UNITED STATES ATOMIC ENERGY COMMISSION

Fifteenth Semiannual Report

OF THE

ATOMIC ENERGY COMMISSION

January 1954

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON, D.C.

netsec,

LETTER OF SUBMITTAL

WASHINGTON, D. C.,
30 January 1954.

SIRS: We have the honor to submit herewith the Fifteenth Semi-annual Report of the United States Atomic Energy Commission, as required by the Atomic Energy Act of 1946.

Respectfully,

UNITED STATES ATOMIC ENERGY COMMISSION,
JOSEPH CAMPBELL.
THOMAS E. MURRAY.
H. D. SMYTH.
EUGENE M. ZUCKERT.
LEWIS L. STRAUSS, *Chairman*

The Honorable
The President of the Senate.
The Honorable
The Speaker of the House of Representatives.

CONTENTS

PART I

PART II

APPENDICES

The histor
on Decembe
velopment.
proposed by
Among the
of the Unite
project for t
industrial n
background
As a basis
activities of
States, Cana
larged to inc
effects of ato
Continued
exploitation
plants to rea
facilities whi
domestic and
centers in the
The new fe
some expansi
the AEC oper
of output and
During the
accounted fo
expenditures.
In connecti
gram, prepar
the Pacific P
production of
cancel constru
a substantial
While conti
against the h
creased emph
nuclear radiat

FOREWORD

The historic proposal of the President before the United Nations on December 8 marks a significant new stage in atomic energy development. As this report is submitted to the Congress the discussions proposed by the President have just begun.

Among the numerous developments in the atomic energy program of the United States during the last 6 months was the start of a project for the design and construction of the Nation's first full-scale industrial nuclear powerplant. This decision was made against a background of continued progress in reactor development.

As a basis for further civil defense planning, the health and safety activities of the technical cooperation program in which the United States, Canada, and the United Kingdom joined in 1948, were enlarged to include information relating to blast, heat, and radiation effects of atomic explosions on human beings and their environment.

Continued emphasis was placed on the discovery, development, and exploitation of new sources of raw materials and the building of new plants to ready these materials for the Commission's manufacturing facilities which continue to expand. Raw materials sources, both domestic and foreign, increased and there are now nine ore processing centers in the United States.

The new feed materials plant at Fernald, Ohio, was completed and some expansion of these facilities is already underway. Throughout the AEC operations new plants came into production, raising the level of output and decreasing unit costs.

During the second half of the year the AEC construction program accounted for 3.35 percent of the Nation's total construction expenditures.

In connection with research and development in the weapons program, preparations are underway for an experimental test series at the Pacific Proving Ground. Recent technical developments in the production of weapons and weapon components made it possible to cancel construction of the Spoon River explosives plant, resulting in a substantial saving.

While continuing the necessary study of means of protecting man against the harmful effects of radiation, the Commission gave increased emphasis to finding new and improved methods of applying nuclear radiation in the treatment of human disease. Further prog-

ress was made in the localization of brain tumors. Radioisotopes were used to study the immunity mechanisms of the body. The value of radiothulium in compact portable units for clinical roentgenography was demonstrated. During the period, the Commission dedicated a new Health Research Laboratory at Los Alamos where biomedical and industrial hygiene groups are pursuing their work with the aid of the finest equipment ever designed for the purpose.

Research continued vigorously with strong emphasis on studies of the fundamental nature of matter. Among new tools that became available for this and other research work are a new small "water boiler" reactor at Livermore and two new electronic computers, the AVIDAC at Argonne and the ORACLE at Oak Ridge.

While the Commission was moving toward its decision to build a full-scale power reactor, it enlarged the program of participation by industrial study teams exploring avenues to industrial power other than the chosen pressurized water design. Work currently going on in other phases of the reactor development program, including constant efforts to improve the performance characteristics of the production reactors at Hanford and Savannah and continued developmental work being done on naval and aircraft propulsion systems, also will contribute eventually to the development of industrial nuclear power.

Events of the year at home and abroad drew attention to the need for important amendments to the Atomic Energy Act. The Commissioners and staff have given, in recent months, considerable time to the preparation of recommendations which will be transmitted early in 1954 for consideration by the Congress.

Lewis L. Strauss of Virginia, as noted in the Fourteenth Report, entered upon the duties of Chairman on July 2 and on July 27 Joseph Campbell of New York became a member of the Commission. Kenneth D. Nichols retired as Major General, U. S. Army, to become General Manager of the Commission on November 1, succeeding Marion W. Boyer who had completed the three-year term he had agreed to serve. In the staff, Walter J. Williams resigned, effective February 1, 1954, as Deputy General Manager; Dr. William L. Davidson, as Director of the Office of Industrial Development, effective December 31, 1953, and Dr. Walter F. Colby, as Director of the Office of Intelligence, effective September 27, 1953.

Part One

Major Activities in Atomic Energy Programs, July–December 1953

Raw Materials

Progress was made during the second half of 1953 in all phases of the Commission's raw materials procurement program. Overseas sources of uranium were expanded and further development is being pushed. The steady increase in the domestic production of uranium ore and concentrates was maintained and expansion of the mining industry continued. Exploration activities, both foreign and domestic, were further expanded and there were advances in research and process development.

Domestic Production

In September the Commission extended from March 31, 1958, to March 31, 1962, the expiration date of its guaranteed minimum price schedule for uranium ores on the Colorado Plateau. The Commission also extended from February 28, 1954, to February 28, 1957, the time during which initial production of uranium ore from new domestic mines will be eligible for bonus payments. These actions were taken to provide a continuing incentive for the discovery, development, and production of uranium from domestic sources.

Ore Production

Ore is being produced from over 525 mines, mostly on the Colorado Plateau, with principal production coming from the Morrison and Shinarump formations, and more recently from the Chinle, Entrada, and Todilto formations. In South Dakota and Wyoming the Lakota formation has been the principal source of ore production. Some production is also coming from fissure veins in the Marysvale, Utah, district, the Colorado Front Range and the Boulder Batholith area near Boulder, Mont.

The three main types of ore being produced are the vanadium-rich ores from the Morrison formation, the vanadium-poor ores from the Shinarump formation and the limestone ores from the Todilto formation. Mine operators, who a few years ago were mining ore mostly from the rims of canyons or through inclined shafts a short distance back from the rims, are now mining through vertical shafts, some of which will be as deep as 600 feet, as the more easily accessible deposits are depleted and deeper deposits are discovered and developed.

Ore Processing

The completion in September of the new ore-processing plant at Bluewater, near Grants, N. Mex., by the Anaconda Copper Mining Co. increased to nine the number of uranium ore-processing plants in the United States. Anaconda is contemplating the construction of additional facilities to treat the sandstone-type ores being produced in this area and stockpiled at the ore-buying station at Grants. Construction of a tenth plant at Shiprock, N. Mex., by Kerr-McGee Oil Industries, Inc., will begin early in 1954. This plant will treat the ores being produced in the Lukachukai Mountain area of northeastern Arizona and other areas on the Navajo Indian Reservation, together with those stockpiled at the Shiprock ore-buying station over a period of about 2 years. Facilities were enlarged by Vanadium Corp. of America at its Naturita and Durango, Colo., mills, and by the Climax Uranium Co. at its Grand Junction, Colo., mill. Additional processing plants are being considered for treatment of ore reserves recently developed in the Bedrock area of Colorado and in the vicinity of Moab, Utah.

The Commission is planning expansion of its facilities at Monticello, Utah. The Galigher Co. is the contractor operating this mill.

Uranium from Phosphate

The second plant for byproduct recovery of uranium from phosphate rock was completed in October at Texas City, Tex., by the Texas City Chemicals, Inc., and is now in production. The third and fourth plants, under construction in Florida by International Minerals and Chemicals Corp. and Virginia-Carolina Chemical Corp., are expected to be ready for production early in 1954.

Legislation Relating to Oil and Gas Leases

On August 12, the President signed Public Law 250, 83d Congress, which provides a means for validating mining claims located between July 31, 1939, and January 1, 1953, on preexisting oil and gas leases on the Colorado Plateau area. The statute, however, did not open lands covered by such leases to future mining locations. The Commission is preparing to issue leases on such lands in order to permit and encourage private prospecting and mining. Details of the leasing conditions will be announced.

Additional Access Roads

The Bureau of Public Roads has allocated $1,054,000 for the construction of 131 additional miles of access roads into uranium pro-

ducing areas. These roads are being built in Utah, Colorado, Arizona, New Mexico, and South Dakota. A total of 783 miles of access roads was completed under an earlier program.

Foreign Production

Substantial quantities of uranium were delivered to the United States from foreign sources during the second half of the year.

Belgian Congo

The Belgian Congo continues to be a major producer of uranium for the atomic energy program.

South Africa

Receipts from South Africa increased as additional plants went into operation to recover uranium as a byproduct of the gold mining industry on the Witwatersrand. Western Reefs Exploration and Development Co., Ltd., and Stilfontein Gold Mining Co., Ltd., completed new facilities in August. Additional plants are scheduled to be completed in 1954.

Canada

Operations by Eldorado Mining and Refining Co., Ltd., at the Eldorado mine in Great Bear Lake in the Northwest Territory were normal and uranium deliveries were on schedule. Eldorado's new processing mill at Beaverlodge in the Lake Athabaska area in Northern Saskatchewan is in full operation. Uranium concentrates are being received regularly from this source.

Exploration and development of the deposit discovered by Gunnar Gold Mines, Ltd., in the Lake Athabaska area have proved this deposit to be important and plans are being made for private construction of a processing plant in the vicinity. Widespread uranium deposits have been found in the Blind River district of Western Ontario, north of Lake Huron. Large scale prospecting and development underway in this region may result in new mining and milling operations. Uranium prospecting and exploration activity reached a new peak throughout Canada during the last season.

Australia

Development of the Radium Hill mine in South Australia has progressed on schedule and a concentrator being built at Port Pirie

to treat the Radium Hill ores is nearing completion. Territory Enterprises Proprietary, Ltd., a subsidiary of the Zinc Corp., is developing the Rum Jungle deposit in the Northern Territory and construction of a treatment plant there is progressing. Both this plant and the Port Pirie concentrator are scheduled to begin production in 1954. Active prospecting has resulted in the discovery of many new uranium occurrences, some of which may be productive.

Domestic Exploration

Principal area of exploration activity by the Commission is the Colorado Plateau where most of the domestic uranium ore is produced. Important deposits of uranium ore have also been found outside the Plateau proper. Principal off-plateau areas of intensive exploration and ore production activity have been the Marysvale district in south central Utah and the area in South Dakota and Wyoming surrounding the Black Hills. Other centers of potential importance are the Colorado Front Range, the Boulder Batholith area, near Boulder, Mont., and several widely separated points in Arizona. Recently an area of widespread ore deposits was discovered in the Wind River Basin in Fremont County, Wyo., and active prospecting is in progress.

On the Colorado Plateau private interests have discovered substantial new ore deposits in the vicinity of Big Indian Wash, near Moab, Utah, in the Chinle formation, a hitherto relatively unproductive source. Drilling and other exploration by the Commission and by private operators have revealed additional ore deposits in this area. Other important areas of exploration activity on the plateau have been the Temple Mountains district, and the White Canyon, San Rafael Swell, Circle Cliffs, and Elk Ridge areas in Utah; Uintah Basin, Bull Canyon, Polar Mesa, Long Park, and Jo Dandy areas in Colorado; the Monument Valley, Lukachukai Mountains, and Holbrook areas in Arizona; and the area around Grants and on the nearby Laguna Indian Reservation in New Mexico.

Research and Process Development

An important aspect of the Commission's raw materials program is research and process development. Process technology studies have been undertaken to find means of treating new types of ore, foreign and domestic, and to develop suitable methods of extracting uranium as a byproduct from such low-grade sources as phosphate rock, shale and lignite. Geological, geophysical and mineralogical research also are important parts of the Commission's program. A more detailed

discussion of the Commission's research and process development program was presented in the Fourteenth Semiannual Report.

Leached Zone Studies

Commercial phosphate rock, a source of byproduct uranium, is produced from the lower layer of the Bone Valley Formation in Florida. The upper layer of the Bone Valley is known locally as the leached zone. This material is currently being discarded as overburden waste during mining operations. The leached zone contains uranium in concentrations somewhat higher than in the phosphate rock and because the zone is extensive it is an important potential source of uranium. The Commission has been investigating the feasibility of extracting uranium and possible co-products such as phosphate and alumina from material. Principal research contractors in this program are the International Minerals and Chemicals Corp. and the Tennessee Valley Authority. The program has already led to development of processes which are being tested on a pilot plant scale.

Uraniferous Shale Project

The Commission is continuing studies of the technical and economic feasibility of mining and recovering the small quantity of uranium in the Chattanooga shale.

Production

The quantity of fissionable materials produced during the last half of 1953 met the approved schedules, with the trend of production continuing to rise.

Construction Progress

All plants of the originally planned Feed Materials Production Center at Fernald, Ohio, have been completed and are being successfully operated. Some of the units of this integrated center are being expanded.

Construction of other production facilities at Hanford, Wash., Oak Ridge, Tenn., Paducah, Ky., Portsmouth, Ohio, and Savannah River, S. C., is proceeding satisfactorily.

Use of Reactor Heat

The first significant use of heat from a production reactor will be made in the new reactor area now under construction at Hanford.

Buildings in the area will be heated by water circulating through ordinary heating equipment after prior heating in a heat exchanger through which reactor effluent water is pumped. Excessive radioactivity in the effluent water prevents its direct use in equipment for heating buildings.

The heating system will save an estimated 1,500,000 gallons of fuel oil annually. An initial investment of $614,000—based on cost of equipment required to use reactor heat compared with cost for conventional heating facilities—will be amortized in less than 8 years through fuel savings.

Electric Power for Gaseous Diffusion Plants

Formal long-term contracts for the supply of power to Oak Ridge, Paducah and Portsmouth gaseous diffusion plants were signed with Electric Energy, Inc. (EEI), the Ohio Valley Electric Corp. (OVEC), and the Tennessee Valley Authority (TVA). These contracts expressly authorized by Public Law 137, 83rd Congress, confirmed arrangements the Commission had previously made with the three power suppliers under limited authority. In the event the Commission terminates them, the contracts now in effect make specific provision for the payment of cancellation costs.

Power Supply

Five steam generators, three in the TVA Shawnee plant and two in the EEI Joppa plant are supplying a substantial portion of the power currently required by the Paducah diffusion plant. The second and third Shawnee units were placed in operation on June 21 and October 10, respectively, and the two generators at Joppa began operation June 27 and August 1, respectively.

To meet power requirements, including reserves, of full-scale operation of the Paducah and Oak Ridge gaseous diffusion plants now under construction, 15 additional generators are being designed and constructed. Four of these units are to be installed at the Joppa plant. TVA will install the 11 others at various locations in its system. Five of these TVA units are scheduled to be added to the Shawnee plant, while two each will be added at the Kingston steam plant in east Tennessee, the Gallatin steam plant on the Cumberland River, and the John Sevier plant near Rogersville, Tenn.

Construction of the Ohio Valley Electric Corp.'s Kyger Creek plant, near Cheshire, Ohio, and Clifty Creek plant, near Madison, Ind., scheduled to serve the Portsmouth plant, proceeded according to plan. The Clifty Creek plant will contain six generators and the Kyger Creek plant, five units.

Until these generating facilities are completed OVEC, EEI, and TVA are supplying power to the various plants from other units of their respective systems.

Construction And Supply

By November, largely as a result of progress in the construction of the major new plants at Savannah River, Paducah, Oak Ridge, Portsmouth, and Hanford, capital investment in atomic energy plant facilities was estimated to have grown to about $5.1 billion before depreciation reserves.

Costs incurred for new plant and equipment averaged about $100 million a month during the second half of 1953 compared with an average of $97 million a month in the first half. After rising to an estimated monthly peak of $125 million early in 1954, monthly construction costs will decline gradually bringing the average level of such costs to about $115 million per month for the first 6 months of 1954. At their peak monthly level AEC construction costs will be about 5 percent of the estimated monthly construction expenditure in the United States. During calendar year 1953, these costs were about 4 percent of the national continental average.

Construction Management

The Public Accounts Subcommittee of the House Committee on Government Operations conducted an investigation of the construction project at Portsmouth, Ohio. The inquiry was prompted by complaints of improper bidding procedures and by the fact that more than $1 billion are being expended on this project. In transmitting to the Chairman of the Commission the findings of the investigation, Representative George H. Bender, chairman of the subcommittee, wrote: "It gives me pleasure to enclose herewith a copy of our subcommittee's report on our study of the operation of your Portsmouth project. As we state in the report, we have found that this project is being handled in an outstanding manner. It is all too seldom that a congressional committee has the opportunity to commend the object of its investigation. Please convey our feelings to those who are associated with you on this project."

The magnitude of the Commission's construction program has emphasized the need for good management measures in order to obtain the greatest economies consistent with the atomic energy program requirements. Thus, the Commission has adopted design criteria embodying broad principles of low-cost design that conform to good

283269—54——2

modern practice. In addition, to secure the most competent project planning and management of labor, the Commission employs the skills of experienced private contractors, selected after analysis of their demonstrated capabilities. These practices are fundamental to economy in construction.

Small Business Participation

The procurement policy of the Commission requires that a fair proportion of total supplies and services be purchased from small business concerns. This policy was reaffirmed by Congress on July 30, 1953, with the enactment of the Small Business Act of 1953. AEC cooperates with the new Small Business Administration by exchanging information on procurement opportunities, small business concerns qualified to participate in AEC procurement, and other matters. AEC small business programs continue in force in conjunction with the procurement activities of AEC operations offices and cost-type contractors.

Direct contract awards to small concerns amounted to $117 million, or 2.9 percent of the $4.1 billion in contracts awarded from July 1, 1951, to September 30, 1953. These figures reflect the fact that construction programs and the operation of major facilities require the services of large firms under cost-type contracts. Thus subcontracts offer small business the best opportunity to participate in the atomic energy program. From July 1, 1951, to September 30, 1953, AEC cost-type contractors awarded subcontracts totaling $1.6 billion. Of this total $628 million, or 38 percent, went to small business.

Procurement Priorities

The AEC functioned under the Defense Materials System and the supplementary Defense Order Rating System provided under the Defense Production Act to insure delivery of materials and equipment needed by the AEC and the Department of Defense.

Owing to the urgency and scope of its construction and operational programs, the diversity of items required, and the fluctuating supply-demand picture, full advantage was taken of the priorities authority delegated to AEC as a claimant agency. The AEC acted also as claimant for the power supply projects essential to the expansion programs at Oak Ridge, Paducah, and Portsmouth. The direct administration of priorities for these projects was carried on by the Department of Interior.

Priority ratings made available by the National Production Authority during February 1953 for specific power generation units

essential to the AEC expansion program at Oak Ridge, Paducah, and Portsmouth continued in effect. However, the power suppliers have rescheduled the commercial operating dates of some of these units because of delays in the manufacturing of major component parts. The Commission, NPA, and the power suppliers have worked closely with the manufacturers to minimize the delays which continue to receive the Commission's close attention.

Licensing Controls

The Commission relaxed its source material control regulation to allow industrial, commercial, hospital, Federal, State, or other Government analytical laboratories, to obtain annually for analysis work up to 3 pounds of chemical compounds containing uranium or thorium. Prior to this change such laboratories were required to obtain specific AEC authorization to purchase any quantity of uranium and thorium materials for use in routine laboratory work. The amendment is the result of the continuing policy of the Commission to administer licensing controls with the least possible interference with the licensee.

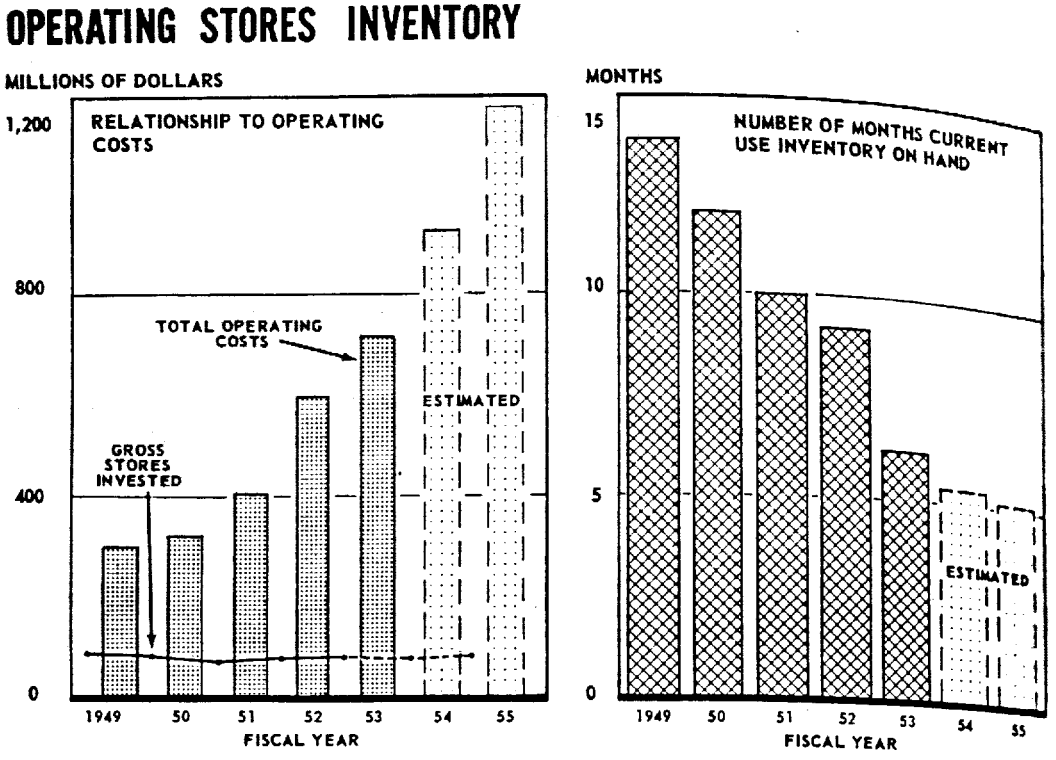
Better Utilization of Automobiles

Progress was made toward more effective utilization of automobiles. The average annual mileage per car increased from 9,772 in 1949 to 13,888 in 1953, a 42 percent gain. According to statistics of the General Services Administration only one of the agencies that report mileage data reached a higher average mileage per automobile in 1953 than the AEC, while the AEC average exceeds the Government-wide average of 11,312 by 2,576 miles.

Reduction in Stores Inventories

In the face of continued expansion in the Commission's operations, there has been a steady and substantial reduction in the operating stores inventories. At the end of fiscal year 1949 the Commission's investment in operating stores was $90.5 million in support of a program operating at a cost level of $293.5 million. By the close of fiscal year 1953 the value of the stores inventory was $85.3 million as against operating program costs of $720 million. The Commission's inventory management program calls for a further reduction of stores to $82.1 million at the end of fiscal year 1955 in support of operations estimated to cost $1.2 billion. This goal represents an inventory 9 percent smaller than in 1949 for a program nearly four times greater

than the 1949 operations. The following chart illustrates the reduction achieved or projected in fiscal years through 1955.



Military Application

Atomic weapons were produced at the rate directed by the President. Improvements continued to be made in weapon design and fabrication. Expansion of the weapons production complex proceeded satisfactorily.

Construction of the Spoon River explosives processing and assembly plant near Macomb, Ill., was canceled. This action was possible because technical developments will considerably enlarge the output of existing plants which turn out the same products as would have come from the projected new plant. It has been established that the future requirements of the atomic energy program in this line can be met by the existing plants. The net saving in construction and engineering costs for the Spoon River plant is $26 million. In addition, about $4 million in start-up costs and $3 million a year in recurring operating costs will be saved. Payments for work already accomplished and costs of contract termination are expected to reach $2 million.

Research and development activities during this period continued to be directed toward the design of new and improved weapons. Further experiments will be required and preparations are underway for a test series at the Pacific Proving Ground.

Construction of research facilities is proceeding satisfactorily. The program at Los Alamos which was begun in 1948 for the replacement of the wartime temporary facilities by permanent installations, is now approximately 90 percent complete.

The major effort involved in the research, development, and testing of weapons has been performed by the Los Alamos Scientific Laboratory and the Sandia Laboratory, which are operated for the Commission under contract by the University of California and Western Electric Co., respectively. During recent years, the University of California Radiation Laboratory, at Berkeley, Calif., has given its assistance on certain phases of the weapons program and has participated in both overseas and continental test operations.

In order to augment research in the field of weapons and to gain wider participation in the program by scientists at UCRL and elsewhere, the Commission, with the cooperation of the University of California, established in June 1952 a weapons research laboratory at Livermore, Calif. Dr. E. O. Lawrence, director of UCRL, and Dr. Herbert York direct the program of this laboratory.

In addition to the weapons work of UCRL, the California Research and Development Co., subsidiary of Standard Oil Co. of California, is engaged in a separate research and development project not related to the weapons effort of UCRL. The programs of both contractors are carried out at the Livermore site. This site, formerly a United States naval facility, was acquired by the Commission in 1950. The present employment at Livermore is approximately 1,500.

The AEC on January 1, 1954, transferred administrative responsibility for the University of California Radiation Laboratory at Berkeley and the Livermore Laboratory to the Santa Fe Operations Office which supervises several other installations related to the weapons program. The San Francisco Operations Office has been redesignated the San Francisco Field Office and is responsible for the same assignments previously carried out by the operations office. In addition to supervising the weapons work, the newly designated field office will administer on behalf of AEC staff divisions in Washington contracts and programs related to biology and medicine, reactor development, and the physical sciences.

Community Operations

A draft of legislation designed to facilitate the establishment of self-government and to permit private ownership of residential and commercial property in Oak Ridge, Tenn., and Richland, Wash., has been under consideration by the Commission and other interested Federal agencies for some time. Comments and recommendations of

the Bureau of the Budget and of other Federal agencies have been considered. A revised draft of the legislation was forwarded to the Bureau for approval and submission to Congress early in 1954.

Housing and Community Facilities

Savannah River

After 11 months of more than 90 percent occupancy of trailers during the period of peak construction employment, trailer vacancies began to occur, as expected, in mid-1953. By July 1, 1953, only 2,533 or 63 percent of the 4,000 trailers originally provided for families of construction workers were occupied. By the end of December, the continually decreasing construction employment had further reduced occupancy to 1,337. It is anticipated that all trailers will have been vacated by the end of 1954. The entire lot of trailers has been sold and about 2,150 delivered to the purchaser by December 31. The others are scheduled for delivery during 1954. The two trailer camps established at Williston and Barnwell, S. C., have been closed. Two others continue to operate, one at Augusta, Ga., and the other at Aiken, S. C.

By December 31, the total cost to the Government of the temporary family housing financed with private capital, with a revenue guaranty arrangement, amounted to $7,122,103. This cost is being offset in part by receipts from the sale of the trailers, which total $1,361,646. The highest current estimate of the final cost to AEC for this temporary housing indicates that the cost will be no greater and probably will be less than if AEC had built and operated the dwellings.

At the end of the year the 2,913 permanent rental dwellings built under Title IX of the National Housing Act, 2,231 were occupied by certified personnel of whom 1,230 were operating personnel and 1,001 were construction workers likely to be transferred to operations; 551 had been released to the general public and most of these were occupied; 50 were retained by their owners, and 81 were vacant.

Portsmouth

The Portsmouth area project will employ about 26,000 construction workers at the peak construction period late in 1954 and by that time an additional 2,400 permanent operating employees are expected to be working at the site. The labor market area for this project is made up of Jackson, Pike, Ross, and Scioto Counties in Ohio, with an estimated population of 180,000 before the project was begun. Late in

1954, construction and operating employees at the Portsmouth plant will comprise almost 30 percent of the total employment in the area, including workers in agriculture, manufacturing, construction, finance, trade and service fields.

About 16,400 of the construction workers for the AEC project will come from outside the area. Housing and Home Finance Agency has programed 1,150 housing units to meet requirements of these temporary workers. The HHFA has also approved 1,000 units of Title IX housing to help accommodate the 4,100 operating employees who will be employed at the project by the end of 1955. Almost 1,900 of these permanent employees are expected to come from outside the local labor market area.

As of December 31, 165 temporary and 375 permanent dwelling units were completed and occupied in the Portsmouth area.

Federal grants totaling $1,063,300 have been approved under Public Law 139 by the HHFA and the U. S. Public Health Service to assist in the necessary expansion of sewer and water facilities.

By the end of the year, local school districts had been granted $2,100,000 by the Office of Education for the construction of permanent classrooms and requests for additional permanent and some temporary school facilities were under consideration. Additional funds will be made available to assist in the maintenance and operation of school facilities in the affected area. These grants are authorized by Public Laws 815 and 874, 81st Congress. The new facilities will not be available until the beginning of the 1954–55 school year, with the result that existing facilities remain overcrowded.

Los Alamos

Overall increases in utility rates at Los Alamos and utility and rental charges for AEC housing at Sandia Base were made effective August 1, 1953. Metering of water as a conservation measure was begun at Los Alamos on the same date.

Los Alamos community construction now programed includes replacement of the existing airstrip with a new airstrip at White Rock and continued replacement of old substandard housing units, largely in the area between the airport and the community center.

Other Areas

All programed housing in the Paducah, Ky., area has been constructed, and all but about 200 of the 500 Title VIII and 450 Title IX dwelling units were occupied on December 31.

At Oak Ridge, Tenn., construction of 500 Title VIII three-bedroom, single-detached houses began in September. At the end of December, 10 of these houses were substantially completed and certifications for occupancy were issued.

Of the 550 Title IX units programed for the area, all but 150 are being located in Oak Ridge proper, with the balance being built within easy commuting distance. By the year's end, certifications for occupancy of 64 substantially completed Title IX units in Oak Ridge were issued, and 15 were occupied. Occupancy certifications were also issued for 58 substantially completed Title IX houses outside of Oak Ridge.

A lease form for land to be used for a privately financed commercial center will be given to Oak Ridge Properties, Inc., during January 1954, with a limited time being allowed for its execution.

All of the 1,000 Title VIII housing units at Richland, Wash., were completed and 748 were occupied on December 31.

Both Oak Ridge and Richland plan to add capacity to their school systems. At Richland the plans and specifications for a high school addition are nearing completion and the need for a new elementary school is being reexamined in the light of current requirements. At Oak Ridge construction of a new junior high school is nearly finished.

Rent Control

Oak Ridge

In July Oak Ridge was certified as a critical defense housing area by the Director, Office of Defense Mobilization (ODM), and the Secretary of Defense, under provisions of the Housing and Rent Act of 1953. As a result, housing accommodations which were subject to Federal rent control on July 31, 1953, continued to be controlled. On September 22 the Commission submitted a petition to ODM for across-the-board increases in controlled rents amounting to approximately 28 percent.

Before acting on the petition ODM announced on December 28 that Federal rent control at Oak Ridge would end on December 31, 1953. Tenants were then notified that residential rents would be increased approximately 28 percent on February 1, 1954, to conform with the requirements of the Bureau of the Budget Circular No. A–45.

Richland

The Richland-Pasco-Kennewick area was decertified as a critical defense housing area for rent control purposes and as a consequence Federal rent control in the area ended July 31, 1953. In conformance

with Bureau of the Budget Circular No. A–45, Richland residential rents were adjusted as of October 1, 1953, to levels prevailing for comparable private housing in the area. The adjustments resulted in an average increase of 26 percent above the rents existing immediately prior to October 1, 1953.

