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**PROJECTS AT THE WESTERN
ENVIRONMENTAL TECHNOLOGY
OFFICE**

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BIOMASS REMEDIATION PROJECT

The goal of the Biomass Remediation System Program is to demonstrate the economic and technical feasibility of commercializing terrestrial and aquatic plants to remediate soils, sediments, surface waters, and groundwaters contaminated by heavy metals and radionuclides.

The project, sponsored by the Department of Energy, Office of Technology Development (DOE-OTD), initially evaluated a fractionation separation technology developed by the Ukrainian Academy of Agrarian Sciences and Burevestnik Scientific Research Institute. Fractionation separation technology (Befito) testing was completed during the second quarter of FY94, and the project has refocused on screening terrestrial and aquatic plants for identification of hyperaccumulator species. In support of this goal, biomass test plots were established in Montana and Ohio during the spring-summer of 1994; these plots were harvested and sampled during September 1994. Additional sampling for potential heavy metal hyperaccumulator plants at abandoned hardrock mine-mill sites in Montana, Colorado, and Idaho also occurred during September 1994.

The bioremediation system being evaluated could be less expensive than soil removal and treating protocols, given the areal extent and topography of the sites under consideration, the problems associated with process-generated fugitive dust emission, and the investment of energy and money in the soil-moving and -treating processes. In situ technology may receive regulatory acceptance more easily than ex situ treatments requiring excavation, processing, and replacement of surface soils. Bioremediation has application potential for a broad spectrum of environmental restoration problems, including heavy metal and radionuclide contamination of soils and water. It may be used as the primary treatment or the final polishing stage, depending on initial contaminant concentrations and process economics considerations.

Technical Accomplishments

All plant and soil analytical data associated with the uranium and heavy metals-related test plots in Ohio and Montana and the hyperaccumulator plant and soils data from abandoned mine-mill sites (in Colorado, Idaho, and Montana) were received and statistically evaluated.

Harbor Branch Oceanographic Institution/Microbial Processing, Inc., submitted their draft final, comprehensive aquatic plant screening/heavy metal adsorption isotherm study report to MSE for review and comment.

Detailed work plans for the contaminant hyperaccumulator (plant uptake) field studies (i.e., ^{137}Cs - ^{90}Sr - ^{60}Co at the Idaho National Engineering Laboratory (INEL); Cd/Zn at Silver Bow Creek) were prepared and submitted to site management personnel for review and comment (including Environmental Safety and Health (ES&H) compliance).

The U.S. Department of Agriculture/National Soil, Plant, and Nutrition Laboratory initiated hydroponic screening of potential radionuclide and heavy metal hyperaccumulating plant species in late January 1995. Composition of these solutions were based on extracts from soils sampled at, or near, the above field test sites.

Efforts were initiated to provide bench- and field-scale testing and evaluation of a rhizofiltration technology at an appropriate DOE site.

Plans/Projected Activities

Biomass Remediation Project activities planned for the third quarter of FY95 include:

- completing ES&H compliance documentation for the terrestrial and aquatic (rhizofiltration) field test sites;
- implementing terrestrial field investigations at INEL and Silver Bow Creek;
- completing bench-scale verification of rhizofiltration technology, using test waters acquired from selected DOE sites, and beginning implementation of aquatic field testing; and
- submitting reports documenting the result of FY94 terrestrial investigations.

HEAVY METALS-CONTAMINATED SOIL PROJECT

Removal of fine-grained radioactive contaminants from soils is an environmental restoration problem common to many DOE sites. For this project, conventional mineral processing technologies were tested for use as fine particle recovery tools.

The benefits afforded by the proposed soil treatment systems include: 1) reduced remediation cost; 2) decreased volume of contaminants requiring disposal; and 3) availability of a developed technology.

MSE was funded by DOE-OTD to oversee a test program consisting of two phases—an initial phase using clean soils spiked with nonhazardous metallic surrogates for plutonium and a second "hot" testing phase to be conducted at the University of Nevada-Reno (UNR) MacKay School of Mines.

The initial surrogate test phase was conducted in Butte, Montana, at the Mineral Research Center, which is owned by Montana Tech and operated by Hydro Processing and Mining, Montana, Inc. MSE provided test direction and engineering support and analytical services.

MSE subcontracted UNR to modify an existing laboratory at the university to support the second phase, which evaluated the capabilities of technologies to effectively and economically remove heavy metal contaminants (specifically plutonium and uranium) from soil. In addition to providing the facility to conduct the testing, the UNR characterized the soils to be tested and provided support during testing.

Plutonium- and uranium-contaminated soil for the second-phase effort was provided by Fernald Environmental Management Project, Los Alamos National Laboratory (LANL), the Hanford Site, the Idaho National Engineering Laboratory (INEL), and the Mound Plant. Soil sample analysis was performed at the Environmental Protection Agency's (EPA) National Air and Radiation Environmental Laboratory (NAREL) under an EPA/DOE interagency agreement.

The technologies tested during the second phase and the organization demonstrating the technologies were:

Denver automated flotation cell; UNR
tall column flotation; UNR
Knelson centrifugal concentrator; UNR
air-sparged hydrocyclone (ASH); Advanced Processing Technologies, Inc. (APT)
Campbell centrifugal jig (CCJ); Trans Mar, Inc.
SEPOR air classifier; U.S. Naval Academy
high-gradient magnetic separator (HGMS); LANL

All technology demonstrations will be performed at UNR with the exception of the HGMS, which will be conducted at LANL. The UNR is to send soil samples to LANL for testing through the HGMS system.

All testing was completed by October 31, 1994.

