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AN INTRODUCTION TO MOUND FACILITY

MASTER

MONSANTO RESEARCH CORPORATION

John R. McClain

Vice President, Director
Mound Facility

Robert T. Braun
Director, Advanced Devices

James E. Caldwell
Director, Finance

William T. Cave
Director, Nuclear Operations

R. C. Herman
Acting Director, Engineering

Robert E. Howard
Director, Coal Conversion
Program

Donald E. Kaldenberg
Manager, Personnel

Morton L. Mullins
Director, Administrative
Services

Arthur F. Vollmer
Director, Management
Information & Systems

Monsanto Research Corporation
P.O. Box 32
Miamisburg, Ohio 45342
(513) 866-7444
TWX 810-473-2974

MOUND FACILITY

Miamisburg, Ohio 45342

operated by

MONSANTO RESEARCH CORPORATION

a subsidiary of Monsanto Company

for the

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WHO WE ARE

Mound Facility is operated for the Department of Energy (DOE) by Monsanto Research Corporation, a subsidiary of Monsanto Company. Mound is an integrated production and laboratory facility which produces components and develops processes for nuclear weapons programs and conducts research and development for several other DOE programs. Based on specialized capabilities established during the last 30 years, today's assignments include work in environmental control, energy-related research, explosives and pyrotechnic technology, tritium technology, plutonium-238 isotopic heat source fabrication, and separation and enrichment of stable isotopes.

Mound originated as a technical organization in 1943 in Dayton, Ohio, when Monsanto Chemical Company accepted responsibility for determining the chemical and metallurgical properties of polonium as part of the Manhattan Project. Construction of a permanent facility for this activity was completed in nearby Miamisburg in 1948. All early programs were concerned with polonium-210 and its applications. Additional assignments soon led to a wide variety of technical activities. During the last 30 years, capabilities for highly specialized research, development, and production operations have multiplied as Mound has served the Atomic Energy Commission, the Energy Research and Development Administration, and now, the Department of Energy.

Today, work performed at Mound supports the goals of nine DOE divisions. Although the main thrust of the facility continues to be the development, production, and surveillance of weapon components for the DOE Division of Military Application, nonweapon activities have diversified rapidly, especially in recent years, until they serve the programs of eight other DOE divisions and avail Mound the support of such other federal agencies as the Environmental Protection Agency and the Nuclear Regulatory Commission.

WHAT WE DO

When the 2½ year-old Energy Research and Development Administration (ERDA) was dissolved in 1977, Mound became a part of the newly formed Department of Energy (DOE). And, as would be expected in a year in which new sources of domestic fuels and alternate forms of energy were pursued in response to national needs, the level of energy-related work at Mound, which had increased measurably under ERDA, continued to mount.

Reflecting the importance that the U. S. places on becoming energy independent, a long-term study was initiated early in 1977 to characterize the geochemical, physicochemical, and gas release properties of the Devonian shale found in the Appalachian Basin. Devonian shale contains rich natural gas deposits that could supply the needs of 20 industrial states for 50 years. Electron microscopy and other analytical techniques will provide basic research data that will be useful for resource evaluation and determination of factors that affect the release of hydrocarbons from shale. In later stages, the study will focus on detailed mapping and gas inventory to identify the regions of greatest resource potential in the Basin.

Other new funding received in 1977 gave Mound a role in the Pricetown I Feasibility Study, an in situ coal gasification experiment in West Virginia. Mound is developing both the data base and the instrumentation to support the field work. Pricetown I and II are running concurrently in 1978, the latter being a follow-on investigation for which Mound is supplying engineering support and performing a statistical study of the instrumentation wells.

Also in the area of fossil fuels, Mound Facility continues as the Government's prime technical representative for monitoring the Fuel Gas Demonstration Program, now in its second year. The demonstration plants will convert high-sulfur coal to fuel gas. At the end of 1977, three contractors had been selected to develop the plants. Mound and Monsanto are providing technical support in the design and construction of the plants.

Mound is contributing to the search for alternate forms of energy by stressing basic research in metal hydrides, long an area of expertise at this facility. In particular, hydrogen diffusion characteristics are being studied in the TiFeH_x system, which is currently the primary candidate for both stationary and mobile hydrogen storage for energy applications.

Closely related to energy options, because of its effect on the safety and public acceptance of the nuclear industry, is the safeguarding of nuclear materials. During 1977 Mound continued to develop the Controllable Unit Approach (CUA) to material control. CUA, a systems methodology, has been shown to meet the performance criterion of the Nuclear Regulatory Commission and to be more sensitive to material diversion than methods now in use. In another Safeguards program, demonstration tests have been completed on the Automated Plutonium Assay System (APAS), which applies calorimetric assay to the safeguarding of nuclear material.