Reactor Development

The Commission continued its program of developing improved reactors for industrial nuclear power and for naval and aircraft propulsion. For these purposes expenditure of about $150 million is expected during the fiscal year ending June 30, 1954. In addition, the AEC sponsored research and development aimed specifically at improving production reactors at Hanford and Savannah River. Both military propulsion and the production reactor activities contribute indirectly to development of industrial nuclear power.

A project was started for the first full-scale industrial nuclear power plant and the program of industrial participation in nuclear power studies was enlarged. Industry teams at work surveying reactor technology and studying reactor designs numbered eight at year-end. AEC-sponsored work progressed on the power plant for the first nuclear submarine which was launched by the Navy on January 21. A large spherical steel building for housing the prototype of the power plant for the second nuclear submarine was completed.

Progress caused estimates of the cost of building and fueling power reactors to continue downward with the result that the outlook for eventual production of nuclear power competitive with power from coal, oil, and gas further improved.

Estimates of the cost of nuclear power plants vary greatly and exceed by a wide margin the $150 to $250 per kilowatt cost of installed capacity of conventional plants. Studies indicate that even after low-cost nuclear fuel is achieved not more than about $300 per kilowatt of installed capacity can be spent if a nuclear power plant is to be competitive. Higher construction costs would have to be offset by returns from the sale of byproducts.

The AEC's reactor development activities, supplemented by the continuing surveys of industrial participation groups, indicate four major technical avenues to power from nuclear fuel at a cost which may eventually be comparable with the cost of power from coal, oil, or gas. These are pressurized water, sodium graphite, fast breeder, and homogeneous. Indications are that the first two can be tested out in a fairly short time—perhaps 3 to 5 years being required to complete a full-scale plant. Before a large plant of the third and fourth designs can be developed 5 to 10 years' work will be necessary. While current

research and development work on these designs is aimed primarily at developing power reactors, much of the information acquired can be applied to production versions of the designs.

Pressurized Water Reactor

In July the Commission authorized a new nuclear powerplant project, known as the Pressurized Water Reactor (PWR), and the development, design, and construction of the reactor part of the plant was assigned to the Westinghouse Electric Company. With an electrical capacity of at least 60,000 kilowatts the PWR will be a major advance toward realization of civilian nuclear power.

Building and operating a plant of this size will yield much more dependable cost data and technological experience than could be obtained from a smaller plant. The pressurized light water reactor was selected in part because more is known about this type than other types. A number of early reactors were water cooled and this technology was advanced considerably more by the recent work of Westinghouse on the Submarine Thermal Reactor and on the canceled large ship reactor project at Bettis Plant. Only slight enrichment of the uranium fuel will be necessary to achieve a critical mass with the light water moderator and coolant.

It is recognized that power from this first nuclear central station may not be competitive with power from modern conventional plants. However, nuclear power costs will really never be known until this and perhaps several large nuclear plants are built and operated.

Although Westinghouse is the principal contractor, wide participation by private enterprise and private capital is being invited. Competitive bidding will be the general rule in purchasing components. The Commission has invited offers from private industry to invest capital in the building of the steam and turbine portions as well as in the operation of the entire plant. Proposals must be submitted by February 15, 1954.

Research and development on the PWR is well underway. Nuclear experiments are being conducted to determine the amount of uranium fuel needed, its exact enrichment, the shape of the fuel elements and methods of fabricating them. According to preliminary scheduling, this power plant should be in operation in 3 or 4 years. The possibility of locating it at or near one of the AEC production plants to supply a small part of the power required by the plant is being considered.

The decision of the Government to build large-scale power reactors is the outgrowth of several years of study by the Commission. One consideration behind this decision is that at the present stage of development larger expenditures are required than private industry

is prepared to make. This fact was illustrated in July 1953 by industrial testimony at the nuclear power hearings of the Joint Committee on Atomic Energy of the Congress. Another consideration is the direct relationship of the development of nuclear power to the international situation. Many countries now outside the orbit of Soviet Russia have urgent need for new sources of power.

In addition to the PWR project, valuable new information on pressurized water reactors was acquired during the past 6 months from research and development by Argonne National Laboratory and Bettis Plant, from experience in operating the Materials Testing Reactor and the prototype Submarine Thermal Reactor, and from investigations by other contractors.

Other Reactor Designs

North American Aviation, Inc., the major contractor exploring sodium-graphite power reactors, continued its investigations. This type of reactor would be cooled by liquid metal sodium and moderated by graphite. It would require slightly enriched uranium fuel.

The background of this design includes graphite technology developed largely at Hanford and sodium technology which has grown out of work on the Submarine Intermediate Reactor by the Knolls Atomic Power Laboratory, and out of investigations at the Argonne National Laboratory and the Oak Ridge National Laboratory.[1]

The Argonne Laboratory continued its promising, yet very difficult and long-range research and development toward a practical breeder reactor for power—a reactor that would produce as much fissionable material as it consumes or more. A fast reactor in which fuel is fissioned largely by fast neutrons now appears to be most attractive for this purpose. More detailed data on the breeding process was obtained by Argonne from various investigations, including those with the Experimental Breeder Reactor at the National Reactor Testing Station in Idaho.

The Homogeneous Reactor Experiment, an experimental reactor with a 1,000-kilowatt heat output, and its nuclear power plant at Oak Ridge were put back into operation after being shut down several months for improvements. A variety of experiments continued to produce a large amount of data on the unique homogeneous design in which the fuel and moderator are one liquid. Potential advantages include simple chemical processing of fuel, simplicity of construction, and elimination of fuel fabrication.

[1] Knolls is operated for the AEC by General Electric Co., Argonne, by the University of Chicago, and Oak Ridge by Carbide & Carbon Chemicals Co., a division of the Union Carbide & Carbon Corp.

Industrial Participation

The Commission approved five new surveys of reactor technology and, at the request of the Joint Committee on Atomic Energy of the Congress, prepared an interim report which estimates the social, political, economic, and international effects of nuclear power. The committee asked for such a report—even though at the July hearings the Commission gave the view that the time for a report under section 7 (b) had not arrived—to aid consideration of contemplated changes in legislation.

Surveys of Reactor Technology

After authorization in October, the five new survey teams immediately began studying reports, visiting AEC laboratories and plants, and talking with Commission and contractor scientists and engineers. The new teams [2] are: (1) Duquesne Light Co., Pittsburgh, and Walter Kidde Nuclear Laboratory, Inc., New York City; (2) a five-company group consisting of Commonwealth Edison Co., Chicago, Ill.; Union Electric Co., St. Louis, Mo.; Bechtel Corp., San Francisco, Calif.; Pacific Gas & Electric Co., San Francisco, Calif.; and American Gas & Electric Service Corp., New York, N. Y.; (3) General Electric Co., Schenectady, N. Y.; (4) Newport News Shipbuilding and Dry Dock Co., Newport News, Va.; and (5) Tennessee Valley Authority, a Government agency, Wilson Dam, Ala.

The five-company group includes 3 of the original 4 teams. American Gas & Electric is the only new contractor of this group. The group is continuing work on solutions to the problem of economic nuclear power but it is not bound by the earlier designs which, in addition to electricity, would produce plutonium of weapon grade.

The Foster Wheeler-Pioneer Service Group, to which Diamond Alkali Co. of Cleveland, Ohio, was added in October, surveyed existing and proposed reactor types known to be applicable to power production. The original group began its survey in the fall of 1952. Its first report contains a technical summary of the design features of these nuclear powerplants, an economic analysis of those to which cost data could be applied, and engineering evaluation of the four types considered most promising. This evaluation was based on a peacetime economy. It assumes the benefit of experience gained in constructing and operating several similar nuclear powerplants. Any fissionable material produced was assigned only a fuel value.

[2] In addition to these new teams there are the following industrial participation groups: (1) Dow Chemical Co., Midland, Mich., and Detroit Edison Co., Detroit, Mich.; (2) Foster Wheeler Corp., New York, N. Y., Pioneer Service & Engineering Co., Chicago, Ill., and Diamond Alkali Co., Cleveland, Ohio; and (3) Monsanto Chemical Co., St. Louis, Mo.

Considered pr
and breeding u
containing fuel
actors with long-
long-life fuel ele
design of a circu
mining approxi
prior to architec
pared with other

Dow Chemical-D
companies contir
breeder type of
reactor would ut
at high temperat
fuel element.

The group has
It is concentratir
fuel elements an
and its chemical
location.

Dow Chemical
ers Manufacturi
New York, N. Y
physical research
tion, the group h
White Plains, N
Clifford Manufac
turing Co., Racin
in these projects
development of
the group is coo
and development
Laboratory, Batt
of Technology.

The design and
fuel value for the
ucts. It is also
would be complet
subsidy.

Commonwealth E
monwealth Ediso
tion of several r
graphite reactors
Atomic Power La

Considered promising are: thermal reactors using circulating fuel and breeding uranium 233 from thorium, fast plutonium breeders containing fuel that can be processed simply, pressurized water reactors with long-life fuel elements, and sodium-graphite reactors with long-life fuel elements. The group is now working on a preliminary design of a circulating fuel breeder powerplant as a basis for determining approximate costs and the degree of development necessary prior to architect-engineering work. This design will then be compared with other thermal breeder designs.

Dow Chemical-Detroit Edison Group. This group and 25 associated companies continued work on a reference design for the special fast breeder type of reactor which it has found most promising. The reactor would utilize highly enriched uranium or plutonium, operate at high temperature, and use a fluid fuel or an easily fabricated solid fuel element.

The group has about 40 full-time scientists and engineers at work. It is concentrating on an enriched, low-melting-point alloy for use in fuel elements and in the breeder blanket. Operation of the reactor and its chemical fuel processing facilities would be integrated at one location.

Dow Chemical and three of the associated companies—Allis Chalmers Manufacturing Co., West Allis, Wis.; Babcock & Wilcox Co., New York, N. Y.; and Ford Motor Co., Dearborn, Mich.—are doing physical research and development on the proposed reactor. In addition, the group has contracted with Nuclear Development Associates, White Plains, N. Y.; Mine Safety Appliance Co., Pittsburgh, Pa; Clifford Manufacturing Co., Waltham, Mass.; and Modine Manufacturing Co., Racine, Wis., to perform various investigations. Included in these projects are development and fabrication of fuel elements and development of liquid metal test loops. All this work sponsored by the group is coordinated with certain AEC general reactor research and development carried on at Argonne National Laboratory, Ames Laboratory, Battelle Memorial Institute, and Massachusetts Institute of Technology.

The design and cost studies of this group are based on a commercial fuel value for the byproduct fissionable material and the fission products. It is also assumed that the reactor and the processing plant would be completely financed by private capital with no government subsidy.

Commonwealth Edison-Public Service Group. In June 1953 the Commonwealth Edison-Public Service group submitted a technical evaluation of several reactor types, including homogeneous and sodium-graphite reactors and a power breeder design developed by the Knolls Atomic Power Laboratory.

The Public Service Co. has been corporately merged with Commonwealth Edison and in the fall Commonwealth Edison became associated with the five-company group.

Commonwealth Edison and Public Service first studied a helium-graphite reactor fueled with natural uranium and decided that it would be uneconomic because of the large investment of uranium needed for the critical mass and the high power required to circulate the helium coolant. The group then studied a pressurized heavy water reactor burning natural uranium fuel. The heavy water makes possible use of natural uranium but requires a larger pressure vessel than would be necessary for light water. Next, a light water design with slightly enriched uranium was studied. The cooling water of the pressurized water reactors would be at a pressure of about 800 pounds per square inch. Each is considered suitable for development in about 3 to 5 years. The new five-company group is reexamining the pressurized water concept for reactors to produce power primarily. Fuel credit only would be given any fissionable material produced.

The Monsanto-Union Electric Group (since October, Monsanto only). The 16 full-time scientists and engineers of this group completed a series of feasibility studies of a dual-purpose, graphite-moderated, sodium-cooled reactor and began to make a detailed preliminary design of a unit which would produce heat energy amounting to 675,000 kilowatts, of which 150,000 kilowatts would be converted into electricity. The reactor would also produce plutonium or uranium 233.

The current Monsanto proposal is to construct and operate a mechanical mockup of full-scale components, prepare a detailed design of a complete, full-scale plant, conduct a joint research and development program, and study legal and administrative problems.

The Monsanto company estimated that this program would cost less than $5 million and proposed that the cost be the "divided appropriately with AEC." The program would last 2 years. Its purpose would be to enable the company to determine whether it can proceed with the financing of a full-scale production reactor and powerplant. Monsanto recommends that a 5- to 10-year agreement with the AEC to purchase plutonium at a competitive price follow. From its studies Monsanto has concluded that electricity and fissionable material can be produced more cheaply together than separately and hence that government demand for plutonium or uranium 233 provides the only way a privately financed reactor business can get started in the near future.

The Bechtel-Pacific Gas and Electric Group (now in the five-company group) has combined heavy and light water in one design, using heavy water for moderation and light water for cooling. With a minimum

amount of expensive heavy water, the design retains use of natural uranium fuel and thus avoids enrichment expense. However, this group considered most promising the long-range development of a fast breeder reactor burning highly enriched uranium and cooled by the liquid metal sodium. The chief advantages were stated to be operation at high temperature yet low pressure, and breeding. Plutonium with weapon value and electricity would be produced.

Participation by Other Public Agencies

At the request of the Federal Power Commission and the Departments of Interior and Commerce, a few representatives of these agencies were given security clearances to facilitate liaison with the AEC.

In July, the Commission approved a request by the National Association of Railroad and Utilities Commissioners to engage in a survey of nuclear power developments. Full security clearances were obtained for the association's six-member committee on development[2] which has undertaken a study of economic and legislative problems of nuclear power development.

Naval Reactor Program

Progress was made on the three projects being carried on jointly with the United States Navy.

Submarine Thermal Reactor

Experimental operation of the prototype Submarine Thermal Reactor at the National Reactor Testing Station was continued by the Westinghouse Electric Corp. as a part of the program of testing the reactor and its associated equipment. Results obtained made it possible to improve the actual STR powerplant being fabricated by Westinghouse for the first nuclear submarine, the USS *Nautilus*, which was launched by the Electric Boat Division of General Dynamics Corp., at Groton, Conn. The Argonne National Laboratory cooperates with Westinghouse on this reactor project.

Submarine Intermediate Reactor

The keel for the second nuclear submarine, the USS *Sea Wolf*, was laid on September 15 by Electric Boat. The *Sea Wolf* will be

[2] Committee members are C. L. Doherty, president of the association and member of the South Dakota Public Utilities Commission; Henry B. Strong, Connecticut Public Utilities Commission; Henry McKay Cary, Missouri Public Service Commission; John H. McCarthy, Michigan Public Service Commission; George P. Steinmetz, chief engineer, Wisconsin Public Service Commission; and Charles W. Mors, general division engineer, California Public Utilities Commission, who is also serving as secretary of the committee.

powered by the Submarine Intermediate Reactor nuclear powerplant which, together with propulsion machinery, is being built by the General Electric Co.

On September 17 the steel sphere at West Milton, N. Y., which will house the prototype powerplant was accepted from the builder, Chicago Bridge & Iron Co., after successful pressure testing. Rust Engineering Co. of Pittsburgh proceeded to transform the steel shell into a usable powerplant building. Electric Boat continued construction of the hull and installation of machinery. This hull will later be moved inside the sphere. Knolls Atomic Power Laboratory, operated by General Electric, continued research and development and fabrication of equipment.

Submarine Advanced Reactor

The Knolls Atomic Power Laboratory progressed with development work on an advanced nuclear powerplant which would give a submarine higher speed than the STR and SIR powerplants and would show other improved characteristics. Argonne and Electric Boat are assisting the Knolls laboratory on this project.

Aircraft Program

The joint Air Force–AEC program of research and development for aircraft nuclear propulsion was reoriented early in the summer. Progress was made in the building of test facilities at the National Reactor Testing Station in Idaho. Utah Construction Co. of Salt Lake City is the major contractor.

The AEC research and development contractors, primarily for nuclear work, are the General Electric Co. (through its Aircraft Nuclear Propulsion Department, Evendale, Ohio); Carbide and Carbon Chemicals Co. (through the Oak Ridge National Laboratory); and United Aircraft Corp. (through the Pratt & Whitney Aircraft Division, East Hartford, Conn.). The Air Force sponsors research and development, primarily airframe work, by three aircraft firms.

General Engineering and Development

In addition to the work on specific reactor projects, a broad program of research and development continued. The object of this program is to acquire general information for furthering the promising types of reactors and for developing new types. These investigations include a number of aspects of reactor development ranging from physics and design evaluation studies to recovery of

luable fuel from radioactive wastes, safe release of the wastes, and ossible uses for reactor fission products.

More suitable materials, fuel elements with longer life, lighter hields, more effective coolants, and simpler instruments and control stems are among the improvements sought.

aterials Testing Reactor

The Materials Testing Reactor at the National Reactor Testing tation is an important tool of these investigations. During the ITR's first year of operation as an irradiation facility, which ended ith August, 128 irradiation projects, submitted by 30 AEC contrac-ors, were approved. In this first year, 82 of the approved projects ere started and 9 completed.

The projects vary as to the number of specimens involved, the ration of the irradiation, and the complexity of the associated quipment. Most irradiations merely call for samples of materials to inserted in the reactor. A few are very elaborate, requiring cir-lation of a coolant around the specimen and maintenance of certain mperatures and pressures with the necessary instrumentation, con-ols, and safeguards. The recent addition of hydraulic "rabbit" cilities makes it possible to enclose small samples in capsules and run em into and out of the high flux regions of the reactor without ring to shut it down each time.

A building housing a "hot cave" was completed. With this facility is possible to examine and work on highly radioactive samples which itherto could be inspected only under many feet of water in the fuel ement discharge canal. Construction advanced on a reactor services ilding which will provide space for assembling and pretesting ex-rimental apparatus before insertion into the reactor.

A crystal spectrometer was placed in operation at the MTR. Since spectrometer utilizes the reactor's especially high neutron flux can make nuclear measurements of various materials that cannot made elsewhere. Two other new research tools at this site are a eutron chopper" which sorts neutrons by energy ranges and a utron flux calibrator, which makes absolute flux values possible. Since the Materials Testing Reactor went critical in March 1952, illips Petroleum Co., operating contractor, has made a number of provements in handling this large and unique machine. This ogress indicates that improvements may be expected in other new ctors as operating experience is acquired.

emical Processing

At the National Reactor Testing Station improvements were made the operation of the new experimental chemical plant which went

into service early in 1953 recovering uranium 235 from partly burned enriched reactor fuel. After successfully handling moderately radioactive fuel the plant began operation with highly radioactive materials early in the fall. The part of the plant in which waste gases are decontaminated of their radioactivity prior to discharge into the atmosphere was tested and put into preliminary operation. The Commission continued at several laboratories a coordinated program of research, development, and design to improve and extend the service of the chemical plant and to explore other methods of processing.

Fission Product Utilization

Preliminary results of AEC-sponsored investigations by the American Meat Institute Foundation at its laboratory in Chicago indicate that the 3-day shelf-life of packaged, fresh beef, kept at the meat counter temperature of 32° F., can be increased to 15 days. The longer period was made possible for test packages by irradiating the meat with a modest pasteurization dose of gamma radiation from a 500 curie cobalt 60 source supplied by Brookhaven National Laboratory. Prior to irradiation, all samples were inoculated with the bacteria which spoil meat under normal refrigeration. Up to 15 days after irradiation, all the irradiated samples were still in good condition. Control samples which had not been irradiated spoiled in 7 days. Tests are in progress to confirm these preliminary results obtained under laboratory conditions. In a commercial application, the irradiation would come from concentrated but unseparated fission products. Additional research is necessary to determine other possible effects of the irradiations and to establish whether or not any of the effects would be harmful to human consumers.

Sanitary Engineering

At the University of Texas experiments seeking better and cheaper methods of concentrating low-level wastes have shown that the radioactivity of such wastes in liquid form can be transferred to algae and the algae removed by rotary vacuum filters. Thus the volume of radioactive liquid which must be retained can be reduced many times. Essentially complete removal of algae was demonstrated. The efficiency of this method is comparable to that of the trickling filter sewage treatment process.

A slightly modified trickling filter process went into operation at the National Reactor Testing Station. The plant is the first to combine treatment of domestic and radioactive laundry wastes and is cheaper to operate than two separate treatment plants.

Dry cleaning rather than washing may decrease by as much as 10 mes the amount of laundry waste requiring treatment, according to a udy completed by Johns Hopkins University.

As a part of AEC's investigations to determine the best methods of sposing of concentrated radioactivity from wastes, Johns Hopkins inished the survey phase of a study comparing the dumping of wastes sea with burial on land. Preliminary indications are that land rial is generally preferred for both economic and technical reasons.

In a project at Brookhaven National Laboratory for fixing radio- tivity onto one type of common clay which is then heat treated d buried, the first run in a "hot cell" with actual wastes was ccessful. Previously, only wastes with tracer amounts of radio- tivity had been used in bench work. The "hot cell" run helped to nfirm the design of a pilot plant which is being built at Brookhaven.

New Advisory Committees

Two advisory committees to the Atomic Energy Commission, the actor Safeguard Committee and the Industrial Committee on Re- tor Location Problems, were combined to form a new group known s the Advisory Committee on Reactor Safeguards. The new com- ittee is made up of nuclear scientists, industrial engineers, and others alified to contribute expert knowledge and experience. The Com- ittee reviews safety studies made by contractors on proposed reac- rs and advises the AEC regarding the safety of projected reactor stallations as compared with safety standards for conventional dustrial plants.

An Advisory Committee on Brazing was formed by the Welding search Council of the Engineering Foundation to assist the AEC problems of fabrication by brazing.

The scope of the service of the Advisory Committee on Stainless el was enlarged to include manufacture, fabrication, and use of stainless steels, in addition to research and development to improve welding of type 347 stainless steel.

The membership of these three committees is given in Appendix 2.

Reactor Testing Station

During October, a number of activities at the National Reactor sting Station in Idaho were consolidated under one contractor, the illips Petroleum Co., Bartlesville, Okla., in a move to reduce over- ad expenses. In addition to the Materials Testing Reactor which had been operating, the Phillips Co. now operates the chemical ocessing plant; central maintenance, craft, and service facilities

used by the technical installations at the station; transportation system; cafeterias; technical library and document control; warehousing, procurement, property disposal, and duplicating facilities. The consolidation is expected to achieve economies in excess of $250,000 annually.

Oak Ridge School of Reactor Technology

In August, 80 students were graduated from the 1952–53 session of the Oak Ridge School of Reactor Technology which is operated by the Oak Ridge National Laboratory. Of this number, 32 returned to their sponsoring industrial firms and 17 to the military services and other Government agencies. Thirty of the recent college graduates who were employees of the school accepted employment with the Atomic Energy Commission and 26 with AEC contractors. Eighty new students are enrolled in the 1953–54 class and will be graduated in August 1954. Thirty-two are recent college graduates and 48 are experienced men from industry and Government. The school has graduated 212 men who are now engaged in reactor design and development in industrial and Government organizations.

Physical Research

The physical sciences continue to play an important role in the development of atomic energy. There is a continuing need for the generation of new information. The Commission tries to meet this need through research contracts with universities and private institutions and through the research programs of the national laboratories. At the same time the national laboratories carry the major responsibility for finding answers to those problems which have an immediate bearing on urgent objectives.

Some recent and important developments in the physical sciences, particularly results of unclassified work being done by the national laboratories, are summarized here.

Nuclear Cross Sections

The activities of the Neutron Cross Sections [4] Advisory Group have been expanded to include cross sections of all kinds (neutron, proton, deuteron, heavy nuclei, photons, electrons, etc.) and of all energies of

[4] The term "cross section" is a very common one in nuclear science and engineering. It indicates to the physicist, chemist, metallurgist, or engineer working with nuclear reactors, the probability that a given nuclear reaction will take place. The cross section measures the size of the "bull's-eye" or nuclear target, which is an important factor in whether a "hit" or reaction occurs. But this is not the only factor; under similar conditions any

terest to the AEC. The name of the group has been changed to the uclear Cross Sections Advisory Group[5] to reflect this change in ope. The NCSAG has been very valuable in assuring a sound and ective expansion in the AEC's neutron cross-section activities and ith its increasing scope; it should be of still greater assistance.

The methods for determining cross sections are constantly being proved at Brookhaven National Laboratory, Knolls Atomic Power aboratory, Oak Ridge National Laboratory, and the Argonne Na- nal Laboratory.

Accurate measurements with the "slow chopper"[6] have been com- ted at the Brookhaven reactor on the neutron cross section of rmal boron and gold. Very low energy neutrons and thermal utrons were used in this work. Recent measurements with the "slow opper" are accurate to one-half percent and differ from the formerly cepted measurements by about 4 percent. The normal boron and ld cross sections are used as standards for other cross-section meas- ements which are important for reactor design.

The "fast chopper" has been operating at the Brookhaven reactor hours a day, 7 days a week, measuring total neutron cross sections. he results obtained with this "chopper" show that a much better ergy resolution is obtained than was available with previous instru- nts. Higher resolution will be available when the rotor is run at gher speed and improved detectors of the scintillation type are ed for neutron detection. In addition to investigations on classified terials useful for reactor and weapon work, other elements have en investigated which are significant in testing theoretical models f the nucleus.

The neutron cross section compilation group at Brookhaven is con- uing to collect, compile and evaluate neutron cross section data the energy range of 0.0001 electron volt to 100 million electron volts. xpansion of the compilation group is being made to include addi- nal types of cross sections essential to reactor and weapon design.

The betatron neutron time-of-flight project at the Knolls labora- ry is making considerable progress in the determination of neutron oss sections. The precise timing with which the betatron electron am can be made to strike its target is making possible a high rate measurement of neutron absorption cross sections and neutron res-

---

of several types of nuclear reactions may occur, each a definite percentage of the time. ientists take care of this situation by assigning a cross section value to each reaction. ese values, which are determined experimentally, enable them to calculate the probable mber of hits.

There are many types of nuclear reactions, such as an alpha-neutron reaction, a proton- tron reaction, or a deuteron-neutron reaction. The symbol for an alpha particle is a; a neutron n; for a proton p; and for deuteron d. Thus, the three reactions mentioned uld be written (a, n), (p, n), and (d, n). The first symbol represents the bombarding rticle, the second, the emitted particle after the reaction has occurred.

[5] Members are listed in Appendix 2.

[6] See pp. 80–81, Seventh Semiannual Report for explanation of "neutron chopper."

onance limits. The knowledge being developed is of fundamental importance in reactor physics and the precision of recent cross-section determinations using the new methods exceeds that heretofore possible. At Argonne improved resolution has been achieved through the use of a new neutron detector utilizing the old "chopper."

High Energy Physics

In the field of high-energy physics some important results are being achieved by physicists working with the Brookhaven cosmotron. Of special importance is the artificial production of heavy mesons (900 to 2,200 times the mass of the electron) as observed in cloud chambers and on photographic emulsions. The ability of the cosmotron to produce heavy mesons means that the study of the structure of neutrons and protons and the forces between them can be carried on under controlled conditions not possible with cosmic rays.

V-Particles Produced

A cloud chamber containing hydrogen gas was placed in the beam of 1.5 billion electron volt, negative pi-mesons coming from the cosmotron. Photographs of this chamber show collisions between the incoming negative pi-mesons and protons in the chamber. These collisions are observed occasionally to produce so-called V-particles which are unstable particles also recently found in cosmic rays. In one photograph, a single collision was observed to produce simultaneously two V-particles, an event of considerable importance to the theory of these processes. One variety in particular lives only about one ten-billionth of a second and then decays into a proton and a pi-meson. This particle thus may be an excited state of a neutron. If this is the fact an inner complexity would be revealed in these fundamental particles which was unsuspected until quite recently. The study of V-particles and other mesons is being carried on by cloud chamber groups from Yale and Harvard Universities and by groups from Brookhaven.

At the University of California Radiation Laboratory fundamental studies continue on the nature of the forces which act between the elementary particles, and the role of the meson in elementary particle interactions. In addition, a study is being made of nuclear reactions at high energies.

A further line of study involving meson production reactions concerns a test of what is believed to be the equivalence of n–p, p–p, and n–n forces. This equivalence is often spoken of as the "charge independence" of nuclear forces. A severe test of this equivalence is

provided by study of the meson production in the bombardment of deuterons by high-energy protons.

Electronic systems have been developed which observe and record with accuracy at a frequency of one-billionth second the effects of this bombardment. Thus the experimenter is able to use the flight time of the heavy particle products of the reactions as an aid in identifying the particles and discriminating against background effects.

Detecting the Free Neutrino

New techniques have been developed at the Los Alamos Scientific Laboratory to help resolve the difficult problem of detecting the free neutrino. The study of neutrino detection has been stimulated by the existence of powerful chain reactors which produce energetic neutrinos in numbers millions of times greater than previously available. In addition, the development of the liquid scintillation techniques at Los Alamos has resulted in new detectors thousands of times more sensitive to reactions caused by neutrinos. With these new tools scientists have tentatively identified the transmutation of protons to neutrons by neutrinos. By further refining the techniques now being used it may be possible to make a definite identification of the proton transmutation and to establish other properties of the neutrino.

The neutrino is an elementary particle the existence of which was assumed 20 years ago to explain the known features of the radioactive disintegrations of nuclei in which electrons are emitted. The neutrino has since been incorporated into the fabric of high-energy physics in connection with the decay of the increasingly numerous mesons. In all instances where the neutrino hypothesis is involved, it is for the purpose of explaining an otherwise unexplained loss of energy or momentum from the system under observation. Theoretically the neutrino interacts very weakly with matter and hence is not easy to detect. The current assumption is that nature's energy and momentum budget is always balanced and that the neutrino is responsible for observed deficits.

Chemistry

Nuclear Chemistry

One of the main developments in nuclear chemistry at Brookhaven has been the study of nuclear reactions in the hitherto unexplored billion volt energy region. Early in 1953 radiochemical investigations were begun on targets irradiated in the 2.2 Bev proton beam of the cosmotron. The radioactive end products of the bombardment of target nuclei by particles isolated chemically are studied by means

of the radiations they emit. This study of nuclear reactions is quite different from and complementary to the physical investigations by cloud chamber, counter, or photographic emulsion techniques, in which emitted particles (mesons, protons, neutrons, etc.) are detected and measured.

The chief effort has been to learn whether the radioactive products resulting from the bombardment of some representative target elements with 2.2 Bev protons differ markedly in kind and in relative yields from those observed with protons in the 200 to 400 Mev range, where many similar studies with synchrocyclotrons have been made. The results indicate that the distribution of products from a given target element differs substantially in the two energy regions.

Properties of Americium

New information obtained at UCRL on the chemical and physical properties of americium (element 95) includes exact measurements of the amount of heat liberated when the ions of americium in solution change from one oxidation state to another. Information of this kind is important in the development of chemical process methods designed to separate americium from the other man-made transition elements.

Rare Earths

The Ames Laboratory at Iowa State College and the Oak Ridge National Laboratory have pioneered basic studies of the rare earths and development of methods to separate them. Recently the Ames process for extracting pure earth elements from ore and separating them in ion-exchange columns was improved so that the yields increased many-fold, thereby greatly reducing the cost of the process. Scientists at Ames have succeeded in separating, in 99.99 percent purity, at least a kilogram quantity of each of the rare earths which occur in nature, except europium and terbium. They have, however, obtained smaller quantities of terbium. In addition, much progress has been made at Ames on the development of a liquid-liquid extraction process for separating rare earths in large quantities,

of nitric acid solutions of the rare earths with tributyl phosphate in a system of glass columns. Kilogram quantities of the oxides of samarium, gadolinium, and dysprosium have already been separated from complex mixtures. Progress is continuing in the improvement of the process and its extension to some of the other rare earths.

