GJO-112(81)

UNITED STATES DEPARTMENT OF ENERGY

Grand Junction Office

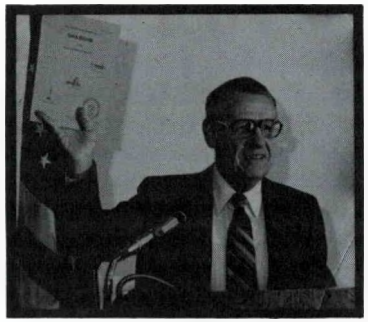
1980

CONTENTS

MESSAGE FROM THE MANAGER

The year 1980 was a highlight in the 33-year history of the Grand Junction Office (GJO), marking the culmination of more than three decades of activity in uranium resource evaluation and related activities in the United States.

Having executed an intensive and highly successful uranium exploration and ore and concentrate purchase program throughout the United States in the 1950s, and having established close working relationships with the free-market uranium mining and milling industry in the 1960s, GJO was called upon in 1974 to launch the National Uranium Resource Evaluation (NURE) program. This program was designed and carried out to develop information for a comprehensive assessment of uranium resources throughout the 48 conterminous United States, plus Alaska. Related goals were the development of improved methods for estimating these resources and improved technology for enhancing the quality of technical data required for the estimates. Since the program's inception, hundreds of reports on the results of investigations of all elements of the NURE program have been released to the public on a timely basis.



In August 1978, GJO was directed by the Secretary of the Department of Energy to complete by October 1980 a substantive report assessing the Nation's uranium resources. The assignment was successfully completed on schedule. The report is the most comprehensive compendium of the Nation's resources for a single mineral commodity ever prepared, including data on the probability of the existence of the various amounts of uranium resources estimated, and on the projected capability of the industry to produce these amounts.

Specifically during 1980, uranium resource assessment on 135 National Topographic Map Series (NTMS) quadrangles was completed, along with other specific studies, to yield October 1980 national resource estimates. In addition, updated uranium supply analysis and production capability projections were completed. All this was accomplished with markedly improved methodology in all phases of the resource assessment process. Another key aspect of this successful program was the development of improved geophysical and geochemical equipment and techniques in support of uranium resource assessment. Much of the hardware and know-how developed was turned over to the public and to the uranium industry at large for application to uranium exploration and the assessment of uranium company resources.

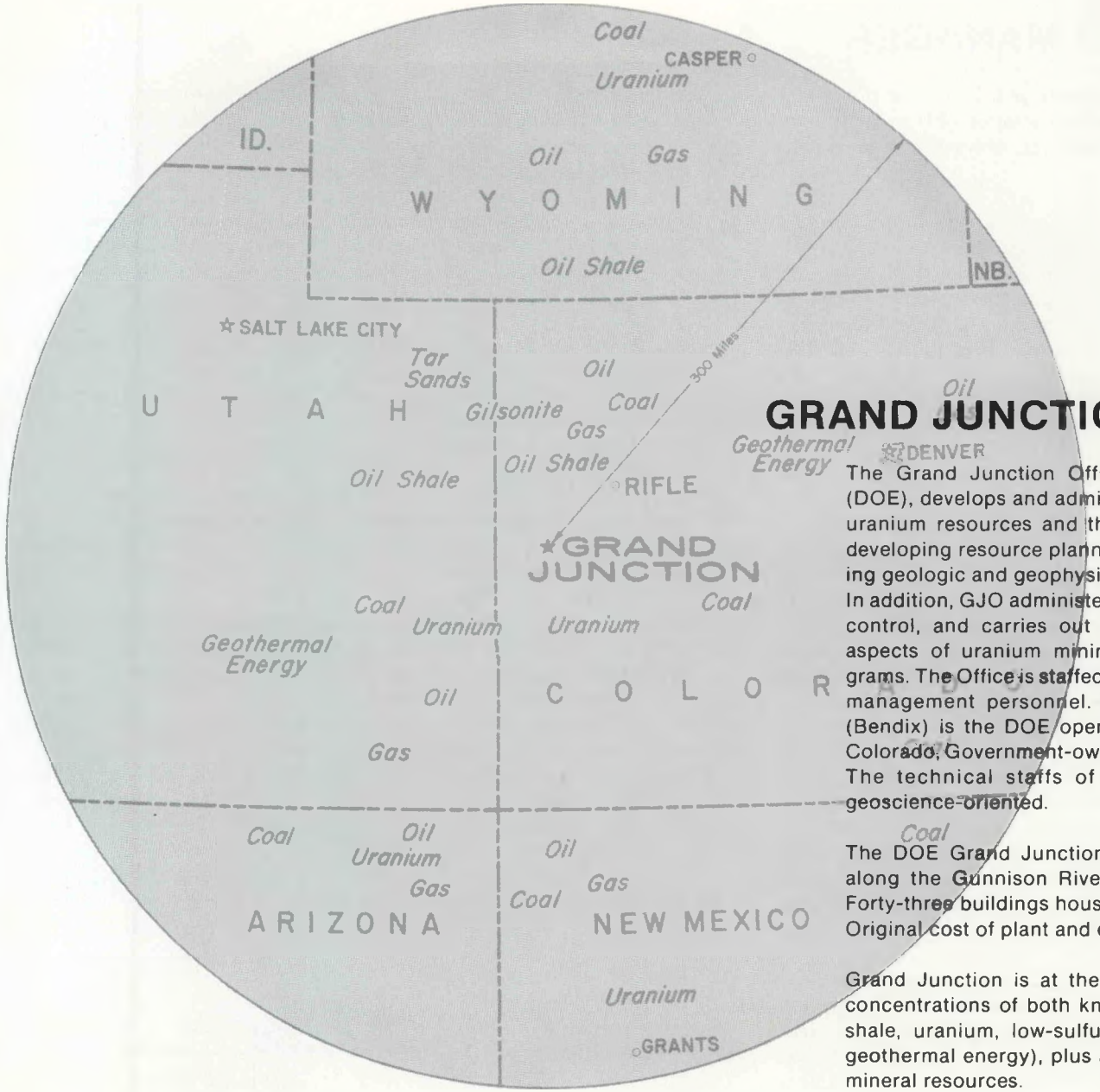
The Grand Junction Office also participated actively during 1980 in international cooperative research on uranium exploration techniques and on the geology of uranium deposits. The Office supports the International Uranium Resources Evaluation Project (IUREP), administered by the International Atomic Energy Agency and the Nuclear Energy Agency to develop information for improved uranium resource estimates in selected countries and for the world. Also during 1980, scientists from 21 foreign countries visited GJO for training in technologies related to uranium resource assessment and for technical exchange.

Aside from these accomplishments, GJO began to look forward in 1980 to an expanded role in the geoscience-related elements of all Department of Energy programs, having developed unique capabilities that can contribute to these other DOE programs. In recognition of this, the groundwork was laid for establishing GJO as DOE's Applied Geoscience Center. Positive steps were made in applying GJO expertise to DOE environmental concerns, nuclear waste disposal site selection, the assessment of non-uranium resources, and other endeavors.

I am personally proud of our accomplishments over the last three decades, and look forward to GJO making meaningful contributions to the Nation's energy program in the years that lie ahead.

Donald L. Everhart

Donald L. Everhart, Manager



GRAND JUNCTION OFFICE, DOE

The Grand Junction Office (GJO), U.S. Department of Energy (DOE), develops and administers programs for evaluating domestic uranium resources and the production capability of industry; for developing resource planning information for DOE; and for advancing geologic and geophysical exploration concepts and techniques. In addition, GJO administers the leasing of mineral lands under DOE control, and carries out activities relating to the environmental aspects of uranium mining and milling, including remedial programs. The Office is staffed by administrative and technical program-management personnel. Bendix Field Engineering Corporation (Bendix) is the DOE operating contractor at the Grand Junction, Colorado, Government-owned/contractor-operated (GOCO) facility. The technical staffs of both GJO and Bendix are primarily geoscience-oriented.

The DOE Grand Junction facility is located on a 48.6-acre tract along the Gunnison River, south of the city of Grand Junction. Forty-three buildings house the many functions of the organization. Original cost of plant and equipment approximates $17 million.

Grand Junction is at the center of one of the Nation's greatest concentrations of both known and potential energy resources (oil shale, uranium, low-sulfur coal, natural gas, oil, tar sands, and geothermal energy), plus a wide range of metallic and nonmetallic mineral resources.

NATIONAL URANIUM RESOURCE EVALUATION

The NURE program was begun in 1974 to provide a comprehensive assessment of the Nation's uranium resources for use in Government energy program-planning and decision-making activities. The evaluation is based on the systematic collection, analysis, and integration of geologic data from aerial radiometric and magnetic surveys, hydrogeochemical surveys, detailed geologic studies of favorable areas, and drill holes.