Mound also continues to address the problems of the nuclear industry in the area of environmental concerns, including the development of methods of waste management. The Cyclone Incinerator, developed at Mound to reduce the volume of combustible waste, especially that contaminated with plutonium-238, has been modified to allow the burning of liquid waste, in particular a 30% tributyl phosphate/70% kerosene mixture common in the nuclear industry. A continuous feed system for the incinerator has also been successfully demonstrated.

From its long experience with radioactive materials, dating back to its inception as a participant in the Manhattan Project, Mound has developed the capabilities to protect its laboratory area and to ensure the integrity of the surrounding environment. These capabilities are being increasingly applied to assess environmental factors associated with various phases of the national energy program.

The Environmental Protection Agency (EPA), in conjunction with the Department of Energy, has initiated a project to assess the radiological impact associated with the utilization of Western coal. An integral part of this program effort is Mound's work to characterize radionuclide pathways in the combustion of coal and the release of effluents to the environment at a power plant burning Western coal.

In another project supported by the Environmental Protection Agency, 14 U. S. laboratories corroborated the results of the technique that Mound developed for determining plutonium-238 and plutonium-239 in water by alpha-pulse-height analysis. Four other analytical methods for determining radioisotopes in water, soil, and air are at various stages of development.

Both of these projects for the EPA utilized Mound's facilities for alpha spectroscopy, which allows for the simultaneous analysis of 48 samples. Data from each sample chamber are input to a computerized data collection and reduction system which determines, by resolving the energy levels, the proportion of alpha-emitting substances such as uranium, plutonium, polonium, radium, and thorium. Alpha-pulse-height analysis is also used in the routine soil monitoring of the area surrounding Mound.

In conjunction with development activities and tritium recovery operations, Mound is continuing to advance technologies for handling and containing tritium. In 1977, a new Emergency Containment System designed to scavenge tritium from the air in processing areas without release to the outside atmosphere was successfully demonstrated. Several current research projects in the environmental area center around tritiated liquid wastes. A combined electrolysis-catalytic exchange system, for example, has been successfully demonstrated as a pilot system for decontaminating low-level tritiated waste. And tritiated wastes are being studied in various simulated storage conditions to design suitable waste disposal containers.

Shipping containers, rather than storage containers, are the subjects of other studies. Mound is equipped for the design, fabrication, and testing of shipping containers for radioactive materials to meet the requirements of the Department of Energy and the Department of Transportation.

Although involvement in energy-related and environmental work is expanding, the substratum of Mound work is basically defined by its mission assignment -- which is designated by DOE's Albuquerque Operations Office (ALO). About 75% of the operating funds are derived from work for DOE's Division of Military Application: production of small complex explosive components; production of plutonium-238 heat sources; surveillance testing of certain explosive and nuclear components; development of materials and production processes; and fabrication of experimental components and assemblies for the weapons design laboratories -- Lawrence Livermore Laboratory (LLL), Los Alamos Scientific Laboratory (LASL), and the Sandia Laboratories (SLA and SLL).

The fabrication of ceramic components for actuators, igniters, and detonators is accelerating. Paralleling this activity is the formulation of pyrotechnic materials.

Technology for the production of thermites -- nonradioactive, solid, chemical heat sources -- has developed at a rapid pace, and various thermite components have already been supplied for experimental programs at one of the weapons design laboratories. Additional applications for thermites are being proposed, and a new hot isostatic pressing process is being developed to provide compacted thermite forms.

Mound's contributions to the field of radioisotopic heat sources date back to the mid-1950's when Mound, using polonium-210 as a fuel, fabricated the first such heat source ever produced. Over the years, Mound has accumulated experience in the encapsulation of plutonium-238, the fuel used in current heat source programs, in forms including metal, alloys, dioxide microspheres, and pressed and sintered oxides.

Each of the two Mariner-Jupiter/Saturn (MJS) spacecraft launched in the fall of 1977 carried three of Mound's Multihundred Watt (MHW) radioisotopic heat sources in the thermoelectric generators used for on-board power generation. Currently in production is the Milliwatt Generator, a 4-watt heat source for a military application. An Impact Test Facility, housing an impact gun, is used in safety evaluations of radioisotopic heat sources.