Neutron Diffraction Study

When a crystalline material is placed in a beam of neutrons the scattering of neutrons out of the beam can give information about the arrangement of atoms within the crystal. This type of experiment, of special use when applied to crystals containing hydrogen, is being applied at the Oak Ridge laboratory to furnish fundamental chemical information. For example, a neutron diffraction study of ice disclosed the precise separation of the two hydrogen atoms and the oxygen atom which comprise a molecule of water. The study also yielded information about the motion of these atoms and about the manner in which adjacent molecules are arranged.

Fundamental Nature of Radiation Damage

Studies in the field of radiation damage show that changes in the physical properties of irradiated metal are caused by the introduction of defects into the normal crystal structure of the metal. These defects are formed by the bombarding neutrons which knock atoms from their normal positions. The defects are: (1) Vacant spots in the crystal structures, called vacancies; (2) displaced atoms in an abnormal position, called interstitial atoms; (3) impurity atoms resulting from reaction of neutrons with the original atoms to form a new type of atom; (4) local high-temperature regions introduced by the slowing down of the original high-speed neutron. The Oak Ridge laboratory has demonstrated that the vacancies introduced into the crystal structure by neutron bombardment can greatly increase the rate of intermingling of different atoms in an alloy. Evidence also has been found that interstitial atoms cause an increase in hardness and strength.

Finding other types of defects and studying the effects produced by radiation in various solids are especially important to the development of reactor science.

Alignment of Nuclei

Many nuclei spin about their axes and behave like tiny magnets. The strength of these magnets is so small that the direction in which

the nuclei point is random and continually changing under the influence of ordinary heat motion. It has long been a goal of nuclear physicists to rearrange nuclei so that they point predominantly in one direction and then to make them interact with subnuclear particles—for example, neutrons—which have also been alined. The object of such rearrangement is to determine if the interaction is in any way influenced by the orientation of the nuclei and the particles.

Physicists at the Oak Ridge laboratory working at 0.2 degrees above absolute zero (−459.72° F.) have recently succeeded in observing effects of this kind. An external magnetic field was applied to manganese ammonium sulphate and to samarium ethyl sulphate so that the tiny nuclear magnets were alined. When polarized neutrons were shot into the manganese sample, the manganese captured 3.4 percent more neutrons when the nuclear magnets and the neutrons were alined antiparallel than when they were alined parallel. In the case of samarium the effect was similar, but the neutron capture was 18 percent greater.

Research Tools

The tools being used for physical research in the field of atomic energy are constantly being improved and new instruments are being developed to obtain more precise and accurate information. Many of the instruments that are developed for use in fundamental research have multiple applications, some of which make possible the solution of problems of immediate importance to the atomic energy program.

Brookhaven Reactor

The Brookhaven reactor, the only nuclear reactor in this country designed to support research programs in both the physical and life sciences, has now been operating continuously for over 3 years. It was brought into operation in August 1950 and has exceeded original performance characteristics in all respects. Designed to operate at 27,000 kilowatts, it has achieved levels as high as 30,000 kilowatts on an around-the-clock schedule. Some 40 separate research equipment arrays set up at the various faces of the reactor pursue simultaneous investigations. In many of these projects the results are automatically recorded 24 hours each day. All the scientific departments at the laboratory participate in reactor experiments.

Knolls Reactor

The thermal test reactor at the Knolls Atomic Power Laboratory, originally designed as a versatile research tool for precise reactivity

measurements and as a standard neutron source, has been used extensively for cross-section measurements, the testing of materials used in reactor construction, and for neutron calibrations. To meet the need for high neutron flux levels, the reactor has been modified to include water cooling for operation at 10 kilowatts. This power provides neutron fluxes greater than 100 billion neutrons per square centimeter per second which can be used for the production of experimental quantities of radioisotopes and for neutron beam experiments.

Raleigh Reactor

The Raleigh Research Reactor, the first university-owned nuclear reactor, went critical at 12:59 a. m., September 5 at North Carolina State College of the Consolidated University of North Carolina. Loading of the fissionable material in the reactor began on the morning of September 4 and the first experiment on criticality was carried out without complications.

The low-powered research reactor was completely designed and built with funds of the Consolidated University made available to North Carolina State. A grant from Burlington Mills provided much of the money used to construct the reactor building. The AEC loaned 999 grams of uranium 235 to fuel the reactor.

One of the major purposes of the reactor will be to supply reactor experience to undergraduate and graduate students in nuclear engineering. For the first year of its operation a program of research on the reactor itself is scheduled, after which the emphasis will shift to the use of radiations and radioactive isotopes produced by the reactor. The reactor project is under the technical direction of Dr. Clifford K. Beck, head of the physics department of the college.

Pennsylvania State Reactor

Pennsylvania State College submitted a formal proposal to build and operate at its own expense a 100-kilowatt research reactor and its request for the loan by AEC of fuel material was given preliminary approval. Construction is expected to begin early in 1954. The reactor will be a light-water-cooled and -moderated, thermal neutron system using enriched uranium fuel. The college and the AEC cooperated under a "no fund" contract in detailed studies which led to the proposal. The reactor will be built and operated without financial assistance from the AEC.

Livermore "Water Boiler" Reactor

A small "water boiler" research reactor was put into use by California Research and Development Co., at the AEC's Livermore,

Calif., research facility. It was designed and built by North American Aviation Co.

Generally similar to other "water boilers," the new reactor has a spherical, stainless steel core 1 foot in diameter and uses about 1 kilogram of uranium 235 in a uranyl sulfate solution of ordinary water. The power is 100 watts and the maximum flux of thermal neutrons is 1 billion (10^9) per square centimeter per second.

The low-power "water boiler" reactor design is inherently safe. Other reactors of this type are at the North American plant at Downey, Calif., at AEC's Los Alamos Scientific Laboratory, Los Alamos, N. Mex., and on the campus at North Carolina State College, Raleigh, N. C.

Electronic Computers

The behavior of nuclear reactors is understood in principle but when accurate, detailed knowledge of reactor characteristics is required many extremely complicated mathematical problems arise. Some of these problems can be solved in reasonable time only by use of modern high-speed electronic computing machines. For this reason Argonne National Laboratory began the construction of such a computer several years ago. The Argonne computer, called the AVIDAC, and another, the ORACLE, needed by the Oak Ridge National Laboratory have been completed recently. The ORACLE was moved in September from Argonne to Oak Ridge and is now in use by the mathematics panel of ORNL. Both machines are based on the general design of one begun earlier at the Institute for Advanced Study at Princeton, N. J. Each computer contains about 3,500 electronic tubes and about 20,000 resistors. These machines can multiply together two 12-digit numbers such as 976,345,012,983 and 276,507,433,209 in less than 1/2000 second. In about 20 to 30 minutes, they can solve complicated problems that would require the time of 2 mathematicians working for 5 to 6 years using ordinary desk-type electric calculators. Despite the speed of these computers, some reactor design studies often require their continuous operation for days or weeks.

The ORACLE was designed after much of the work on the AVIDAC was completed and contains many improved features. One of these improvements is in the memory device. In both machines, instructions and intermediate results of computation are held in a memory unit consisting of cathode ray tubes and auxiliary circuits. In the ORACLE, pairs of cathode tubes are used so that the second tube will remember what the first one is unable to, because of small defects in the first tube. Either one tube or the other gives the right answer. Using this system, the machine has been found to have a very high degree of reliability.

Cosmotron

Since June the cosmotron at Brookhaven, with only occasional interruptions, has been providing high-energy particles for experiments on a schedule calling for 60 hours of operating time a week. In normal operation, protons are accelerated to energies as high as 2.2 Bev but in test runs energies as high as 2.8 Bev have been reached without difficulty. Regular operation at 3 Bev is to start in 1954. One gratifying aspect of the research program is the number of different experiments that can make simultaneous use of the various cosmotron beams. It is not unusual for five different groups of physicists to be taking data at the same time, greatly increasing the effectiveness of this instrument.

High Energy Accelerator

The construction of an ultra-high-energy particle accelerator of a type known as an alternating-gradient proton synchrotron has been authorized. Brookhaven National Laboratory has begun the design of a machine that will accelerate protons to energies up to 25 billion electron volts.

The synchrotron will use a series of alternate strongly converging and diverging magnetic fields to confine a proton beam in a tube of relatively small cross-section. This focusing effect will allow the production of high-energy beams with smaller electromagnets and related equipment than would otherwise be possible.

The cost of design and construction of the new accelerator is estimated at $20,000,000. It is expected that the machine can be completed in 5 to 6 years.

The selection of Brookhaven as the site for this accelerator is in line with the policy of providing large, unique facilities for cooperative use by university scientists at the national laboratories.

86-Inch Cyclotron

By accelerating large current protons to an energy of 22 Mev, the 86-inch cyclotron at Oak Ridge National Laboratory, is capable of producing special radioisotopes at rates many times higher than any previously reported. For example, beryllium 7, an important research isotope, is produced at the rate of 100 millicuries per hour by bombarding lithium with protons. Comparable high yields of other isotopes are obtained. The high production rate materially reduces the costs of these isotopes. The cyclotron is being modified to produce high energy neutrons.

Scintillating Plastics

A recently developed instrument of major importance for the detection and measurement of nuclear radiations is the scintillation counter. This device is the modern development of a very old method of counting radioactive rays. In its original form, the human eye observed and counted the light flashes produced in a fluorescent screen which was irradiated with alpha particles from a radioactive substance. In the modern instrument the human eye is replaced by a more sensitive device, the photomultiplier. This device can detect very small scintillations, count them as rapidly as one million per second, and at the same time accurately discriminate between light flashes of different brightness. By replacing the microcrystalline fluorescent screen with large single crystals, the scintillation counter can count not only alpha particles, but beta particles, gamma rays, and with special crystals can count neutrons.

Until recently, the use of scintillation counters was limited because of the difficulty of obtaining single crystals of sufficient size to obtain the desired sensitivity. After intensive study Argonne National Laboratory has succeeded in developing several scintillating plastics which compare well in performance to the best crystals. In many respects plastics are the ideal scintillation material.

The Argonne research program on scintillation materials has produced a great deal of information about the nature of the scintillation process by which part of the energy of the radioactive particle is converted into visible or ultraviolet light. An apparatus has been devised for measuring the intensity, spectral distribution, and time-duration or "lifetime" of the scintillations, and is capable of measuring time intervals as short as 5/1,000,000,000 second with an accuracy of about 4 percent. However, apparatus now designed will extend the range of time measurements to tenfold shorter times.

Mass Spectrometry

Mass spectrometry is the science of analyzing substances to determine the mass of the elements and molecules present in the substance. In certain types of mass spectrographs the atoms are charged electrically, accelerated to high velocities by electric fields and then sorted out by deflecting magnetic fields. Particles of different masses are deflected through different angles and thus separated.

One method of producing charged particles is to put a tiny speck of the material to be studied on a strip of metal which is then heated electrically to vaporize the material. A fraction of the atoms evaporated are then electrically charged by the capture of electrons released by the hot metal strip. Using a variation of this method Argonne National Laboratory has been able to increase the sensitivity of its mass

spectrograph making it possible to analyze smaller samples than those previously studied.

Developments in mass spectrometry at Knolls Atomic Power Laboratory have achieved high sensitivity in the detection of ion beams for the investigation of isotopic changes in materials exposed in reactors. The construction of a dual-magnet mass spectrometer for the measurement of istopic concentrations is in progress.

A nonmagnetic mass spectrometer of high transmission has been developed at the University of California Radiation Laboratory to aid in the mass assignment of cyclotron-produced radioactive nuclides and in the study of their radiation without interference from other isotopes. The spectrometer is a time-of-flight device based on a novel use of high-frequency sawtooth voltages applied to a grid system. Ions formed in the source end pass through a long cylindrical evacuated tube. Mass selection is based on the time-of-flight through the main part of the tube, the only ions recovered at the receiver end being those which reach the receiver end grids at the proper time for acceleration by the sawtooth grid voltage.

Isotope Program

By the end of the year 1,858 institutions in the United States had been authorized to use reactor-produced radioisotopes. This number represents an increase of about 30 percent in 1 year. The most significant trend was the increasing use of isotopic materials by industry, the largest single category of users. The second largest application continued to be in the field of medicine.

Since the isotope program began in 1947, 2,406 shipments of AEC-produced radioisotopes have been made to 39 foreign countries. These shipments included a small quantity of radioactive phosphorus sent to Yugoslavia in July for use by Dr. John Lawrence, of the University of California Donner Laboratory in treating Cardinal Stepinac, who is a victim of polycythemia vera.

Radioisotope Production

The graphite reactor at the Oak Ridge National Laboratory continued to be the principal isotopes production center. About 50,000 radioisotope shipments have been made from this facility. Shipments now average almost 1,000 a month. During the past 6 months, prices were reduced for quantity purchases of the most widely used radioisotopes—radiocarbon, radiophosphorus, radioiodine, and radiothallium which is used in thickness gages.

Brookhaven National Laboratory has continued to prepare special items for the isotope distribution program and now has available a new facility which will irradiate piston rings up to 16 inches in diam-

eter and related engine parts. Argonne National Laboratory is expected to resume its isotope service with the start up of its new reactor, CP–5. In October, the low intensity test reactor (LITR) at Oak Ridge National Laboratory and the materials testing reactor (MTR) at the National Reactor Testing Station in Idaho were made available for the production of special radioisotopes. The higher fluxes of these reactors will permit the production of more intense forms of certain long-lived radioisotopes such as radioactive cobalt.

Commercial participation in the isotope distribution program continued to increase. In 1953 private firms engaged in the processing and secondary distribution of radioactive materials, compounds, and sources grossed more than $500,000. This revenue was derived from refining radioisotopes for biological and medical use, synthesizing special radioactive compounds for research, preparing radioactive sources for thickness gages and radiographic testing. It is expected that secondary sales will reach the million dollar mark within the next 3 years.

Following extensive studies, Tracerlab, Inc., of Boston, Mass., and Bendix Aviation Corp., of Detroit, Mich., submitted reports to AEC indicating complete commercial handling of isotope production and distribution is probably not feasible now, nor will it be within the next 5 years. Similar conclusions were reached by Stanford Research Institute in the survey conducted for the AEC on a pricing policy for radioisotopes.

Technical Cooperation Program Broadened

Since 1948 a program of technical cooperation has been under way among the United States, Canada, and the United Kingdom. This program, under which the three countries have been exchanging information on health and safety, low-power reactor research, extraction chemistry, isotopes, and reactor materials was described in detail in the Fifth Semiannual Report to the Congress and in subsequent reports. Last autumn it was found possible, within the existing law, to extend the area of cooperation in the health and safety portion of the program to include facts concerning the effects of atomic explosions on human beings and their environments. The added exchange procedure has been established to provide all three nations with basic information required for protection of civilian populations and military formations in the event of an atomic attack. The exchange applies to facts on blast, heat, and radiation damage from atomic explosions to persons, structures, equipment, and plant and animal life. It excludes information which would aid in design or fabrication of weapons or nuclear devices or would indicate energy release of weapons.

Biology and Medicine

Progress has been made in many aspects of the Commission's program to safeguard the health of atomic energy workers and develop the beneficial uses of atomic energy. AEC-financed research is being conducted in the laboratories of universities, colleges, hospitals, and other research institutions (see Appendix 7) as well as in the laboratories of major AEC research centers. Whenever possible civil-effects programs are included in weapons test activities. Long-range studies of the survivors of Hiroshima and Nagasaki are continuing. Specialized courses are sponsored at the university level to train personnel in atomic energy fields. These courses are supplemented by on-the-job training at Commission installations.

Construction Progress

Construction of a new Health Research Laboratory at Los Alamos was completed in July 1953 at an approximate cost of $2.2 million. Dedication ceremonies were held in October.

The biomedical research and industrial hygiene groups which have been conducting studies pertinent to the weapons research program at Los Alamos Scientific Laboratory will be housed in the new building. This is the only health laboratory in which a group of medical and biological scientists are concerned with all aspects of hazard involved in the development and production of atomic weapons. For these studies the building is equipped with modern laboratories, animal quarters, X-ray rooms, counting rooms and temperature-control rooms, in addition to library, office, and storage space. It contains special shielding devices, hoods, ventilation, and instrumentation particularly designed for biomedical studies of radioactive elements. The structure is of reinforced concrete, has two stories and basement with subbasement. Total space is 58,000 square feet.

Research Accomplishments

Teletherapy Units and Radiation Sources for Cancer Research

Important advances have been made in the cancer research program of the Commission. The medical division of the Oak Ridge Institute of Nuclear Studies is expected to receive in the spring of 1954 an specially designed teletherapy unit capable of housing a radiation source of several thousand curies. The unit is being built by the W. F. and John Barnes Co., of Rockford, Ill. It will permit the study of a

283269—54——4

variety of rotational therapy [7] patterns and may use cobalt, cesium, or europium as a radiation source. About the same time the first cesium source, currently in preparation from reactor fission waste, will be available for preliminary testing in the Barnes teletherapy unit. The strength of this source is estimated to be 1,000 to 2,000 curies.

Meanwhile the Barnes Co. has loaned to the hospital of the medical division at Oak Ridge a low-curie teletherapy unit designed by the company. This unit is capable of housing a cobalt source of from 300 to 600 curies. It is being tested with the expectation that it may become a standard therapy unit within the next few years.

Use of Radioisotopes in Clinical Diagnosis and Therapy

Brookhaven National Laboratory in cooperation with St. Albans Naval Hospital is studying the use of germanium oxide needles in administering radioactive isotopes in local body areas. The isotope can be incorporated in the needles in any desired amount and will remain there for its life or the life of the needle. An additional feature is the fact that the material is slowly dissolved in the body fluids, and eventually vanishes.

Preliminary investigations at Argonne National Laboratory indicate that thulium 170 has properties which may make it useful as a source of radiation for clinical radiography. The laboratory has prepared a 100 millicurie thulium source for the Argonne Cancer Research Hospital where it is now being tested. Further studies will determine the value of this material in portable diagnostic units for which no power supply is needed.

The Massachusetts General Hospital is investigating the use of the positron emitting isotope, arsenic 74, in locating brain tumors. When this isotope is administered intravenously it concentrates to a certain degree in cancerous tissue. The slightly higher concentration in the tumor mass makes it possible to determine the location of the diseased tissue by use of special detection instruments and techniques.

Protection From Radiation by Tissue Transplants to Eye

For several years it has been known that spleen transplants offer protection against the effects of irradiation. It is not clear whether these beneficial effects are the result of the release of active substances from the spleen cells, or of the seeding of the bone marrow from the site of transplants. In recent experiments at Brookhaven National Laboratory embryonic mouse spleen tissue was transplanted to the

[7] In rotational therapy the source of radiation is rotated around the center of a tumor or the patient is rotated in such a manner that radiation is centered on the tumor, permitting maximum concentration of the radiation on the diseased tissues.

anterior chamber of the eyes of mice. Such a transplant appears to preclude the possibility of cells escaping into the general circulation. The indication is that some substance produced by cells, and not the cells themselves, may be the active agent. These experiments show clearly that only a few unirradiated cells from the spleen of a normal animal growing in the anterior eye chamber of an irradiated animal can save the latter from death from a degree of radiation which would otherwise have been fatal. The transplants were made after exposure of the test animal to radiation.

Effects of Surgery Following Irradiation

In an AEC-sponsored project the Western Reserve University School of Medicine is investigating the effect on casualties of major surgery undertaken as lifesaving measures because of injuries after whole-body radiation. One group of animals was given 200 roentgens of whole-body radiation and another group, 300 roentgens. Twenty hours after exposure standard major operations were performed on these animals in which several inches of intestine were removed. A third group of animals was exposed to the same amounts of radiation but not subjected to surgery. When the mortality rates of the two groups were compared, it was found that there were only slightly more deaths in the operative groups than in the other.

Antibody Synthesis

A research group at the University of Chicago examining the incorporation into blood proteins of amino acids labeled with radioisotopes has made important observations that may relate to the immunological reactions of the body. The time patterns of the appearance of the labeled groups in the blood proteins have been compared with those of antibodies produced in response to injected egg albumin. Findings suggest that the antibodies are not formed merely by modification of preexisting plasma globulins, but are synthesized independently. The synthesis appears to begin almost at once after injection of the foreign protein so that considerable antibody has been formed before it becomes evident in the blood. A search is being made of various tissues to locate the antibody during the early period of production, or to demonstrate the possibility of the existence of an antibody percursor.

Studies on Immunity Mechanisms

The effects of whole-body gamma irradiation on immunity mechanisms have been tested at Brookhaven National Laboratory. In these

experiments, a cobalt 60 source was used and radiation of somewhat less than average lethal dosage was administered to mice. The results show that while irradiation effectively destroys the ability of the body to withstand pneumococcal infection even in the presence of abundant specific antibody, it does not abolish active immunity to the influenza type A virus, nor does it affect the activity of tetanus antitoxin present at the time of irradiation. Taken together with other bits of evidence, this finding suggests that with this type of infection the lowered antibacterial resistance following whole-body irradiation is attributable primarily to the failure of phagocytes to act against bacteria because of white cell deficiency, and that phagocyte reaction may not be necessary in antiviral immunity or in preventing the intoxicating effects of tetanus toxin.

Related studies are also being undertaken at Washington University, St. Louis, Mo., the University of Pittsburgh, the Memorial Medical Center of Sloan Kettering Institute, New York, and the University of Michigan. Radioiodine is used to tag antibodies in fundamental studies of immune mechanisms of the body's capacity to combat infectious disease. The technique being developed is to label antibodies which had been specifically developed to concentrate in given organs and tissues. There is hope that this work may lead to a practical method of directing into tumors useful concentrations of radioisotopes or of such elements as boron which may be converted into a radioactive source when bombarded by neutrons. Such a method would also be applicable to the treatment of tumors in deep seated tissues elsewhere in the body.

Tracer Studies in Physiology

Under active investigation at Brookhaven National Laboratory are various tracer methods for physiology investigations involving the use of radioactive isotopes such as sodium, potassium, chlorine, bromine, hydrogen and other elements. These methods are devised to study the rate of distribution of elements in various body structures and systems and to evaluate the significance of the difference in those rates as in muscle and brain, for example. The application of this methodology has been extended to investigations of the manner of use of amino acids labeled with carbon 14.

Information is being accumulated on the mechanisms of edema or swelling of the body; the relation of mineral content of the diet to the control of hypertension and complications in kidney disease, and to the alleviation of some manifestations of cancer; and the treatment of brain tumor by neutron capture therapy. Many other aspects of the study have equally useful immediate practical implications.

Other investigations deal with the movement of substances from

the blood stream, through the capillary walls into the fluids bathing the various cells of the body and from there through the cell walls into the cell itself.

Atomic Bomb Casualty Commission

A preliminary report has been released to the scientific public in Japan and the United States on the genetic studies being made to determine late effects of radiation exposure on survivors of the bombing in Hiroshima and Nagasaka. These studies are a part of extensive medical and biological investigations financed by the AEC and administered by the National Research Council of the National Academy of Sciences.

During the 5 years, 1948–52, data were collected on the parents and the first-generation offspring. More than 60,000 births were registered and the babies examined by the medical staff of the Atomic Bomb Casualty Commission. This represents about 95 percent of births in the 2 cities. Initial records were set up to collect information on exposure of parents, indicators of genetic damage, and nonradiation factors affecting these indicators. The indicators used were type of termination (stillbirth or live birth), major malformation, weight of live birth, sex ratio, and neonatal and infantile death. The principal nonradiation factors affecting these indicators are maternal age, birth order, consanguinity or relationship of parents, economic status, and regional origin. Fathers and mothers were separately divided into two groups: a heavily exposed group with symptoms of radiation sickness, most of whom had been within 1,845 meters of ground zero; and a lightly exposed group without symptoms, most of whom were more than 1,845 meters from the explosions.

Present evaluation of the data, which include allowances for the nonradiation factors, indicates that no effect can be found in the first-generation babies for four of the indicators, namely—stillbirth rate, major malformation, weight of live babies, and neonatal or infantile death. For sex ratio, exposure of the father is shown to have no effect, but heavy exposure of the mother appears to have produced a significant though small decrease (1.3 percent) in the number of male children. This result is in the direction which would be expected if radiation had caused genetic changes in the maternal sex chromosome. This finding, however, is still tentative and may not be supported by subsequent data.

Agricultural Applications

In the University of Tennessee-AEC agricultural studies at Oak Ridge National Laboratory, extensive experimentation has been car-

ried out with both laboratory and domestic animals in an effort to evaluate possible effects of dissemination of radioactive materials in the animals, the effects of exposure to external radiation, and to explore the beneficial use of radioisotopes in agriculture.

By developing information on the absorption and retention by domestic animals of important fission products, it is possible to estimate the hazard which may result from human consumption of products of such animals. Also, the effects of these materials on the animals themselves are being determined. Studies are well underway which may help to establish maximum permissible tolerances for radioisotopes of chromium, zinc, and nickel.

The quantity of external gamma radiation which will produce death of a large animal such as a burro has been measured, and typical pathological symptoms and blood picture changes have been noted. Respiration measurements have shown that whole body irradiation of 600 roentgens or more interferes with the animal's normal use of carbon dioxide. Studies of the effect of small daily doses of the order of 25 roentgens now underway are expected to yield early results.

Investigations with radiocalcium have led to new methods for evaluating this element in the nutrition of livestock. Also, important information has been gained on the formation of the fetal skeleton, the drain on the maternal skeleton, the effect of high fluorine levels on bone growth, and the relationship of bone minerals to milk secretion.

In experiments with a radioisotope of molybdenum it has been shown that molybdenum is an integral part of an important enzyme system in the body; namely, xanthine oxidase. The role of molybdenum as an essential element in animal nutrition and its relationship to copper and cobalt which are essential elements in normal growth in animals and plants are now being reexamined.

Potassium Absorption by Tropical Crops

Research with radioisotopes has made it possible to trace the movements of fertilizers through soil into plants, and to understand some of the complex processes of absorption and distribution in plants. Much work has been done with potassium, one of the major crop fertilizing elements, which is normally absorbed from the soil by plants through their roots. However, precise data are not available on the relative absorption of potassium by tropical plants from fertilizers and from the soil to which the fertilizer is applied. Recently studies were initiated with the University of Puerto Rico Agricultural Experiment Station (Rio Piedras, P. R.) for the use of radioisotopes in experiments with tropical crops. Such knowledge will be

of value in the study of mineral absorption by plants, and in determining to what extent the addition of fertilizer on plant nutrients to tropical soils is beneficial.

Savannah River Survey

The Academy of Natural Sciences of Philadelphia has completed an extensive study of the biological conditions of the Savannah River. This work by the Academy is part of a continuing survey undertaken by AEC in cooperation with the United States Public Health Service and the Universities of Georgia and South Carolina to determine if changes attributable to AEC production operations occur in the normal pattern of plant and animal life in the area.

An intensive study was made of five areas of the river to determine the number of algae and of several animal groups present during summer, fall, winter and spring. Information was collected by a group of seven specialists using methods and procedures developed by the Academy for this specific purpose. The study is the first to be made of a coastal plain river in the United States which sets forth the pattern of aquatic life in one region during the various seasons. Findings to be released soon will include the most extensive list yet published of species from a coastal plain river.

Algal Productivity in the Pacific

A cooperative project is underway with the University of Hawaii to investigate the use of isotope techniques for determining algal productivity in the tropical Pacific. Work recently reported indicates that the productivity of the sea can be estimated from measurements of carbon dioxide fixation by algae in sea water samples collected over a large area. These studies at the University of Hawaii are expected to yield significant information on the mechanics, quantity, and rate of carbon being fixed through photosynthesis by the marine algae.

Training in Health Protection

Under the fellowship program of the Commission, selected applicants are trained in the specialized health fields of radiological physics, industrial hygiene, and industrial medicine, as they relate to the atomic energy industry.

Radiological Physics

In the field of radiological physics, training is provided select college graduates with degrees in basic science or engineering. The

training deals with health problems associated with handling radioactive material and with the release of nuclear energy. It includes such topics as radiation monitoring, radioisotope measurements, health physics, and instrumentation.

Beginning with the academic year 1948–49, this program was set up to provide seriously needed personnel for health physics work in atomic energy plants and laboratories. During the first 2 years, the program was administered by the National Research Council and training conducted at Oak Ridge National Laboratory or at the University of Rochester atomic energy project. The fellowships offered no academic credit and could not be renewed. Their purpose was purely that of training for health physics work. In 1950, the Oak Ridge Institute of Nuclear Studies took over the administration of the program. Fellowships were offered to include academic study and credit in the graduate school of the University of Rochester, with field training at Brookhaven National Laboratory during the summer months, and in the graduate school of Vanderbilt University, with field training at Oak Ridge National Laboratory.

In 1953, a new training center was added at the University of Washington, in cooperation with the Hanford Works for field training. Approximately 25 fellowships are offered annually by each of the 3 training centers. Awards are made about March 1 preceding the academic year. Complete details and application forms are available from the Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn.

Present status of the trainees follows:

Employment in health physics (AEC)	52
Employment in health physics (non-AEC)	[8] 23
Employment utilizing health physics	5
Continuing education	[9] 42
Teaching or nonindustrial research	8
Industrial employment in physics	10
In Armed Forces	4
Not working or no information	8
Training incompleted (dropped out)	3
Total (1948–53)	155
New fellowships in effect, 1953–54	42
Total	197

[8] Non-AEC projects include universities, United States Public Health Service and Armed Forces laboratories.

[9] A large percentage of those continuing their education will go into health physics work or will be closely associated with it. Some have already held interim health physics jobs.

Industrial Hy

The Oak R
fellowship pro
the fields of ch
in its second ye
of academic tr
in the first year

Industrial Med

Advanced tra
particularly in
men and wome
to study during
University of F
of Cincinnati, 1
or contractor i
Administration
the University

Evaluation o
series of atomic
degree of succes
tural and biome
structural and
medical experim
and further stu
work of the Ato
tamination and
areas on native
ods, and indoct
logical personne

One hundred
were made in th
and carried out
Administration;
The remaining 2
of technical and
Operations Offic
as several indust
been evaluated,
gations which re

Industrial Hygiene

The Oak Ridge Institute of Nuclear Studies also administers a fellowship program in industrial hygiene for qualified graduates in the fields of chemistry, physics or engineering. This program is now in its second year, and eight candidates have been selected for one year of academic training. Four trainees completed the course of study in the first year of the program.

Industrial Medicine

Advanced training and on-the-job experience in industrial medicine, particularly in relation to the atomic energy activities is also open to men and women physicians. Eight applicants have been approved to study during the 1953 academic year at the following institutions: University of Rochester, 4; Harvard University, 3; and the University of Cincinnati, 1. A second year of in-plant training at a Commission or contractor installation is offered after completion of the courses. Administration of the training is under the atomic energy project at the University of Rochester, Rochester, N. Y.

Weapons Test Program

Evaluation of the civil effects test program conducted in the spring series of atomic tests at the Nevada proving grounds indicates a high degree of success in developing original and basic data in both structural and biomedical tests. The tests were limited to: experiments in structural and functional design and materials of construction; biomedical experiments with emphasis on the effects of ionizing radiation and further studies in genetics, implementing and reinforcing the work of the Atomic Bomb Casualty Commission; studies of soil contamination and effects resulting from fallout in the test and nearby areas on native animals; testing of dosimetry instruments and methods, and indoctrination and training for State civil defense radiological personnel.