In October 1980, GJO issued a publication entitled *An Assessment Report on Uranium in the United States of America,* which was based on data provided by the NURE program and by uranium industry sources. The report includes DOE estimates of uranium resources, an analysis of supply and demand, and projections of industry's capability to produce. It provides critical inputs to key issues involved in national planning, including the future growth of light-water reactors, and the need for and optimum timing of the breeder reactor and other advanced nuclear electric-power-generating systems.

The Aerial Radiometric and Magnetic Survey (ARMS) of the United States is being conducted by geophysical service companies using sensitive gamma-spectrometry techniques to measure low concentrations of uranium, thorium, and potassium from an altitude of about 400 feet. The purpose of the surveys, flown on flight lines usually 4 to 5 miles apart, is to define the distribution of these radioactive elements—information that is useful in identifying discrete geologic units favorable for uranium deposits. Radioelement signatures related to deposits in a variety of geologic environments may be used to infer favorability in geologically similar unexplored areas.

Data from the Hydrogeochemical and Stream-Sediment Reconnaissance (HSSR) program also identify areas favorable for the occurrence of uranium resources. Sediment samples from permanent and ephemeral stream beds, and water samples from streams, lakes, springs, and wells are systematically collected from throughout the Nation, and analyzed for uranium and other associated elements.

Drilling is done in selected areas where subsurface geologic information needed for evaluating favorability for uranium resources is lacking. Geologic investigations are fundamental to the NURE program, since results of all other investigative elements must be related to the geologic environment.

Estimation of the potential uranium resources of a region is based on the evaluation of all available data. These evaluations are being conducted by Bendix, other private firms, the U.S. Geological Survey, state geological surveys, and universities.

Aerial Radiometric Reconnaissance

The national Aerial Radiometric and Magnetic Survey (ARMS) program was initiated in 1974 to define radioelement distributions and to identify areas favorable for uranium resources in the United States. Total magnetic-intensity data useful in interpretation of geologic studies are acquired concurrently in the survey. Some 464 of the 468 NTMS quadrangles in the conterminous United States and 98 of the 153 quadrangles in Alaska have been surveyed. Flight-line spacings of from 1 to 12 miles are used in the survey.

Since the inception of the ARMS program, about 1 million flight-line miles have been flown, of which 267,000 were flown in 1980. By the end of 1980, 61 percent of the projected surveys had been completed and the data open-filed. Flying and/or report preparation were in progress on an additional 30 percent of the Nation.

A detailed aerial radiometric survey program, supplemental to the nationwide ARMS reconnaissance, was begun in 1978. By the end of 1980, some 58,000 flight-line miles had been flown in 17 areas, with flight-line spacings of from one-fourth to 1 mile. Data from these detailed surveys provide a basis for better delineation of favorable areas in localities of complex geology.

POTENTIAL USES FOR AERIAL DATA

Potential uses for the aerial radiometric data, additional to their use in uranium resource assessment, include the preparation of radiation exposure-rate maps, radiation maps for baseline studies, and geologic maps.

The magnetic data acquired in both the detailed and the reconnaissance surveys are helpful in determining geologic structural features and in defining certain geologic units that may influence the localization of uranium deposits. At Oak Ridge National Laboratory, Oak Ridge, Tennessee, the magnetic survey data are contributing substantially to the preparation of a National Magnetic Anomaly Map which will be useful in exploration for certain metallic minerals in geologic mapping.

Aerial Survey Interpretation Methods

A demonstration project conducted in 1980 utilized the aerial radiometric survey data acquired for the NURE program to construct total radiation exposure-rate maps for the Richfield, Salina, and Moab NTMS quadrangles in Utah. This was accomplished by combining the terrestrial component derived from ARMS data with the cosmic component developed from data of the National Oceanic and Atmospheric Administration in Boulder, Colorado. Color planimetric contour maps and three-dimensional perspectives of the total radiation exposure-rate values were prepared for the three quadrangles.

Other research conducted includes STAARS (Statistical Techniques Applied to Aerial Radiometric Surveys), a cooperative effort between Bendix and Los Alamos National Scientific Laboratory, Los Alamos, New Mexico, to evaluate various statistical techniques for interpreting NURE aerial radiometric data.

Hydrogeochemical and Stream-Sediment Reconnaissance

The Hydrogeochemical and Stream-Sediment Reconnaissance program provides data on the distribution of uranium in stream sediments and in surface and subsurface waters for use in identifying areas favorable for uranium resources. Three DOE laboratories have conducted the HSSR program for GJO: Los Alamos National Scientific Laboratory is responsible for completing the HSSR survey of the Rocky Mountain states and Alaska, Oak Ridge Gaseous Diffusion Plant for completing the central United States, and the Savannah River Laboratory in Aiken, South Carolina, for completing both the western and eastern portions of the United States.

During the past four years, more than 700,000 samples covering 75 percent of the Nation have been collected. Sampling is at a density of one sample per 5 to 10 square miles. Analyses of nearly 400,000 of these samples have been completed, using delayed neutron activation, plasma-source and arc-source emission spectrography, fluorometry, atomic-absorption spectrophotometry, X-ray fluorescence, and isotope-dilution mass spectrometry. All analytical results are released promptly to the public. During 1980, 79,000 samples were collected, 200,000 samples were analyzed, and 70 reports were issued, covering 10 percent of the Nation.

Chemical analyses conducted as a part of the HSSR program have potential application in exploration for other mineral commodities, as well as in health sciences, environmental studies, and crop and livestock production. NURE program activities have provided GJO with considerable expertise in the comprehensive evaluation and presentation of geochemical data on regional scales.

The HSSR program has identified a number of areas with anomalous amounts of uranium. Analyses of stream sediments in 1980 identified anomalies in Taos and Colfax Counties, New Mexico; in placer deposits west of Anchorage, Alaska; and in an area northeast of Steamboat Springs, Colorado. Ground-water sample analyses indicated areas of possible uranium accumulation in the vicinity of Lytle, Texas, and in Presidio and Jeff Davis Counties, Texas. Other areas of interest identified by the HSSR program during 1980 are in east-central Minnesota; in Stark, Billings, Hetlinger, and Adams Counties, North Dakota; and in Natrona County, the Powder River Basin, and Old Woman Creek, Wyoming.

GEOCHEMICAL ANALYSIS CAPABILITY

The Grand Junction Office has expanded the scope of its geochemical analysis capability and enhanced the reliability of its analytical data by updating equipment, instrumentation, and procedures. Capabilities well beyond routine analyses have been developed. Senior personnel are experienced in the design of analytical programs in support of research, as well as in analytical methods development, the subcontracting of analytical work, industrial-hygiene-oriented sampling and analysis, and design of environmental programs, including interpretation and reporting of results.

During 1980, the geochemical analysis program at GJO produced approximately 120,000 analytical determinations. Analytical capabilities were improved through acquisition of a carbon analyzer and a sulfur analyzer. An ion chromatograph was also installed, and procedures for identifying and analyzing anions in water were developed. A new microprocessor-controlled atomic absorption unit with heated-graphite atomization capabilities was acquired, for which a polonium-210 procedure was developed. Procedures for analyzing other radioisotopes are also under development. Determinations for boron in water and for mercury, tungsten, and tin in rock samples have been implemented. In addition, an X-ray fluorescence procedure is in place for determining rubidium, strontium, yttrium, and zirconium in rock samples. Also installed during 1980 were a new germanium/lithium detector, a Canberra multichannel analyzer, and a PDP11/34 computer. Quality control, reporting, and storage of data from the direct-reading emission spectrograph are now automated.