Technical Accomplishments

With the completion of all testing, technology reports for testing were initiated. The final report on ASH testing was received from APT, Inc., and the final report for CCJ testing was received from TransMar, Inc. The UNR reports for the automated flotation, tall column flotation, and Knelson centrifugal concentrator are due April 24 or 25. The final rollup report is scheduled to be issued in May; however, that date may not be met if there is a delay in reporting by UNR.

Major Events

Project closeout continues. DOE equipment was inventoried by UNR and appropriate forms were submitted to MSE; disposition of the equipment is pending. Government equipment previously held by TransMar and APT was transferred to MSE.

Report review comments were provided to all the subcontractors to aid in finalization of their reports.

Contract closeout was completed with APT. The UNR contract performance period was completed; however, the contract was not closed due to outstanding items with UNR.

The period of performance for the contract with TransMar was completed March 31, and contract closeout is scheduled to follow.

Plans/Projected Activities

Soil washing activities planned for the third quarter of FY95 include:

- completing test reports for all technologies;
- completing the rollup report; and
- completing project closeout activities.

MHD SHUTDOWN

The main focus for FY95 is to perform dry lay-up of all magnetohydrodynamic (MHD) systems; continue preventive maintenance, where possible, to maintain integrity; decontaminate and decommission (D&D) those systems identified as excess; and provide an MHD Program Summary Report.

Operations Accomplishments

Discharge of water from the east evaporation pond to the publicly owned treatment works remains on hold because the floating pump failed last September and the pond and pipeline are frozen. In order to begin pumping out the pond the first part of April, the pump was repaired and reinstalled in the latter part of March.

The MHD system preventative maintenance activities as identified in the MHD Program Shutdown Plan continued on their regular and scheduled cycles throughout the reporting period.

Cleanup and consolidation of extraneous materials on the site continued. The two storage trailers were emptied, and the skirting material was removed in preparation for disposal through the excess property disposition process.

The cleanup of extraneous piping and support structures associated with the liquid seed system in Building 50 was completed. The liquid seed tank in Building 50 was removed, and efforts continue on the remaining D&D in that area.

Removal of the coal-handling compressor, air dryer, and ancillary interfaces was completed; the as-built drawings are undergoing final corrections for task closeout.

Final cleanup and repair of the floor and grating were completed on the D&D of the slag removal system in the pit area of Building 60. As-built drawings are in the final stages of correction.

The combustion air valve hydraulic power unit and the associated control cabinet in Building 50 were removed; repair of the concrete floor remains to be completed.

Work began on removing the primary cooling water instrumentation that had remained after previous removal efforts on MHD components. Work also began on removing the coal unloading and stockpiling system.

Cleanup began on the areas at WETO that have had coal and thermintol contamination. This item was identified in the June 1994 Argonne National Laboratory Property Assessment Report.

Technical Accomplishments

The Montana State Department of Health and Environmental Sciences (MDHES) determined that MSE can landfarm on-site the 40 yards of contaminated soil that were removed from around the

underground fuel oil storage tank when it was extracted. That soil has residual contamination from the fuel oil spill that occurred in January 1990. A report documenting the results of that landfarming will be submitted in October 1995 for final determination and closure.

The bid was awarded and the preconstruction meeting was held for installation of the monitoring well that will be downgradient from the two coal basins. The Water Quality Division of the MDHES has concurred with this approach and requested that construction and well log information and subsequent sampling data be submitted to that division. This decision was an outgrowth of the characterization of the groundwater flow regime and vadose aquifer zone adjacent to the south coal basin that had previously been requested in the Argonne National Laboratory Property Assessment Report.

The MHD Program Summary Report is being reviewed internally. Sections on the Safety Analysis Report/Experiment Safety Analysis history at WETO and the Data Acquisition System were included in the final report. Efforts continue on removing various MHD-related material from the WETO library in preparation for final disposition and archiving.

Engineering work packages were developed to relocate secondary cooling water piping and valves that are blocking access to the new open area in Building 50 and to remove extraneous structural steel from the nitrogen tank farm area.

Site Environmental Compliance Activities

Regulatory Compliance

The annual Superfund Amendments and Reauthorization Act Title III, Tier Two report was prepared and submitted to State and local officials. This report provides an inventory of materials stored at the facility that would be of particular interest when planning emergency responses.

A hazardous material and waste tracking software package was purchased and is being used to track hazardous materials at WETO.

A hazardous waste compliance inspection of WETO was conducted by a representative of the Waste Management Division of the MDHES; there were no findings from this inspection.

Air Quality

Monitoring of point-source emissions from the plasma arc centrifugal treatment (PACT) system continued. A Relative Accuracy Test Audit and Cylinder Gas Audit were performed as required by the facility air quality permit; these audits validate continuous emission monitoring system data.

Waste Management

Of the 40 barrels of potassium formate solution left over from the MHD program, 20 were mixed for uniformity and sampled; the analytical results were then forwarded to Cole Chemical in Houston, Texas. Cole Chemical is attempting to find an end user for this material.

Work began on excavating coal fines from the soil surrounding the coal pad and Area 20. This soil is nonhazardous and will be disposed at the local sanitary landfill.

Plans/Projected Activities

MHD Shutdown activities planned for the third quarter of FY95 include:

- continuing the scheduled preventative maintenance activities identified in the MHD Program Shutdown Plan;
- installing a monitoring well downgradient of the two coal basins;
- completing internal review of the MHD Program Summary Report and transmitting the draft review copies to PETC;
- completing final cleanup and repair of the floor as part of the removal of the combustion air valve hydraulic power unit;
- completing removal of the liquid seed system in Building 20;
- completing removal of the primary cooling water instrumentation remaining from the coal-fired combustor removal;
- completing engineering work packages and beginning removal of the instrumentation and control components in Building 50 associated with the vitiated and metallic air heaters;
- finalizing as-built drawings of the slag removal system, coal-handling compressor, and fuel oil system; and
- continuing cleanup of grounds in anticipation of excess scrap sales.