One hundred and fourteen civil effects tests comprising 36 projects were made in the series. Six of the projects were planned, financed, and carried out under the sponsorship of the Federal Civil Defense Administration; two were conducted jointly with the Commission. The remaining 28 projects, sponsored by the AEC, required the services of technical and scientific personnel from Washington Headquarters, Operations Offices, cooperating universities and laboratories, as well as several industrial organizations. All civil effects experiments have been evaluated, except those on genetics and other biological investigations which require further study.

Civil Defense

Classified briefings on the overall atomic energy program were conducted for the Administrator and principal staff of the Federal Civil Defense Administration (FCDA). Classified motion pictures of nuclear weapons tests were shown at a conference of State civil defense directors in September and at the White House conference of mayors in December. Both meetings were conducted by the FCDA.

The AEC participated in a post-graduate course on medical aspects of atomic energy given by the University of Utah College of Medicine in Salt Lake City, Utah, in October. AEC representatives presented the problems associated with the effects of nuclear detonations, particularly the effects of radiation, heat, and blast. Local, State and national areas of civil defense responsibility were described and the need for increased coordination of all civil defense activities emphasized.

The Commission continued to lend radiation instruments and radioactive material for civil defense training and operations purposes. Sources were sent during the last 6 months to Alabama and New Hampshire for use in calibrating radiological detection instruments. The latter received a cobalt 60 source of 5 curies, the first of such high intensity to be loaned since the program began.

Emergency, Disaster and Mobilization Committee

An Emergency, Disaster, and Mobilization Committee was established in the Office of the Assistant General Manager to coordinate disaster or emergency plans on an overall Commission basis. The committee which assumed the functions of the disaster planning coordinator, an office now abolished, consists of representatives from the various AEC divisions. It will study the definitions of disasters and minimum standards for operational plans, compile existing directives, memoranda, and bulletins, applicable to disaster or emergency plans, and draft proposals for action necessary to assure removal of personnel and equipment from Washington headquarters, if the necessity arises.

Effects of Tests on Animals

The AEC found after extensive research studies that radioactivity from atomic tests was not responsible for deaths and illness among sheep in areas adjacent to the Nevada Proving Ground last spring. Earlier the Commission had determined that radiation fall-out had caused lesions to the backs of 16 horses and to the eyes of a few of them but had not otherwise injured their health. There was no

evidence that the death of cattle adjacent to the proving ground during the spring was due to radiation. Their death was attributed to malnutrition.

Investigation of the sheep deaths began after unusually heavy losses had occurred and the sheep showed lesions on their faces and backs. Several methods were used to determine whether the sheep had experienced harmful exposure to radiation. Bones of the affected sheep were compared with bones from herds which had no abnormal losses and no significant differences in radioactivity were found. The levels of radioactivity detected were far below those which could affect the health of the animals. In another study the thyroid glands of affected sheep were compared with the thyroids of sheep that had received known amounts of radioactive iodine, which concentrates in the thyroid. It was found that the exposure to radioactive iodine suffered by the Utah sheep was no more than one-fortieth of the level known to cause gross observable effects in sheep. A third study compared burns experimentally produced on sheep by beta radiation with those observed on the Utah sheep. The two types of burns were found to have distinct differences. It was found possible to produce by a variety of means other than radiation lesions similar to those found on the Utah sheep.

The AEC finding was concurred in by the United States Public Health Service and the Bureau of Animal Industry, United States Department of Agriculture. Prior to issuance by the AEC, the report was reviewed by the Department of Health, State of Utah. The special studies were conducted by scientists at Los Alamos Scientific Laboratory, Hanford Works, and the University of Tennessee.

Legislative Developments

There have been several amendments to the Atomic Energy Act. Public Law 137, 83d Congress, approved July 17, 1953, amended the Atomic Energy Act by adding, as section 12 (d), a provision authorizing the Atomic Energy Commission to enter into long-term utility contracts. This legislation was required in connection with AEC contracts for the furnishing of power for operation of the Oak Ridge, Paducah, and Portsmouth installations.

Public Law 164, 83d Congress, approved July 31, 1953, amends section 2 (a) (4) (B) of the Atomic Energy Act by eliminating the statutory requirements for the Divisions of Production, Research, and Engineering. It retains, however, the statutory requirement for the Division of Military Application, the Director of which is required

to be a member of the Armed Forces. The Commission is authorized, under this amendment, to establish as many as 10 additional program divisions, as it determines them to be necessary in the discharge of its responsibilities. This amendment also provides that such division directors shall be compensated at a rate determined by the Commission, but not in excess of $16,000 per annum.

Public Law 164 also extends to the Commission express authority to issue general regulations necessary to carry out the provisions of the Atomic Energy Act and authority to arm guards and couriers as necessary in discharge of the Commission's security responsibilities. Similar authority is extended to the Joint Committee on Atomic Energy with respect to the arming of its members, employees, and consultants.

Public Law 262, 83d Congress, approved August 13, 1953, provides for the elimination from the Atomic Energy Act of 1946 of the last sentence of section 9 (b) which provided: "The Commission, and the property, activities, and income of the Commission, are hereby expressly exempted from taxation in any manner or form by any State, county, municipality, or any subdivision thereof." This sentence was interpreted by the United States Supreme Court, in *Carson* v. *Roane-Anderson Co.* (342 U. S. 232 (1952)), as exempting transactions involving certain AEC contractors from the Tennessee sales and use taxes. This interpretation afforded the AEC an exemption from State and local taxation broader in scope than that available to the other departments and agencies of the Federal Government. The latter rely only upon the constitutional immunity of the Federal Government for their exemption from State and local taxation. Public Law 262 has the effect of repealing the special statutory exemption of the AEC and placing the AEC on a basis identical to that of most Federal agencies with respect to such taxation.

Patents

One hundred seventeen patents have been released for nonexclusive, royalty-free licensing by the Commission since November 25, 1952, bringing to 606 the total released since December 1949 when the Commission adopted its policy of making inventions and discoveries available for public use. The latest releases are listed in Appendix 5. Abstracts of the patents are published in the United States Patent Office Official Gazette as the patents are issued. They are also published in other journals and periodicals.

Two settlements of patent claims were entered into in 1953. In May of 1953 a settlement was negotiated with Mr. Nicholas Christofilos in

which for the sum of $10,000 he accorded to the Government a license on United States patents Nos. 2,531,028 and 2,567,904, and certain pending patent applications owned by him. The principal subject matter of the patents and applications is Mr. Christofilos' concept of alternate gradient focusing in particle accelerators. In the agreement, Mr. Christofilos waived any claims against the Government for possible infringement as well as for an award under the Atomic Energy Act.

In July of 1953 a patent claim against the Commission filed by G. M. Giannini and Co., Inc., on the Fermi et al. patent (United States patent No. 2,206,634) was settled for $300,000. This claim had been pending before the Commission since October 25, 1948. The claim was presented by G. M. Giannini and Co. on behalf of itself and various inventors, including Enrico Fermi and Bruno Pontecorvo. Because of the fact that Mr. Pontecorvo is believed to be in the Soviet Union, the net share payable to him was deposited in a blocked account with the United States Treasury Department. The settlement provided for the release of all claims against the Government based on the Fermi patent or the inventions disclosed therein and for the assignment of that patent to the United States. The assignment was duly recorded in the United States Patent Office on July 27, 1953.

Organization and Personnel

Job Evaluation System

A job evaluation system, adapted from selected private industry plans, was put into effect. The system was developed for supervisors who do not have extensive training and experience in job evaluation. It takes account of the responsibility of the supervisor for personnel administration and establishes a balance between salaries paid and the value of services performed.

Issuance System

A new system for issuing administrative documents has been developed and is being established. It combines into one easily revised manual all statements of policy, procedure, and program responsibilities formerly issued in varying forms. Important features of the system are a detailed subject index which will be kept up to date, and the flexibility of the manual which makes it possible to detach portions so that special purpose manuals may be assembled. The manual will also include subject matter which is not of the nature of directives, such as explanatory and administrative materials. With this

broad scope the manual will be a complete reference document on all AEC policies and procedures.

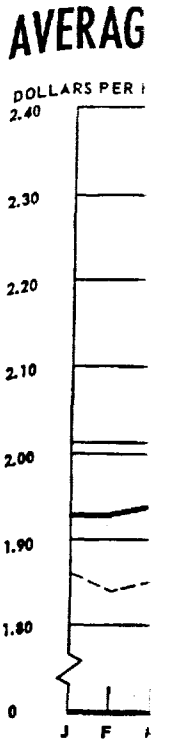
Junior Management Development Program

Participants in the junior management development program adopted in June 1953 were given rotating work assignments in Washington and in the field following completion in July of a general orientation. The program is designed as a means of recruiting and training promising young persons for responsible positions. Nine trainees are taking part.

Atomic Energy Labor-Management Relations Panel

An Atomic Energy Labor-Management Relations Panel was established by the President on March 24, 1953, within the Federal Mediation and Conciliation Service. Members of the new panel are Cyrus S. Ching, industrial consultant and former Director of the Federal Mediation and Conciliation Service, chairman; Thomas W. Holland, industrial consultant and former professor of economics at the University of Miami, vice chairman; Peter J. Manno, industrial consultant and former mediator in the Federal Mediation and Conciliation Service; Arthur M. Ross, professor of industrial relations at the University of California, Berkeley, Calif.; and Rev. Leo C. Brown, director of the Institute of Social Sciences, St. Louis University.

The panel's operating procedures have been promulgated by Federal Mediation and Conciliation Service in accordance with the Presidential announcement. By December 1, 1953, this panel had made recommendations in two disputes. In both instances the parties, after further discussion, arrived at settlements on the basis of the recommendations issued. Personnel at the Oak Ridge National Laboratory and Y–12 plant engaged in the first work stoppage in operations in the 10-year history of the AEC program. Employees represented by the Atomic Trades and Labor Council, AFL, went on strike July 27 and 28 against Carbide and Carbon Chemicals Co., climaxing negotiations that started in May. Formal panel hearings were held at Oak Ridge August 5 and 6 and recommendations for settlement were made on August 19. The other dispute referred to the panel involved the Sheet Metal Workers International Association, AFL, on strike from July 8 to 28 against the Zia Co. at Los Alamos. Hearings were held August 17 and 18 in Washington and recommendations were issued the next day, August 19.

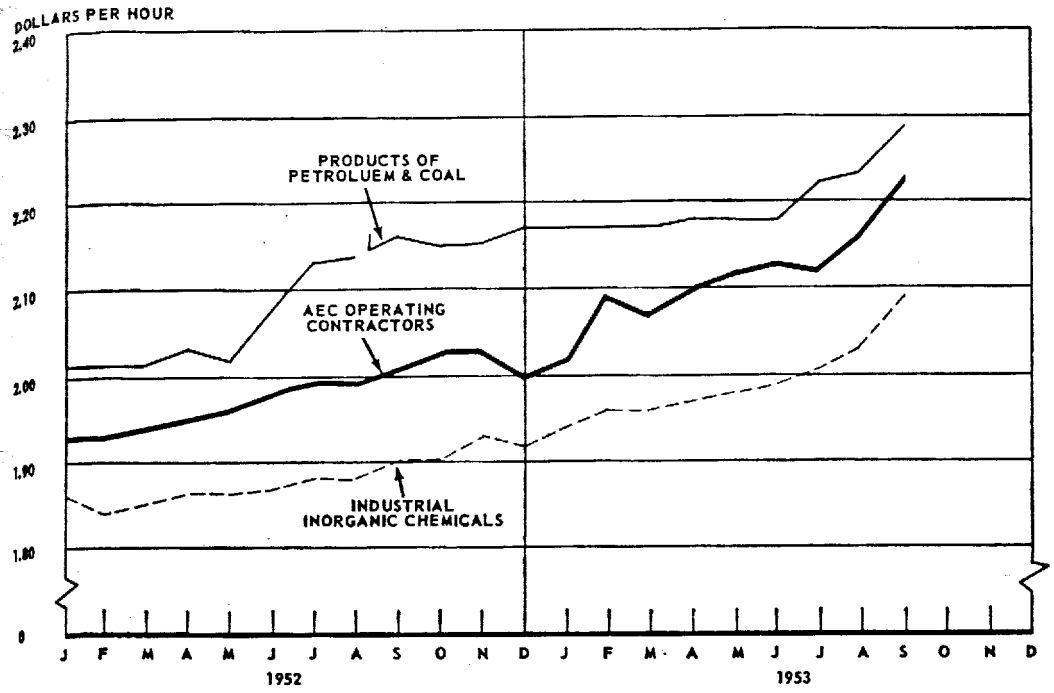


Earnings o

The abov
duction wo
program wi
facturing o
and petrole
atomic ener
were 6.7 per
below petro
earnings of
ings of wor
products ind
ing the sam
by atomic en
40.7; and i
atomic ener
to an averag

Labor Dispu

The patte
the first 10



Earnings of Atomic Energy Workers

The above chart compares gross average hourly earnings of production workers of major operations contractors in the atomic energy program with those of employees in the two industries whose manufacturing operations are most nearly comparable—inorganic chemicals and petroleum and coal products. Gross average hourly earnings of atomic energy workers during September, the last month reported, were 6.7 percent above industrial inorganic chemicals and 2.7 percent below petroleum and coal products. During the 21 months reported, earnings of atomic energy workers increased 15.5 percent, while earnings of workers in the inorganic chemicals and petroleum and coal products industries increased 13.9 and 12.4 percent, respectively. During the same period, the average number of hours worked per week by atomic energy employees was 41.6; for petroleum and coal products, 40.7; and industrial inorganic chemicals, 41.1. Weekly hours for atomic energy workers, which averaged 41.9 during 1952, decreased to an average of 41.2 during the first 9 months of 1953.

Labor Disputes

The pattern of work continuity throughout AEC continued during the first 10 months of 1953 at the high level established in previous

years as all activities were free of work stoppages 98.8 percent of the scheduled working time. In construction and design activities there were fewer major stoppages than during the corresponding period in 1952, although the percentage of scheduled time worked decreased slightly from 98.1 to 97.7 percent. The most serious losses were experienced at the Paducah, Ky., project; however, a substantial improvement over 1952 was shown and further improvement is anticipated as a result of the recent project agreement. Lost time in operations, research and development activities was negligible when expressed as a percentage of scheduled working time (0.08 percent). However, the near perfect record of recent years was marred by a 2-day stoppage at the Oak Ridge X–10 and Y–12 plants and a one-half-day stoppage at the Sandia Laboratory, Albuquerque, N. Mex. Less than 1 percent of the scheduled time was lost in maintenance and service activities; disputes involving sheet metal workers at Los Alamos, N. Mex., and painters at Oak Ridge caused the principal interruptions.

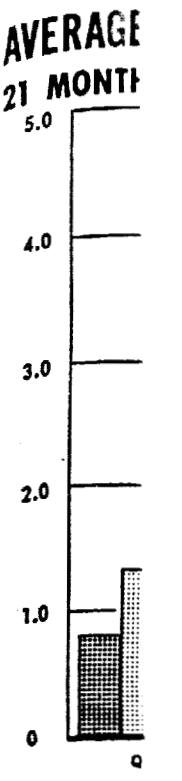
Construction Project Agreements

AEC construction work is customarily performed under wage scales and general working conditions established for the locality in bargaining between local contractor groups and local unions. These conditions are usually adequate to meet the needs of local contractors when local people are employed on relatively small jobs. Large AEC construction projects are long-term jobs, often located in remote areas, and carried on by national contractors who employ thousands of workers recruited throughout the country. Difficult problems are encountered in constructing such projects on the customary basis of local conditions.

In recognition of these problems, the General Manager encouraged use of special project agreements in areas where AEC construction work is of such magnitude as to overshadow local construction. The agreements are intended to achieve a measure of uniformity in the conditions established for the various crafts and to meet the requirements of a particular AEC project. Recent project agreements at Paducah and Portsmouth are accomplishing an essential degree of stability.

Labor Turnover

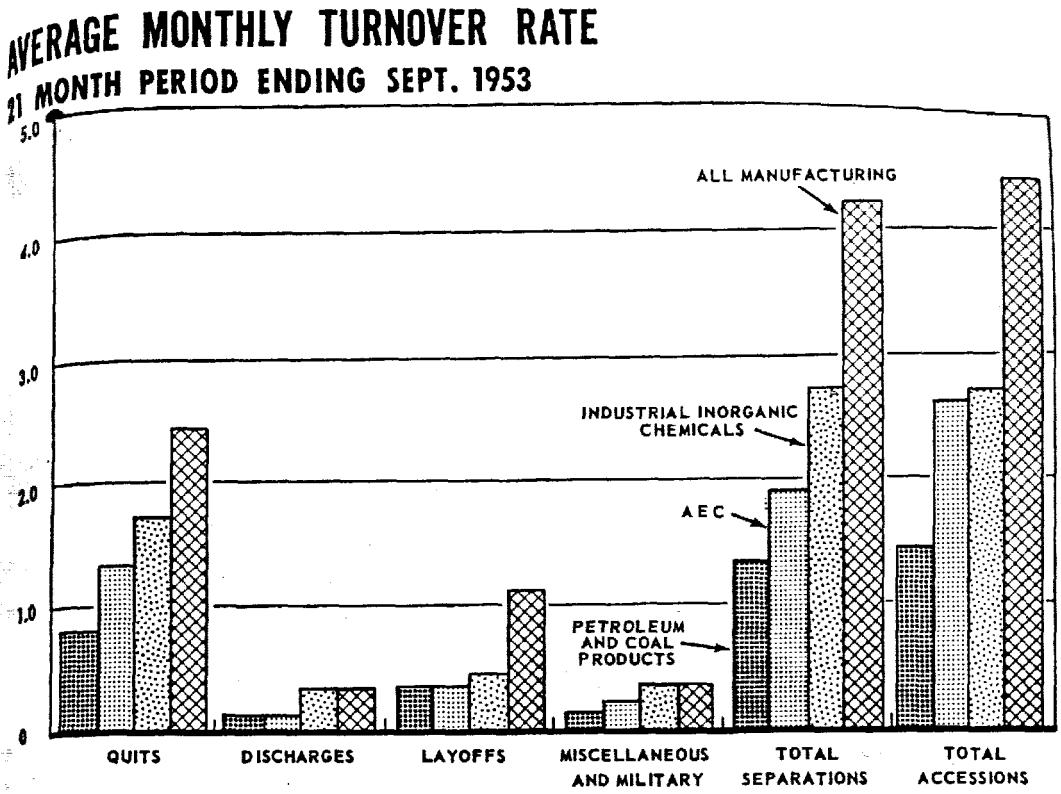
The chart on page 57 compares average monthly labor turnover rates per 100 employees in atomic energy operations with those in selected industries and in all manufacturing for the 21-month period ending



Septembe
in the ato
tries and
operation

AEC and

During
energy pr
of 151,695
this total,
of whom
architect-
The trend
chart on
ployment
81,500 by
increase i
Savannah
Paducah,
including
74,800 and
then begir

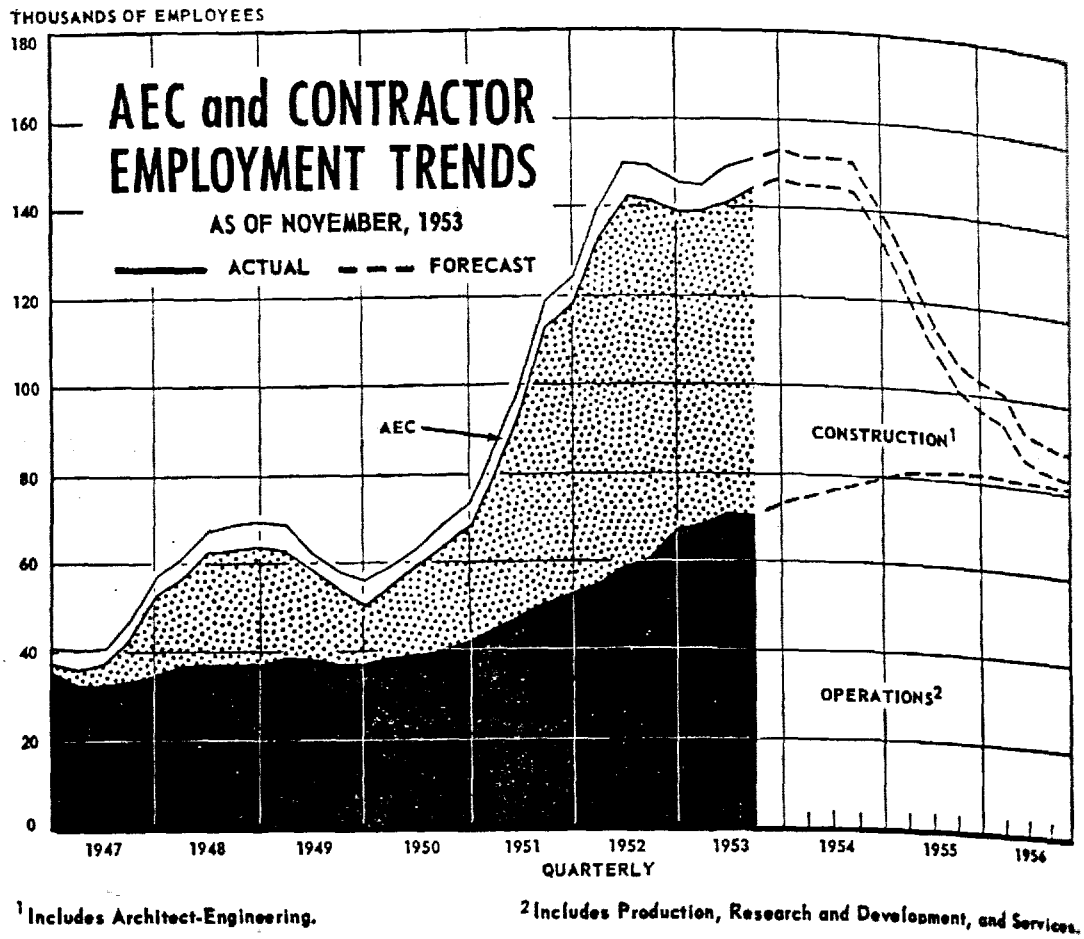


September 1953. The marked difference in accessions over separations in the atomic energy industry when compared with the selected industries and all manufacturing reflects the continued expansion of operations.

AEC and Contractor Employment Trends

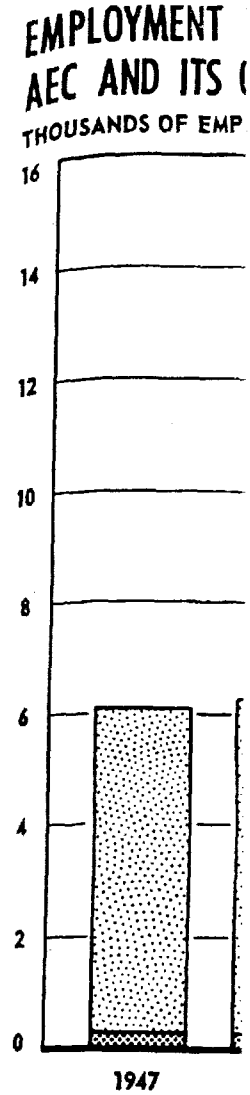
During the third quarter of 1953 total employment in the atomic energy program rose from 148,800 on June 30, 1953, to an all-time high of 151,695 in August and then declined to 150,700 in September. Of this total, 6,500 were AEC employees and 144,200 contractor employees of whom 71,200 were engaged in operations while 73,000, including architect-engineer contractor employees, were engaged in construction. The trends in AEC and contractor employment are illustrated in the chart on page 58. As currently forecast, operating contractors' employment is expected to increase approximately 10,000 to a total of 81,500 by the end of 1955 and then level off. The major portion of this increase is to meet operating staff requirements of new facilities at Savannah River and Portsmouth and expanded facilities at Oak Ridge, Paducah, and Hanford. Employment in the construction program, including architect-engineer employees, is expected to peak at about 74,800 and remain fairly constant until the fourth quarter of 1954 and then begin a rather sharp decline extending through 1955 and 1956.

5002380 283269—54——5



[1] Includes Architect-Engineering.

[2] Includes Production, Research and Development, and Services.



Scientific and Engineering Employment Trends

Scientific and engineering staffs of AEC and its operating contractors more than doubled in size during the past 7 years, as shown in the chart on page 59. This trend has followed closely the trend in total AEC and operating contractor employment. By far the largest increase occurred in the 4-year period between 1949 and 1952. In 1947 these staffs numbered 6,050 scientists and engineers or 17.28 percent of a total of 35,000 AEC and operating contractor employees. As of September, of a total employment of 77,700 such employees in the AEC program 13,582 or 17.48 percent were scientists and engineers. This total was made up of the following occupational categories:

Biological and medical scientists	1,561
Chemists	2,476
Physicists	1,704
Other physical scientists	768
Chemical engineers	1,623
Electrical engineers	1,412
Mechanical engineers	1,804
Metallurgical engineers	448
Other engineers	1,786
Total	13,582

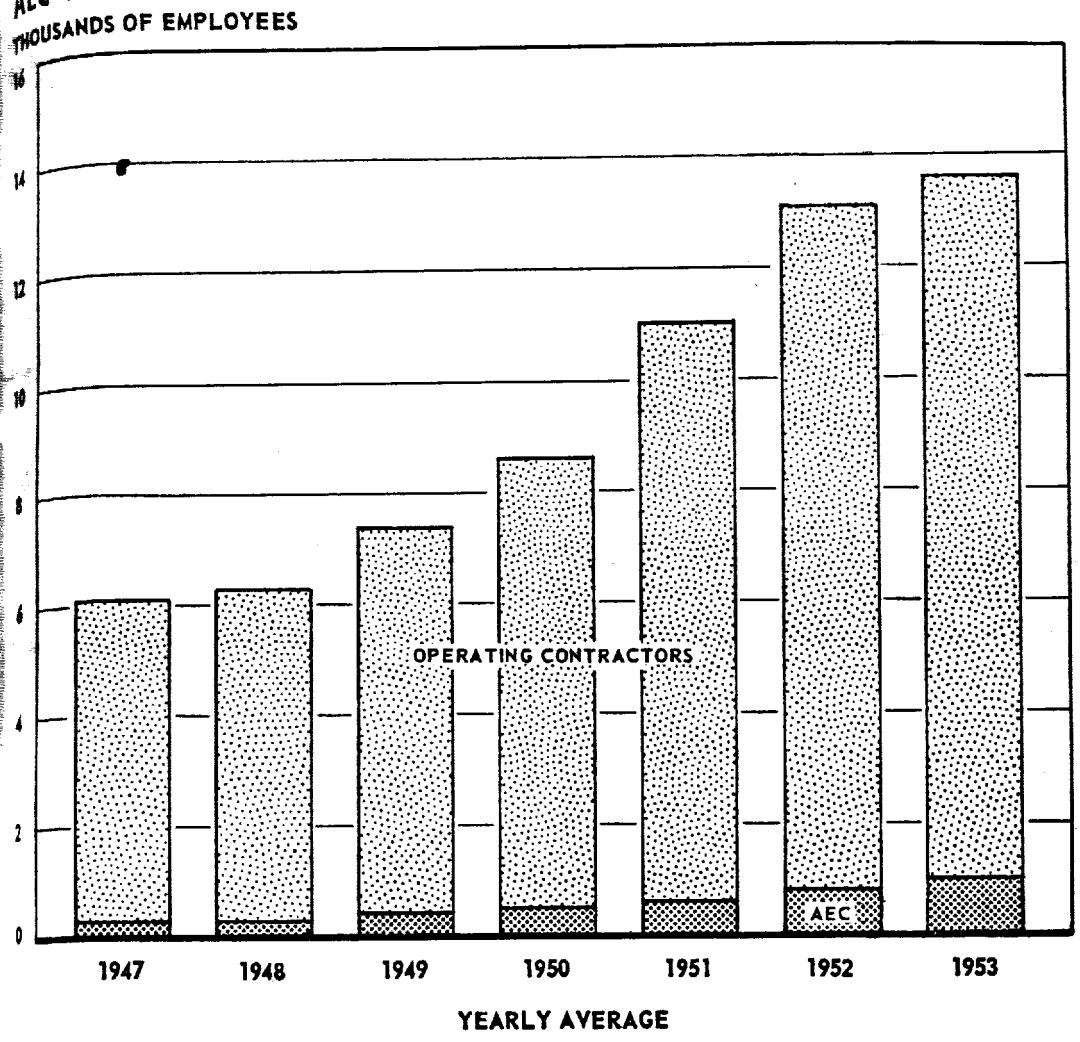
Safety

The AEC acc
page 60, contin
industry. Ove
all-time low of
slight increase
This increase re
construction.

The National
in recognition c
On December 9,
Ned H. Dearbor
its contractors.

The injury ra
since the end of

EMPLOYMENT TREND OF SCIENTIFIC AND ENGINEERING STAFFS OF AEC AND ITS OPERATING CONTRACTORS



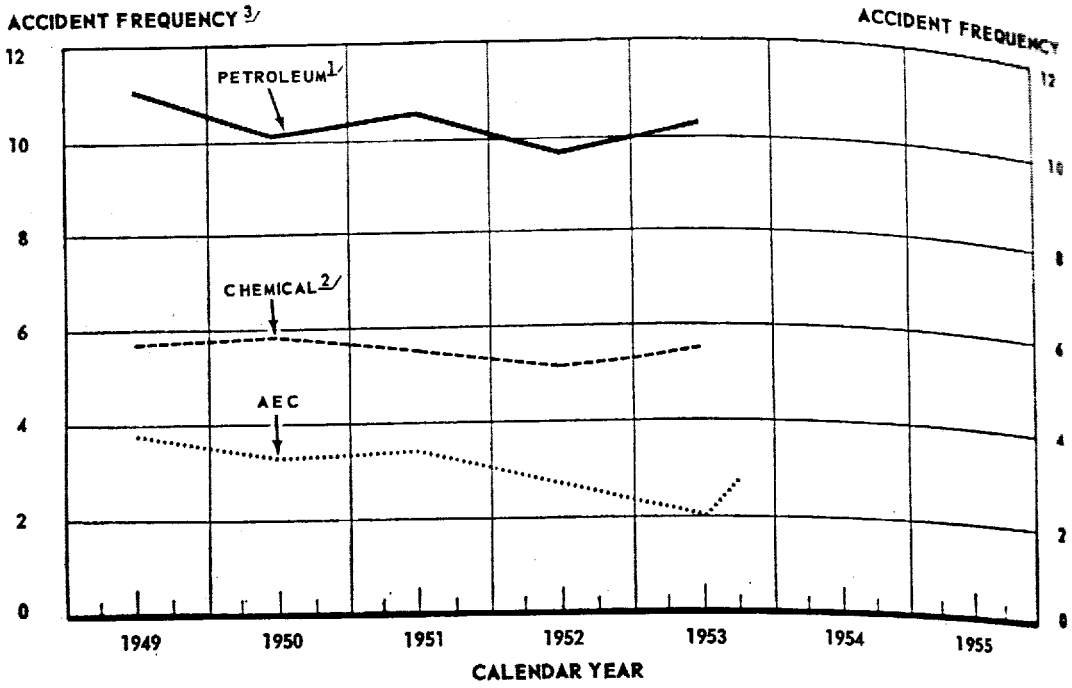
Safety

The AEC accident-prevention program, illustrated in the charts on page 60, continues to compare favorably with similar programs in industry. Overall AEC injuries per million man-hours were at an all-time low of 2.03 in March 1953. Since that time there has been a slight increase to 2.6 at the end of August, the last month reported. This increase reflects in part a higher frequency experienced on new construction.