Drilling Programs

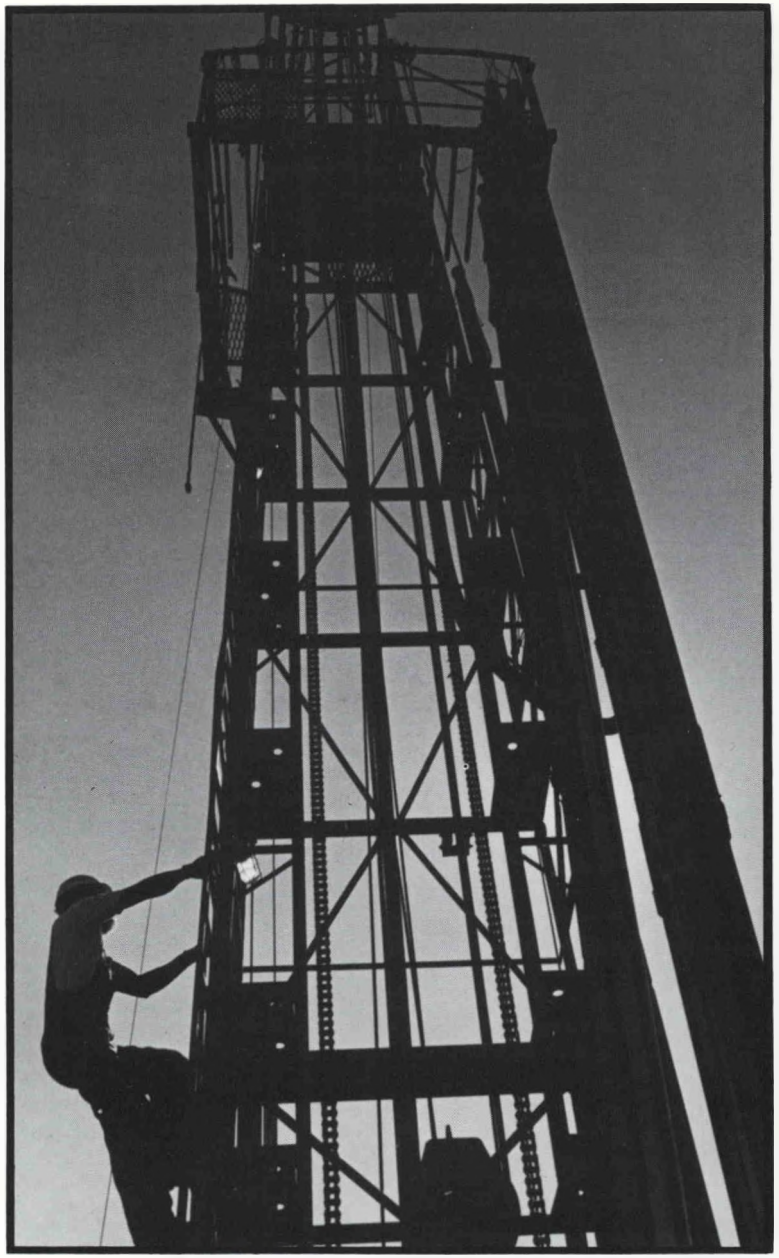
During the past five years, drilling and coring of 435,000 feet has been accomplished in rocks ranging from crystalline rocks of Precambrian age to evaporites of Quaternary age. During 1980, nine projects were completed, which involved about 68 holes for a total of 103,000 feet. In Brooks County, south Texas, 10 holes totaling 27,000 feet were drilled in the favorable Oakville and Goliad Formations. One of the holes intersected anomalous concentrations of uranium.

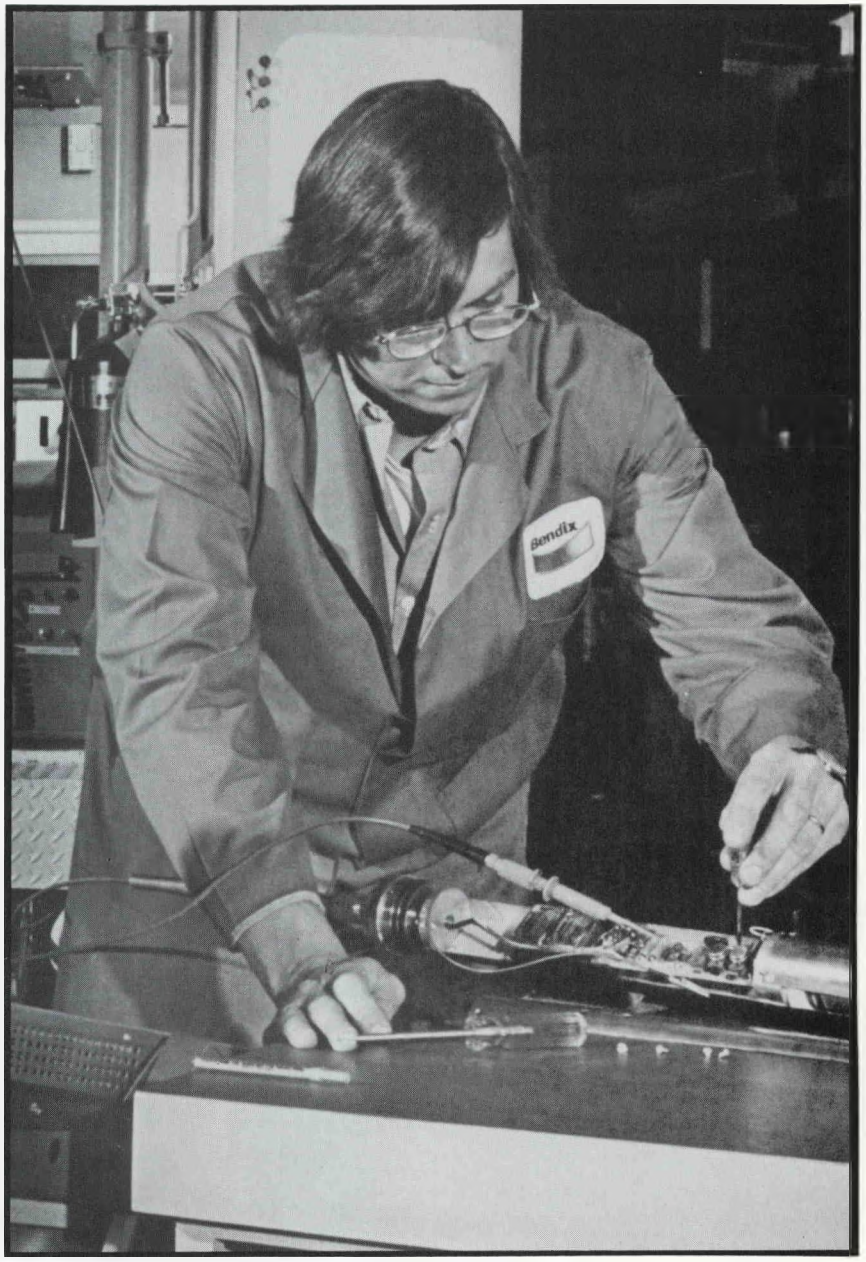
The Sand Wash project, near Craig, Colorado, included 19 holes totaling 11,700 feet which indicated less favorable conditions in the Browns Park Formation than had previously been assumed.

The Red Desert project, north of Rawlins, Wyoming, consisted of four holes totaling 9,770 feet. All four intersected thin mineralized intervals of intermediate-grade uranium deposits, enhancing the potential for uranium resources in the Wasatch Formation.

The southeast Wyoming project, near Saratoga, was conducted in support of World Class studies and consisted of eight holes totaling 6,400 feet. Results of drilling in this area indicated rather low favorability for uranium resources in the Precambrian quartz-pebble conglomerate target.

Drilling started 12 November 1980 on the McDermitt caldera project in northern Nevada and southern Oregon. Two of five holes were completed by the end of 1980.





Advances in Geophysical Logging

Recent research into advanced methods for the geophysical logging of drill holes has concentrated on field demonstration of the Prompt Fission Neutron (PFN) system developed by GJO contractors, as well as on a field comparison study of all available neutron-logging methods. The PFN system and required ancillary probes are now operational on a GJO logging vehicle. During 1980, GJO acquired the computer programs and expertise necessary to perform detailed radiation-transport calculations to simulate the performance of all types of nuclear-logging probes and calibration models. These programs are now being used to refine the PFN probe-calibration process and to better assess its performance.

Other research efforts in geophysical logging have been directed toward improving data reduction and analysis methods for spectral potassium/uranium/thorium (KUT) logs and for gross gamma-ray logs. These improvements result in more quantitative field logs with higher accuracy. A significant development has been the implementation of these data reduction and analysis methods in the operation of computer-based logging vehicles, making processed log results available to the geologist in the field. Gamma-ray detector studies this past year have shown that the new bismuth/germanium scintillation detector crystal promises to greatly enhance the sensitivity of existing KUT probes to the daughter products of potassium, uranium, and thorium.

A significant array of geophysical logging capabilities exist at GJO. These include a cooled high-purity germanium-detector logging system for high-resolution work, a fission neutron-logging system, and several spectral and gross-count gamma-ray systems. A research and development logging vehicle is equipped for radioelement and fissile-element borehole determinations, as well as with a suite of probes for measuring magnetic susceptibility, density, moisture, resistance, spontaneous potential, and borehole size.