MINE WASTE TECHNOLOGY PROGRAM

The objective of the Mine Waste Technology Program (MWTP) is to provide a technology test and evaluation program through a collaborative effort among the EPA; DOE; MSE, Inc.; and Montana Tech of the University of Montana (Montana Tech) that:

- identifies national mine waste problems that most severely affect human health and the environment at the local, regional, and national levels;
- prioritizes the most promising mine waste treatment technologies based on their engineering and economic value;
- provides documented demonstration, test, and evaluation data on the most promising mine waste treatment technologies;
- promotes accelerated commercialization and transfer of technologies for selected mining waste treatment technologies that are developed, tested, and evaluated; and
- systematically trains users and establishes education programs.

The statement of work provided in the Interagency Agreement (IAG) identifies six activities to be completed by the MWTP.

Activity I—Montana Tech will establish screening criteria to identify and prioritize technical issues and promising innovative treatment techniques. Based on this criteria, a prioritized list and narrative discussion of each technical issue and treatment technique will be produced; these will then be considered as candidates for demonstration projects. Technical issues of primary interest will be acid generation, mobile toxic constituents in water, mobile toxic constituents in air, cyanide, and nitrates. Wasteforms that will be reviewed relating to these issues include, but may not be limited to, point- and nonpoint-source acid mine drainage, abandoned mine acid mine drainage, streamside tailings, impounded tailings, contaminated soils, heap leach cyanide/acid tailings, sulfide-bearing mine dumps, and storm water runoff.

Activity II—Montana Tech will deliver a generic Quality Assurance Project Plan (QAPP) that will provide specific instructions on how data is to be gathered, analyzed, and reported for all activities of the MWTP. As part of the requirements of Activity II, MSE will work with Montana Tech and incorporate DOE requirements into the generic QAPP; DOE requirements are met in MSE's Quality Management Manual. A project-specific QAPP will be developed for each demonstration under Activities III and IV.

Activity III—MSE will conduct and report on large pilot- or field-scale demonstrations of innovative technologies for remediation of mine waste. The demonstrations chosen will be the result of a thorough investigation of the technical issue, an identification of the specific wasteform to be tested, and a sound engineering and cost determination of the appropriate technology. MSE will rely on the list of technologies and wasteforms produced in Activity I; however, others may be proposed if they follow the basic criteria outlined in the IAG.

Activity IV—Montana Tech will develop and conduct bench- or small pilot-scale research of several innovative techniques that show promise for cost-effective remediation of mine waste. Project-specific QAPPs will be written as projects are identified.

Activity V—MSE will be responsible for preparing and distributing all reports for the MWTP. These include routine weekly, monthly, quarterly, and annual reports and technical progress and final reports for all MWTP activities. MSE will also publicize information developed under the MWTP in

local, regional, and national publications. Any necessary public meetings and public relations will also be addressed in this activity. In addition, MSE and Montana Tech will develop and conduct a series of workshops and symposia to convey the progress and results of the MWTP.

Activity VI—Montana Tech will develop a graduate or post-graduate degree program for environmental remediation and waste management. The program will contain elements of geophysical, hydrogeological, environmental, geochemical, mining and mineral processing, extractive metallurgical, and biological engineering. Also, Montana Tech will offer short courses relating to mine waste.

Technical Accomplishments

Activity I—Screening Criteria

Development of a Pyrite volume was initiated. The Pyrite volume will detail the economics of resource recovery related to pyrite and the technologies available that address the removal of pyrite from mine wastes.

Activity II—Quality Assurance

A number of quality assurance plans for Activity III and Activity IV projects were initiated.

Activity III, Project 1—Remote Mine Site Demonstration

The field system was started during the fourth quarter of FY94, and monitoring of the system was continued on a full-time basis during the reporting period. A data base to contain the data from the field activities for the project was initiated.

Activity III, Project 2—Clay-Based Grouting Demonstration

Analysis of data generated during the first phase of grout injection continued during the reporting period. A second phase of grout injection will be undertaken in the spring.

Activity III, Project 3—Sulfate-Reducing Bacteria (SRB) Demonstration

Work on the SRB laboratory report and laboratory data validation report continued during the reporting period.

The field system was started during the fourth quarter of FY94, and monitoring of the system continued on a full-time basis. A data base to contain the data from the field activities for the project was initiated. A continuation of the monitoring of the field portion of the project for 3 years was approved by the IAG Management Committee.

Activity III, Project 4—Nitrate Removal Demonstration

The site access agreement was completed, and subcontracts were initiated with vendors to supply field-scale equipment. A conceptual design was developed for the field-scale demonstration device.

Activity III, Project 5—Biocyanide Demonstration

Activities during the reporting period consisted of developing a field site and laboratory work to determine values for working parameters that will be applied to the field reactor.

Activity IV, Project 1—Berkeley Pit Water Treatment Research

Work on the final report for the project continued throughout the reporting period.

Activity IV, Project 2—Sludge Stabilization Demonstration

During the reporting period, sludges were produced using sulfide-reducing bacteria and water from the Crystal Mine. Work was performed on methods of separating solids from liquids and producing dense sludges and on developing an arsenic analysis method to determine the presence of organic arsenic species in acid drainage.