The National Safety Council granted the AEC the award of honor in recognition of the Commission's safety accomplishments in 1952. On December 9, 1953, Chairman Strauss accepted the award from Mr. Ned H. Dearborn, president of the council, on behalf of the AEC and its contractors.

The injury rate in the atomic energy program has declined steadily since the end of 1949. The frequency of injuries from accidents in

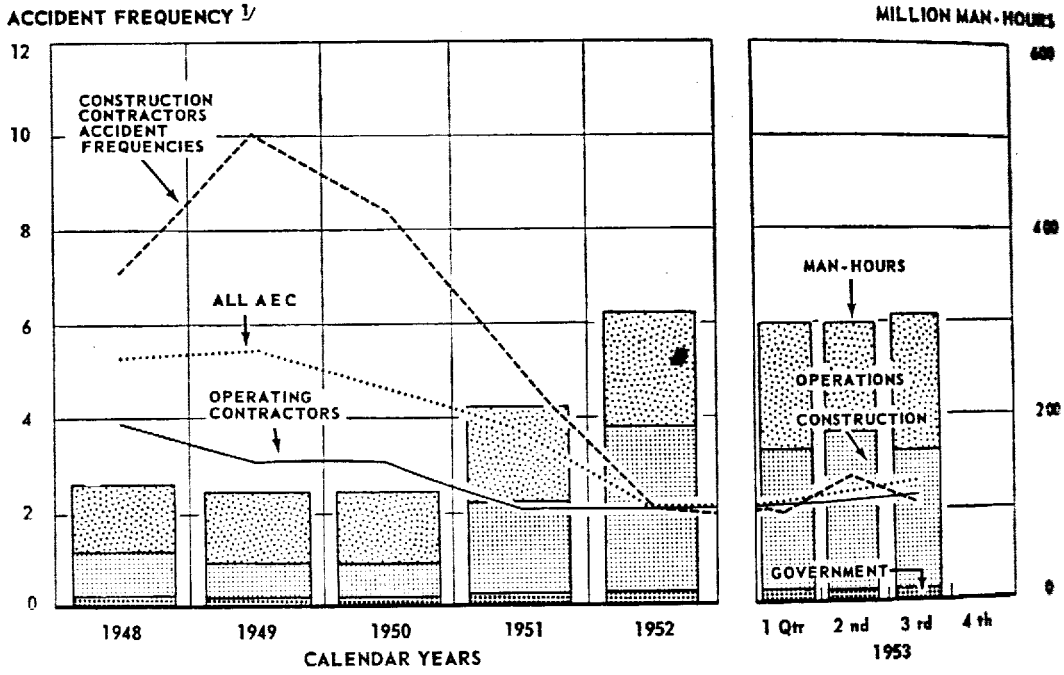
AEC INJURY RATES
COMPARED WITH SELECTED INDUSTRIES



1/ 2/ Figures as reported annually by the National Safety Council Accident frequency report. 1953 figures based on three year trend.

3/ Number of injuries per million manhours.

AEC INJURY RATES



1/ Number of injuries per million man-hours.

the overall progr
1949 to 2.51. The
10.14 to 8.40 per m
The injury rate
2.29 per million m
The 1952 rate repo
cal industry, the n

Fire Protection

Industrial, rese
suffered $449,107 d
$103,882 damage i
fire loss during 19
property, roughly
handling "preferre
ments per million
during 1952, reflec
sion's large-scale
AEC communities
in AEC history an
average loss per ca

Infor

Technical Informat

In the interest of
field the Commissi
and disseminating w
will aid research an
private projects. T
this information is d
As in many othe
for advice and assi
dustry which shoul
This service is rend
on Industrial Infor
various AEC install
to be valuable guide
ening their informat
in the reports is av
business publication
of the AEC. This

the overall program dropped from 5.40 per million man-hours in 1949 to 2.51. The injury rate for American industry decreased from 10.14 to 8.40 per million man-hours during the same period.

The injury rate for employees of AEC operations contractors was 2.29 per million man-hours in 1952, compared with 3.02 for 1949–51. The 1952 rate reported by the National Safety Council for the chemical industry, the nearest comparable industry, was 5.10.

Fire Protection

Industrial, research and construction facilities owned by AEC suffered $449,107 damage from 845 fires during 1952, compared with $103,882 damage in the first 9 months of 1953. The rate of annual fire loss during 1953 was $0.0027, or 3 mills per $100 of AEC-owned property, roughly one-quarter the loss rate of insurance companies handling "preferred" industrial fire risks. Cost of paid fire departments per million dollars of AEC-owned property increased slightly during 1952, reflecting fire protection requirements of the Commission's large-scale construction program. Municipal fire losses in AEC communities in 1952 were $28,201. This is the second lowest in AEC history and represents approximately one-fifth the national average loss per capita basis.

Information on Atomic Energy

Technical Information

In the interest of inducing most rapid progress in the atomic energy field the Commission continues to pursue its policy of publishing and disseminating widely the unclassified technical information which will aid research and development workers, both in Government and private projects. The AEC program of publishing and disseminating this information is described in detail in Appendix 8.

As in many other fields the Commission calls on private industry for advice and assistance in identifying information of use to industry which should be submitted for declassification and issued. This service is rendered the Commission by the Advisory Committee on Industrial Information (see Appendix 2). Reports of visits to various AEC installations by members of this committee are proving to be valuable guides to project personnel in expanding and strengthening their information services for American industry. Information in the reports is available on request to editors of engineering and business publications who do not have access to restricted facilities of the AEC. This information serves as an introduction to un-

classified or declassifiable technology which may be reported from AEC research, development, processing and other laboratory and plant operations.

A task group of the committee visited the Hanford Works and the National Reactor Testing Station and found technology of particular interest to industry being developed or in use. This technology concerns heat exchange, instrumentation, remote and automatic control, demineralization and other water treatment, solvent extraction, ion-exchange processes, distillation, and disposal of radioactive wastes. The group also examined methods of overcoming corrosion, welding techniques, studies of radiation damage and other metallurgical investigations.

It was felt that presently there is little reactor technology at Hanford that would be of industrial interest inasmuch as the Hanford reactors are designed and used exclusively for the production of fissionable materials for weapons purposes. Some unique methods of control, including safety interlocks and instrumentation, might find commercial application. Certain features of the water supply system for the Hanford reactors also were reported to be of interest to pump manufacturers, operators of pumping plants and consulting engineers in applications where continuity of water supply is vital.

Work in metallurgy and ceramics at various Oak Ridge installations was reviewed and numerous lines of investigation and results of basic and applied research were found which are potentially valuable to general industry. Studies were reported on the kinetics of phase transformation; age-hardening phenomenon; preferred orientation in relation to manufacturing techniques; alloying habits and properties of alloys of titanium, zirconium, hafnium, and thorium; physics of the solid state including effects of radiation on strength, hardness, and toughness, and on creep, fatigue, and corrosion resistance at various temperatures; metallography, X-ray, and spectrographic techniques; powder metallurgical techniques; welding, brazing, and fabrication techniques particularly with respect to the "newer" metals.

In the field of ceramics, they reported that studies under way, while predominantly on oxides and silicides of present or possible use in reactors, include work on carbides and borides, manufacturing methods (compacting and sintering), high-temperature refractories for crucibles and furnace linings, metal-ceramic combinations (cermets), and ceramic-protected refractory metals—all for ultra-high-temperature service.

A survey of the available literature in various Oak Ridge libraries showed a great deal of unclassified material of industrial interest in the fields of metallurgy and ceramics.

Industrial Dev

The Office of
tact point betwe
with their own
Three hundred
during this per
contacts made si
of its program t
energy developn
pared a mobile
during June 195
Since the 1st of
River, at the Bo
chusetts, and at
sored by the New
staff members a
terested in atom
the formulation
program.

Declassification

As a result o
classification Co
ada, the AEC h
on reactors and
techniques of bas
The authorized
ing the feasibilit
to burn natural
formation in thi
dorsed by the cc
terest which ma
and handling fiss
plutonium metal
chemical extracti
plutonium 240;
methods for the
sion declassified
production of u
result of recomm

Industrial Development

The Office of Industrial Development continued to serve as a contact point between the AEC and industrial firms desiring to explore with their own funds commercial applications of atomic energy. Three hundred and forty-five additional firms sought information during this period, bringing to 710 the total number of industrial contacts made since this office was organized in May 1952. As part of its program to acquaint industry with the potential value of atomic energy developments, the Office of Industrial Development has prepared a mobile exhibit which was first displayed in New York City during June 1953 at the Exposition on Basic Materials for Industry. Since the 1st of July 1953 this exhibit has been shown at Savannah River, at the Boston meeting of the Associated Industries of Massachusetts, and at an atomic energy symposium in Buffalo, N. Y., sponsored by the New York State Department of Commerce. In addition, staff members addressed many national industrial organizations interested in atomic energy applications and the office participated in the formulation of policies governing the industrial participation program.

Declassification of Information

As a result of recommendations by the Sixth International Declassification Conference in April 1953 at Chalk River, Ontario, Canada, the AEC has authorized the release of additional information on reactors and associated technology and some additional data and techniques of basic scientific interest.

The authorized reactor information is considered necessary in studying the feasibility of power reactors. It concerns reactors designed to burn natural and slightly enriched uranium fuel. Release of information in this category will be subject to certain limitations endorsed by the conference. Other information of basic scientific interest which may now be released includes techniques for preparing and handling fission product sources; some physical properties of pure plutonium metal; some basic data on ion-exchange resins used in chemical extractions; the spontaneous fission rate of uranium 236 and plutonium 240; some fluoride surface chemistry; and research scale methods for the preparation of tritium and helium 3. The Commission declassified information of industrial interest concerning the production of uranium metal, pure graphite and heavy water as a result of recommendations of the Sixth Conference.

Part Two

Condensed AEC Annual Financial Report Fiscal Year 1953

Condensed AEC Annual Financial Report
Fiscal Year 1953

The financial position of the United States Atomic Energy Commission at June 30, 1952, and June 30, 1953; the results of operations for the fiscal years ended on those dates; and other financial data appear in the statements and charts on the following pages. The statements in this condensed version of the annual financial report of the Commission for fiscal year 1953 are derived from the accounts maintained directly by AEC and those maintained by its major cost-type contractors. Following normal industrial practice, AEC and these cost-type contractors keep accounts in terms of accrued costs. These accounts are audited periodically by AEC auditors. These statements have been prepared in conformity with the generally accepted accounting principles followed by industry except that for security reasons inventories of source and fissionable materials and atomic weapons and weapons components have been excluded from the balance sheet.

Condensed Comparative Balance Sheet

The Condensed Comparative Balance Sheet, pages 70 and 71, sets forth the assets, liabilities, and AEC equity at June 30, 1952, and June 30, 1953.

Among the significant changes in the comparative balance sheet is an increase of about $2.3 billion in cash during 1953 resulting from the appropriations made by the Congress for the expansion program. The cash in the hands of contractors decreased as AEC moved to cut down the advance financing of its cost-type contractors.

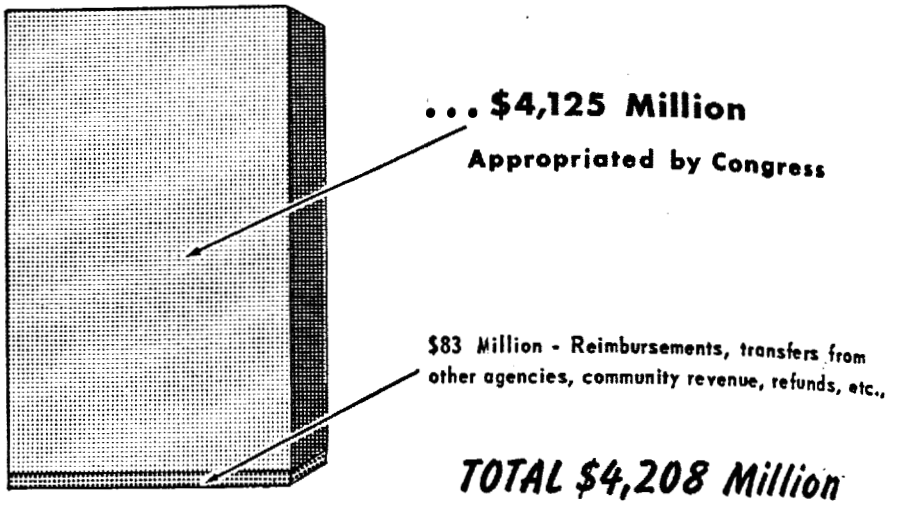
Construction costs for plant and equipment during 1953 totaled $1.125 billion. Over 23 percent of such costs were for projects under the expansion program authorized early in 1953. In conformity with generally accepted industrial accounting practice, AEC treats depreciation on its physical plant as an element of operating costs. In determining the amount of depreciation, AEC generally uses the straight-line method which spreads the cost of the depreciable plant and equipment evenly over their useful life. In 1953 depreciation and obsolescence amounted to $177 million. The total accumulated depreciation and obsolescence at June 30, 1953 was $755.1 million or about 24 percent of the cost of depreciable plant and equipment.

Collateral funds and other deposits decreased $3.5 million during fiscal year 1953. Since June 30, 1953, AEC has obtained refunds of insurance collateral amounting to about $13.4 million.

The total liabilities of AEC increased $10.9 million during 1953. Most of this amount was accounted for by an increase in the working-fund advances received from other Government agencies.

AEC equity increased almost $3.5 billion during 1953. This increase consists mainly of the increase in United States Treasury cash of $2.3 billion and the plant increase of a billion dollars.

RESOURCES IN F Y 1953 WERE . . .



USED FOR . . .

. . . CONSTRUCTION	$1,125
OPERATIONS	740
REIMBURSABLE WORK	43
INCREASE IN WORKING CAPITAL	2,293
OTHER	7
	$4,208

Comparative

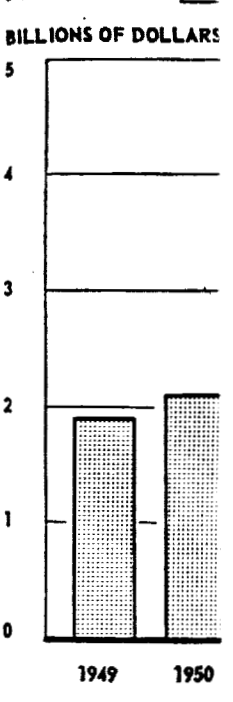
The Compa
costs for proc
and fissionab
search, and b
operating co
all programs
1953 operatio

Investment

The summa
atomic energy
the National
of June 30, 1
program amo
through June

The chart
during fiscal
AEC plant a

AEC GROWTH



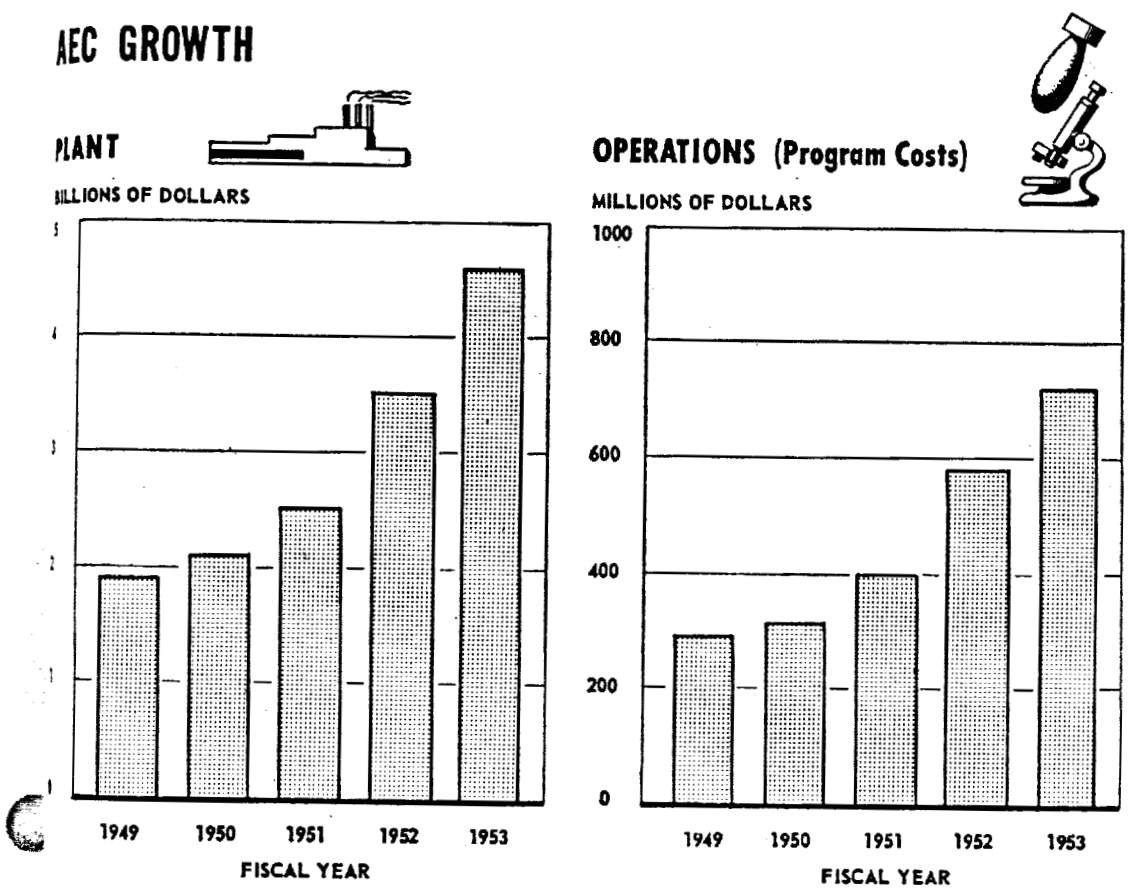
Comparative Statement of Operations

The Comparative Statement of Operations on page 72 reports AEC costs for production, research, and development in the areas of source and fissionable materials, weapons, reactor development, physical research, and biology and medicine. AEC incurred additional costs for operating communities at three installations and for administering all programs and financing security investigations. The net cost of 1953 operations was $904,596,278.

Investment

The summary of the United States Government's investment in the atomic energy program on page 73 shows the amounts invested since the National Defense Research Council started the project in 1940. As of June 30, 1953, the total funds appropriated to the atomic energy program amounted to $12.1 billion as compared with about $8 billion through June 30, 1952.

The chart on page 68, illustrates the resources received and applied during fiscal year 1953. The chart below illustrates the increase in AEC plant and operations from 1949 through 1953.



COMPARATIVE BALANCE SHEET AS OF

ASSETS	1953	1952
Cash and working funds:		
U. S. Treasury	$3,747,313,554	$1,413,254,623
Contractors	118,847,778	162,525,957
Other Federal agencies	73,871,429	69,294,870
	3,940,032,761	1,645,075,450
Accounts receivable less allowance for uncollectible accounts	13,408,396	8,291,845
Inventories at cost less allowance for losses	91,965,528	82,113,031
Prepayments	19,789,126	22,453,822
Plant and equipment at cost:		
Land and land rights	15,656,295	14,737,092
Production and research facilities	2,680,879,324	1,635,394,003
Community facilities	298,453,569	287,998,569
General facilities	154,523,506	195,745,587
Construction in progress	1,429,576,436	1,363,082,151
	4,579,089,130	3,496,957,402
Less accumulated depreciation and obsolescence	755,149,196	610,306,414
	3,823,939,934	2,886,650,988
Collateral funds and other deposits	44,525,235	47,998,386
Total assets	$7,933,660,980	$4,692,584,422

NOTES:

Inventories of raw source materials, fissionable materials, and weapons parts and assemblies are excluded from the balance sheet.

The balance sheet does not include the market value of 350,924,917 troy ounces of silver at June 30, 1953, and 401,971,068 troy ounces of silver at June 30, 1952, provided by the Treasurer of the United States and still in the Y-12 Oak Ridge plant in the form of electrical conductors. Its market value was $299,163,000 at June 30, 1953, and $332,641,000 at June 30, 1952. This silver is returnable in bullion form to the Treasurer of the United States for processing into commercial bars.

JUNE 30, 1953 AND JUNE 30, 1952

LIABILITIES AND AEC EQUITY

	1953	1952
Liabilities:		
Accounts payable	$168,407,193	$169,897,580
Working funds from other Federal agencies	48,976,742	39,273,311
Employees' and other funds on deposit	9,903,069	7,242,604
Deferred credits	354,444	287,717
Total liabilities	227,641,448	216,701,212
AEC equity:		
Equity, beginning of year	4,475,883,210	3,557,284,001
Additions:		
Appropriated funds (net)	4,136,475,500	1,605,756,473
Transfers from other Federal agencies without reimbursement	7,278	3,036,606
	8,612,365,988	5,166,077,080
Deductions:		
Net cost of operations and prior years' adjustments (See Comparative Statement of Operations)	900,555,265	682,079,187
Transfers to other Federal agencies without reimbursement	----------	2,673,511
Collections paid to U. S. Treasury	5,791,191	5,441,172
	906,346,456	690,193,870
Equity, end of year	7,706,019,532	4,475,883,210
Total liabilities and AEC equity	$7,933,660,980	$4,692,584,422

NOTES—(Continued)

As part of the domestic uranium program, the Commission has guaranteed minimum prices through March 31, 1958, for refined uranium and for uranium-bearing ores and mechanical concentrates. In addition, bonuses are payable under certain circumstances to encourage the discovery of new uranium resources. (See Domestic Uranium Program Circulars No. 1 through No. 6). The Commission also has long-term commitments for the procurement of foreign ores, and development of foreign ore sources, and for the return of residues of ores processed in this country.

In addition to the liabilities shown on the balance sheet, AEC had (*a*) a commitment for unfunded accrued annual leave of AEC employees at June 30, 1953, of $3,527,804 and at June 30, 1952, of $4,552,167; (*b*) known commitments

COMPARATIVE STATEMENT OF OPERATIONS FOR THE YEARS ENDED JUNE 30, 1953, AND JUNE 30, 1952

	1953	1952
Production, research and development:		
Source and fissionable materials	$281,039,542	$225,313,197
Weapons	236,385,273	202,355,404
Reactor development	91,129,087	60,576,273
Physical research (net)[1]	38,401,571	35,649,774
Biology and medicine	24,813,806	23,864,710
	671,769,279	547,759,358
Community operations:		
Operating costs	19,648,386	20,632,199
Less revenue	18,382,224	18,071,958
	1,266,162	2,560,241
AEC administrative expenses	34,426,151	30,466,712
Security investigations	12,547,537	1,328,027
Total program costs and expenses	720,009,129	582,114,338
Other expenses and income:		
Depreciation and obsolescence	176,972,295	103,372,620
Projects abandoned	713,414	147,126
Other charges	10,280,492	676,782
	187,966,201	104,196,528
Less other income	3,379,052	2,129,415
	184,587,149	102,067,113
Net cost of operations	904,596,278	684,181,451
Prior years' adjustments (net)	(4,041,013)	(2,102,264)
Net cost of operations and prior years' adjustments	$900,555,265	$682,079,187

[1] Costs have been reduced by proceeds from sales of isotopes aggregating $866,273 for the fiscal year ended June 30, 1953, and $604,901 for the fiscal year ended June 30, 1952.

U. S. GOVERNMENT INVESTMENT IN THE ATOMIC ENERGY PROGRAM FROM JUNE 1940 THROUGH JUNE 1953

Appropriated funds disbursed, net of reimbursements:		
National Defense Research Council		[1] $468,000
Office of Scientific Research and Development		[1] 14,624,810
War Department (Manhattan Engineer District):		
Fiscal year 1943	$77,098,355	
Fiscal year 1944	730,321,470	
Fiscal year 1945	858,571,646	
Fiscal year 1946	366,355,447	
Fiscal year 1947 (part)	185,975,321	
		2,218,322,239
Atomic Energy Commission:		
Fiscal year 1947 (part)	146,108,325	
Fiscal year 1948	477,557,826	
Fiscal year 1949	627,347,271	
Fiscal year 1950	534,308,839	
Fiscal year 1951	920,467,872	
Fiscal year 1952	1,669,386,036	
Fiscal year 1953	1,812,672,917	
		6,187,849,086
Net disbursements		8,421,264,135
Unexpended balance of appropriations, June 30, 1953		3,694,775,222
Total appropriated funds		12,116,039,357
Less:		
Collections paid to U. S. Treasury	[2] $22,163,743	
Property and services transferred to other Federal agencies without reimbursement, net of such transfers received from other Federal agencies	[3] 2,111,860	
		24,275,603
Total investment through June 30, 1953		[4] 12,091,763,754
Less:		
Cost of operations and cost of inventories of source and fissionable materials and weapons components on hand at June 30:		
June 1940 through June 1952	$3,485,188,957	
July 1, 1952, through June 1953 per statement of operations	900,555,265	
		4,385,744,222
AEC equity at June 30, 1953		$7,706,019,532

[1] Based on published reports.
[2] From Jan. 1, 1947, to date. Prior data not available.
[3] For the fiscal years 1949 through 1953. Prior data not available.
[4] The total investment through June 30, 1953, represents only the funds appropriated to agencies that have been charged specifically with the responsibility of administering the atomic energy program.

283269—54——6

APPENDIX 1

Organization and Principal Staff of U. S. Atomic Energy Commission, Jan. 1, 1954

Atomic Energy Commission	Lewis L. Strauss, *Chairman.*
	Joseph Campbell.
	Thomas E. Murray.
	H. D. Smyth.
	Eugene M. Zuckert.
General Manager	Kenneth D. Nichols.
Special Assistant to General Manager	Edward R. Trapnell.
Deputy General Manager	Walter J. Williams.
Assistant General Manager for Administration	James L. Kelehan.
Controller	Don S. Burrows.
General Counsel	William Mitchell.
Secretary to Commission	Roy B. Snapp.
Director, Office of Classification	James G. Beckerley.
Director, Office of Industrial Development	(Vacancy).
Director, Office of Intelligence	(Vacancy).
Chief, Office of Operations Analysis	David P. Herron.
Chief, Office of Special Projects	John A. Hall.
Director, Division of Biology and Medicine	Dr. John C. Bugher.
Director, Division of Engineering	Lawrence R. Hafstad, *Acting.*
Director, Division of Military Application	Brig. Gen. K. E. Fields.
Manager, Santa Fe (Albuquerque, N. Mex.) Operations Office	Carroll L. Tyler.
Manager, Burlington (Iowa) Field Office	E. W. Giles.
Manager, Eniwetok Field Office (Albuquerque, N. Mex.)	Paul W. Spain.
Manager, Kansas City (Mo.) Field Office	James C. Stowers.
Manager, Las Vegas (Nev.) Field Office	Seth R. Woodruff, Jr.
Manager, Los Alamos (N. Mex.) Field Office	Frank C. Diluzio.
Manager, Pantex (Amarillo, Tex.) Field Office	Walter W. Stagg.

Director, Division of Military Application—Continued	
Manager, Rocky Flats (Colo.) Field Office	GILBERT C. HOOVER.
Manager, Sandia (N. Mex.) Field Office	DANIEL F. WORTH, JR.
Manager, San Francisco (Calif.) Field Office	JOHN FLAHERTY.
Director, Division of Production	R. W. COOK.
Manager, Hanford (Wash.) Operations Office	DAVID F. SHAW.
Manager, New York (N. Y.) Operations Office	HENRY B. FRY.
Manager, Brookhaven (Long Island, N. Y.) Area	E. L. VAN HORN.
Manager, Cleveland (Ohio) Area	BUFORD SPARKS.
Manager, Fernald (Cincinnati, Ohio) Area	C. L. KARL.
Manager, St. Louis (Mo.) Area	J. PERRY MORGAN.
Manager, Oak Ridge (Tenn.) Operations Office	S. R. SAPIRIE.
Manager, Dayton (Miamisburg, Ohio) Area	JOHN H. ROBERSON.
Manager, Paducah (Ky.) Area	FRED BELCHER.
Manager, Portsmouth (Ohio) Area	KENNETH A. DUNBAR.
Manager, Savannah River (Augusta, Ga.) Operations Office	CURTIS A. NELSON.
Manager, Dana (Terre Haute, Ind.) Area	CHARLES W. REILLY.
Manager, Wilmington (Del.) Area	D. EWING IRONS.
Director, Division of Raw Materials	JESSE C. JOHNSON.
Manager, Grand Junction (Colo.) Operations Office	SHELDON P. WIMPFEN.
Director, Division of Reactor Development	LAWRENCE R. HAFSTAD.
Manager, Chicago (Ill.) Operations Office	A. TAMMARO.
Manager, Ames (Iowa) Area	W. W. LORD.
Manager, Lockland (Ohio) Area	E. M. VELTEN.
Manager, Pittsburgh (Pa.) Area	LAWTON D. GEIGER.
Manager, Idaho (Idaho Falls) Operations Office	L. E. JOHNSTON.
Manager, Schenectady (N. Y.) Operations Office	JON D. ANDERSON.

Director, Division of Research	THOMAS H. JOHNSON.
Director, Division of Construction and Supply	E. J. BLOCH.
Director, Division of Information Services	MORSE SALISBURY.
Director, Division of Organization and Personnel	OSCAR S. SMITH.
Director, Division of Security	JOHN A. WATERS, Jr.

APPENDIX 2

MEMBERSHIP OF COMMITTEES

STATUTORY COMMITTEES

Joint Committee on Atomic Energy—Eighty-third Congress

This committee was established by the Atomic Energy Act of 1946 (sec. 15) to make "continuing studies of the activities of the Atomic Energy Commission and of problems relating to the development, use, and control of atomic energy." The committee is kept fully and currently informed with respect to the Commission's activities. Legislation relating primarily to the Commission or to atomic energy matters is referred to the committee. The committee's membership is composed of nine members of the Senate and nine members of the House of Representatives.

Representative W. STERLING COLE (New York), *chairman.*
Senator BOURKE B. HICKENLOOPER (Iowa).
Senator EUGENE D. MILLIKIN (Colorado).
Senator WILLIAM F. KNOWLAND (California).
Senator JOHN W. BRICKER (Ohio).
Senator GUY R. CORDON (Oregon).
Senator RICHARD B. RUSSELL (Georgia).
Senator EDWIN C. JOHNSON (Colorado).
Senator CLINTON P. ANDERSON (New Mexico).
Senator JOHN O. PASTORE (Rhode Island).
Representative CARL HINSHAW (California).
Representative JAMES E. VAN ZANDT (Pennsylvania).
Representative JAMES T. PATTERSON (Connecticut).
Representative THOMAS A. JENKINS (Ohio).
Representative CARL T. DURHAM (North Carolina).
Representative CHET HOLIFIELD (California).
Representative MELVIN PRICE (Illinois).
Representative PAUL J. KILDAY (Texas).
CORBIN ALLARDICE, *executive director.*

Military Liaison Committee

Under sec. 2 (c) of the Atomic Energy Act of 1946, as amended, "there shall be a Military Liaison Committee consisting of a chairman, who shall be the head thereof, and of a representative or representatives of the Departments of the Army, Navy, and Air Force, detailed or assigned thereto, without additional compensation, in such number as the Secretary of Defense may determine. Representatives from each of the three Departments shall be designated by the respective Secretaries of the Army, Navy, and Air Force. The committee chairman shall be appointed by the President, by and with the advice and consent of the Senate, and shall receive compensation at a rate prescribed by law for the Chairman of the Munitions Board. The Commission shall advise and consult with the committee on all atomic energy matters which the committee deems to relate to military applications, including the development, manufacture, use and

storage of bombs, the allocation of fissionable material for military research, and the control of information relating to the manufacture or utilization of atomic weapons. The Commission shall keep the committee fully informed of all such matters before it and the committee shall keep the Commission fully informed of all atomic energy activities of the Department of Defense. The committee shall have authority to make written recommendations to the Commission on matters relating to military applications from time to time as it may deem appropriate. If the committee at any time concludes that any action, proposed action, or failure to act of the Commission on such matters is adverse to the responsibilities of the Department of Defense, derived from the Constitution, laws, and treaties, the committee may refer such action, proposed action, or failure to act to the Secretary of Defense. If the Secretary concurs, he may refer the matter to the President, whose decision shall be final."