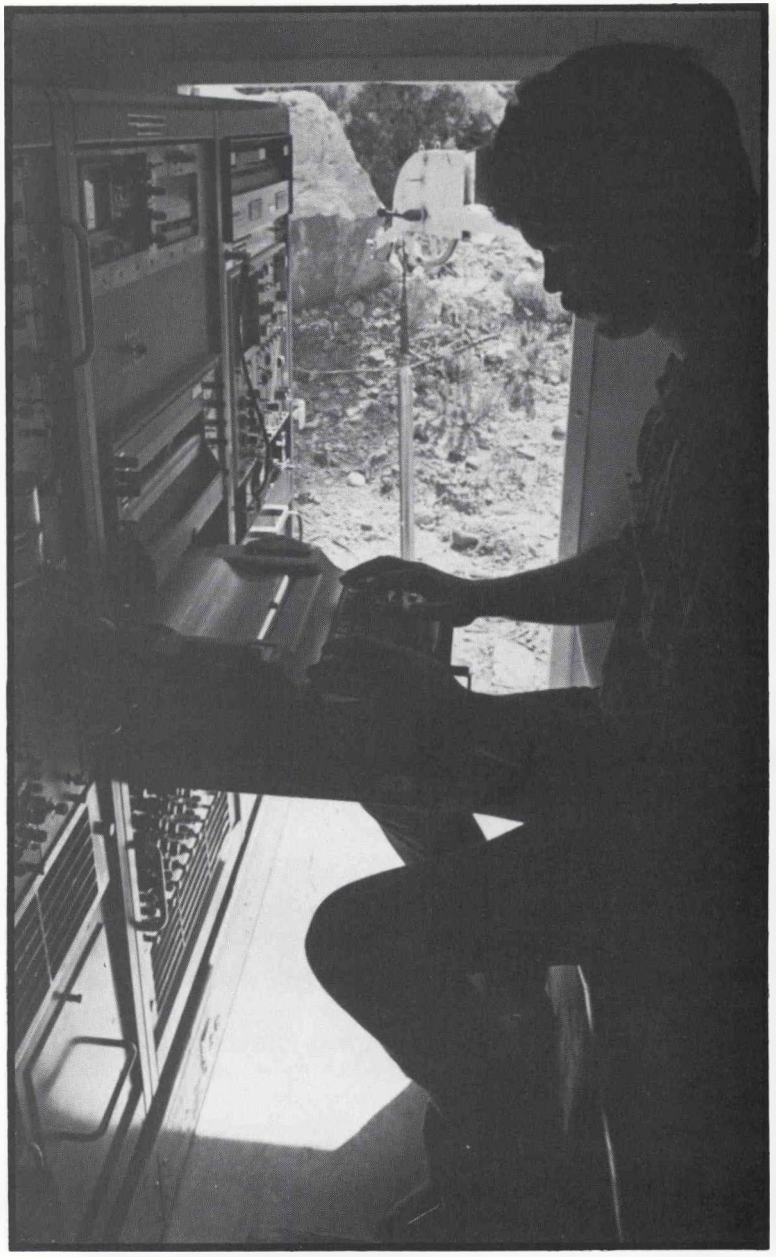
A prototype version of a magnetic-susceptibility (MS) probe has also been evaluated for field performance during the past year. Several production versions of the MS probe have been delivered and will be put in operation on the computer-based logging vehicles during 1981.

Concurrent with the development of new logging tools, significant progress has been made in projects designed to improve data acquisition and transmission hardware for borehole-logging systems. A prototype pulse-height analyzer for use within spectral gamma-ray probes is currently being designed and built by Bendix. A prototype digital-data transmission system for acquiring data from all standard logging probes is also under construction.

National Logging Program

The objective of the NURE National Logging Program (NLP) is the acquisition of quantitative radiometric log data from holes drilled for purposes other than uranium exploration. During 1980, 800 holes totaling 2,040,000 feet have been logged by contracted commercial logging services. Some 1,090,000 feet were logged in 440 holes drilled for oil, gas, water, coal, geothermal, and mineral exploration in the Denver-Julesburg Basin, the Wyoming Basin, south Texas, the San Joaquin Valley in California, eastern Nevada, Georgia, and selected areas in the northeastern United States. More than 70 holes with total gamma radiation and/or KUT anomalies exceeding three times background were identified; eight exceeded ten times background.

In addition to contracted logging, four DOE-owned, Bendix-operated units logged more than 665,000 feet in 156 boreholes during 1980 in California, Utah, Colorado, New Mexico, Wyoming, Texas, Georgia, South Carolina, Tennessee, West Virginia, Pennsylvania, and New York. These units, which can log to a depth of 7,000 feet, collect resistivity, natural-gamma, spectral-gamma (KUT), neutron-neutron, caliper, magnetic-susceptibility, temperature, and vertical-deviation log data. The units are operated on call, 7 days a week, 24 hours a day. Three additional units are being assembled to augment the present borehole-logging capability.



Technology Applications

The GJO Technology Applications program provides for the development, evaluation, and integration of new and improved techniques, methods, instrumentation, equipment, and systems for uranium exploration and resource assessment.

The Grand Junction Office currently is conducting a program to determine the relationship of species from the uranium-decay series to uranium mineralization. Also under study are the primary migration mechanisms for these species and the most appropriate methods for measuring them. Species being evaluated include radon, helium, the uranium isotopes, and the lead isotopes. Surface- and ground-water sampling programs at four known uranium occurrences have confirmed the value of radon, helium, and uranium-isotope ratio measurements for uranium exploration. The migration of radon and its alpha-emitting progenitors and decay products is now being traced through nuclear emulsions.

The environmental impact of radon released to the atmosphere by open drill holes has also received attention. A prototype instrument has been developed to test the feasibility of measuring radon in recirculating drilling mud. The system works by degassing the drilling mud as it recirculates, continuously measuring the radon activity of the evolved gas. The result is a record of relative radon activity as related to borehole depth.

CALIBRATION

The Grand Junction Office designs, constructs, and maintains facilities for the calibration of borehole, surface, and airborne radiometric geophysical systems. Measurements from these facilities are processed by computer to provide calibration factors and systems characteristics to industrial users on a nationwide basis.

New field calibration facilities were completed during 1980 at Morgantown, West Virginia, Spokane, Washington, and Reno, Nevada. These facilities, together with existing facilities at Casper, Wyoming, Grants, New Mexico, George West, Texas, and Grand Junction, Colorado, provide models for the calibration of gross-gamma, spectral-gamma (KUT), and fission-neutron borehole probes. They also provide calibration blocks for the calibration of field-portable gross-gamma instruments.

Radon data obtained at the Red Desert site in Wyoming and at a site in the Sand Wash Basin in Colorado have indicated that anomalous radon zones can correspond to uranium concentrations and variations in lithology.

ELECTRONICS SUPPORT

Electronics support for GJO programs is provided in the areas of design, instrumentation engineering, instrumentation calibration, and laboratory services.

The design support group works closely with users to develop conceptual designs, system-performance specifications, and calibration criteria. The group is also available for technical consultation, technical monitoring of contracts, project management for development of new instrumentation systems, and participation in the test, evaluation, and documentation of operational systems.

The instrumentation engineering function translates conceptual designs and performance specifications for instrumentation systems into detailed hardware and software designs. Working with minicomputers, microprocessors, and state-of-the-art integrated electronics, this function develops and tests the circuits, subsystems, and interfaces needed to construct complex geophysical and geochemical data-acquisition and recording systems.

The instrumentation calibration function ensures that all laboratory and field measuring and test equipment and devices are operating within acceptable tolerances.

The electronics laboratory fabricates and installs the instrumentation systems and components developed by the instrumentation engineering and design functions.

Technology Integration

Technology integration projects at GJO focus around three objectives: to detect halo effects surrounding uranium deposits in different geologic environments, to develop genetic models, and to develop cost-effective methods for uranium exploration and resource assessment. These objectives are being pursued through integration of geologic, geochemical, geophysical, and emanometric studies in four project areas: Spokane Mountain in Washington, Copper Mountain in Wyoming, Red Desert in Wyoming, and the San Juan Basin in New Mexico.

At Spokane Mountain, aerial radiometric anomalies define known uranium occurrences. Magnetic and structural studies indicate tectonic control of uranium concentrations. Mineralogic, geochemical, and emanometric studies reveal anomalies indicative of nearby mineralization.

At Copper Mountain, anomalous uranium concentrations in dust-size particulates at ground surface and in the air match well with ground geochemical anomalies and with known mineralization.

In the Red Desert, preliminary results indicate helium and radon in ground water are useful for locating buried uranium deposits. Uranium isotope ratios and the total uranium content of ground water are good indicators of the transitions from oxidizing to reducing conditions which control the localization of uranium.

In the San Juan Basin, seismic surveys define structures that influence the distribution of uranium deposits. Magnetic-susceptibility anomalies occur below the mineralized zones, indicating that magnetic minerals within the uranium-enriched zones have been destroyed by the mineralization process.

Geologic Activities

Geologic investigations are conducted to identify formations and environments favorable for uranium resources, to develop favorability guides useful in both assessment and exploration, and to provide a basic framework for estimating uranium resources. Geologic features of uranium concentrations in different environments are characterized by models for use in the evaluation of undiscovered resources. Geostatistical studies to improve methods for estimating reserves and for assessing potential resources are also conducted.