Activity IV, Project 3—Photoassisted Reactions

Work was performed that was oriented toward removing dissolved metals from waters. Work also continued on optimizing the oxidation of cyanide. A second phase of this project was approved by the IAG Management Committee.

Activity IV, Project 4—Neutral Chelating Polymers

A number of experiments were conducted to quantify literature-determined methodologies. A new software system that models the energy involved in different polymeric configurations was installed and is being used to develop a number of models of possible configurations. Literature searches also continued on methods of synthesizing electrically conducting polymers and attaching them to a substrate.

Activity V—Reporting, Technology Transfer, and Documentation

Presentations were held for groups of people interested in the MWTP. A tour of the Crystal Mine site was held for personnel of the EPA Risk Reduction Engineering Laboratory (RREL) on February 28, 1995. RREL personnel also visited WETO on February 27 and March 1.

Activity VI—Education

A number of mineral waste emphasis graduate students completed their course work and graduated from the program.

Plans/Projected Activities

MWTP activities planned for the third quarter of FY95 include the tasks given below.

Activity I—Screening Criteria

Development of a Pyrite volume will continue. This volume will identify and prioritize promising new treatment techniques for remediating pyrite from mine sites relative to economic issues specifically related to resource recovery.

Activity III, Project 1—Crystal Mine Treatment

Monitoring of the project will continue throughout the reporting period.

Activity III, Project 2—Grouting

A second phase of grout injection will be undertaken during June or July, and the analysis of data generated from the first phase of grout injection will be completed.

Activity III, Project 3—SRB

The project will be monitored during the next reporting period.

Activity III, Project 4—Nitrates

Project activities will continue. A field demonstration is scheduled for the June - July 1995 timeframe.

Activity III, Project 5—Biocyanide Remediation

Project activities will continue. A field demonstration is scheduled for the June - July 1995 timeframe.

Activity III, Development Projects

The projects Photo-Oxidation of Arsenic and Underground SRB Reactors will be initiated during the next reporting period, pending the arrival of funds.

Activity IV, Montana Tech Research Project 1—Berkeley Pit Water Treatment

This project will be completed during the next reporting period.

Activity IV, Montana Tech Research Project 2—Sludge Stabilization

Laboratory activities for the project will be completed during the next quarter, and long-term storage samples will be stored for future analysis. Final reporting on the project will begin.

Activity IV, Montana Tech Research Project 3—Photoassisted Reactions

Improvements in the oxidation of cyanide are expected during the next reporting period. Activities should also begin on the second portion of the project—metals removal from water.

Activity IV, Montana Tech Research Project 4—Neutral Chelating Polymers

Electrochemistry equipment for the synthesis and characterization of the polymers will be delivered next quarter.

Activity V—Reporting, Technology Transfer, and Documentation

The annual report will be published. Planning of the fourth annual Mine Waste Conference will be initiated.

Activity VI—Education

A short course on *Mine Operations and Closure* will be presented at the Mine Design, Operations, and Closure Conference, being held in Whitefish, Montana, on April 10 through 13, 1995.

PLASMA PROJECTS

The Plasma Centrifugal Furnace (PCF) Development Program began in August 1988 with initiation of the Plasma Arc Furnace Experiment (PAFE) Project at WETO. The original scope of the PAFE Project was to provide a location within an EPA Superfund site to demonstrate the Retech, Inc., PCF under the EPA Superfund Innovative Technology Evaluation (SITE) Program.

In 1988, DOE contract personnel from the Idaho National Engineering Laboratory (INEL) worked with the EPA in an attempt to have the PCF demonstrated at a Superfund site on INEL property, east of Idaho Falls, Idaho. This attempt was unsuccessful; therefore, MSE personnel approached the State of Montana with the proposition that the PCF technology be demonstrated at WETO under the auspices of the SITE Program. The State of Montana agreed, and the project was initiated under an Interagency Agreement (IAG) between EPA and DOE.

The PCF was installed at WETO in 1989. Commissioning and startup of the PCF began with the first plasma torch ignition on October 20, 1989, after which EPA and DOE Shakedown testing was performed. Results of the EPA and DOE Shakedown test series proved the applicability of the technology to totally destroy organic waste and provide a nonleachable solid product in which the waste volume is reduced by at least two-thirds. During the DOE portion of the SITE test, three Radioactive Waste Management Complex (RWMC) tests were successfully completed before the end of the fiscal year.

In 1990, the Rocky Flats Compacted Waste Project, which used plasma technology to process simulated waste, was initiated. MSE subcontracts this work to Science Applications International Corporation's (SAIC) Idaho office, which performs the work at Retech's Ukiah, California, facility.

In mid-summer of 1992, the INEL Buried Waste Integrated Demonstration (BWID) Program supplied funding for PCF testing. The BWID tests would attempt to establish the partitioning of a plutonium surrogate in the PCF using the RWMC-4 feed specification, which was established during the DOE Shakedown Testing phase, but increasing the surrogate concentration to better establish its fate. One BWID test was performed in FY92. The remaining tests, i.e., cerium balance, oxides of nitrogen (NO_x) reduction, and BWID sludges were completed in FY93 and FY94. Testing successfully determined the fate of cerium in the system, determined the impact on NO_x generated from different torch gases, and proved BWID sludges could be treated in the system.

Two Department of Defense (DOD) funded projects were initiated in 1992. The first, the Pyrotechnic Ordnance Plasma Destruction (POPD) Project tested the ability of the PCF to process smoke grenades, illuminating signals, and similar pyrotechnic devices. The second project (Army II) used the PCF to destroy obsolete classified fuzes. Other incineration processes had previously been tested for fuze destruction; however, they left recognizable components in the residue. The plasma process eliminated this problem.

