little interest to other parties because of shipping costs or age. Such materials included filter resins and compressed gas cylinders.

## **Phone, Email, and Face-to-Face Contacts**

Grand Junction site personnel made extra effort to contact potential users of ACL materials by phone, email, and face-to-face contact, especially other DOE facilities that were previous ACL customers, to achieve maximum reuse success.

## **REUSE ACHIEVEMENTS**

The DOE-LM Grand Junction site was successful in finding reuse opportunities for approximately \$3 million worth of ACL instrumentation, equipment, chemicals, and miscellaneous supplies and materials:

- More than 300 controlled-property items valued at approximately \$2.9 million were transferred to other sites. Argonne National Laboratory-West at Idaho Falls, Idaho, and the Waste Isolation Pilot Plant in Carlsbad, New Mexico, were the primary recipients of high-value instrumentation and equipment, such as gas chromatographs, energy analyzers, spectrometers (atomic absorption, dual, inductively coupled plasma, and mass), germanium detectors, filtration systems, and temperature-controlled sample storage units. The University of Oklahoma, University of Tulsa, Alfred University, Carnegie Mellon University, Colorado State University Research Center, and Mesa State College in Grand Junction, Colorado, also received instrumentation and equipment.
- Approximately 3,500 cubic feet of uncontrolled-property items was transferred to the previously noted DOE facilities, universities and colleges, Grand Junction site projects, and the Grand Junction site's Environmental Sciences Laboratory. No value was assigned to the uncontrolled property, though it is believed these items were worth tens of thousands of dollars. The uncontrolled property primarily consisted of miscellaneous laboratory supplies and equipment, such as spare parts for instrumentation, software, microscopes, water-filtration system parts, pumps, heating elements, glassware, Teflon beakers, utensils, and sample racks, carts, and tables.
- Approximately 40 containers of various hazardous chemicals, 120 gallons of sodium hydroxide, 115 pounds of sodium hydroxide pellets, 11 compressed gas cylinders, and a deionized water system were transferred to the Grand Junction site's Environmental Sciences Laboratory, other DOE facilities, and universities.
- Thirty-nine radioactive sources and standards, including a vial of enriched uranium standard, and approximately 2 kilograms of various metal foils were transferred to Argonne National Laboratory-West at Idaho Falls, Idaho.

- Approximately 11.7 pounds of precious metals, including gold, silver, platinum, and palladium, valued at an estimated \$160,000 was sent to the DOE Business Center for Precious Metals Sales and Recovery in Oak Ridge, Tennessee.
- Eight large mixed-bed resin tanks for water deionization systems were returned to manufacturers.
- One hundred compressed gas cylinders of various types, sizes, and configurations were returned to a cylinder distributor.

## **SUBSEQUENT REUSE ACHIEVEMENTS**

The Grand Junction site's efforts to locate reuse opportunities for laboratory equipment and supplies did not stop after September 30, 2004. Achievements after that date include

- Ten relatively modern ventilation hoods were transferred to the University of North Carolina-Charlotte and to Reed College in Portland, Oregon, in October 2004.
- Approximately 30 compressed gas cylinders were transferred to Argonne National Laboratory-West at Idaho Falls, Idaho, in January 2005.
- Arrangements were made to transfer approximately 7,000 pounds of radioactively contaminated and uncontaminated lead shielding (mostly bricks) to Oak Ridge, Tennessee, for recycling through the DOE's National Center of Excellence for Metals Recycling.

## **CHALLENGES**

Personnel faced numerous challenges while finding reuse remedies for laboratory equipment and supplies. Some of the more significant challenges are described below.

### **Perchloric Acid Ventilation Hoods**

Although considered of modern design, four of the laboratory's ventilation hood systems, which consisted of eight hoods, potentially contained explosive perchlorate crystals because perchloric acid was used during sample preparation under the hoods. Therefore, these hood systems could not be offered for reuse. A specialized subcontractor was hired to safely decontaminate, decommission, and dispose of the hoods, associated ductwork, and scrubbing systems for a cost of approximately \$35,000. During decommissioning, potentially explosive perchlorate crystals were identified around hood joints and in areas that could not be accessed by the wash-down systems. The material was safely removed, and decommissioning of the hood systems was completed without incident.

## Property Management Process

The contents of the ACL had to be thoroughly inventoried to identify excess controlled and uncontrolled property. Specific protocols and DOE orders had to be followed to transfer ACL property appropriately to other DOE and federal facilities and to educational institutions.

## Radioactive Sources

Reuse opportunities were difficult to locate for some radioactive sources and standards, such as a vial containing an enriched uranium standard. Such sources and standards were used to calibrate special instrumentation and perform specific radiochemical analyses that are uncommon to many other laboratories. There also were heightened safety concerns and more complex transportation requirements for some of the radioactive materials.

## Germanium Detectors

The germanium detector units were difficult to manage because of their weight, size, and location. Though only table size, each unit weighed approximately 7,000 pounds because of associated lead shielding. A large forklift and crane were necessary to carefully lift the units through the frame of a large plate glass window and place them onto a truck for packaging and shipment to another DOE facility (see Fig. 3).