Isotope separation, providing enriched isotopes for use in many disciplines, has been a part of Mound's mission for 20 years. The most obvious uses for these stable (nonradioactive) isotopes are in nuclear physics research -- in studies of nuclear properties, forces, and structure -- and in chemistry research -- in kinetic and structural studies. Other uses are in agriculture, biology, cryogenics, geology, and medicine. Using gaseous thermal diffusion columns, which exploit slight differences in mass to effect enrichments, Mound produces carbon-13 and stable isotopes of the noble gases. Elemental carbon with a carbon-13 concentration of 99.7% is now available. In 1977, a liquid thermal diffusion cascade composed of 21 columns was fabricated and used for the separation of chlorine-37. In addition, special radioisotopes, such as thorium-229 and -230, protactinium-231, and uranium-234 are separated by chemical extraction processes.

OUR MAJOR CAPABILITIES

In its 30 years of operation, Mound has developed a diverse technology base and many specialized supporting capabilities. Major ongoing activities include work in the following areas:

- Calorimetry
- Coal gasification program management
- Cermets and glass ceramic technology
- Chemical heat source (thermite) technology
- Cryogenics
- Effluent control and measurement of radioactive and non-radioactive materials
- Environmental control, including
 - Engineering design of closed systems
 - Microanalytical techniques
- Gaseous and liquid thermal diffusion
- Explosives technology
- Instrumental analysis, including
 - Radiometric analysis
 - Neutron emission and spectroscopy
- Low-energy physics
- Material compatibility studies
- Metal hydride technology
- Metallurgy and metallography
- Metrology
- Nondestructive testing
- Plastics and adhesives technology
- Plutonium-238 heat source fabrication
- Pyrotechnics formulation and testing

- Recovery, separation, and purification of radioisotopes
- Shale characterization
- Shipping container design and testing
- Tritium technology
- Welding technology

OUR RESOURCES

About 400 of Mound's staff of almost 1700 people hold technical degrees; among these are about 65 MS and 70 PhD degrees. In addition there are many specialized craftsmen and technicians with longtime experience in Mound technologies.

The 182-acre Mound site currently includes 91 buildings with a total of 876,119 square feet of floor area.

The operating areas and laboratories are extensively and often uniquely equipped for Mound's varied programs, especially those involving radioactive materials such as tritium and plutonium-238, diagnostic testing of explosive components, and separation of stable isotopes.

Many facilities developed over the years to support major missions now are also valuable resources for a wide range of energy-related work. Some prime examples:

ANALYTICAL FACILITIES

Analytical facilities are used for physical property studies, wet chemistry, radiocounting, neutron activation analysis, atomic absorption spectrophotometry, nuclear magnetic resonance spectroscopy, x-ray fluorescence and diffraction studies, mass spectrometry, gas chromatography, and optical and electron microscopy.

ENVIRONMENTAL MONITORING FACILITIES

The environment surrounding Mound Facility is continually monitored by mobile units and stationary instrumentation. Air, water, foodstuffs, vegetation, soil, and silt samples are analyzed to ensure that radioisotopic concentrations and other possible pollutants are well within the stringent standards adopted by the Department of Energy and the Environmental Protection Agency.

HEALTH PHYSICS AND BIOASSAY FACILITIES

Radiation monitoring of personnel and processes is performed on-site. This monitoring includes analysis of biological samples and the use of film badges, thermoluminescent detectors, and area radiation detectors.

MATERIALS DEVELOPMENT FACILITIES

In direct support of program requirements, many materials and techniques are developed to fabricate models for experimental purposes. A range of precision machining capabilities is available for fabrication of intricate parts from both metals and non-metals. Fixtures, dies, molds, and other product-related tooling are also designed and fabricated to produce small quantities of specialty items with very high tolerances, quality, and reliability. Associated capabilities include metal plating, glass working, and compatibility testing.

METALLOGRAPHIC FACILITIES

Extensive facilities and highly specialized equipment are available for alloy preparation, metallographic examination, physical property measurements, and constituent analysis.

METROLOGY FACILITIES

A standards laboratory is equipped with the latest optical, electronic, pneumatic, and mechanical gauging devices. Rigorously defined length, mass, time, and electrical standards are maintained to calibrate components used in production and quality control.

NONDESTRUCTIVE TESTING FACILITIES

Mound is equipped for a wide range of nondestructive testing techniques, including x-ray radiography, ultrasonic analysis, acoustic emission, and infrared thermography. A recently constructed californium multiplier (CFX) neutron radiography facility can be used for neutron activation analysis as well as for neutron radiography.

WELDING AND JOINING FACILITIES

A special facility is maintained for welding nonradioactive materials and encapsulation of special materials such as radioactive heat sources. Processes include metal-inert gas welding, heliarc welding, and gas-metal arc welding. In addition, facilities are also available for welding of certain products by advanced techniques such as ultrasonic welding, laser welding, and electron beam welding.

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OUR RESOURCES

Monsanto

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