During the fall of 1993, Pit 9 duration testing was performed on the 6-foot plasma arc centrifugal treatment (PACT-6) system (previously known as the PCF) at WETO. The test objective was to prove the capability of the PACT-6 system by processing approximately 30,000 pounds of material in 100 hours. Additional objectives included proof of remote operation; compliance with all emissions applicable and/or relevant and appropriate requirements; and determination of the fate of cerium, which was used as a plutonium surrogate, in the system. The test was successfully completed November 8, 1993.

PACT-6 in the test bay at WETO.

Testing under the U.S. Army Corps of Engineers Research Laboratory (CERL) workscope was conducted during the spring/summer of 1994. This testing focused on processing high metals feed with the PACT-6 and verifying the quality of the final wasteform. The CERL tests proved the PACT-6 could successfully process high metals feed.

Activities under CERL continued during the fall of FY94. The focus of these activities was on optimizing the system to support full-scale implementation. The workscope involved upgrading equipment to support system optimization, installing a small-scale plasma furnace (SSPF) for more cost-effective screening tests, developing process and economic models, testing for other services, and developing hybrid torches.

An additional effort is being expended on developing a controlled emissions test bed at WETO in support of the Mixed Waste Focus Area (MWFA). This test bed can be used to support all DOE and DOD thermal programs. The effort for FY95 has focused on identifying and testing candidate technologies that will accomplish what the current technologies accomplish while minimizing inputs to the system or improving control. The technologies chosen for demonstration include a continuous emissions monitoring system monitor, two metals monitors, a flameless oxidizer, and a hot-gas filter.

Starting in January 1995, MSE initiated work for the U.S. Army Research, Development, and Engineering Center (ARDEC). This work capitalizes on the previous plasma effort at the WETO facility with the ultimate goal of implementing a plasma system for the destruction of energetic material at a DOD facility. Previous plasma work for ARDEC focused on screening wastestreams in the plasma furnace to determine if the technology was applicable for demilitarization of these items. The on-going effort will focus on the next phase of development such as long-duration operation, feedrate maximization studies, and system optimization. The final task of the effort will be the actual procurement of some of the systems required for the full-scale system.

Technical Accomplishments

Controlled Emissions Demonstration Project

The Technical Task Plan (TTP) and project implementation plan were completed. Propak Systems, Ltd., was awarded a contract to develop a detailed cost estimate and scope for a monoethanolamine (carbon dioxide) removal skid. Discussions with PALL Corporation personnel were completed, and procurement of the high temperature filter was initiated. Design of the flameless oxidizer and high temperature filter installation continued. The contract for initiation of the instrumentation demonstration at the Science, Technology, and Research Center in Idaho Falls was awarded to SAIC.

Plasma Testing and Support

Procurement of the electrothermal processing system was initiated. Efforts began to coordinate a visit to WETO by representatives of the French Commissariat A L'Energie Atomique. The French representatives will be touring WETO and observing operation of the PACT-6.

CERL

Work continued on the final reports for the high metals testing. Installation and startup of the SSPF were completed. The conceptual design of the hybrid torch was completed, and the detailed design for the hybrid torches was awarded to BUSEK and Aerotherm. The scope of work and preliminary test plans were completed for testing to be conducted for the U.S. Navy and Rocky Mountain Arsenal.

Small-scale plasma furnace at WETO.

ARDEC

Funding was received on site to initiate project activities. A draft of the configuration study was completed. A particulate loading test was started to determine if the existing off-gas configuration is capable of handling the peak particulate loads from smoke generators; however, the test was stopped due to a water seal leak. The engineering package for installation of the new power supply was initiated. A slag conditioning study was initiated to look at the probable slag resulting from the nonenergetic components.

Decontamination & Decommissioning (D&D)

The TTP for the feasibility study for the regional metal recycling facility was finalized, and proposals were issued for architectural-engineering support in developing the feasibility study.

Operations Accomplishments

CERL

SSPF installation and the system operability test procedure were completed.

ARDEC

The rotary water seal for the PACT-6 was replaced, and work was started on repairing/replacing the shaft water seal. Particulate loading tests were set up and started.

Plans/Projected Activities

Activities planned for the third quarter of FY95 include:

- conducting SSPF testing;
- conducting U.S. Army and U.S. Navy testing;
- installing the new power supply;
- starting work on the hybrid torch fabrication.
- completing the ARDEC configuration study;
- completing the particulate loading test;
- repairing the PACT-6 water seal;
- continuing work on the metals volatility project;
- starting work on the in situ vitrification project;
- continuing work on the metal recycling and volumetric decontamination activities for the D&D Program; and
- continuing work on the controlled emissions off-gas effort.

Stationary Plasma Furnace

The plasma hearth process (PHP), currently being designed for DOE by SAIC and Retech in Ukiah, California, through a subcontract with MSE, uses the energy generated by a plasma arc torch to pyrolyze organics and to melt and vitrify inert waste components. The subcontract through MSE involves field-scale unit design only.

This technology feeds waste into a fixed crucible (unlike the rotating tub of the PACT-6) and uses a plasma torch to vitrify the waste material in the crucible. The project was divided into three phases. Phase 1 is a proof-of-principle phase that will evaluate the ability of the PHP to treat several simulated waste matrices. The objective of Phase 2 is to design a fully integrated field-scale plasma treatment process; Phase 2 will consist of advanced testing on a wider range of wastes, optimization of the process, and completion of the design. The objective of Phase 3 will be to construct and demonstrate a prototypic field-scale plasma treatment process.

Plans/Projected Activities

Stationary plasma furnace activities planned for the third quarter of FY95 include:

- monitoring SAIC PHP prototypic design activities; and
- continuing design of the field-scale PHP system.