Hon. Robert F. LeBaron, *Chairman.*
Brig. Gen. Kenner F. Hertford, United States Army.
Brig. Gen. Harry McK. Roper, United States Army.
Rear Adm. George C. Wright, United States Navy.
Rear Adm. James S. Russell, United States Navy.
Maj. Gen. James E. Briggs, United States Air Force.
Maj. Gen. Howard G. Bunker, United States Air Force.

General Advisory Committee

This committee was established by the Atomic Energy Act of 1946 (sec. 2 (b)). The nine civilian members are appointed by the President to advise the Commission on scientific and technical matters relating to materials, production, and research and development. Under the Atomic Energy Act, the Committee shall meet at least four times in every calendar year; the committee held its first meeting in January 1947, and to date has averaged six meetings a year.

Dr. I. I. Rabi, chairman; professor of physics, Columbia University, New York, N. Y.
Dr. Oliver E. Buckley, former chairman, Bell Telephone Laboratories, New York, N. Y.
Dr. J. B. Fisk, director of research—physical sciences, Bell Telephone Laboratories, Murray Hill, N. Y.
Dr. W. F. Libby, professor of chemistry, University of Chicago, Chicago, Ill.
Eger V. Murphree, president, Standard Oil Development Co., New York, N. Y.
Dr. John Von Neumann, professor, school of mathematics, Institute for Advanced Studies, Princeton, N. J.
Dr. J. C. Warner, president, Carnegie Institute of Technology, Pittsburgh, Pa.
Walter G. Whitman, head, department of chemical engineering, Massachusetts Institute of Technology, Cambridge, Mass.
Dr. Eugene P. Wigner, professor of physics, Princeton University, Princeton, N. J.
Dr. Richard W. Dodson, secretary; chairman, department of chemistry, Brookhaven National Laboratory, Upton, Long Island, N. Y.

PATENT COMPENSATION BOARD

This board was established in April 1949 pursuant to section 11 of the Atomic Energy Act of 1946, which provides that upon application for just compensation for awards or for the determination of a reasonable royalty fee certain proceedings

shall be held before such a board. To date the board has held 10 sessions; 14 cases have been filed, of which 10 have been finally determined by the board; 2 claims have been awarded and 1 claim has been withdrawn.

CASPER W. OOMS, chairman; firm of Casper W. Ooms, Chicago, Ill.
ISAAC HARTER, of Babcock & Wilcox Tube Co., Beaver Falls, Pa.
JOHN V. L. HOGAN, consulting engineer, Hogan Laboratories, Inc., New York, N. Y.

COMMITTEE OF SENIOR REVIEWERS

The Committee of Senior Reviewers appointed in 1946 by the Manhattan District and reaffirmed by the AEC has been increased from four to six members to meet the expanding scope of the Atomic Energy Commission's technical activities. The committee reviews the major phases of the Atomic Energy Commission program and is the principal adviser to the Commission on classification and declassification matters, making recommendations for formulating and modifying the rules and guides for classifying scientific and technical information. The committee members are appointed for a term of 5 years on a rotating basis. The next new appointment will be made on July 1, 1954.

Dr. WARREN C. JOHNSON, chairman; associate dean of physical sciences, University of Chicago, Chicago, Ill.
Dr. R. H. CRIST, director of physical research, Carbide & Carbon Chemicals Co. Plant, Charleston, W. Va.
Dr. THOMAS B. DREW, head, department of chemical engineering, Columbia University, New York, N. Y.
Dr. ALVIN C. GRAVES, J division leader, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.
Dr. JOHN P. HOWE, section chief, reactor materials, North American Aviation, Inc., Downey, Calif.
Dr. J. R. RICHARDSON, associate professor of physics, University of California, Los Angeles, Calif.

ADVISORY BODIES TO THE ATOMIC ENERGY COMMISSION

Advisory Committee on Biology and Medicine

The Advisory Committee on Biology and Medicine was created in September 1947, on the recommendation of the Commission's Medical Board of Review. The committee reviews the AEC programs in medical and biological research and health and recommends to the Commission general policies in these fields.

Dr. E. C. STAKMAN, chairman; chief, division of plant pathology and botany, University of Minnesota, Minneapolis, Minn.
Dr. CHARLES H. BURNETT, professor of medicine, University of North Carolina, Chapel Hill, N. C.
Dr. EDWARD A. DOISY, director, department of physiology and biochemistry, St. Louis University School of Medicine, St. Louis, Mo.
Dr. GIOACCHINO FAILLA, director, department of radiology, Columbia University, Medical School, New York, N. Y.
Dr. CURT STERN, professor of zoology, University of California, Berkeley, Calif.
Dr. SHIELDS WARREN, pathologist, New England Deaconess Hospital, Boston, Mass.

This board was
hears contract
and subcontracts
their disposition

HENRY P. BRAN
Chapel Hill, N
SHELDON D. ELL
University, Ne
ROBERT KINGSLE
Angeles, Calif.
EDMUND R. PUR
ington, D. C.
HERBERT F. TAG
Michigan, Ann

This committee
of the Engineeri
involving fabrica

F. W. DAVIS, ch
CHARLES D. Cox
Harman, Brid
FRANK G. HARKI
Lt. T. HIKIDO, W
Dayton, Ohio.
G. O. HOGLUND,
num Company
T. E. KIHLGREN,
Bayonne, N. J.
A. R. LYTLE, dire
New York, N.
ROBERT L. PEASL
W. SPRAGUEN, se
LYALL ZICKRICK,
tory, Schenect

This committee
AEC program of
and the relations
gram. Most of
sultation as spec

Dr. FARRINGTON
son, Wis.
Dr. G. B. KISTIAK
Mass.

Advisory Board of Contract Appeals

This board was established in February 1950. One or more of its members hears contract appeals arising under the "disputes articles" of AEC contracts and subcontracts and makes recommendations to the General Manager concerning their disposition.

HENRY P. BRANDIS, Jr., dean of the law school, University of North Carolina, Chapel Hill, N. C.
SHELDON D. ELLIOTT, director of institute for judicial administration, New York University, New York, N. Y.
ROBERT KINGSLEY, dean, school of law, University of Southern California, Los Angeles, Calif.
EDMUND R. PURVES, executive director, American Institute of Architects, Washington, D. C.
HERBERT F. TAGGART, dean, school of business administration, University of Michigan, Ann Arbor, Mich.

Advisory Committee on Brazing

This committee was formed at AEC request by the Welding Research Council of the Engineering Foundation to serve in an advisory capacity on problems involving fabrication by brazing.

J. W. DAVIS, chairman; engineering division, AEC, Washington, D. C.
CHARLES D. COXE, assistant manager, metallurgical department, Handy and Harman, Bridgeport, Conn.
FRANK G. HARKINS, chief welding engineer, Solar Aircraft Co., San Diego, Calif.
J. T. HIKIDO, Wright Air Development Center, Wright Patterson Air Force Base, Dayton, Ohio.
J. O. HOGLUND, welding engineer, process and development laboratories, Aluminum Company of America, New Kensington, Pa.
J. E. KIHLGREN, welding section, research laboratory, International Nickel Co., Bayonne, N. J.
J. R. LYTLE, director of research, Union Carbide & Carbon Research Laboratories, New York, N. Y.
ROBERT L. PEASLEE, development engineer, Wall Colmonoy Corp., Detroit, Mich.
J. SPEARAGEN, secretary; director, Welding Research Council, New York, N. Y.
HALL ZICKRICK, head, materials engineering unit, Knolls Atomic Power Laboratory, Schenectady, N. Y.

Advisory Committee on Chemistry

This committee was appointed in June 1949 to advise on policy concerning the AEC program of supporting basic unclassified chemistry research in universities, and the relationship of this program to the AEC's own chemistry research program. Most of the work of the committee is accomplished by individual consultation as specific problems arise.

FARRINGTON DANIELS, professor of chemistry, University of Wisconsin, Madison, Wis.
G. B. KISTIAKOWSKY, professor of chemistry, Harvard University, Cambridge, Mass.

Dr. JOSEPH E. MAYER, professor of chemistry, University of Chicago, Chicago, Ill.
Dr. DON M. YOST, professor of chemistry, California Institute of Technology, Pasadena, Calif.

Advisory Committee on Industrial Information

This committee was reconstituted and expanded in April 1952 to replace an ad hoc committee appointed in 1949 to advise the AEC on disseminating unclassified technological information to industry. The members are visiting AEC sites to identify information of use to industry which should be submitted for declassification and recommending arrangements for the widest possible publication and distribution of such declassifiable information.

SIDNEY D. KIRKPATRICK, chairman; vice president and director of editorial development, McGraw-Hill Book Co., Inc., New York, N. Y.
Dr. ALLAN G. GRAY, editor, Steel, Penton Publishing Co., Cleveland, Ohio.
EUGENE HARDY, National Association of Manufacturers, Washington, D. C.
KEITH HENNEY, editor, Nucleonics and Electronics, McGraw-Hill Publishing Co., Inc.; American Institute of Radio Engineers, New York, N. Y.
Dr. ELMER HUTCHISSON, editor, Journal of Applied Physics, American Institute of Physics, New York, N. Y.
WALTER E. JESSUP, editor, Civil Engineering, The American Society of Civil Engineers, New York, N. Y.
ANDREW W. KRAMER, editor, Power Engineering, The Technical Publishing Co., Chicago, Ill.
EVERETT S. LEE, American Institute of Electrical Engineers, New York, N. Y.
Dr. WALTER J. MURPHY, editor, Chemical and Engineering News, American Chemical Society, Washington, D. C.
EDWARD H. ROBIE, secretary, American Institute of Mining and Metallurgical Engineers, New York, N. Y.
KARL T. SCHWARTZWALDER, The American Ceramic Society, Inc., Columbus, Ohio.
GEORGE F. SULLIVAN, managing editor, The Iron Age, Chilton Publications, Inc., New York, N. Y.
E. E. THUM, editor, Metal Progress, American Society for Metals, Cleveland, Ohio.
OLIVER H. TOWNSEND, secretary, Atomic Industrial Forum, Inc., New York, N. Y.
S. A. TUCKER, publications manager, American Society of Mechanical Engineers, New York, N. Y.
F. J. VAN ANTWERPEN, editor, Chemical Engineering Progress, American Institute of Chemical Engineers, New York, N. Y.
DR. ALBERTO F. THOMPSON, secretary; chief, technical information service, division of information services, AEC, Washington, D. C.
N. H. JACOBSON, assistant secretary; chief, industrial information branch, division of information services, AEC, Washington, D. C.

Advisory Committee on Isotope Distribution

This committee was originally appointed by the Manhattan District to advise on the off-project distribution of isotopes. The Commission approved its continuation in December 1947 to aid in establishing new policies on distributing radioactive materials and to review existing policies. The committee reviews all initial applications for use of radioisotopes in human beings, and all other re-

quests for their use
it by the Commissio

pr. DONALD E. HULI
Research Corp., Ri
pr. RICHARD CHAMB
delphia, Pa.
pr. JOHN E. CHRIS
chemistry, Purdue
pr. SAMUEL E. EATON
pr. STERLING B. HEN
Agricultural Engin
pr. LEON O. JACOBSO
of Chicago, Chicag
pr. EDITH H. QUIMBY
Surgeons, Columbi
pr. HOWARD E. SKI
mingham, Ala.
pr. JOHN E. WILLARI
Wis.
pr. PAUL C. AEBERS
Tenn.

Adviso

This committee of le
was named in Septen
continuous review of
best personnel metho
policies. The commit

ARTHUR S. FLEMMING
ington, D. C.; pres
L. CLAYTON HILL, pro
Arbor, Mich.
ROBERT RAMSPECK, vi
WALLACE SAYRE, pro
York, N. Y.
PHILLIP YOUNG, chai
(Vacancy).

I

This board was appo
security cases which
cedure and to make r
The board, in its mon
considerations regar
eligibility for securit

GANSON PURCELL, ch
Dr. PAUL E. KLOPSTE
ington, D. C.
WILLIAM E. LEAHY, p

quests for their use in research, education, and industry which are referred to it by the Commission.

Dr. DONALD E. HULL, chairman; research chemist, process division, California Research Corp., Richmond, Calif.
Dr. RICHARD CHAMBERLAIN, University of Pennsylvania Medical School, Philadelphia, Pa.
Dr. JOHN E. CHRISTIAN, associate professor, department of pharmaceutical chemistry, Purdue University, Lafayette, Ind.
Dr. SAMUEL E. EATON, A. D. Little, Inc., Cambridge, Mass.
Dr. STERLING B. HENDRICKS, head chemist, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture, Beltsville, Md.
Dr. LEON O. JACOBSON, associate dean, division of biological sciences, University of Chicago, Chicago, Ill.
Dr. EDITH H. QUIMBY, associate professor of radiology, College of Physicians and Surgeons, Columbia University, New York, N. Y.
Dr. HOWARD E. SKIPPER, associate director, Southern Research Institute, Birmingham, Ala.
Dr. JOHN E. WILLARD, professor of chemistry, University of Wisconsin, Madison, Wis.
Dr. PAUL C. AEBERSOLD, secretary; chief, isotopes division, AEC, Oak Ridge, Tenn.

Advisory Committee on Personnel Management

This committee of leading authorities from government, industry, and education was named in September 1948 to provide the Atomic Energy Commission with a continuous review of its personnel management practices and to evaluate the best personnel methods of government and industry in determining over-all AEC policies. The committee usually meets quarterly.

ARTHUR S. FLEMMING, chairman; director, Office of Defense Mobilization, Washington, D. C.; president, Ohio Wesleyan University, Delaware, Ohio.
J. CLAYTON HILL, professor of industrial relations, University of Michigan, Ann Arbor, Mich.
ROBERT RAMSPECK, vice president, Eastern Airlines, Inc., Washington, D. C.
WALLACE SAYRE, professor, department of government, City College of New York, N. Y.
PHILLIP YOUNG, chairman, U. S. Civil Service Commission, Washington, D. C. (Vacancy).

Personnel Security Review Board

This board was appointed in March 1949 primarily to review specific personnel security cases which arise under the Commission's administrative review procedure and to make recommendations concerning them to the General Manager. The board, in its monthly meetings, also advises the Commission on the broader considerations regarding personnel security, such as criteria for determining eligibility for security clearance and personnel security procedures.

VANSON PURCELL, chairman; of Purcell & Nelson, Washington, D. C.
Dr. PAUL E. KLOPSTEG, associate director, National Science Foundation, Washington, D. C.
WILLIAM E. LEAHY, president, Columbus University, Washington, D. C.

AEC Computer Council

This group is appointed on a yearly basis to make a continuing review of the AEC computing requirements and facilities and to recommend the most advantageous apportionment of computer time on the AEC Computer at New York University. The following members were appointed to serve from July 1953 to July 1954.

Dr. EDWARD TELLER, chairman; department of physics, University of California, Berkeley, Calif.
Dr. ELEAZER BROMBERG, institute for mathematics and mechanics, New York University, New York, N. Y.
Dr. RICHARD COURANT, institute for mathematics and mechanics, New York University, New York, N. Y.
Dr. ALSTON S. HOUSEHOLDER, mathematics panel, Oak Ridge National Laboratory, Oak Ridge, Tenn.
Dr. HENRY HURWITZ, Jr., theoretical physics division, Knolls Atomic Power Laboratory, Schenectady, N. Y.
Dr. GEORGE A. KOLSTAD, vice chairman; physics branch, division of research, AEC, Washington, D. C.
Dr. SIDNEY KRASIK, physics division, Westinghouse Atomic Power Division, Pittsburgh, Pa.
Dr. V. LAWRENCE PARSEGIAN, division of technical advisors, AEC, New York, N. Y.
Dr. ROBERT D. RICHTMYER, secretary; theoretical division, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.
Dr. BERNARD SPINRAD, physics division, Argonne National Laboratory, Chicago, Ill.

Advisory Committee on Reactor Safeguards

Two advisory committees of the U. S. Atomic Energy Commission—the Reactor Safeguard Committee and the Industrial Committee on Reactor Location Problems—have been combined to form a new group known as the Advisory Committee on Reactor Safeguards. The new committee reviews safety studies prepared by organizations planning to build or operate reactor facilities and appraises proposed reactor locations in terms of accepted industrial safety standards.

Dr. C. ROGERS MCCULLOUGH, chairman; general development department, Monsanto Chemical Co., St. Louis, Mo.
Dr. MANSON BENEDICT, professor of chemical engineering, Massachusetts Institute of Technology, Cambridge, Mass.
Dr. WILLARD P. CONNER, manager, physics division, research department, Hercules Powder Co., Wilmington, Del.
Dr. R. L. DOAN, manager, atomic energy division, Phillips Petroleum Co., Idaho Falls, Idaho.
Dr. HYMER FRIEDELL, director, department of radiology, Lakeside Hospital, Western Reserve University, Cleveland, Ohio.
Dr. I. B. JOHNS, assistant director, central research department, Monsanto Chemical Co., Dayton, Ohio.
Dr. MARK M. MILLS, radiation laboratory, University of California, Livermore, Calif.
K. R. OSBORN, manager of industrial development, general chemical division, Allied Chemical and Dye Corp., New York, N. Y.

D. A. ROGERS, I
Morristown, N
REUEL C. STRAT
division, the T
Dr. EDWARD TE
California, Li
Dr. ABEL WOLM
University, Ba
Dr. HARRY WEX
Department of
Dr. C. R. RUSSI
D. C.

This committee,
Engineering Fou
Commission in r
type 347 stainles
made public. I
enlarged to inclu

Dr. V. N. KRIVOB
Nickel Co., Inc.
W. O. BINDER, re
N. Y.
F. W. DAVIS, eng
W. B. DELONG, E.
R. B. GUNIA, Ca
LORIN K. POOLE, I
Dr. M. A. SCHEIL
Wis.
R. DAVID THOMA
Corp., Philadel

This committee
Commission's ra
development, an
formation.

IRA B. JORALEMON
FRANCIS CAMERO
EVERETTE L. DEG
Tex.
THOROLD F. FIELD
J. K. GUSTAFSON,
FRANK W. MCQU
York, N. Y.
ERNEST H. ROSE,
mingham, Ala.

P. A. ROGERS, manager, central engineering, Allied Chemical and Dye Corp., Morristown, N. J.
REUEL C. STRATTON, supervising chemical engineer, engineering and loss control division, the Travelers Insurance Co., Hartford, Conn.
Dr. EDWARD TELLER, professor of physics, radiation laboratory, University of California, Livermore, Calif.
Dr. ABEL WOLMAN, head, department of sanitary engineering, Johns Hopkins University, Baltimore, Md.
Dr. HARRY WEXLER, chief, scientific services division, U. S. Weather Bureau, Department of Commerce, Washington, D. C.
Dr. C. R. RUSSELL, secretary; U. S. Atomic Energy Commission, Washington, D. C.

Advisory Committee on Stainless Steel

This committee, formed in 1950, by the Welding Research Council of the Engineering Foundation, in July 1951 at AEC request became advisory to the Commission in regard to research and development to improve the welding of type 347 stainless steel. All data resulting from these investigations are being made public. In October 1953 the scope of the Committee's services was enlarged to include the manufacture, fabrication, and use of all stainless steels.

Dr. V. N. KRIVOBOK, chairman; development and research division, International Nickel Co., Inc., New York, N. Y.
W. O. BINDER, research laboratory, Union Carbide and Carbon Co., Niagara Falls, N. Y.
F. W. DAVIS, engineering division, AEC, Washington, D. C.
W. B. DELONG, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
S. B. GUNIA, Carnegie Illinois Steel Corp., Pittsburgh, Pa.
ROBIN K. POOLE, project engineer, Arcos Corp., Philadelphia, Pa.
Dr. M. A. SCHEIL, director, metallurgical research, A. O. Smith Corp., Milwaukee, Wis.
J. DAVID THOMAS, Jr., vice president & director, research & engineering, Arcos Corp., Philadelphia, Pa.

Committee on Raw Materials

This committee was appointed in October 1947 to review the Atomic Energy Commission's raw materials program and to advise on questions of exploration, development, and procurement. The committee has met 13 times since its formation.

JOHN B. JORALEMON, chairman; geologist, San Francisco, Calif.
FRANCIS CAMERON, vice president, St. Joseph Lead Co., New York, N. Y.
EVERETTE L. DEGOLYER, petroleum geologist; DeGolyer & McNaughton, Dallas, Tex.
HAROLD F. FIELD, consulting mining engineer, Duluth, Minn.
K. GUSTAFSON, consulting geologist, M. A. Hanna Co., Cleveland, Ohio.
FRANK W. MCQUISTON, Jr., metallurgical engineer, Newmont Mining Corp., New York, N. Y.
ERNEST H. ROSE, chemical engineer, Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.

WALTER O. SNELLING, director of research and consulting chemist, Trojan Powder Co., Allentown, Pa.
ORVIL R. WHITAKER, consulting mining engineer, Denver, Colo.
CLYDE E. WILLIAMS, director, Battelle Memorial Institute, Columbus, Ohio.

Industrial Information Committee

This committee, representing AEC operating divisions and offices of operations and the major contractors, was appointed in 1952 to guide the dissemination of AEC-developed information to industry. Meetings are held three times a year.

Dr. ALBERTO F. THOMPSON, chairman; chief, technical information service, division of information services, AEC, Washington, D. C.
H. C. BALDWIN, director of information, Chicago Operations Office, AEC, Lemont, Ill.
BREWER F. BOARDMAN, supervisor, technical information service, Phillips Petroleum Co., Idaho Falls, Idaho.
GEORGE L. BROWN, manager of public relations, General Electric Co., Hanford Works, Richland, Wash.
Dr. F. L. CUTHBERT, technical director, National Lead Co. of Ohio, Cincinnati, Ohio.
H. W. DAVIS, Jr., deputy director, technical and production division, Savannah River Operations Office, AEC, Augusta, Ga.
W. E. DREESZEN, administrative aide to director, Ames Laboratory, Ames, Iowa.
R. G. ELLIOTT, director of information, Santa Fe Operations Office, AEC, Albuquerque, N. Mex.
LESTER C. FURNEY, assistant to director, Argonne National Laboratory, Lemont, Ill.
J. F. HAGGERTY, biochemist, medical branch, division of biology and medicine, AEC, Washington, D. C.
W. L. HARWELL, head, patents and declassification department, Carbide & Carbon Chemicals Co., div. of Union Carbide & Carbon Corp., Oak Ridge, Tenn.
F. SEYMOUR HENCK, assistant to manager for public education, Oak Ridge Operations Office, AEC, Oak Ridge, Tenn.
EDWARD L. HILL, supervisor, technical services unit, General Electric ANP Project, Cincinnati, Ohio.
JOHN F. HOGERTON, director of public information service, New York Operations Office, AEC, New York, N. Y.
MYRON KRATZER, division of production, AEC, Washington, D. C.
DAVID P. KUNTZ, organization and methods examiner, division of raw materials, AEC, Washington, D. C.
ARTHUR R. LEE, division of information, Idaho Operations Office, AEC, Idaho Falls, Idaho.
FRANK R. LONG, supervisor, technical information group, atomic energy research department, North American Aviation, Inc., Downey, Calif.
Dr. GEORGE G. MANOV, office of industrial development, AEC, Washington, D. C.
Dr. A. R. MATHESON, head, technical operations division, Schenectady Operations Office, AEC, Schenectady, N. Y.
Dr. DANIEL J. PFLAUM, chief, materials and information branch, division of research, AEC, Washington, D. C.
DENNIS PULESTON, head, technical information division, Brookhaven National Laboratory, Upton, Long Island, N. Y.

Dr. H. W. Rus
Ohio.
Dr. W. E. Shou
tric Corp., P
Dr. CHARLES S
cation, AEC,
Dr. RALPH CA
Los Alamos
Dr. JOHN R. ST
Laboratory,
Dr. M. H. WA
Atlanta, Ga.
Dr. R. K. WAK
versity of Ca
E. A. WIGGIN,
Operations O
J. W. YOUNG, te
Washington,
N. H. JACOBSON.
formation ser

This group is a
AEC program o
for cross sectio
ing members we

Dr. RICHARD F.
tific Laborato
Dr. TOM W. BON
Dr. JOSEPH L. I
Ridge, Tenn.
Dr. HERBERT GO
N. Y.
Dr. WILLIAM W.
York, N. Y.
Dr. DONALD J. H
Upton, Long I
Dr. ALEXANDER
Chicago, Ill.
Dr. CARL O. MUE
tory, Upton, L
Dr. JACK M. PET
oratory, Liver
Dr. HERBERT S.
Oak Ridge, Te
Dr. THOMA M.
Schenectady, N
Dr. LOUIS A. TURI
Dr. GEORGE A. K
AEC, Washingt

Dr. H. W. RUSSELL, assistant director, Battelle Memorial Institute, Columbus, Ohio.
Dr. W. E. SHOUPP, assistant manager, atomic power division, Westinghouse Electric Corp., Pittsburgh, Pa.
Dr. CHARLES SLESSER, director, division of technical information and declassification, AEC, New York Operations Office, New York, N. Y.
Dr. RALPH CARLISLE SMITH, assistant director for classification and security, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.
Dr. JOHN R. STEHN, physicist, theoretical physics division, Knolls Atomic Power Laboratory, Schenectady, N. Y.
Dr. M. H. WAHL, atomic energy division, E. I. du Pont de Nemours & Co., Atlanta, Ga.
Dr. R. K. WAKERLING, chief, information division, Radiation Laboratory, University of California, Berkeley, Calif.
A. WIGGIN, chief, isotopes development branch, isotopes division, Oak Ridge Operations Office, AEC, Oak Ridge, Tenn.
W. YOUNG, technical information officer, division of reactor development, AEC, Washington, D. C.
H. JACOBSON, secretary; chief, industrial information branch, division of information services, AEC, Washington, D. C.

Nuclear Cross Sections Advisory Group

This group is appointed on a yearly basis to make a continuing review of the AEC program of nuclear cross section measurements, and to evaluate the needs for cross section information in the various activities of the AEC. The following members were appointed to serve from July 1953 to July 1954.

Dr. RICHARD F. TASCHEK, chairman; department of physics, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.
Dr. TOM W. BONNER, department of physics, Rice Institute, Houston, Tex.
Dr. JOSEPH L. FOWLER, physics division, Oak Ridge National Laboratory, Oak Ridge, Tenn.
Dr. HERBERT GOLDSTEIN, Nuclear Development Associates, Inc., White Plains, N. Y.
Dr. WILLIAM W. HAVENS, Jr., department of physics, Columbia University, New York, N. Y.
Dr. DONALD J. HUGHES, department of physics, Brookhaven National Laboratory, Upton, Long Island, N. Y.
Dr. ALEXANDER S. LANGSDORF, physics division, Argonne National Laboratory, Chicago, Ill.
Dr. CARL O. MUEHLHAUSE, department of physics, Brookhaven National Laboratory, Upton, Long Island, N. Y.
Dr. JACK M. PETERSON, cyclotron group, University of California Radiation Laboratory, Livermore, Calif.
Dr. HERBERT S. POMERANCE, physics division, Oak Ridge National Laboratory, Oak Ridge, Tenn.
Dr. THOMA M. SNYDER, physics division, Knolls Atomic Power Laboratory, Schenectady, N. Y.
Dr. LOUIS A. TURNER, physics division, Argonne National Laboratory, Chicago, Ill.
Dr. GEORGE A. KOLSTAD, vice chairman; physics branch, division of research, AEC, Washington, D. C.

Dr. IRA F. ZARTMAN, division of engineering, AEC, Washington, D. C.
Dr. CARROLL W. ZABEL, secretary; department of physics, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.

Patent Advisory Panel

This panel was appointed in January 1947 to make a general review and appraisal of the problems raised by the patent provisions of the Atomic Energy Act of 1946. It makes informal reports and recommendations to the Commission and its staff on various questions of policy and procedure relating to patents and inventions.

H. THOMAS AUSTERN; of Covington & Burling, Washington, D. C.
WILLIAM H. DAVIS; of Davis, Hoxie & Faithfull, New York, N. Y.
JOHN A. DIENNER; of Brown, Jackson, Boettcher & Dienner, Chicago, Ill.
HECTOR M. HOLMES; of Fish, Richardson & Neave, Boston, Mass.
CASPER W. OOMS; firm of Casper W. Ooms, Chicago, Ill.

Stack Gas Problem Working Group

The appointment of this group was authorized in May 1948 to advise the Commission in connection with problems in the control of gaseous effluents from AEC installations. The group has held six formal meetings and has rendered assistance in the field of air cleaning through specific research and development projects directed by individual members and by individual consulting advice.

Dr. ABEL WOLMAN, chairman; head, department of sanitary engineering, Johns Hopkins University, Baltimore, Md.
Dr. PHILIP DRINKER, professor of industrial hygiene, Harvard University School of Public Health, Boston, Mass.
Dr. LYLE GILBERTSON, director, research and engineering department, Air Reduction Co., Murray Hill, N. J.
Dr. H. FRASER JOHNSTONE, professor of chemical engineering, University of Illinois, Urbana, Ill.
Dr. CHARLES E. LAPPLE, professor of chemical engineering, Ohio State University, Columbus, Ohio.
Dr. MOYER D. THOMAS, department of agricultural research, American Smelting & Refining Co., Salt Lake City, Utah.
Dr. WILLIAM P. YANT, director of research, Mine Safety Appliances Co., Pittsburgh, Pa.

Technical Information Panel

This panel, representing the major AEC research contractors, was appointed in June 1948 to advise the Commission on all aspects of its technical information services. Meetings are held three times a year to work out better methods of disseminating technical information.

Dr. ALBERTO F. THOMPSON, chairman; chief, technical information service, division of information services, AEC, Washington, D. C.
Dr. HENRY A. BLAIR, director, atomic energy project, University of Rochester, Rochester, N. Y.

BREWER F. BOARD
leum Co., Idaho
Dr. F. L. CUTHBI
Ohio.
W. E. DREESZEN,
SYLVAN HARRIS,
N. Mex.
W. L. HARWELL, h
Chemicals Co.,
EDWARD L. HILL,
ect, Cincinnati,
FRANK R. LONG, s
department, Nor
GLENN MAYNARD,
Development Co
Dr. JAMES A. ME
Akron, Ohio.
Dr. JAMES W. Mc
Pont de Nemou
Dr. E. J. MURPHY
Co., div. of Uni
Dr. G. M. MURPH
N. Y.
Dr. DANIEL J. PFI
search, AEC, W
DENNIS PULESTON
Laboratory, Upt
Dr. RICHARD F. R
ect, University o
D. P. RUDOLPH, di
AEC, Lemont, Il
Dr. H. W. RUSSEL
Ohio.
Dr. W. E. SHOUPP,
tric Corp., Pittsb
Dr. CHARLES SLESS
cation, AEC, Ne
Dr. RALPH CARLIS
Los Alamos Scie
Dr. JOHN R. STEHN
Laboratory, Sche
C. G. STEVENSON, h
partment, Gener
Dr. R. K. WAKERL
versity of Califor
WILLIS H. WALDO,
Dr. H. D. YOUNG, c
Lemont, Ill.