To date, 135 NTMS quadrangles (1 degree latitude by 2 degrees longitude), covering the 22 percent of the United States most favorable for uranium resources, have been evaluated comprehensively. Anomalous areas, indicated by either aerial radiometric or geochemical surveys or both, have been investigated in the field to determine the sources of the anomalies. All formations in each quadrangle have been investigated and classified as either favorable or unfavorable for the occurrence of uranium. Subsequent work, including various subsurface compilations, provides a basis for delineating the favorable areas. The results of these studies are being compiled into individual quadrangle folios containing text, tables, and maps that depict favorability.

World Class studies, to evaluate possibilities of the occurrence in the United States of types of deposits that are of major importance elsewhere in the world, have concentrated on the uranium-bearing quartz-pebble conglomerates in the Medicine Bow and Sierra Madre Mountains of Wyoming and in the Black Hills of South Dakota.

Intermediate-grade studies have been conducted to characterize potentially large sources of uranium in the grade range of 0.01 to 0.05 percent U_3O_8 (uranium oxide) at Copper Mountain and in the Great Divide Basin, Wyoming, as well as in the Sand Wash Basin, Colorado. Geologic models of these deposits are being developed for use in estimating the potential resources in similar geologic settings.

GJO geologists with expertise in particular regions of the United States are assigned to regional field offices. They enjoy excellent working relationships with the USGS, state geological surveys, numerous universities, and many private consulting firms.

Technical Information Management Systems

Central to all NURE data gathering and evaluation activities are computerized information systems designed to systematically capture and process all data used in uranium resource assessment. Since initiation of the NURE program, geologic and topographic map parameters, water and soil sample analyses, and aerial radiometric and magnetic survey data have been systematically stored in a computer-retrievable mode and utilized in geologic favorability studies.

More than 3,000 reels of magnetic tape have been produced by the NURE program. Geoscience and computer specialists, along with statistical and mathematical support groups, design systems and process information in this computing environment. Bendix, Oak Ridge National Laboratory, and other DOE facilities analyze, integrate, and produce interpreted outputs from perhaps the largest single national data base of current geologic information in existence or under development. Advanced systems are available for use in either production or research modes and may be interfaced with a variety of terminals, plotters, and digitizers.

A large CDC-6600 computer system at the GJO facility includes a remote access link to the Computer Center at Oak Ridge National Laboratory, a minicomputer-based dual flatbed digitizing system, a key-entry system, a Calcomp line plotter, and an Applicon color plotter.

All technical projects are monitored through a computer-based project management system. Analysts assigned to specific program elements use these systems to monitor schedules and cost performances, to analyze results, and to prepare consolidated status reports.

RESOURCE ASSESSMENT

Uranium resource assessment includes the estimation of uranium reserves in well-defined deposits and potential resources in largely undiscovered deposits. Reserves are estimated for individual properties throughout the Nation, based on detailed information voluntarily made available to GJO by the uranium companies. Potential uranium resources in the United States are included in the resource assessment, utilizing data acquired from geologic and related studies. A supply-analysis program includes evaluation of physical, economic, and environmental factors affecting the availability of these resources and the viability of the domestic uranium mining and milling industry. From these considerations, projections of industry's capability to produce the estimated resources are prepared.

Potential Resources

Grand Junction Office estimates of potential uranium resources—quantities of uranium that are incompletely defined or undiscovered—are developed from a data base accumulated during the past three decades of Government and industry activities, and are enhanced by the NURE program investigations of the past six years. This data base has permitted the development of improved estimates of potential resources, systematically derived for hundreds of areas determined to be favorable within the United States.

The unique features of DOE assessments—geographic delineation, and geologic and economic characterization of resources—have been expanded to include presentations of uranium resource estimates in terms of statistical confidence; that is, probabilities of the existence of resources at various tonnages, supplementing the mean values which are reported. The estimates are subjected to rigorous peer and staff review.

Uranium Reserves

For over three decades, the Grand Junction Office has estimated uranium reserves as part of its uranium resource assessment program. Reserve estimates are based on industry-provided data from boreholes drilled closely enough to provide reliable estimates of tonnage and grade in deposits estimated at selected cost levels. This activity involves computer records on more than 5,000 uranium properties, of which 1,800 have ore reserves. Some 300 of these properties contain more than 90 percent of the total domestic reserves, and the records on these properties are updated annually. The Grand Junction Office, which has developed unique capabilities in estimation methodology and data handling, evaluates approximately 50,000 gamma-ray logs of drill holes each year.

The Grand Junction Office possesses capabilities not only in uranium resource estimation but also in design and development as applied to mining, mine plants, waste dumps, haul roads, tailings dams, materials handling, underground facilities, reinforced concrete, drilling and blasting, earth-moving equipment, pit-slope stability, stress and strain analysis, and such computer applications as simulation modeling, interactive graphics, data-base management, and subcontract management.

Supply Analysis

Studies were carried out during 1980 to determine the elasticity of future U.S. uranium supplies, based on the availability of domestic uranium resources currently estimated at various cost levels. Analyses were made of the extent to which near-term (20-year) and long-term (40-year) requirements for domestic nuclear power could be met from currently estimated reserves and probable potential resources. The core of this work consisted of evaluating the projected production capability for each of 83 existing, planned, or postulated uranium processing facilities (production centers) based on uranium resources tributary to each of the facilities. The processing facilities consist of conventional mills fed by production from underground, open-pit, and surface-leach operations, and other facilities fed by production from in-place solution mining and from the recovery of uranium as a byproduct of phosphate, copper, and beryllium mining and milling operations.

Conferences with individual uranium companies were held at GJO during 1980, involving managerial and staff personnel from 25 major uranium exploration, mining, and milling firms. Grand Junction Office engineers visited numerous processing plants and mines throughout the United States to examine uranium extraction and processing techniques and to obtain data on production costs and employment.

An annual survey of 160 companies engaged in uranium exploration solicited information concerning the quantity and cost of exploration and development drilling during 1979. Additional costs were also obtained for geologic and geophysical investigations, and for field, overhead, and administrative charges associated with exploration activities. Other information supplied included the extent of lands held for exploration, the costs incurred in exploring for uranium outside the United States, and company plans for exploration drilling during 1981 and 1982. A report summarizing this information provides insight on overall trends, costs, and successes in uranium exploration, and industry's plans for the future exploration and development of domestic uranium resources.

SPECIAL STUDIES

The GJO technical staff consists of engineers, economists, and operations research analysts and computer specialists with extensive experience in the analyses of mining operations, mineral economics, cost estimation, statistical analysis, mathematical modeling, computer applications, and project management. The staff conducts special studies on potential long-term sources of uranium, and evaluates the relationship between projected uranium production and a variety of uranium demand situations. It also prepares capital and operating cost estimates and discounted cash-flow rate-of-return analyses on conventional mining and milling operations, solution mining, and byproduct recovery of uranium. Finally, the staff develops new methodology, computerized data management systems, and computer-based analytic models for monitoring the production capability of the domestic uranium mining and milling industry. The use of probability theory to improve the characterization of cost uncertainties in assessing the level of potential uranium resources is currently being investigated. The staff is capable of conducting and monitoring supply and demand analyses on U_3O_8 as well as on other energy resources and metallic commodities.

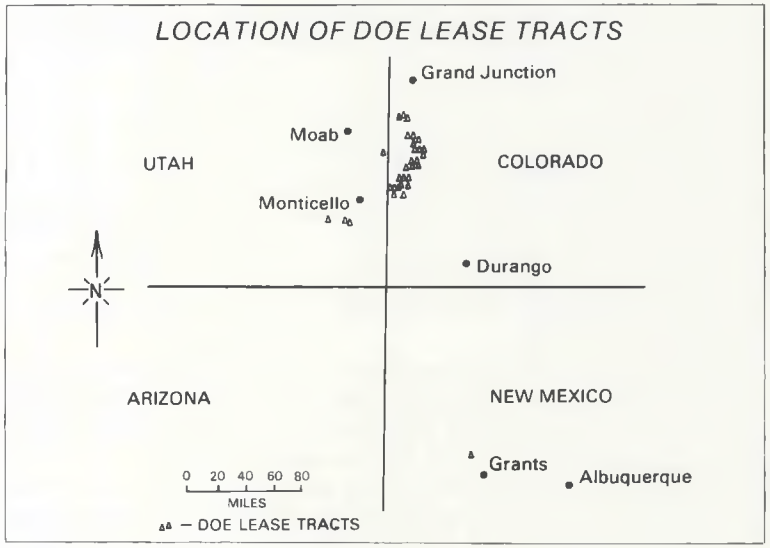
URANIUM LEASING PROGRAM

The Grand Junction Office administers uranium leases on 43 tracts of land covering 25,000 acres in Colorado, Utah, and New Mexico (see figure at right). This land, which was withdrawn by the Government during the period 1948 to 1954, was opened for competitive leasing in 1974. Exploration and development began later that year, and the level of subsequent activity has increased steadily. Since 1974, a total of 2,366 tons U_3O_8 (uranium oxide, also known as yellowcake) and 11,760 tons V_2O_5 (vanadium oxide) have been produced. From this production, the Government has received almost $42 million in royalties. Cumulative production and royalty data since initiation of the program are shown in the table at the right.