RESOURCE RECOVERY PROJECT

The Resource Recovery Project (RRP) was funded in August of 1992 for the purpose of evaluating, testing, and demonstrating technologies for recovering water, metals, and other resources from surface and groundwater that are contaminated with dilute solutions of heavy metals.

The primary purpose of the RRP is to determine through bench- and pilot-scale testing, and demonstrations, which technologies or combinations of technologies can be used by DOE and others to recover clean, usable water from surface/underground systems contaminated with dilute solutions of heavy metals. The project will also recover valuable resources, including heavy metals and compounds. Economic analyses of each technology and the resources recovered will be used to project resource recovery/remediation costs for similar DOE and industrial sites using similar technologies. The project focuses on resource conservation and end-use application of the recovered resources by maximizing resource use and minimizing nonusable by-products.

The Berkeley Pit, an inactive open-pit copper mine filled with water contaminated with dilute solutions of metals, is the test bed for the project. WETO is within the boundaries of the Silver Bow Creek/Butte Area Superfund site making execution of the project fall under the jurisdiction of the Superfund regulations of the State of Montana. The EPA considers the waters of the Berkeley Pit to be exempt from the Resource Conservation Recovery Act under the Beville amendment.

For FY95, the project has been divided into seven tasks: project management, general support, technology selection, technology demonstration, water acquisition, facility modification and maintenance, and technology transfer.

Technical Accomplishments

Project Management

The FY95 Technical Task Plan was accepted by DOE.

Agreement was reached with the Superfund Office of the Montana Department of Health and Environmental Sciences (MDHES) on requirements for shipping Berkeley Pit water off site (from the Superfund site). In summary, the agreement states that no more than 20 gallons can be shipped to any one vendor, and the vendor must be under contract with MSE. Applicable U.S. Department of Transportation shipping requirements must be met, and permission to ship must be obtained from MDHES.

Butte-Silver Bow Metro Sewer officials have not yet issued a sewer user's discharge permit for the project due to revisions of discharge standards internal to them. The project will adhere to the agreed upon limits in the draft permit as if it were in place.

Technology Selection

The DOE Headquarters Project Manager and the WETO Technical Project Manager postponed the TTP milestone of issuing a Commerce Business Daily (CBD) Announcement and Request for Proposal (RFP) to select technologies from demonstration in FY96 to later in the Fiscal Year. The postponement was due to uncertainty of FY96 funding. The project was directed to finalize the CBD and RFP in preparation for issue.

Technology Demonstration

The final report for the TETRA Technologies, Inc., demonstration was completed and is available for distribution. Copies of the complete report were given to the responsible DOE WETO and DOE Headquarters personnel.

The draft final report for the Vail Research and Technology Corporation demonstration was submitted for review. This report will be available for distribution early next quarter.

Delay of the Phase I demonstration of the Electrochemical Design Associates (EDA) technology continued until mid-March. DOE headquarters and Plume Focus Area personnel made additional comments on the Phase I Test Plan; these comments were incorporated. The test plan was signed, and the demonstration was conducted the week of March 13. The Phase I report has not been received from EDA.

IBC Advanced Technologies, Inc.'s personnel began assembling equipment for their demonstration. The flowrate and duration of this demonstration was renegotiated because the overall demonstration costs were determined to be excessive. The flowrate was reduced from 4 gallons per minute (gpm) to 1 gpm, and the duration of the demonstration was reduced from a maximum of 6 months to a maximum of 3 months.

Negotiations for FY95 demonstration subcontracts with ChromatoChem, Inc., and E-Rem are still on hold. Rebudgeting and delays in receiving FY95 funding made it impossible to negotiate in good faith with these vendors. Acceptance of the FY95 TTP in late March will allow negotiations with both firms to be restarted.

Facility Modification and Maintenance

The System Operating Test Procedure for the post-treatment water handling system (PTWHS) was completed, and 500 gallons of water were processed to sewer discharge limits using the system. This activity completes the successful implementation of the PTWHS.

The thickener tank floating cover was installed by MSE personnel with the assistance of the cover vendor. This cover will allow for long-term storage of Berkeley Pit water without significant oxidation of the water.

Work was completed on the in-house work packages to complete installation of equipment and utilities to support the thickener tank modifications. A system operating test procedure was developed to check out the system when installation is complete, and the WETO Operating and Maintenance Manual was updated to reflect the modifications.

Water Acquisition

No Berkeley Pit water was transported to WETO this quarter.

Technology Transfer

Graduate students at Montana Tech completed scheduled work on several research areas. The water economics graduate completed a progress report on the influences of releasing clean, recovered Berkeley Pit water into the Clark Fork and Big Hole River Basins and gathered data to determine the economics of use. Use areas identified were hydroelectric power production, fishing and other recreational activities, and agriculture and irrigation. The mineral economics graduate student gathered economic data on the marketability of cupric oxide, metal powders, and metal sulfates.

Plans/Projected Activities

RRP activities planned for the third quarter of FY95 include:

- continuing contract negotiations with approved technology vendors and beginning demonstration testing.

SPRAY CASTING PROJECT

The objective of the Spray Casting Project is to perform research and development on the pressure-controlled atomization process (PCAP) as a means of replacing electroplated chromium on United States Air Force aviation parts. The process will also be applied to near-net shape fabrication of DOE-OTD special nuclear materials as a means of waste minimization. After the spray casting process has been Air Force qualified as a replacement for electroplated chromium, pilot-scale equipment will be designed and fabricated, and the process will be tested on aviation parts.