BREWER F. BOARDMAN, supervisor, technical information service, Phillips Petroleum Co., Idaho Falls, Idaho.

Dr. F. L. CUTHBERT, technical director, National Lead Co. of Ohio, Cincinnati, Ohio.

W. E. DREESZEN, administrative aide to director, Ames Laboratory, Ames, Iowa.

SYLVAN HARRIS, manager, documents department, Sandia Corp., Albuquerque, N. Mex.

W. L. HARWELL, head, patents and declassification department, Carbide & Carbon Chemicals Co., div. of Union Carbide & Carbon Corp., Oak Ridge, Tenn.

EDWARD L. HILL, supervisor, technical services unit, General Electric ANP Project, Cincinnati, Ohio.

FRANK R. LONG, supervisor, technical information group, atomic energy research department, North American Aviation, Inc., Downey, Calif.

GLENN MAYNARD, head, technical information center, California Research and Development Co., Livermore, Calif.

Dr. JAMES A. MERRILL, director, laboratory division, Goodyear Atomic Corp., Akron, Ohio.

Dr. JAMES W. MORRIS, technical division, Savannah River laboratory, E. I. du Pont de Nemours & Co., Augusta, Ga.

Dr. E. J. MURPHY, assistant to research director, Carbide & Carbon Chemicals Co., div. of Union Carbide & Carbon Corp. (ORNL), Oak Ridge, Tenn.

Dr. G. M. MURPHY, professor of chemistry, New York University, New York, N. Y.

Dr. DANIEL J. PFLAUM, chief, materials and information branch, division of research, AEC, Washington, D. C.

DENNIS PULESTON, head, technical information division, Brookhaven National Laboratory, Upton, Long Island, N. Y.

Dr. RICHARD F. RILEY, chief, radiation chemistry section, atomic energy project, University of California, Los Angeles, Calif.

D. P. RUDOLPH, director, technical services division, Chicago Operations Office, AEC, Lemont, Ill.

Dr. H. W. RUSSELL, assistant director, Battelle Memorial Institute, Columbus, Ohio.

Dr. W. E. SHOUPP, assistant manager, atomic power division, Westinghouse Electric Corp., Pittsburgh, Pa.

Dr. CHARLES SLESSER, director, division of technical information and declassification, AEC, New York Operations Office, New York, N. Y.

Dr. RALPH CARLISLE SMITH, assistant director for classification and security, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.

Dr. JOHN R. STEHN, physicist, theoretical physics division, Knolls Atomic Power Laboratory, Schenectady, N. Y.

G. STEVENSON, head, technical information, technical section, engineering department, General Electric Co., Richland, Wash.

Dr. R. K. WAKERLING, chief, information division, Radiation Laboratory, University of California, Berkeley, Calif.

WILLIS H. WALDO, technical editor, Mound Laboratory, Miamisburg, Ohio.

Dr. H. D. YOUNG, director, information division, Argonne National Laboratory, Lemont, Ill.

283269—54——7

APPENDIX 3

Major Research and Development Installations of the U. S. Atomic Energy Commission

Ames Laboratory (Iowa State College, contractor), Ames, Iowa

Director ..... Dr. Frank H. Spedding
Associate Director ..... Dr. H. A. Wilhelm
Assistant to Director ..... Dr. Adolph F. Voight

Argonne National Laboratory (University of Chicago, contractor), Chicago, Ill.

The participating institutions are:

Battelle Memorial Institute
Carnegie Institute of Technology
Case Institute of Technology
Illinois Institute of Technology
Indiana University
Iowa State College
Kansas State College
Loyola University (Chicago, Ill.)
Marquette University
Mayo Foundation
Michigan College of Mining and Technology
Michigan State College
Northwestern University
Ohio State University
Oklahoma Agricultural and Mechanical College
Purdue University
St. Louis University
State University of Iowa
Washington University (St. Louis, Mo.)
Wayne University
Western Reserve University
University of Chicago
University of Cincinnati
University of Illinois
University of Kansas
University of Michigan
University of Minnesota
University of Missouri
University of Nebraska
University of Notre Dame
University of Pittsburgh
University of Wisconsin

Director ..... Dr. Walter H. Zinn
Deputy Director ..... Dr. Norman Hilberry
Business Manager ..... John H. McKinley
Associate Director, University Relationships ..... Dr. Joseph C. Boyce
Assistant Director, Technical Services ..... John T. Bobbitt

Bettis Plant (Westinghouse Electric Corp., Atomic Power Division, contractor), Pittsburgh, Pa.

Manager, Westinghouse Atomic Power Division ..... Charles H. Weaver
Assistant Manager (Technical Operations) ..... John W. Simpson
Assistant Manager (Administrative) ..... Edmund T. Morris
Assistant Manager (Development) ..... Dr. William E. Shoupp
Contract Manager ..... W. Dee Shepherd

Brookhaven National Laboratory (Associated Universities, Inc., contractor), Upton, Long Island, N. Y.

The participating institutions are:

Columbia University	Princeton University
Cornell University	Yale University
Harvard University	University of Pennsylvania
Johns Hopkins University	University of Rochester
Massachusetts Institute of Technology	

Chairman, Board of Directors ..... THEODORE P. WRIGHT
President, AUI ..... LLOYD V. BERKNER
Vice President, AUI and Laboratory Director ..... Dr. LELAND J. HAWORTH
Deputy Laboratory Director ..... Dr. GERALD F. TAPE
Assistant Director, University Liaison ..... Dr. ROBERT A. PATTERSON

Knolls Atomic Power Laboratory (General Electric Co., contractor), Schenectady, N. Y.

General Manager, Operating Department ..... K. R. VAN TASSEL
Manager, Technical Department ..... Dr. K. H. KINGDON

Los Alamos Scientific Laboratory (University of California, contractor), Los Alamos, N. Mex.

Director ..... Dr. NORRIS E. BRADBURY
Technical Associate Director ..... Dr. DAROL K. FROMAN

Mound Laboratory (Monsanto Chemical Co., contractor), Miamisburg, Ohio

Project Director ..... Dr. N. N. T. SAMARAS
Laboratory Director ..... Dr. JOSEPH J. BURBAGE

Oak Ridge Institute of Nuclear Studies (contractor), Oak Ridge, Tenn.

The sponsoring universities of the Institute are:

Agricultural and Mechanical College of Texas	Mississippi State College
Alabama Polytechnic Institute	North Carolina State College
Catholic University of America	Rice Institute
Clemson Agricultural College	Southern Methodist University
Duke University	Tulane University of Louisiana
Emory University	Tuskegee Institute
Florida State University	Vanderbilt University
Georgia Institute of Technology	Virginia Polytechnic Institute
Louisiana State University & A. and M. College	University of Alabama
	University of Arkansas
	University of Florida

The sponsoring universities of the Institute are—Continued

University of Georgia	University of Oklahoma
University of Kentucky	University of Puerto Rico
University of Louisville	University of South Carolina
University of Maryland	University of Tennessee
University of Mississippi	University of Texas
University of North Carolina	University of Virginia

Chairman of Council—Dr. GEORGE H. BOYD
Vice Chairman of Council—Dr. MARTEN TEN HOOR
President of Institute—Dr. PAUL M. GROSS
Vice President of Institute—Dr. J. W. BEAMS
Scientific and Educational Consultant—Dr. GEORGE B. PEGRAM
Executive Director of Institute—Dr. WILLIAM G. POLLARD

Oak Ridge National Laboratory (Carbide & Carbon Chemicals Co., div. of Union Carbide & Carbon Corp., contractor), Oak Ridge, Tenn.

Director—Dr. C. E. LARSON
Research Director—Dr. A. M. WEINBERG
Deputy Research Director—Dr. J. A. SWARTOUT
Assistant Research Director—Dr. E. H. TAYLOR
Assistant Research Director—Dr. E. D. SHIPLEY
Assistant Research Director—Dr. C. E. WINTERS

Radiation Laboratory (University of California, contractor), Berkeley, Calif.

Director—Dr. ERNEST O. LAWRENCE
Associate Director—Dr. DONALD COOKSEY
Business Manager and Managing Engineer—WALLACE B. REYNOLDS
Assistant Director—WILLIAM M. BROBECK
Director, Crocker Laboratory—Medical Physics—Dr. JOSEPH G. HAMILTON
Director, Donner Laboratory of Medical Physics—Dr. J. H. LAWRENCE
Assistant Director, Donner Laboratory—Dr. HARDIN JONES

Raw Materials Development Laboratory (American Cynamid Co., contractor), Winchester, Mass.

Director—DANIEL M. KENTRO
Assistant Director—HUGH H. BEIN

Rochester Atomic Energy Project (University of Rochester, contractor) Rochester, N. Y.

Director—Dr. HENRY A. BLAIR
Assistant Director for Education—Dr. J. NEWELL STANNARD
Business Manager—C. M. JARVIS

Sandia Laboratory (Sandia Corp., contractor), Sandia Base, Albuquerque, N. Mex.

President ..... JAMES W. McRAE

University of California, Los Angeles, Atomic Energy Project (University of California, contractor) Los Angeles, Calif.

Director ..... Dr. STAFFORD WARREN
Project Manager ..... ROBERT J. BUETTNER

University of California Medical Center, Radiological Laboratory (University of California, contractor) San Francisco, Calif.

Director ..... Dr. ROBERT S. STONE

APPENDIX 4

Isotope Distribution Data

	Number of Shipments [1]								
	1946	1947	1948	1949	1950	1951	1952	1953 [2]	Total [2]
Shipments classified by kind of Isotope:									
Radioactive Isotopes:									
Iodine 131	68	495	978	1,537	2,353	3,183	3,867	4,559	17,040
Phosphorus 32	48	537	901	1,420	1,736	2,112	2,101	2,316	11,171
Carbon 14	47	108	124	192	259	342	431	260	1,763
Sodium 24	1	80	119	229	286	176	363	338	1,592
Sulfur 35	12	39	41	108	125	168	163	204	860
Gold 198	17	52	29	36	164	268	431	545	1,542
Calcium 45	5	42	33	68	89	111	104	108	560
Iron 55	5	41	33	54	68	67	149	145	562
Cobalt 60	4	32	30	64	137	190	147	190	794
Potassium 42	6	31	24	75	123	132	107	167	665
Strontium 89, 90	3	9	18	19	46	62	94	90	341
Other	30	186	314	568	848	1,014	1,145	1,754	5,859
Total	246	1,652	2,644	4,370	6,234	7,825	9,102	10,676	42,749
Shipments to AEC Installations: Radioactive	29	265	574	943	1,574	1,653	1,171	1,041	7,250
Stable Isotopes:									
Deuterium Oxide	------	91	113	116	106	112	84	27	649
Deuterium	------	80	69	86	89	129	112	140	705
Boron	------	24	23	31	28	23	31	45	205
Helium 3	------	------	------	------	------	13	6	14	33
Oxygen 18	------	14	12	19	17	29	67	141	299
Electromagnetically concentrated	------	------	98	117	148	153	110	173	799
Argon 38	------	------	------	------	------	1	------	3	4
Total	------	209	315	369	388	460	410	543	2,694
Shipments to AEC Installations: Stable	92	138	197	260	250	270	258	202	1,667

[1] Shipments from Oak Ridge National Laboratory, Oak Ridge, Tenn.
[2] December shipments estimated.

LOCATION AND TYPE OF USERS 1946

States	Medical Institutes and Physicians		Colleges and Universities		Industrial Firms		Federal and State Laboratories		Foundations and Institutions		Other		Total	
	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable

1,667	2,694	4	299	33	205	705	649	7,250	42,749	5,859	341	665	794	562	560	1,542	800	1,592	1,763	11,171	17,040	Total [illegible]

LOCATION AND TYPE OF USERS

1946

States	Medical Institutes and Physicians		Colleges and Universities		Industrial Firms		Federal and State Laboratories		Foundations and Institutions		Other		Total	
	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable
California	5		1		3								9	
Connecticut					1								1	
Delaware					1								1	
District of Columbia			2	1			1						3	1
Florida			2										2	
Hawaii									1				1	
Illinois	2		2				1						5	
Indiana			1										1	
Kansas			1										1	
Louisiana	1												1	
Maryland	3		1				1						5	
Massachusetts	7		2						1				10	
Michigan					2								2	
Minnesota	2												2	
Missouri	2												2	
New Jersey					3								3	
New York	7	1	2	1	2								11	2
Ohio	3		2		1		1		1				8	
Oregon	1		1										2	
Pennsylvania	2	1	3		3	1			1				9	2
Tennessee	2		1										3	
Texas					1								1	
Utah					1								1	
Wisconsin	1		1										2	
Total	38	2	22	2	18	1	4		4				86	5

1947

Alabama									1				1	
Arkansas	1												1	
California	4	1		4		1	1						5	6
Connecticut	1		1	1			1						3	1
Delaware									1	1			1	1
District of Columbia	3	1		1				3					3	5
Georgia				1										1
Illinois	4	1	1	2	2	1				1			7	5
Indiana			2	3	2	1							4	4
Kansas				1										1

LOCATION AND TYPE OF USERS
1947—Continued

States	Medical Institutes and Physicians		Colleges and Universities		Industrial Firms		Federal and State Laboratories		Foundations and Institutions		Other		Total	
	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable
Kentucky	1		1										2	
Louisiana	2	1		1									2	2
Maryland	4	1	2	1			1	1					7	3
Massachusetts	2	1		2	4								6	3
Michigan	3		1	2	1	2							5	4
Minnesota	1		1	2									2	2
Missouri	1	1	2	1									3	2
Montana				1									1	1
Nebraska	1												1	
New Jersey			1	1	3	2			3				7	3
New York	6	3	4	6	3	2	1		2				16	11
North Carolina	1		1										2	
Ohio	2	1	1	1	2	3							5	5
Oklahoma				1		1							1	2
Oregon			1										1	
Pennsylvania	3	2		2		5		1		1			3	11
Tennessee	1		1										2	
Texas	3	2	2	2		1							5	5
Utah	1		1	1									2	1
Virginia	1		1	1			1						3	1
Washington	2		2										4	
Wisconsin				1										1
Total	48	15	26	39	17	19	5	5	7	3			103	81

1948

Alabama			1										1	
Arkansas			1		1								2	
California	4	1		2		2	2						6	5
Colorado	1			1									1	1
Connecticut	1			1									1	1
District of Columbia													1	
Florida	1												1	
Georgia			1					1					3	2
Illinois	2			1	1	2							1	1
Indiana	1												3	
Iowa	1		2	1									1	
Kentucky	1												1	
Louisiana				1									1	1
Maine			1										1	
Maryland		1		1			1	1					1	3
Massachesetts	3		3		2	4			1				9	4
Michigan	2		2		2								6	
Minnesota	1												1	
Mississippi							1						1	
Missouri			1										1	
Montana		1											2	
New Jersey			1	1	1	2								1

Indiana	1														
Iowa	1		2	1		2								3	1
Kentucky	1														
Louisiana				1										1	1
Maine			1				1	1						1	3
Maryland		1		1										9	4
Massachesetts	3		3		2	4			1					6	
Michigan	2		2		2									1	
Minnesota	1						1							1	
Mississippi														1	
Missouri			1												1
Montana		1												2	3
New Jersey			1	1	1	2								1	
New Mexico	1													6	7
New York	1	2	2	3		2	2		1					3	2
North Carolina	1	1	2	1										6	2
Ohio			1		2	1	2		1	1				1	
Oklahoma					1									10	5
Pennsylvania	1	1	1	2	7	1			1	1				1	
Rhode Island			1											1	
South Carolina	1													3	
Tennessee	2				1									6	1
Texas	3	1			2				1						1
Utah		1												1	
Virginia	1													1	1
West Virginia			1			1								3	
Wisconsin	2				1										
TOTAL	31	9	21	16	21	15	8	2	5	2				86	44

1949

Alabama				1	1		1							2	1
California	1		1		2		1							5	
Colorado	1		2											3	
Connecticut			2		3									5	
Delaware			1											1	
District of Columbia	1	1	1											2	1
Georgia	1						1							2	
Illinois	1	2	1	1	4	1	1		2					9	4
Indiana	1				2									3	
Kansas	1													1	
Louisiana			1			1								1	1
Maine			1											1	
Maryland	1		1	1	1		2	1						5	2
Massachusetts	3	1	1		7									11	1
Michigan	1		1		4	1								6	1
Minnesota		1			1									1	1
Missouri			1											1	
Montana		1													1
New Jersey					4	2	1							5	2
New York	7	4	3	2	9									19	6
North Carolina	1		1				1							3	0

LOCATION AND TYPE OF USERS
1949—Continued

States	Medical Institutes and Physicians		Colleges and Universities		Industrial Firms		Federal and State Laboratories		Foundations and Institutions		Other		Total	
	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable
Ohio	1			1	4		1	1		1			6	3
Oklahoma					1	1			1				2	1
Oregon				1										1
Pennsylvania	1	1	1		2	1	2	1					6	3
Rhode Island				1										1
South Carolina			1										1	
Tennessee	1			1			1						2	1
Texas	3				1	1				1			4	2
Vermont					1								1	
Virginia						1	2						2	1
Washington	1			2									1	2
West Virginia				1										1
Wisconsin							1						1	
Total	27	11	20	12	47	9	15	3	3	2			112	37

1950

Alaska	1												1	
Alabama			1										1	
Arizona			1										1	
California	6	2	2	1	11	4	3		2				24	7
Colorado	3				1		1		1				6	
Connecticut	1		1		3	1							5	1
District of Columbia	1			1			2						3	1
Georgia	1		1	1	1		1						4	1
Hawaii	1								1				2	
Idaho			1										1	
Illinois	4		1		6		1				1		13	
Indiana	3				5								8	
Iowa				1	1								1	1
Kansas	1		1		2								4	
Kentucky					1		1						2	
Louisiana	1		1										2	
Maryland		2			4		1	2					5	4
Massachusetts	1	1	1		8	1	2	1		1			12	4
Michigan					2								2	
Minnesota			2		1								3	
Mississippi			1					1					1	1
Missouri	1			1	2								3	1
Montana	1												1	
Nebraska			1										1	
New Hampshire			1										1	
New Jersey	1				7	2			1				9	2
New Mexico	1		1										2	
New York	13	2	6	3	15	3			3				37	8
North Carolina	1			1			1						2	1
North Dakota			1										1	
Ohio	3		2		9		1						15	
Oklahoma	1				2	1							3	

Louisiana	1		1		4		1	2					9	4
Maryland		2			8	1	2	1		1			12	
Massachusetts	1	1	1		2								2	
Michigan				2	1								3	
Minnesota				1				1					1	1
Mississippi														
Missouri	1			1	2								3	1
Montana													1	
Nebraska			1										1	
New Hampshire			1										1	
New Jersey	1				7	2			1				9	2
New Mexico	1		1										2	
New York	13	2	6	3	15	3			3				37	8
North Carolina	1			1			1						2	1
North Dakota			1										1	
Ohio	3		2		9		1						15	
Oklahoma	1				2	1							3	1
Oregon	1			1			1						2	1
Pennsylvania	7		1	2	8	2	1						17	4
Rhode Island	1		1										2	
South Dakota	1												1	
Tennessee	2		1	1	1			1					4	2
Texas	1	2		1	3		1		2			1	7	4
Utah	1		1										2	
Virginia			2		1								3	
Washington					2								2	
West Virginia	1				1								2	
Wisconsin	1		1		6								8	
Wyoming			1										1	
TOTAL	62	9	34	14	103	14	17	5	10	1	1	1	227	44

1951

Alaska			1				1						2	
Alabama	1				1		1						3	
Arizona							1						1	
California	18		6	1	13	1	12	3	2				51	5
Canal Zone							1						1	
Colorado	2				2	1							4	1
Connecticut	2				6	1	1						9	1
Delaware					1	1							1	1
District of Columbia	1	1			2		5	1			1		9	2
Florida	2		1										3	
Georgia	1		1				1						3	
Hawaii	2												2	
Illinois	5			1	10	3	3						18	4
Indiana	2				8								10	
Kansas	1			1	1								2	1
Kentucky	1			1									1	1
Louisiana					1		1						2	
Maine					2		1						3	
Maryland	1				1	1	2						4	1
Massachusetts	2	3	2	1	11	1	2				1		18	5
Michigan	5		1	1	3		1						10	1
Minnesota	1	1	1		4		1						7	1
Mississippi	1												1	

LOCATION AND TYPE OF USERS
1951—Continued

States	Medical Institutes and Physicians		Colleges and Universities		Industrial Firms		Federal and State Laboratories		Foundations and Institutions		Other		Total	
	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable
Missouri	5			2	1								6	2
Montana	2		1										3	
Nebraska							1						1	
New Hampshire	1			1	2		1						4	1
New Jersey	1		2		11		1	1	1	1			16	2
New Mexico	1												1	
New York	11		3	2	16	2	5		1				36	4
North Carolina	2		1										3	
North Dakota	1		1				1						3	
Ohio	5		2	1	22		3	1					32	2
Oklahoma	1		1		6		1		1				10	
Oregon				1	1								1	1
Pennsylvania	5		3		20	3	5						33	3
Puerto Rico							2						2	
South Carolina	1		1				1						3	
South Dakota			1										1	
Tennessee	5		1	1			2						8	1
Texas	2	1			9	2	1						12	3
Utah	1						2						3	
Vermont	1												1	
Virginia					3		4						7	
Washington	3		1		3		1						8	
West Virginia	3						1						4	
Wisconsin	2				5		2						9	
Total	101	6	31	14	165	16	68	6	5	1	2		372	43

1952

Alabama	3				3					1			6	1
Arizona	1												1	
Arkansas	1			1	1								2	1
California	21		4	2	22	2	10		5		1		62	4
Colorado	5			1	2		2						10	1
Connecticut	4	1	1		7								12	1
Delaware					6	2							6	2
District of Columbia	1				3		3						7	
Florida	1		1	1	1		3						6	1
Georgia	1		1	1	1		2						5	1
Hawaii							1						1	
Idaho	1				1								2	
Illinois	9			1	7		3						19	1
Indiana	1				4						1		6	
Iowa					2								2	
Kansas	2												2	
Kentucky	1				1		1						3	
Louisiana	3		1		4	1							8	1
Maine	1		1		3								5	
Maryland			1		4		1						6	
Massachusetts	5	1	2	3	15	1	2	1					24	6
Michigan	2	1	2		6	1							10	2
Minnesota	1		1		2								4	

Alabama	3				3						1			6	1
Arizona	1													1	
Arkansas	1													2	1
California	21		4	2	22	2	10		5					62	4
Colorado	5			1	2		2				1			10	1
Connecticut	4	1	1		7									12	1
Delaware					6	2								6	2
District of Columbia	1				3		3							7	
Florida	1		1	1	1		3							6	1
Georgia	1		1	1	1		2							5	1
Hawaii							1							1	
Illinois	9				17		5							29	1
Indiana	1			1	4									6	
Iowa					2						1			2	
Kansas	2													2	
Kentucky	1													3	
Louisiana	3		1		1									8	1
Maine	1		1		4	1	1							5	
Maryland			1		3									6	
Massachusetts	5	1	2	3	4		1							24	6
Michigan	2	1	2		15	1	2	1						10	2
Minnesota	1		1		6	1								4	
Mississippi	1				2		2							3	
Missouri	6						1							7	
Montana	1						1							2	
Nebraska	1													1	
Nevada					1									1	
New Hampshire	3		1		1									2	
New Jersey	1				19	2	1		1					24	2
New Mexico	23		1	1			1							3	1
New York	1		2	1	26	1	2							53	2
North Carolina	2			1										1	1
North Dakota	2	1			14	1								2	
Ohio	2				2	2								16	2
Oklahoma	1		1		1				1					5	2
Oregon	11		1		21									3	
Pennsylvania	3								2					35	
Puerto Rico					5									3	
Rhode Island	1				1									5	
South Carolina	9		1		3		1							1	
Tennessee			1		13	2								5	
Texas	1				1									23	2
Utah	1													2	
Vermont	3				1		1							1	
Virginia	1		1		2		2							3	
Washington		1												7	
West Virginia					6									2	
Wisconsin														6	1
TOTAL	138	5	24	13	212	15	40	1	9	1	2			425	35

1953

Alabama															
Arizona	1			1	3		1	1	1					5	1
Arkansas	3						1							2	1
California	29		1	1	21	1	1							4	
Colorado	2		1				5	1	1	1	1			58	4
Connecticut				1	5	1	1				1			5	
Delaware	1			1										5	2
District of Columbia	1	1					1							1	1
														2	1

LOCATION AND TYPE OF USERS
1953—Continued

States	Medical Institutes and Physicians		Colleges and Universities		Industrial Firms		Federal and State Laboratories		Foundations and Institutions		Other		Total	
	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable
Florida	5		2								1		8	
Georgia	2				1		1						4	
Hawaii			1										1	
Illinois	12		2		17	2	4				1		36	2
Indiana	3			1									3	1
Iowa	1	1	1		2								4	1
Kansas	6												6	
Kentucky	1				5				1		1		8	
Louisiana	1				1								2	
Maine	1			1	2								3	1
Maryland	1				3	2	2						6	2
Massachusetts	5		2	1	8	2							15	3
Michigan	4				6	1							10	1
Minnesota	2												2	
Mississippi					2								2	
Missouri	7	1			2					1			9	2
Nebraska	1												1	
Nevada	2				1		1						4	
New Hampshire	1			1			1						2	1
New Jersey	5				15	2	3				1	2	24	4
New Mexico	1				1		2						4	
New York	28		4		26	3	2	2			1		61	5
North Carolina	1				4		3						8	
North Dakota	3												3	
Ohio	11			3	15	1			1		1		28	4
Oklahoma	1				4	1							5	1
Oregon		1					2						2	1
Pennsylvania	8		1		19		1				1		30	
Rhode Island					2		1						3	
South Carolina				1										1
South Dakota	1		1										2	
Tennessee	5	1			2	1	1						8	2
Texas	18		2	1	15		3						38	1
Vermont	1												1	
Virginia	1		1		3								5	
Washington	1		1			1	1						3	1
West Virginia	1				1		1						3	
Wisconsin	3				5		1						9	
Wyoming	1			1			1						2	1
Total	182	5	20	14	191	18	41	4	4	2	9	2	447	45

LOCATION AND TYPE OF USERS
CUMULATIVE TOTAL

Alaska	1		1				1							
Alabama	4		2	1	8		3	1	2	1			3	
Arizona	2		1	1			2						19	3
Arkansas	5		1	1	2		1						5	1
California	88	4	15	11	72	11	34	4	10	1	1		9	1
Canal Zone							1						220	31
Colorado	14		3	2	5	1							1	

Washington	1		1			1	1						3	1
West Virginia	1				1		1						3	
Wisconsin	3				5		1						9	
Wyoming	1			1			1						2	1
TOTAL	182	5	20	14	191	18	41	4	4	2	9	2	447	45

LOCATION AND TYPE OF USERS
CUMULATIVE TOTAL

Alaska	1		1				1						3	
Alabama	4		2	1	8		3	1	2	1			19	3
Arizona	2		1	1			2						5	1
Arkansas	5		1	1	2		1						9	1
California	88	4	15	11	72	11	34	4	10	1	1		220	31
Canal Zone							1						1	
Colorado	14		3	2	5	1	4		1		2		29	3
Connecticut	9	1	5	3	25	3	2						41	7
Delaware	1		1	1	8	3			1	1			11	5
District of Columbia	8	4	3	4	5		12	4			1		29	12
Florida	9		6	1	1		3				1		20	1
Georgia	6		4	3	3		6						19	3
Hawaii	3		1				1		2				7	
Idaho	1		1		1								3	
Illinois	39	3	7	6	47	7	13	1	2	1	2		110	18
Indiana	11		3	4	21	3					1		36	7
Iowa	2	1	3	2	5								10	3
Kansas	11		2	2	3								16	2
Kentucky	5		1	1	7		2		1		1		17	1
Louisiana	8	1	3	2	6	2	1						18	5
Maine	2		3	1	7		1						13	1
Maryland	10	4	5	3	13	3	11	5					39	15
Massachusetts	28	7	13	7	55	9	6	2	2	1	1		105	26
Michigan	17	1	7	3	26	5	1						51	9
Minnesota	8	2	5	2	8		1						22	4
Mississippi	2		1		2		3	1					8	1
Missouri	22	2	4	4	5		1			1			32	7
Montana	4	2	1	1			1						6	3
Nebraska	3		1				1						5	
Nevada	2						1						5	
New Hampshire	2		2	2	3		2						9	2
New Jersey	10		4	2	63	12	6	1	6	1	1	2	90	18
New Mexico	5		2	1	1		3						11	1
New York	96	12	26	18	97	13	12	2	7		1		239	45
North Carolina	8	1	5	3	4		5						22	4
North Dakota	6		2				1						9	
Ohio	27	2	8	6	69	6	8	2	3	2	1		116	18
Oklahoma	5		1	1	16	6	1		3				26	7
Oregon	3	1	3	3	2		3						11	4
Pennsylvania	38	5	11	6	80	13	9	2	4	2	1		143	28
Puerto Rico	3						2						5	
Rhode Island	1		2	1	7		1						11	1
South Carolina	2		2	1	1		1						6	1
South Dakota	2		2										4	
Tennessee	19	1	4	3	7	1	5	1					35	6
Texas	39	6	5	4	44	6	5		3	1		1	96	18
Utah	3	1	3	1	2		2						19	2
Vermont	3				1								4	0

LOCATION AND TYPE OF USERS
CUMULATIVE TOTAL—Continued

States	Medical Institutes and Physicians		Colleges and Universities		Industrial Firms		Federal and State Laboratories		Foundations and Institutions		Other		Total	
	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable	Radio	Stable
Virginia	4	----------	4	1	8	1	8	----------	----------	----------	----------	----------	24	2
Washington	10	----------	4	2	7	1	4	----------	----------	----------	----------	----------	25	3
West Virginia	6	----------	2	1	2	1	2	----------	----------	----------	----------	----------	12	2
Wisconsin	9	1	2	1	23	----------	4	----------	----------	----------	----------	----------	38	2
Wyoming	1	----------	1	1	----------	----------	1	----------	----------	----------	----------	----------	3	1
Total	627	62	198	124	774	107	198	26	47	12	14	3	1,858	334

SHIPMENTS OF RADIOISOTOPES TO FOREIGN COUNTRIES

COUNTRY	1947	1948	1949	1950	1951	1952	1953	TOTALS
Argentina	1	20	23	6	14	21	20	105
Australia	16	44	30	6	3	------	4	103
Austria	------	------	------	------	------	------	1	1
Belgium	------	35	46	11	18	9	12	131
Bermuda	------	10	4	1	------	1	------	16
Bolivia [3]	------	------	------	------	------	------	------	------
Brazil	------	1	5	49	34	42	79	210
British West Africa	------	1	------	------	------	------	------	1
Canada	------	14	12	26	24	91	254	421
Chile	------	------	------	24	21	18	16	79
Colombia	------	------	1	3	1	------	------	5
Costa Rica [3]	------	------	------	------	------	------	------	------
Cuba	------	------	1	3	9	43	77	133
Denmark	1	23	46	50	44	21	22	207
Dominican Republic	------	------	------	------	1	------	------	1
Egypt	------	------	1	------	------	------	------	1
El Salvador [3]	------	------	------	------	------	------	------	------
England	1	57	30	3	16	14	10	131
Finland	------	------	4	1	------	4	4	13
France	------	8	15	10	11	21	25	90
Germany	------	------	------	------	------	------	6	6
Gold Coast	------	------	------	------	------	------	1	1
Guatemala	------	------	------	------	------	------	3	3
Iceland	------	1	1	------	1	1	1	5
India	------	------	------	1	1	7	3	12
Indonesia	------	------	------	------	------	------	3	3
Ireland [3]	------	------	------	------	------	------	------	------
Israel	------	------	------	------	2	------	4	6
Italy	------	1	3	1	9	4	10	28
Japan	------	------	------	24	33	80	90	227
Lebanon	------	------	------	3	2	1	------	6
Mexico	------	------	1	1	5	7	33	47
Netherlands	------	25	10	7	5	2	4	53
New Zealand	------	2	3	4	1	1	------	11
Norway	------	10	22	4	1	4	1	42
Pakistan	------	------	------	------	3	1	1	5
Paraguay [3]	------	------	------	------	------	------	------	------
Peru	------	4	3	------	2	1	3	13
Portugal	------	------	------	------	------	2	3	5
Spain	------	1	2	1	------	------	1	5
Sweden	------	62	48	27	19	11	15	182
Switzerland	------	8	15	13	6	5	4	51
Syria [3]	------	------	------	------	------	------	------	------
Trieste	------	------	1	1	------	------	1	3
Turkey	------	1	------	3	1	------	------	5
Union of South Africa	------	9	18	------	1	------	------	28
Uruguay	------	------	------	7	1	1	1	10
Yugoslavia	------	------	------	------	------	------	1	1
TOTALS	19	337	345	290	289	413	713	2,406
ISOTOPE								
Phosphorus 32	10	169	160	106	102	71	155	773
Iodine 131	4	73	92	52	71	124	219	635
Carbon 14	------	29	35	44	38	43	62	251
Sulfur 35	1	17	22	14	8	21	20	103
Iron 55, 59	2	15	13	14	9	14	17	84
Cobalt 60	1	13	4	35	22	21	42	138
Strontium 89, 90	1	3	4	------	7	22	16	53
Calcium 45	------	8	7	8	8	18	29	78
Other	------	10	8	17	24	79	153	291
TOTALS	19	337	345	290	289	413	713	2,406

[3] Authorized to receive isotopes; no shipments made.