Fig. 3. Removal of a germanium detector unit from the Analytical Chemistry Laboratory

## Hazardous Chemicals

Hazardous chemicals and reagents also presented significant reuse challenges that involved safety concerns, hazardous materials shipping requirements, and costs. Other laboratories could purchase hazardous chemicals from a chemical manufacturer or distributor and have them

shipped to their facilities at a lower cost than shipping hazardous chemicals from the Grand Junction site. Most laboratories had no interest in already opened containers of hazardous chemicals. Consequently, in August 2004 the Grand Junction site used a licensed waste broker to package and legally dispose of more than 1,000 containers of chemicals, varying in volumes from 1 milliliter to 55 gallons, as hazardous waste. Table II presents examples of these chemicals.

Table II. Laboratory Chemicals Disposed of as Hazardous Waste

Chemical	Hazardous Waste Classification
Acetone, ethyl ether, hexane, and methanol	Ignitable liquid
Aluminum nitrate, calcium nitrate, cesium nitrate, ferric nitrate, and zinc metal	Ignitable solid
Ammonia Acids: acetic, hydrochloric, hydrofluoric, nitric, perchloric, and sulfuric Bases: ammonium, potassium, and sodium hydroxides	Corrosive
Ammonium thiocyanate, ferrous sulfide, sodium sulfide, and titanium trichloride	Reactive solid
Laboratory standards (expired and unexpired) – arsenic, arsenic liquid, barium, cadmium, cadmium oxide, chromic acid, chromium, herbicides, lead, lead chloride, mercuric oxide, pesticides, selenium, selenium oxide, silver, and trichloroethylene	Toxicity characteristic
Arsenic trioxide, potassium cyanide, sodium cyanide, and thallium oxide	Acutely toxic (“P” listed waste)
Benzene, methylene chloride, phenol, toluene, and trichloroethylene	Toxic (“U” listed waste)

### Permit and Agreement Terminations

Permits and agreements requiring termination or notification upon laboratory closure included

- Termination of an air emissions permit with the State of Colorado.
- Notification to the local wastewater treatment plant that the industrial effluent from laboratory activities was discontinued.
- Notification to the State of Colorado that the Grand Junction site would become a one-time large quantity generator during packaging and off-site shipment of laboratory chemicals.

### Records and Reference Materials

A large quantity of ACL documentation had to be reviewed so that records and reference materials could be properly dispositioned. As a result of this effort, approximately 63 cubic feet of records was microfilmed, 2 cubic feet of reference materials was transferred to the Grand Junction site technical library, and 300 cubic feet of paper was recycled.



## **Work Conditions**

Significant coordination and communication were required between multiple parties to complete work activities associated with reusing ACL equipment and supplies. These parties had wide-ranging responsibilities, such as property management, environmental compliance (National Environmental Policy Act [NEPA], waste management, and pollution prevention), health and safety, procurement, and shipping. An underlying theme of all activities was to perform work safely. ACL equipment and supplies had to be thoroughly surveyed to ensure the lack of any radiological contamination before releasing materials for reuse by other parties. Certain work, such as decommissioning the perchloric acid hood systems, had to be performed under the guidance of job safety analyses, radiation work permits, or safety plans.

## **BENEFITS**

The DOE-LM Grand Junction site's success in finding reuse remedies for the ACL's equipment and supplies provided several benefits:

- Taxpayer dollars were saved because DOE facilities avoided the cost of purchasing new laboratory equipment and supplies.
- DOE facilities could purchase items that would not otherwise be affordable because of cost savings from receiving the Grand Junction site's ACL equipment and supplies.
- The private sector (universities and colleges) received valuable goods and the associated cost savings.
- The quantity of waste that would require disposal at municipal, industrial, and hazardous waste facilities and the associated disposal costs were reduced.
- Closure expenses for the ACL stayed within the allotted budget because disposal of various solid, hazardous, and radioactive materials was avoided.

## **DOE POLLUTION PREVENTION AWARDS**

In early 2005, the DOE-LM Grand Junction site received two DOE P2 awards for the success achieved in reusing the ACL's equipment and supplies.

- The DOE-LM Best-in-Class Award (Recycling Category) recognized innovative and/or exemplary pollution prevention practices within DOE Program Offices.
- The DOE Office of Environment, Safety, and Health (DOE-EH) P2 Star Award, recognized excellence in pollution prevention efforts within the entire DOE complex.

## **REMAINING ACTIONS**

Demolition of the ACL building is scheduled in fiscal year 2006. Radioactive tailings and soils beneath the ACL will be removed and disposed of at the Grand Junction Disposal Cell after demolition of the structure. The Grand Junction site's owner anticipates planting grass on the remediated area for reuse as open space.

## **CONCLUSION**

Reusing and recycling excess equipment and supplies from the DOE-LM Grand Junction site's closed ACL took considerable time, energy, and attention to detail and costs were incurred to perform this work. Multiple groups had to work cooperatively to ensure the property was dispositioned safely, efficiently, and appropriately. However, it was demonstrated that these waste minimization efforts could result in considerable overall savings for DOE and other parties by providing valuable goods and reducing disposal costs. In addition, reusing and recycling ACL materials reduced the waste burden on the environment.

## **ACKNOWLEDGMENTS**

This work was conducted under DOE contract number DE-AC01-02GJ79491 for the U.S. Department of Energy Office of Legacy Management.