In 1980, 23 of the leases were in production. New mine entries were completed on seven of these, four new mines were brought into production, and exploration was initiated on three others, leaving only one of the original 43 leases on which no work has been done. In late 1980 the depressed uranium market resulted in suspension of mining on 10 leases. As a result, a drop in production is expected in 1981.

A highlight of the year was the commencement of the first large open-pit operation on a lease tract. The stripping of overburden started in April 1980 and will continue for five years through several phases of pit development. Eventually, some 65 million cubic yards of waste material will be removed. The anticipated yield from this operation will approximate 2,500 tons U_3O_8 and 12,500 tons V_2O_5.

LOCATION OF DOE LEASE TRACTS



DOE LEASE DATA

	Royalty Received	U_3O_8 Produced Tons	V_2O_5 Produced Tons	Leases in Production in Given Year
1974	$ 1,199,500.00	0.80	5.42	1
1975	255,792.17	14.41	105.33	6
1976	2,982,025.21	253.61	1,209.21	11
1977	5,452,507.85	377.18	1,853.54	15
1978	9,141,036.98	585.55	2,905.77	17
1979	10,220,997.35	572.54	2,870.13	19
1980	12,492,699.32	561.84	2,810.92	23
Totals	$41,744,558.88	2,365.93	11,760.32	

LEASE ADMINISTRATION

Lease-administration functions and capabilities at GJO include mine and mineral evaluation; monitoring of exploration and mining techniques; maintenance of production records; collection, preparation, and distribution of standard uranium samples for an analytical comparison program directed toward quality control of ore production assays; assessment of methods, equipment, and plant design related to ore sampling; and land and mine surveys.

Environmental-related functions and responsibilities include evaluation of proposed drill sites and approval of exploration plans; establishment of reclamation bonds, and monitoring of ongoing exploration projects to limit environmental impact; monitoring of drill-site restoration; and recontouring of abandoned waste dumps, and revegetation of disturbed areas.

INTERNATIONAL ACTIVITIES

The Grand Junction Office participates in various international activities sponsored by the Nuclear Energy Agency and the International Atomic Energy Agency. The information developed through these activities provides a basis for monitoring the progress of foreign exploration, and for evaluating foreign uranium resource developments, their impact on world uranium prices, and their effect on the viability of the U.S. industry.

A major program of these agencies is the International Uranium Resources Evaluation Project, to which DOE contributes funding, and which is designed to expand the identified world uranium resource base to ensure an adequate supply of uranium to support nuclear energy development. The Project has identified 40 priority countries where the possibility for discovery of uranium resources is good but where exploration and evaluation have been inadequate. Orientation studies have been completed in six of these priority countries, and studies in several others have been initiated.

The Grand Junction Office also contributes to internationally identified research on the geology of uranium deposits and on uranium exploration techniques by NURE funding of selected topical investigations.

Technical personnel from foreign countries visit GJO to exchange technical data and to acquire information on NURE program strategies and research activities. Visitors from Greece and Pakistan have received extended training in GJO geophysical and geochemical procedures under the International Atomic Energy Agency Fellowship Program. An international workshop on Production Capability and Methodology, sponsored by the International Atomic Energy Agency and held here in February 1980, drew delegations from Canada, France, Italy, the United Kingdom, and the United States.

INTERAGENCY AGREEMENTS

Under an interagency agreement with the Environmental Protection Agency (EPA), a survey of public and private properties located near uranium mining areas is being conducted to establish whether or not mine waste materials were used in any part of construction. An EPA-owned, Bendix-operated mobile radiation scanner unit is the primary survey vehicle. For the approximately 5,000 buildings surveyed to date, 221 anomalous features have been detected. Anomalous properties will be further investigated by a follow-up crew to determine the extent and source of the anomalous radiation levels.

A 1980 agreement with the U.S. Geological Survey provided for evaluation of the geologic favorability for uranium resources in 24 NTMS quadrangles as part of the NURE program to assess U.S. uranium resources. Additionally, the USGS will perform studies leading to site selection for detailed investigation and assessment of uranium resources.

The U.S. Bureau of Mines, under an interagency agreement, is investigating recovery of uranium from metallurgically complex cores. Current emphasis is on carbonaceous shales.

WASTE MANAGEMENT ACTIVITIES

Remedial Action Program

The Grand Junction Remedial Action Program (GJRAP) was authorized by Congress through Public Law 92-314, enacted on 16 June 1972. The objective of GJRAP is to limit exposure of individuals to radiation emanating from uranium mill tailings used as construction-related materials in Mesa County, Colorado. The program is managed jointly by the Colorado Department of Health (CDH) and the U.S. Department of Energy through the Grand Junction Office. The State of Colorado, which funds the program, is reimbursed by the Federal Government for 75 percent of program costs.

The function of the program is to provide remedial action for Mesa County structures where radiation levels resulting from the presence of uranium mill tailings exceed the criteria set forth in document 10 CFR 12. Of the 1,832 applications received prior to the 16 June 1980 application deadline, some 740 are probably valid and will require attention. Because the program is voluntary, remedial action at 10 to 15 percent of the potentially eligible locations might not be requested by owners.

Remedial action costing $2 million was accomplished at 32 locations during 1980. By June 1983, all requested radiologic assessments of properties will have been completed, and the absolute number of structures requiring remedial action will have been determined. All remedial action will result in reducing the radiation exposure of occupants to acceptable levels in 85 to 90 percent of these structures. Total program completion is scheduled for January 1987.

Mine and Mill Tailings Disposal

The Monticello Decontamination and Decommissioning project involves remedial action for (1) former Atomic Energy Commission mill-site areas and inactive tailings piles, and (2) off-site properties that have been contaminated by material from the former mill at Monticello, Utah. The project is part of the DOE Surplus Facilities Management Program (SFMP), which, under the aegis of the Richland Operations Office in Washington State, has been assigned to the Grand Junction Office. Objectives of the project are to decontaminate surplus DOE facilities to eliminate potential hazards to public health and the environment, and thus render those facilities suitable for productive use.

During 1980, an economic decontamination study was completed to evaluate the economic practicality of reprocessing the tailings. The results of this study will provide a basis for development of the Monticello Decontamination and Decommissioning project plan during 1981.

The major project activity during 1981 will involve remedial action at two off-site properties where it is believed that uranium mill tailings may have been used as construction-related material. If mill tailings or other contaminated material were indeed used in building construction, corrective action will be taken as soon as weather permits. Estimated cost for this work, scheduled for completion by September 1981, is $100,000.

Engineering and environmental studies for the mill-site work will commence in 1982. Subsequent remedial action is tentatively scheduled for completion by about 1990. Total cost of the project is currently estimated at approximately $50 million.

SUPPORT AND ADMINISTRATION

Procurement and Contracts

There were 17 prime procurement actions (direct Government contracts) at GJO during FY 1980, having a total value of $47,471,000. Seven of these, totaling $3,215,000, were awards to small businesses for aerial radiometric surveys, geophysical drill-hole logging, and construction of a radiation-instrument calibration facility at Spokane, Washington.

The GJO procurement staff coordinates and monitors procurement to ensure that contract-administration requirements are met, with emphasis on optimum use of the Bendix program-dedicated staff. The GJO procurement staff is actively involved in project planning, review of Bendix procurement plans, review of and consent on Bendix subcontracts, and contract- and property-administration functions required for the DOE/Bendix cost-plus-award-fee contract. The staff also plays a limited prime-procurement role.

The Bendix procurement staff is dedicated to subcontracting and purchasing for DOE/GJO. During FY 1980, this staff processed 9,179 procurement actions having a total value of $25,348,000. Awards included 5,879 actions to small businesses in the amount of $13,679,000 and 179 actions to minority businesses in the amount of $1,170,500.

High Life Helicopters, Inc., a minority and small-business helicopter service company in Puyallup, Washington, began flying for the NURE program in March 1977. Since that time, High Life has surveyed 88 NTMS quadrangles totaling 202,280 line miles. The GJO contracts signed with High Life are the largest minority-business contracts of their kind within DOE, an important contribution to the involvement of DOE within the minority and small-business community.

Documentation Support

The GJO facility contains complete documentation support services, from manuscript receipt through printing and distribution. Available in-house services include editing, word processing, drafting, photography, micrographics, and several forms of reproduction. The associated Technical Library maintains a 100,000-volume collection of books and other references related to geology, mining, and uranium resources; energy periodicals, maps, and drilling information; and a law library, all extensively used by the public as well as by DOE and Bendix personnel. The Technical Library is also the repository for all NURE-related and other open-filed reports, some dating back to the mid-1940s. (For open-file locations and information, see Appendix 1, page 22.)