Technical Accomplishments

A signed FY95 Technical Task Plan (TTP) was received from DOE-OTD. The focus of the TTP changed from fabricating bowl-shaped components to fabricating cylindrical components. The first major milestone of the DOE work was achieved with the fabrication of a copper circular cylinder that was 3 inches in diameter, 4 inches in length, and one-quarter of an inch thick. The cylinder also featured stepped ends that would allow cylinders to be stacked.

Copper circular cylinder fabricated at the Spray Casting Facility.

All of the spray tests and metallurgical, corrosion, and wear tests were completed for the Air Force Wear and Corrosion Integrated Test Series. A total of 35 spray tests were conducted for the four phases of the test series. The test data was analyzed, and the Wear and Corrosion Integrated Test Series final report will be completed early next quarter. The Wear and Corrosion Integrated Test Series final report will then become one section of the final report for the Air Force portion of the Spray Casting Project; this final report will also contain previously published reports for the MSE, Boeing, and Wright Laboratory Test Series.

MSE responded to a Request for Cost Proposal from Concurrent Technologies Corporation (CTC) to design, fabricate, and install an Engineering Demonstration PCAP unit at the National Defense Center for Environmental Excellence, in Johnstown, Pennsylvania.

Plans/Projected Activities

Spray Casting Project activities planned for the third quarter of FY95 include:

- initiating the contract with CTC to design and fabricate an Engineering Demonstration PCAP unit;
- publishing the Wear and Corrosion Test Series for the Air Force;
- completing the spraying of a 3-inch-diameter nickel circular cylinder; and
- publishing the final report for the Air Force portion of the Spray Casting Project.

WATERVLIET ARSENAL PROJECT

In May 1994, MSE met with U.S. Army Corps of Engineers' Construction Engineering Research Laboratory (CERL) representatives to discuss potential projects for industrial wastestream remediation and minimization. The potential projects were development and demonstration of alternative technologies to treat Watervliet Arsenal's (WVA) flexible manufacturing system (FMS) and development and demonstration of a technology to treat chromatic and other acidic wastestreams.

The eight WVA projects that are planned, are in progress, or have been completed by MSE are listed below.

Project 1: Manufacturing Operation Oil Waste—MSE will provide engineering services, construction oversight, and technology testing services for selecting, designing, and testing a full-scale unit that will address fluid management and waste minimization concerns of the metal-working fluids (coolants) for the FMS and other machining facilities at WVA.

This project was divided into four phases: 1) selection, installation, and evaluation of a metal-working fluid management system at the FMS; 2) installation of a reverse osmosis system, which was purchased by CERL; 3) selection, installation, and evaluation of an oil-water separation technology at the FMS; and 4) selection and installation of two to three reverse osmosis units at other machining facilities at WVA.

Project 2: Treatment of Chromium Wastestreams using Sulfate-Reducing Bacteria (SRB)—MSE will demonstrate, at bench-scale, a bioreactor system to treat chromium-containing wastewaters with SRB. The primary objective of the SRB project will be to mitigate the hexavalent chromium-contaminated wastewater from the WVA. A bioreactor system, in which hexavalent chromium-contaminated water will be treated, will be designed, constructed, and evaluated to achieve this objective.

Secondary objectives of the SRB project are to evaluate the treatment system primarily for technology effectiveness and cost effectiveness.

Project 3: Instrument and Process Control Upgrade-Industrial Waste Treatment Plant (IWTP)—MSE will review an Architectural and Engineering firm's preliminary design of the instrumentation upgrade for the IWTP; perform a detailed design, procurement, and fabrication of the control system; and conduct a final installation and training. The design affects the processing of chromic wastestreams handled by two redundant waste treatment lines in the IWTP.

Project 4: Chrome-Plating Facility Environmental Technology—MSE will provide engineering services, construction oversight, project management, and technology testing services for installing and testing pilot-scale demonstration units for chrome-plating bath purification, and rinse water recycle.

The first demonstration, chrome-plating bath purification, will use a technology submitted by the U.S. Bureau of Mines. The second demonstration, rinse water recycle, will use a technology submitted by Norchem International, Inc., and Zenon Environmental, Inc.

The third demonstration, chromium emissions, which will use a closed loop fume eliminator submitted by Castle Hone, Inc., has been redesignated as Project 7 and is awaiting funding transfer from PETC.

Project 5: Waste Acid Detoxification and Reclamation—The objective of the waste acid detoxification and reclamation technology demonstration is to evaluate the effectiveness of this acid recovery system. The system will be tested on the sulfuric/phosphoric acid used in the chrome-plating facility. MSE will support installation and evaluation of Viatch's technology in the 120 Chrome-Plating Area at WVA.

Project 6: Heavy Metals in Soils and Plume—This task includes identifying and characterizing contamination sources and determining the specific contaminants and the extent of the contamination if it exists. MSE will perform a site characterization and recommend technologies for the specific remediation situations. MSE will also followup to ensure the site cleanup is complete, using the best appropriate technologies.

Project 7: Hazardous Air Pollution Demonstration—MSE will provide engineering services, construction oversight, project management, and technology testing services for installing and testing the Castle Hone, Inc., technology.

Project 8: Underground Storage Tank Monitoring Upgrade—This project involved providing engineering and installation services to link existing underground storage tank fluid level indicators and leak detection monitoring equipment to the WVA computer network. This project allows for remote monitoring of fluid level and leak detection information through the computer network to designated monitoring personnel and emergency response locations at WVA.

Technical Accomplishments

Project 1—Manufacturing Operation Oil Waste

Phase 1—The selection process for the metal-working fluid management system was completed; Sanborn Technology's Pioneer system was selected to recycle the coolant at the FMS. This system is a centrifugal technology with a patented pasturization process that has been proven in similar industrial applications; has the ability to remove tramp oils, microbes, and dirt to acceptable levels; and has the ability to increase the life of the metal-working fluid.