Legal Support

Legal support at the Grand Junction Office is provided directly by a resident DOE Chief Counsel who is knowledgeable in the areas of procurement, mineral leasing, environmental impact activities, and land matters, as well as interactions with industry, Federal and state agencies, Indian organizations, and the public.

Organization and Staffing

At the end of FY 1980, DOE/GJO was staffed with 81 full-time employees. Professional disciplines include the geosciences, mining engineering, safety engineering, mineral economics, finance and budget, personnel management, contracts and procurement, and law (see organization chart, Appendix 2, page 23).

The Grand Junction Office has regional field offices in Spokane, Washington, Reno, Nevada, Casper, Wyoming, Grand Junction, Colorado, Albuquerque, New Mexico, Austin, Texas, and Pittsburgh, Pennsylvania.

Bendix ended FY 1980 with a permanent work force of 528 professionally diverse people. Represented on the Bendix staff are the geosciences, mining and safety engineering, computer sciences, administration, and craft and service operations (see organization chart, Appendix 3, page 24).

Financial Management

The financial-management support activity at GJO is responsible for meeting all reporting requirements imposed on DOE by the U.S. Treasury Department.

The greater part of FY 1980 uranium resource assessment appropriation funds were allocated to Bendix for participation in the NURE program. Operating costs included $17,464,255 for subcontracts and $20,238,689 for contractor operations.

Grand Junction Office funds were directed primarily into an interagency agreement with the U.S. Geological Survey, Small Business Administration contracts, and program direction and administrative costs. Funds were also allocated to seven national laboratories performing 13 technical projects, the largest being those associated with the HSSR program. Funds were expended at DOE headquarters for program direction, administrative costs, and minor procurements.

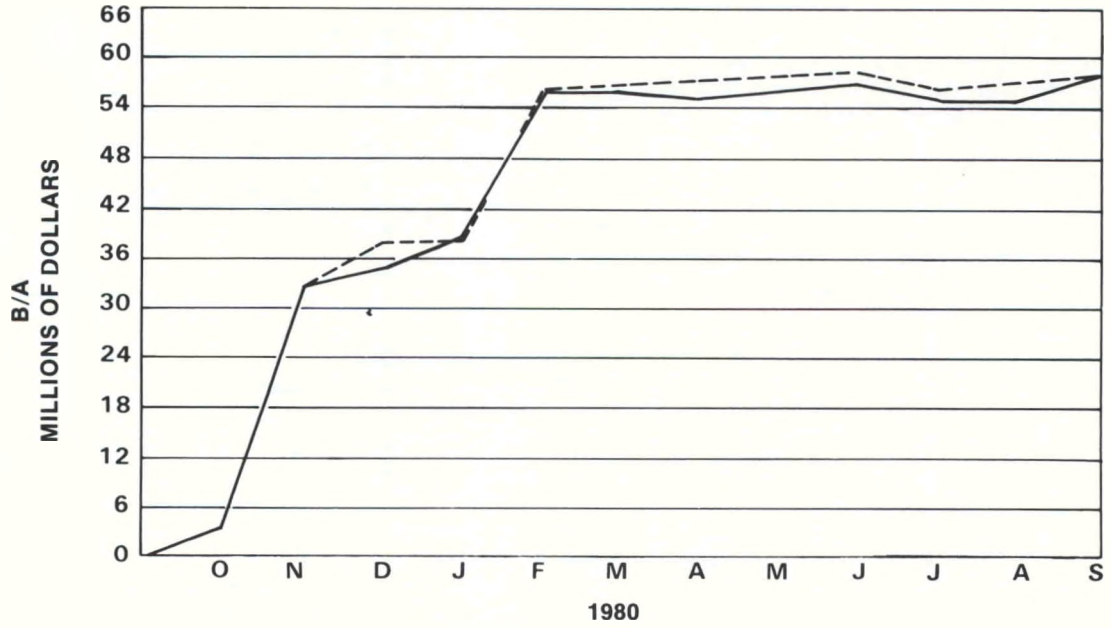
Royalty revenues from uranium and vanadium production on GJO-administered Government leases during FY 1980 totaled $12,496,825. These dollars were returned to the U.S. Treasury as an appropriation reimbursement.

The FY 1980 Uranium Resource Assessment program was appropriated operating expenses of $57,523,000 in Budget Authority (B/A) and $61,793,000 in Budget Outlay (B/O). An additional $4,000,000 was made available for Plant and Capital Equipment (P&CE). A profile of this budget is presented below. Note that during part of May and all of June, when the FY 1980 budget reductions were under consideration, a moratorium was placed on the awarding of new subcontracts, and, where possible, subcontractors were requested to slow down the rate of incurring costs. Recovery from the impact of these actions could not be made during the balance of the fiscal year.

FY 1980 PROGRAM FINANCIAL SUMMARY

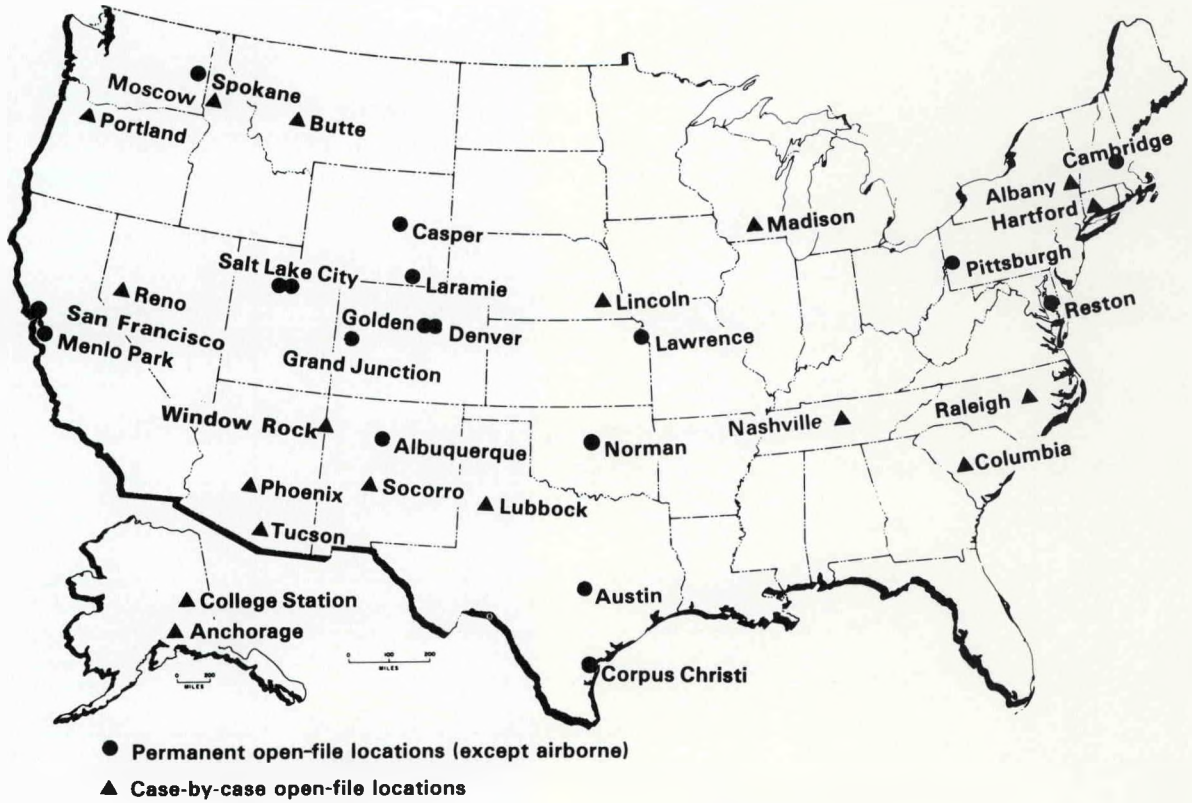
	Financial Plans			Actual			Variances Under (Over)		
	P&CE	Operations		P&CE	Operations		P&CE	Operations	
	B/A	B/A	B/O	B/A	B/A	B/O	B/A	B/A	B/O
GJ-DOE	$ 70	$ 8,575	$ 9,242	$ 70	$ 8,531	$ 8,850	$	$44	$ 392
BFEC	3,135	37,439	39,779	3,135	37,439	37,704			2,075
National Labs	795	11,040	12,146	791	11,040	11,974	4		172
Hqts—URE & DCAS		469	626		469	612			14
TOTALS	$4,000	$57,523	$61,793	$3,996	$57,479	$59,140	$ 4	$44	$2,653

URANIUM RESOURCE ASSESSMENT
MONTHLY FINANCIAL REPORT FY 1980
(Total Uranium Resource Assessment Operating Obligations)