Phase 2—Final design and subcontract preparation was started for installation of the metal-working fluid management system. Installation and evaluation of the system has been delayed approximately one month because of the time involved in the selection process. The new date to begin installation and evaluation of the system is August 1, 1995.

MSE prepared preliminary drawings for installation of the reverse osmosis unit purchased by CERL. The subcontract to install the reverse osmosis unit was issued. Due to the urgency of WVA to replace the coolant in the FMS, the construction contractor will install the reverse osmosis unit with the associated electrical and plumbing. The reverse osmosis unit will be installed per MSE specifications. Installation is planned for the week of May 1, 1995.

Phase 3—A Request for Proposal was prepared for procurement of an oil-water separation technology. The purchase of this technology is an attempt by WVA to minimize the amount of oil waste each manufacturing facility generates during a coolant replacement cycle. MSE and WVA personnel will select the technology; procurement and installation of the oil-water separation

technology will depend on the performance of the Sanborn Pioneer system. The selection process will be similar to the selection process used in Phase 1. The selection process for Phase 3 is scheduled to be completed by May 15, 1995.

Phase 4—No work has been scheduled to start selection and procurement of the reverse osmosis units.

Project 2—Treatment of Chromium Wastestreams Using SRBs

The workplan was signed by the Technical Project Officer from CERL. An environmental questionnaire for the project was prepared and submitted to PETC to fulfill National Environmental Policy Act requirements, and a Categorical Exclusion for the project was granted from PETC. The literature review portion of the project was continued. A list of laboratory equipment items needed for the project was prepared and submitted to procurement. The experimental design for the laboratory testing was completed, and the laboratory test plan was initiated.

Project 3—Instrument and Process Control Upgrade-IWTP

MSE provided CERL and WVA a cost estimate to complete the controls upgrade; however, the amount of the estimate exceeded existing funds available. MSE then provided an alternative scope of work based on a modified design. This modified design also requires additional funding. The funding and scope of work are presently being reviewed; all design work has been suspended until the funding and scope of work are approved.

Procurement of long-lead items may start depending on approval date.

Project 4—Chrome-Plating Facility Environmental Technology

The following was accomplished for each of the Project 4 activities.

Rinse Water Recycle Demonstration—Proposals were received from Norchem International, Inc., and Zenon Environmental, Inc. Contract negotiations are nearly complete, and contracts should be signed soon. Norchem is a distributor for the patented RETEC Chrome Recovery System (CRS), and Zenon is supplying their patented microfiltration technology for separating tramp metal sludges precipitated from CRS. Recycle of secondary rinse water will result in operating cost savings and reduced waste volumes. Water will be recycled instead of purchased and treated at the water treatment facility for discharge. Hexavalent chromium will be recovered, minimizing makeup requirements in the chrome-plating bath.

Chrome-Plating Bath Purification—An electrolytic process developed by the U.S. Bureau of Mines at the Rolla Research Center will be used to remove contaminants from the plating bath. An agreement was sent to the U.S. Bureau of Mines to outline the scope of work and to formalize tasks for the Bureau's \$100,000 in-kind contribution; however, the Bureau's move from Rolla to the Twin Cities has resulted in a delay for formalizing the agreement. The Bureau is planning to provide design and oversight for fabrication of the unit, which will be done at MSE.

Project 5—Waste Acid Detoxification and Reclamation

Pacific Northwest Laboratories (PNL)/Viotech has been contacted to obtain system configuration information in preparation for developing installation and test plans. WVA is preparing documentation to transfer funds to PNL for their equipment.

Project 6—Heavy Metals in Soils and Plume

Funding for this project has not yet been received.

Project 7—Hazardous Air Pollution Demonstration

Castle Hone, Inc., was contacted regarding their proprietary closed loop fume eliminator technology. Work on this activity was temporarily put on hold pending additional funding. CERL has transferred \$100,000 to PETC for this project, and MSE is awaiting a contract modification to make these funds available.

Project 8—Underground Storage Tank Monitoring Upgrade

Interface electronics boxes were installed and tested at eight underground storage tanks to provide automatic tank level/leak detector information to the WVA computer network. Four additional interface boxes were fabricated for future installation.

Plans/Projected Activities

WVA activities planned for the third quarter of FY95 include the tasks given below.

Project 1—Manufacturing Operation Oil Waste

- preparing subcontracts;
- completing the final design package; and
- completing procurement of all equipment.

Project 2—Treatment of Chromium Wastestreams Using SRBs

- installing the laboratory equipment;
- setting up the laboratory experiment; and
- preparing the Laboratory Test Plan with an attached Quality Plan.

Project 3—Instrument and Process Control Upgrade-IWTP

- starting detailed design work upon approval of the funding and scope of work; and
- starting long-lead procurements.

Project 4—Chrome-Plating Facility Environmental Technology

- initiating design for rinse water recycle technology integration; and
- issuing a subcontract for installation of the rinse water recycle technologies.

Project 5—Waste Acid Detoxification and Recycling (WADR)

- preparing piping and instrumentation drawings for the installation of the WADR system;
- selecting a subcontractor for system installation; and
- installing and evaluating the performance of the WADR system.

Project 6—Heavy Metals in Soils and Plume

- receiving a defined workscope and funding for the project.

Project 7—Hazardous Air Pollution Demonstration

- obtaining funding from PETC;
- negotiating the vendor contract;
- developing the demonstration plan; and
- preparing the installation design package.