Monthly: Plan ----	3.6	29.1	5.4	0.4	18.0	0.9	0.4	0.4	0.7	-2.6	0.4	0.8
Monthly: Actual ——	3.6	29.2	2.4	3.9	16.8	0.6	0.6	0.5	0.6	-2.8	0.6	2.7
Cumulative: Plan ----	3.6	32.7	38.1	38.5	56.5	57.4	57.8	58.2	58.9	56.3	56.7	57.5
Cumulative: Actual ——	3.6	32.8	35.2	39.1	55.9	56.5	55.9	56.4	57.0	54.2	54.8	57.5

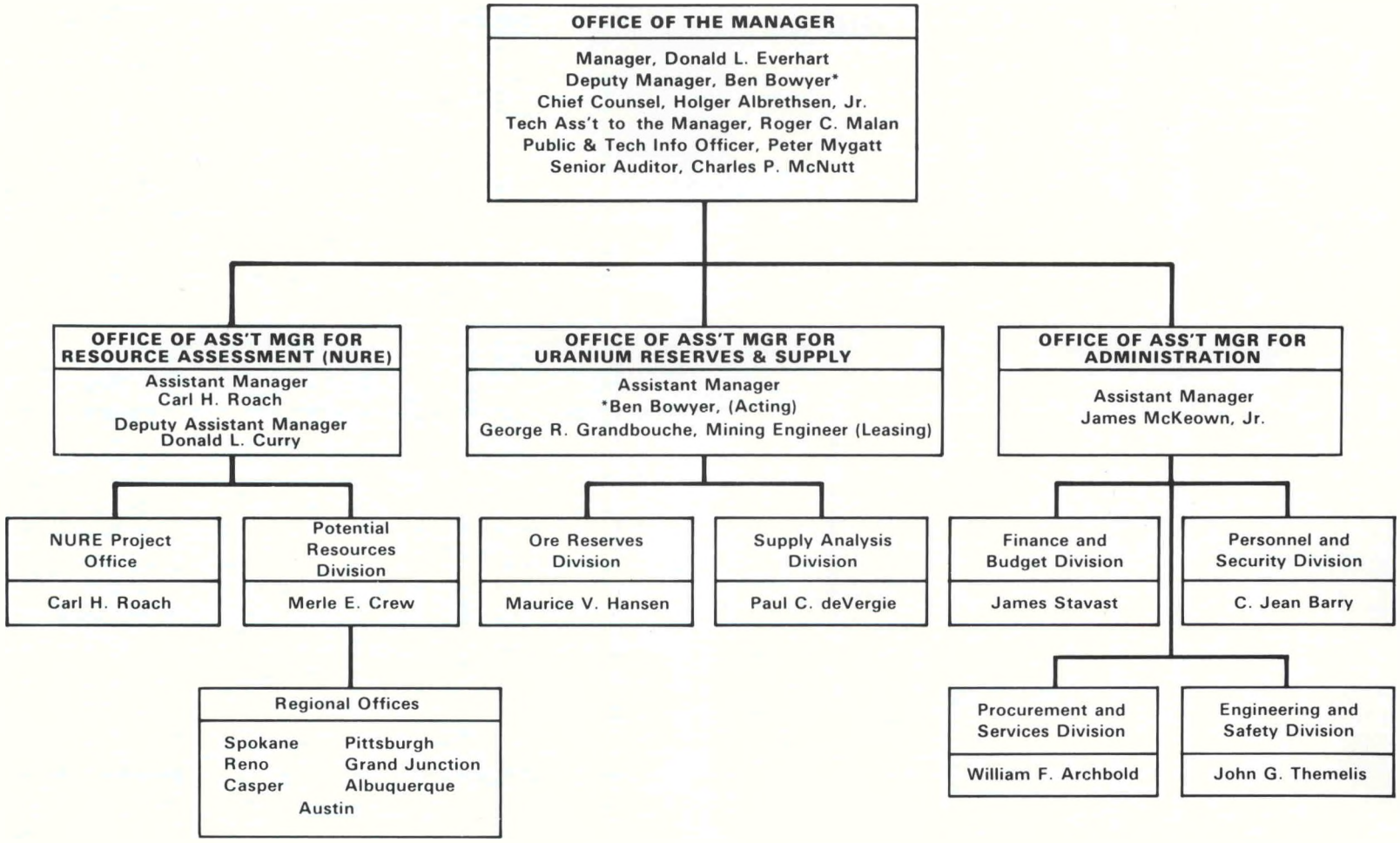
Appendix 1. **OPEN-FILE LOCATIONS**



GJO-originated reports are placed on open file in depositories across the Nation as indicated in the map above. For a bibliography of the open-file reports and their availability, contact:

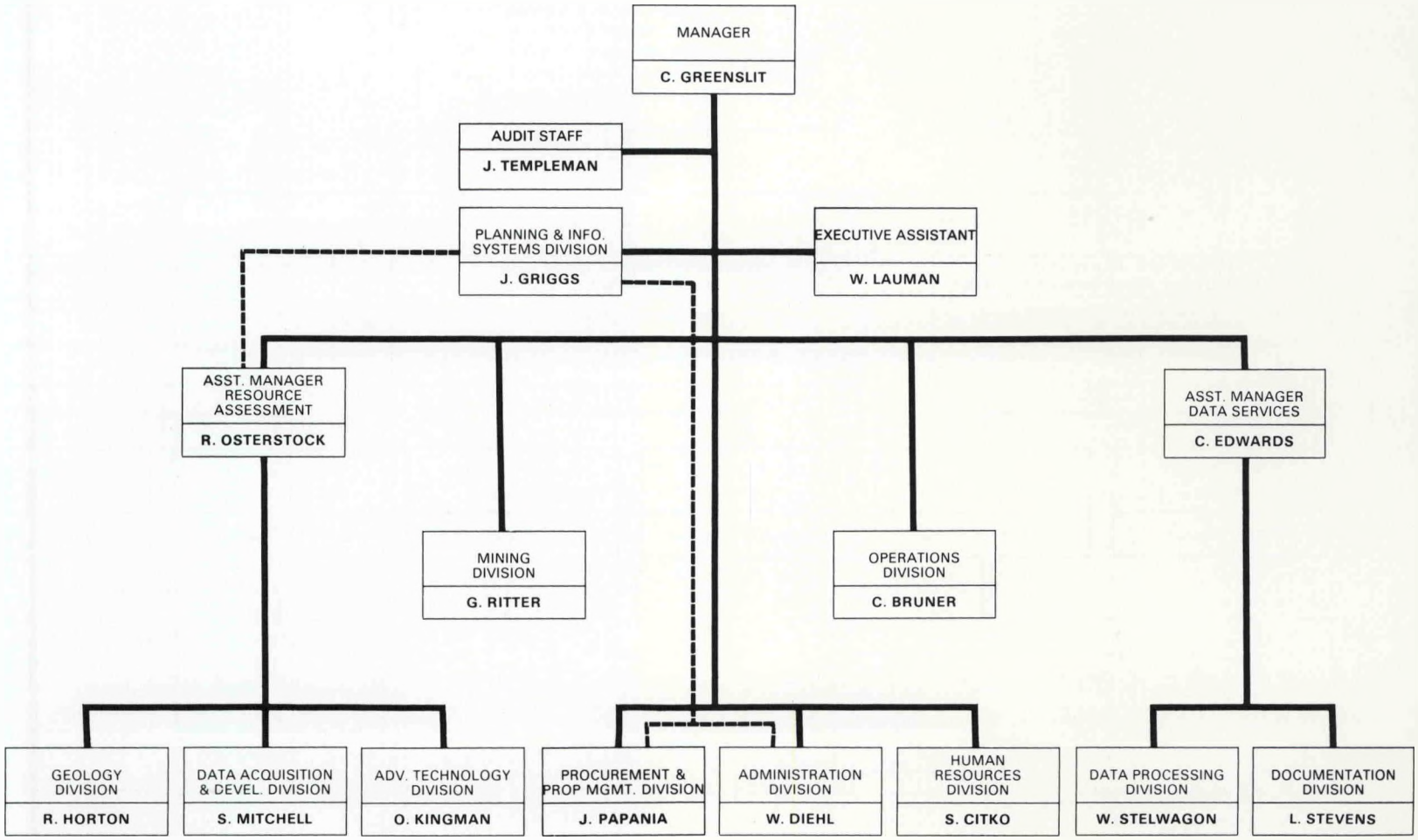
Technical Library
Bendix Field Engineering Corporation
P.O. Box 1569
Grand Junction, CO 81502

Appendix 2. GRAND JUNCTION OFFICE, U.S. DEPARTMENT OF ENERGY



*Dual Capacity

Appendix 3. **BENDIX FIELD ENGINEERING CORPORATION, GRAND JUNCTION, COLORADO**



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