APPENDIX 5

AEC Owned Patents

PATENTS ISSUED TO THE COMMISSION WHICH ARE AVAILABLE FOR LICENSING [1]

The following 117 U. S. Letters Patents owned by the United States Government as represented by the United States Atomic Energy Commission are in addition to the 489 patents listed in the 13th Semiannual report. The patents listed have been made available for licensing at periodic intervals. Licenses are granted on a nonexclusive, royalty-free basis. Abstracts of patents available for licensing are published in the Patent Office Official Gazette.

PATENT NO.	TITLE	PATENTEE
2,206,634	Process for the Production of Radioactive Substances.	E. Fermi, Chicago, Ill., E. Amaldi, Rome, Italy, F. Rasetti, Baltimore, Md., E. Segre, Berkeley, Calif., and B. Pontecorvo, Rome, Italy.
2,619,601	Radioactivity Survey Apparatus	S. M. Zollers, Haddonfield, N. J.
2,620,256	Analyzer	Q. A. Kerns, Oakland, L. W. Whitcomb and E. E. Brown, Berkeley, Calif.
2,620,446	Radiation Detection and Measuring Means	H. D. Le Vine, Arlington, N. J., and H. J. Di Giovanni, New York, N. Y.
2,621,296	Ion Source	R. W. Thompson, Minneapolis, Minn.
2,621,912	Receptacle	R. N. Lyon, Oak Ridge, Tenn., S. G. Bankoff, Nutley, N. J., and F. J. Smetana, Wilmington, Del.
2,622,008	Production of Carbon Dioxide	W. W. Miller, State College, Pa., J. Turkevich, Princeton, N. J., and N. Zwiebel, Whitestone, N. Y.
2,622,014	Method for Preparing Boron Trifluoride	I. Kirshenbaum, New York, N. Y.
2,622,130	Automatic Cable Tester or Fault Analyzer Means.	L. J. Kabell, R. A. Richards and A. L. Dyer, Albuquerque, N. Mex.
2,622,204	Mass Spectrograph	A. E. Shaw and W. Rall, Chicago, Ill.
2,622,208	Radioactive Particle Counting	W. Bernstein, Middle Island, N. Y., and R. Ballentine, Baltimore, Md.
2,624,009	Ion Source	R. R. Wilson, Cambridge, Mass.
2,624,656	Remote Control Pipetting Unit	H. C. Andrews, Denver, Colo., and J. F. Gifford, Richland, Wash.
2,624,783	Apparatus and Method for Measuring Magnetic Flux.	V. A. Nedzel, Chicago, Ill.
2,624,841	Method of and Apparatus for Accelerating to High Energy Electrically Charged Particles.	E. M. McMillan, Berkeley, Calif.
2,624,845	Ion Source	R. W. Thompson, Minneapolis, Minn.
2,624,847	Ballistic Electrometer	W. P. Jesse, Chicago, Ill., J. W. Broxon, Boulder, and W. H. Hinch, Denver, Colo.
2,624,860	Arc Hash Analyzer by Cathode-Ray Tube	W. R. Baker, Berkeley, Calif.
2,625,507	Method of Electrodepositing Nickel	S. A. Mayper, New York, N. Y.
2,625,653	Coincidence Circuit	L. F. Wouters, Oakland, Calif.
2,625 657	Monitoring Gas for Radioactive Xenon	W. R. Kanne, Richland, Wash.
2,626,203	Method of Making Zirconium Tetrachloride	W. B. Blumenthal, Niagara Falls, N. Y.
2,626,254	Method of Polymerizing Trifluorochloroethylene.	W. T. Miller, Ithaca, N. Y., and J. T. Maynard, Wilmington, Del.
2,626,351	Beam Extractor	W. M. Powell, Berkeley, Calif.
2,626,359	Target for Particle Accelerators	F. R. Weber, Jr., Alameda, Calif.
2,626,989	Comparative Photometer	A. A. Brown, Danville, Calif.
2,628,268	Amplifier Circuit for Testing	Q. A. Kerns, Oakland, Calif.
2,628,297	Shielded Switch Assembly	C. T. Grauer, Oakland, Calif.
2,628,338	Portable Voltage Supply for Radiation Counters.	C. D. Gould, Cleveland, Ohio.
2,628,638	Flow Valve Control	N. S. Herod, Smyrna, Ga., and L. R. O'Neill, Fairmont, W. Va.
2,628,892	Apparatus for Fractional Sublimation	A. F. Reid, Dallas, Tex.
2,629,459	Filter	R. P. Hammond and J. A. Leary, Los Alamos, N. Mex.
2,629,837	Radioactive Resistor	J. M. Benade, Chicago, Ill., E. E. Goodale, Hiram, Ohio, and W. P. Jesse, Chicago, Ill.
2,630,529	Tachometer	E. R. Mann and R. G. Hester, Oak Ridge, Tenn.
2,630,878	Mist Filter.	
2,631,170	Process for t	
2,631,245	Method of Uranium :	
2,632,103	Stabilized P	
2,632,574	Remote Cor	
2,632,763	Separation I	
2,633,539	Device for S Masses.	
2,633,540	Electrical Aj	
2,633,740	Leakage Tes	
2,634,307	High-Freque	
2,634,374	Pocket Radi	
2,635,035	Preparation	
2,635,037	Preparation	
2,635,339	Method an Recomposi	
2,635,944	Production o	
2,635,956	Preparation	
2,636,044	Rare Earth S	
2,636,118	Pulse Equali	
2,636,886	Uranium Con	
2,636,990	Ion Source Ui	
2,636,993	Fast Countin	
2,637,297	Apparatus fo trodes in M Vapors.	
2,637,298	do	
2,637,536	Method of Di	
2,637,882	Vacuum Die-	
2,638,406	Production of	
2,638,560	Improved Wi ers.	
2,639,074	Implement fo	
2,640,866	Torque Comp	
2,640,924	Accelerator T	
2,640,935	Mass Spectro	
2,640,949	Electron Sour	
2,640,950	Point Electro	
2,640,953	Radiation Cu	
2,642,527	Multichannel	
2,642,531	Radio-Freque	
2,643,341	Mass Spectro	
2,643,342	Ionization Ga	
2,643,343	Balanced Dou Monitor.	
2,643,360	Voltage Suppl	
2,644,913	Surge Suppres	
2,644,922	Magnetic Flu paratus.	
2,645,610	Process for the	
2,645,940	Snap Sampler.	
2,645,941	Atmospheric I	
2,646,252	Well Casing S	
2,646,346	Multistage Mi	
2,646,544	Automatic Te	
2,646,925	Electrical Inte	
2,647,175	Ultra-Wide Ba	
2,647,213	Isotope Separa	
2,647,557	Heat Sealing A	
2,647,629	Flotation of U	
2,647,770	Sealed Telesco	
2,647,998	Method and A quency.	
2,649,571	Bridge for Resi	
2,651,613	Fluorine Cell	
2,651,723	Mass Spectrom	
2,651,726	Ionization Cha	
2,651,751	Apparatus for	
2,651,940	Apparatus for	
2,652,188	Automatic Tan	

[1] Patents listed as of November 24, 1953. Applicants for licenses should apply to the Chief, Patent Branch Office of the General Counsel, U. S. AEC, Washington 25, D. C., identifying the subject matter by patent number and title.

PATENT NO.	TITLE	PATENTEE
2,630,878	Mist Filter	D. L. Hopper, Jacksonville, Ill., H. E. Criner, Pittsburgh, Pa.
2,631,170	Process for the Preparation of Fluorocarbons	R. D. Fowler, Baltimore, Md.
2,631,245	Method of Forming Coating Containing Uranium and Method of Isotopic Analysis.	B. Cohen, New York, N. Y.
2,632,103	Stabilized Pulse Circuit	M. W. Horrell, Detroit, Mich.
2,632,574	Remote Control Manipulator	R. C. Goertz, Elmhurst, Ill.
2,632,763	Separation Process for Actinium	F. T. Hagemann, Chicago, Ill.
2,633,539	Device for Separating Particles of Different Masses.	W. Altar, Pittsburgh, Pa.
2,633,540	Electrical Apparatus and Method	V. C. Wilson, Santa Fe, N. Mex., and J. A. Simpson, Jr., Chicago, Ill.
2,633,740	Leakage Testing Method	J. P. Howe, A. B. Greninger, and R. F. Plott, Chicago, Ill.
2,634,307	High-Frequency Shunt	Q. A. Kerns, Berkeley, Calif.
2,634,374	Pocket Radiation Meter	F. R. Shonka, Riverside, Ill.
2,635,035	Preparation of Uranium Bromide	J. E. Powell, Ames, Iowa.
2,635,037	Preparation of Zirconium Tetrafluoride	H. A. Wilhelm, Ames, Iowa, and K. A. Walsh, Los Alamos, N. Mex.
2,635,339	Method and Apparatus for Stereoscopic Recomposing and Measuring.	W. M. Powell, Berkeley, and H. P. Hernandez, Jr., San Francisco, Calif.
2,635,944	Production of Granular Beryllium Fluoride	K. A. Walsh and H. A. Wilhelm, Ames, Iowa.
2,635,956	Preparation of Powdered Thorium	H. A. Wilhelm and P. Chiotti, Ames, Iowa.
2,636,044	Rare Earth Separation By Anion Exchange	E. H. Huffman and R. L. Oswalt, Berkeley, Calif.
2,636,118	Pulse Equalizer	B. Smaller, Chicago, Ill.
2,636,886	Uranium Complexes of Heterocyclic Diketones.	H. I. Schlesinger, Chicago, Ill., and H. C. Brown, Detroit, Mich.
2,636,990	Ion Source Unit	J. D. Gow, Richmond, and J. S. Foster, Jr., Albany, Calif.
2,636,993	Fast Counting Circuit	M. J. Jakobson, Berkeley, Calif.
2,637,297	Apparatus for Attaching Filaments to Electrodes in Machines for Coating with Metal Vapors.	Z. M. Shapiro, Pittsburgh, Pa.
2,637,298	do	Do.
2,637,536	Method of Dispersing Materials in Water	J. De Ment, Portland, Oreg.
2,637,882	Vacuum Die-Casting	R. F. Plott, Chicago, Ill.
2,638,406	Production of Uranium Tetrafluoride	A. D. Tevebaugh, Ames, Iowa, and F. Vaslow, Los Alamos, N. Mex.
2,638,560	Improved Window for Alpha Particle Counters.	C. J. Borkowski, Oak Ridge, Tenn.
2,639,074	Implement for Use in Chemical Apparatus	C. H. Prescott, Jr., Berkeley, Calif. (deceased).
2,640,866	Torque Compensated Galvanometer	W. M. Powell, Berkeley, Calif.
2,640,924	Accelerator Target	E. M. McMillan, Berkeley, Calif.
2,640,935	Mass Spectrometer Control	S. B. Spracklen, Oak Ridge, Tenn.
2,640,949	Electron Source	L. J. Cook, Berkeley, Calif.
2,640,950	Point Electron Source	L. J. Cook, Berkeley, Calif.
2,640,953	Radiation Current Source	H. H. Rossi, Orangeburg, N. Y.
2,642,527	Multichannel Analyzer	G. G. Kelley, Oak Ridge, Tenn.
2,642,531	Radio-Frequency Oscillator	W. R. Baker, Berkeley, Calif.
2,643,341	Mass Spectrometer Ion Source	W. T. Leland, St. Paul, Minn.
2,643,342	Ionization Gauge	K. M. Simpson, Santa Barbara, Calif.
2,643,343	Balanced Double Ionization Chamber X-Ray Monitor.	L. J. Rainwater, New York, N. Y.
2,643,360	Voltage Supply Regulator	E. Fairstein, Oak Ridge, Tenn.
2,644,913	Surge Suppressor	W. G. Stone, Oak Ridge, Tenn.
2,644,922	Magnetic Flux Direction Determining Apparatus.	D. C. Sewell, Concord, Calif.
2,645,610	Process for the Separation of Isotopic Ions	S. L. Madorsky, Chicago, Ill., and A. K. Brewer, Richland Center, Wis.
2,645,940	Snap Sampler	J. Kohl, Berkeley, E. G. Reid, Palo Alto, and L. R. Zumwalt, Lafayette, Calif.
2,645,941	Atmospheric Dust	E. G. Reid, Palo Alto, Calif.
2,646,252	Well Casing Soil Sampler	H. E. Hylbak, Richland, Wash.
2,646,346	Multistage Mixer-Settler Apparatus	B. V. Coplan, Troy, and E. L. Zebrowski, Albany, N. Y.
2,646,544	Automatic Temperature Regulator	M. L. Sands, Pasadena, Calif.
2,646,925	Electrical Integrator	M. Bevis, Oak Ridge, Tenn.
2,647,175	Ultra-Wide Band Amplifier Tube	C. Sheer, New York, N. Y.
2,647,213	Isotope Separating Apparatus	W. E. Parkins, Los Angeles, Calif.
2,647,557	Heat Sealing Apparatus	G. J. Selvin, Bronx, N. Y.
2,647,629	Flotation of Uranium	P. L. Veltman, Severna Park, Md.
2,647,770	Sealed Telescopic Pipe Joint	O. E. Tollefsbol, Oak Ridge, Tenn.
2,647,998	Method and Apparatus for Determining Frequency.	G. D. Paxson, El Cerrito, Calif.
2,649,571	Bridge for Resistance Measurement	R. J. Smith, Elmhurst, Ill.
2,651,613	Fluorine Cell	R. D. Fowler and W. B. Burford III, Baltimore, Md.
2,651,723	Mass Spectrometer Beam Regulator	W. R. Baker, Berkeley, Calif.
2,651,726	Ionization Chamber Circuit	R. J. Watts, and D. K. Froman, Santa Fe, N. Mex., and W. H. Hinch, Denver, Colo.
2,651,751	Apparatus for Measuring Resistance	H. R. Heath, Berkeley, Calif.
2,651,940	Apparatus for Measuring Liquid Level	K. H. Kline, Oak Ridge, Tenn.
2,652,188	Automatic Tank Pump Down	R. R. Cyr, Berkeley, Calif.

PATENT NO.	TITLE	PATENTEE
2,652,497	Temperature Measurement	A. J. Miller, Oak Ridge, Tenn.
2.652,778	Electromagnetic Centrifugal Pump	F. E. Crever, Scotia, N. Y.
2,653,076	Preparation of Carrier-Free Radioactive Phosphorus Values.	W. E. Cohn, Oak Ridge, Tenn.
2,653,494	Method of Forging Metals	E. C. Creutz, Pittsburgh, Pa.
2,654,840	Pulse Generator	C. E. Wiegand, Oakland, Calif.
2,654,845	Vapor Detector	C. S. Presenz, Berkeley, Calif.
2,654,851	Beam Deflector	D. T. Scalise, Richmond, Calif.
2,655,107	Electromagnetic Fluid Pump	N. H. Godbold, Idaho Falls, Idaho.
2,656,476	Survey Instrument	R. H. Firminhac, Oak Ridge, Tenn.
2,656,527	Signal Deviation Warning System	J. E. Tillman, Albuquerque, N. Mex.
2,658,150	Method and Apparatus for Focusing Charged Particles.	J. G. Backus, Los Angeles, Calif., and B. Peters, Rochester, N. Y.
2,658,452	Electromagnetic Pump	K. O. Donelian, Fairlawn, N. J.
2,658,909	Process for Separation and Purification of Alkyl Phosphoric Acids.	H. W. Crandall, Berkeley, Calif., and D. C. Stewart, Park Forest, Ill.
2,658,981	Welding Beryllium and Beryllium Alloy	D. C. Martin, Worthington, Ohio
2,658,999	Bevatron Acceleration Regulation	G. M. Farly, Berkeley, Calif.
2,659,012	X-Ray Densitometer	R. Bromberg and W. L. Martin, Los Angeles, Calif.
2,659,013	Badge Meter	D. M. Davis, Corryton, and J. C. Hart, Oak Ridge, Tenn.
2,659,589	Integrating Accelerometer	C. N. Hickman, Albuquerque, N. Mex.
2,659,822	Mass Spectrometer	G. H. Lee, Oak Ridge, Tenn.
2,659,826	Radiation Measuring Device	G. Failla, New York, N. Y., and H. H. Rossi, Orangeburg, N. Y.
2,660,677	Ion Selector	A. O. C. Nier, Minneapolis, Minn.

REGUL

PART 5—

EQ

Title 10, Ch
Federal Regul
ment Policy" i
following resp
1953:

Section 5.69

(4) Where
bids are receiv
business conce
not) not in a
area and the ot
who, although r
cern, will perfo
tressed employ
be made to the
is changed to re

(4) When tw
bids have been
business concer
business concern
employment are
bidder who is a
not located in a
area, award shal

(60 Stat. 755–77
1819)

Dated at Washi
day of Septembe

PART 30—RADIOI

APPEALS; RE

Pursuant to the
of 1946, as amen
79th Cong.; 60 Sta

[1] Policies and regu
in Appendix 4, Fift
Report to Congress;
Tenth Semiannual R
gress; Appendix 6,
Report; Appendix 5,

APPENDIX 6

Regulations of the U. S. Atomic Energy Commission [1]

Part 5—Procurement Policy

EQUAL LOW BIDS

Title 10, Chapter I, Part 5, Code of Federal Regulations, entitled "Procurement Policy" is hereby amended in the following respects, effective October 1, 1953:

Section 5.69 (a) (4) now reading:

(4) Where two or more equal low bids are received, one bid being from a business concern (whether small or not) not in a distressed employment area and the other being from a bidder who, although not a small business concern, will perform the contract in a distressed employment area, award shall be made to the latter.

is changed to read:

(4) When two or more equal low bids have been received, and from a business concern other than a small business concern located in a distressed employment area, and the other from a bidder who is a small business concern not located in a distressed employment area, award shall be made to the latter.

(60 Stat. 755–775; 42 U. S. C. 1801–1819)

Dated at Washington, D. C., this 18th day of September 1953.

M. W. Boyer,
General Manager.

Part 30—Radioisotope Distribution

APPEALS; REVIEW OF ORDERS

Pursuant to the Atomic Energy Act of 1946, as amended (Pub. Law 585, 79th Cong.; 60 Stat. 755 ff) and section 4 (a) of the Administrative Procedure Act of 1946, as amended (Pub. Law 404, 79th Cong.) and in accordance with Title 10, Chapter I, Part 30, Code of Federal Regulations, entitled "Radioisotope Distribution," promulgated April 9, 1951, and published in volume 16, pages 3251, et seq. of the *Federal Register*, amendments to the Radioisotope Distribution Regulation are set forth hereunder.

1. A center headnote, Appeals, is added preceding new § 30.90.

2. Section 30.90, reading as follows, is added:

§ 30.90 *Review of orders.* (a) Review of orders under this regulation of the Director, Isotopes Division, Oak Ridge Operations Office, shall be by appeal to the General Manager. Any such order may be appealed by sending a written notice of appeal by registered mail to the General Manager, U. S. Atomic Energy Commission, Washington 25, D. C., within thirty days from the receipt of notice of such order. A copy of such notice shall be sent to the Director, Isotopes Division, U. S. Atomic Energy Commission, Oak Ridge Operations Office, P. O. Box "E", Oak Ridge, Tennessee. Service of a notice of appeal pursuant to this section shall stay the order of the Director unless the Director provides in said order that it shall be effective notwithstanding service of a notice of appeal upon the ground that the public health, safety or interest so requires.

(b) (1) Within ten days after receipt of the copy of the notice of appeal, the Director shall forward to the General Manager the record of the

[1] Policies and regulations of the U. S. AEC announced prior to July 1952 can be found in Appendix 4, Fifth Semiannual Report to Congress; Appendix 10, Sixth Semiannual Report to Congress; Appendix 4, Ninth Semiannual Report to Congress; Appendix 6, Tenth Semiannual Report to Congress; Appendix 6, Eleventh Semiannual Report to Congress; Appendix 6, Twelfth Semiannual Report; Appendix 6, Thirteenth Semiannual Report; Appendix 5, Fourteenth Semiannual Report; and in the *Federal Register*.

matter under appeal, together with a statement of the grounds of his decision. A copy of such statement shall be sent to the appellant.

(2) Within ten days after receipt of such copy of the statement of the Director, the appellant shall submit to the General Manager a statement of the grounds of the appeal, together with such affidavits and other written materials as the appellant wishes to be considered in connection with the appeal. The appellant shall furnish a copy of said statement and any written material submitted in connection therewith to the Director.

(3) The General Manager may request the Director or the appellant, or both, to submit further information.

(4) The General Manager may, or, upon the timely filing by the appellant of a written request for hearing with the General Manager, shall direct that a hearing be held. Such request for hearing may be filed within the time allowed for appellant to file the statement of the grounds of the appeal, or, if the General Manager requests appellant to submit further information, within the time allowed by the General Manager for such submission, whichever is later.

(c) The General Manager may appoint a board or other designee to make recommendations or, if a hearing is to be held as provided in paragraph (b) (4) of this section, to conduct the hearing and make recommendations. If a board or other designee is appointed to conduct a hearing, such board or other designee shall at the conclusion thereof submit to the General Manager a transcript of the proceedings before it. Copies of the recommendations of a board or other designee shall be sent to the parties. Written exceptions to such recommendations may be filed with the General Manager within a reasonable time to be specified therefor by said board or other designee.

(d) The General Manager shall review the entire record and decide the appeal.

(e) The General Manager may authorize the Deputy General Manager to carry out any function of the General Manager provided for in this section. Any decision made by the Deputy General Manager so authorized by the General Manager shall have the same force and effect as if made by the General Manager.

The foregoing additions to the regulation shall be effective July 25, 1953.

Dated at Washington, D. C., this 20th day of July 1953.

WALTER J. WILLIAMS,
Deputy General Manager.

DIRECTOR, ISOTOPES DIVISION

STATEMENT OF AUTHORITY

Pursuant to section 3 of the Administrative Procedure Act, the following statement of authority is published:

1. The Director, Isotopes Division, Oak Ridge Operations Office, U. S. Atomic Energy Commission, is authorized to issue orders:

a. Approving or denying applications for authorizations to possess and use radioisotopes, applications for renewals of such authorizations, and requests for modification of such authorizations;

b. Annulling, suspending or revoking, in whole or in part, authorizations to possess and use radioisotopes;

c. Withholding or recalling radioisotopes; and

d. Establishing for individual cases such standards and instructions governing the possession and use of radioisotopes as he may determine to be necessary or desirable to protect health or to minimize danger from hazards to life or property.

2. Any such order by the Director may be appealed to the General Manager, U. S. Atomic Energy Commission, Washington 25, D. C., in accordance with the procedures specified in Title 10, Chapter I, Part 30, § 30.90, Code of Federal Regulations, entitled "Radioisotope Distribution."

Dated at Washin
day of July 1953.

WALTI
Deputy

PART 60—DOMESTIC

GUARANTEED MINIM
NIUM-BEARING
ROSCOELITE-TYPE
PLATEAU AREA

Section 60.5 of Ti
eral Regulations, i
tending the expirati
anteed minimum pr
1958, to March 31,
graph (a) of § 6
follows:

§ 60.5 *Guarantee*
for uranium-bearin
roscoelite-type ores
Plateau area—(a)
stimulate domestic
nium-bearing ores o
teau area, commonl
tite-type or roscoelit
the interest of the c
security, the United
ergy Commission he
guaranteed minimun
§ 60.5a effective d
March 1, 1951, throu
for the delivery of su
mission at Monticell

Dated at Washington, D. C., this 20th day of July 1953.

WALTER J. WILLIAMS,
Deputy General Manager.

PART 60—DOMESTIC URANIUM PROGRAM

GUARANTEED MINIMUM PRICE FOR URANIUM-BEARING CARNOTITE-TYPE OR ROSCOELITE-TYPE ORES OF COLORADO PLATEAU AREA

Section 60.5 of Title 10, Code of Federal Regulations, is amended by extending the expiration date of the guaranteed minimum prices from March 31, 1958, to March 31, 1962, so that paragraph (a) of § 60.5 shall read as follows:

§ 60.5 *Guaranteed minimum price for uranium-bearing carnotite-type or roscoelite-type ores of the Colorado Plateau area*—(a) *Guarantee.* To stimulate domestic production of uranium-bearing ores of the Colorado Plateau area, commonly known as carnotite-type or roscoelite- type ores, and in the interest of the common defense and security, the United States Atomic Energy Commission hereby establishes the guaranteed minimum prices specified in § 60.5a effective during the period March 1, 1951, through March 31, 1962, for the delivery of such ores to the Commission at Monticello, Utah, in accordance with the terms of this section and § 60.5a.

Dated at Washington, D. C., this 9th day of October 1953.

By order of the Commission.

M. W. BOYER,
General Manager.

PART 60—DOMESTIC URANIUM PROGRAM

BONUS FOR INITIAL PRODUCTION OF URANIUM ORES FROM NEW DOMESTIC MINES

Section 60.6 (c) of Title 10 is amended by extending the period for payment of bonus for initial production of uranium ore from new domestic mines from February 28, 1954, to February 28, 1957, so that § 60.6 (c) shall read as follows:

§ 60.6 *Bonus for initial production of uranium ores from new domestic mines.* * * *

(c) *Term of this section.* This section will apply to deliveries made under its terms between March 1, 1951, and February 28, 1957, inclusive.

(60 Stat. 755–775; 42 U. S. C. 1801–1819)

Dated at Washington, D. C., this 9th day of October 1953.

By order of the Commission.

M. W. BOYER,
General Manager.

APPENDIX 7

Current AEC Unclassified Research Contracts in Physical and Biological Sciences, Raw Materials, and Reactor Development[1]

PHYSICAL RESEARCH CONTRACTS

Chemistry

Alabama, University of. J. L. Kassner and E. L. Grove, Principles, Theory and Practice of High Frequency Titrimetry.

Arizona, University of. E. B. Kurtz, Jr., Uranium Accumulation in Plants.

Arkansas, University of. R. R. Edwards, Chemical Effects of Nuclear Transformations.

Arkansas, University of. R. R. Edwards, Radioactivity of Thermal Waters and its Relationship to Geology and Geochemistry of Uranium.

Buffalo, University of. G. M. Harris, Applications of Isotopes in Chemical Kinetics.

California Institute of Technology. Harrison Brown, Fundamental Geochemistry of Critical Materials and Development of Economic Processes for Their Isolation.

California Institute of Technology. Norman Davidson, Complex Ions and Reaction Mechanisms in Solution.

California, University of. C. S. Garner, Isotopic Exchange Reactions.

California, University of. J. H. Hildebrand, Studies in Intermolecular Forces and Solubility.

California, University of. R. A. James, Nuclear Chemistry Research.

California, University of. R. L. Scott, Fluorocarbon Solutions.

Carnegie Institute of Technology. T. P. Kohman, Nuclear Chemistry Research.

Catholic University of America. F. O. Rice, Thermal Production and Identification of Free Radicals.

Chicago, University of. Anthony Turkevich and Norman Sugarman, Nuclear Chemical Research.

Chicago, University of. Anthony Turkevich and Norman Sugarman, Operation of Synchrocyclotron.

Chicago, University of. H. C. Urey, Natural Abundance of Deuterium and Other Isotopes.

Clarkson College of Technology. H. L. Shulman, Determination of Interfacial Area in Packed Absorption and Distillation Columns.

Colorado, University of. R. N. Keller, Scintillation Properties of Coordination Compounds.

Columbia University. J. L. Kulp, Uranium-Lead Method of Age Determination.

Columbia University. V. K. LaMer, Fundamental Investigation of Phosphate Slimes.

Columbia University. J. M. Miller, Research in the Field of Radiochemistry.

Columbia University. R. M. Noyes, Photochemical Reactions of Iodine.

Columbia University. W. A. Selke, Ion Exchange Chromatography.

Columbia University. T. I. Taylor, Separation of Isotopes by Chemical Exchange.

[1] Contracts listed as of November 30, 1953.

Connecticut, University of. Roland Ward, Trace Element Distribution Between a Melt and a Solid.

Cornell University. J. L. Hoard, Structure of Fluorocarbons, Elementary Boron, and Boron Compounds.

Duke University. D. G. Hill, Study of Some Chemical Reactions at High Temperatures.

Emory University. R. A. Day, Jr., Stability of Complex Ions of Uranium.

Emory University. W. H. Jones, Mass Distribution in Proton-Induced Fission.

Florida State University. R. E. Johnson, Exchange Between Labeled Halogens and Certain Inorganic Halides.

Florida State University. Raymond Sheline, Search for Long-Lived Radioactivities; and Theoretical Nuclear Studies.

Florida, University of. G. B. Butler and A. H. Gropp, Preparation and Properties of Quaternary Ammonium Ion Exchange Resins.

Fordham University. Michael Cefola, Formation of Complexes by Thenoyltrifluoroacetate and Other Chelating Agents.

George Washington University. C. R. Naeser, Fluorides of Rare Earth Elements.

Harvard University. E. S. Barghoorn, Radioactivity in Uraniferous Plant Fossils.

Harvard University. R. M. Diamond and Geoffrey Wilkinson, Nuclear and Inorganic Chemistry of Transitional Elements.

Hunter College. G. R. Burns, Mechanism of the Oxo Reaction Using Carbon 14.

Illinois Institute of Technology. George Gibson, Fundamental Chemistry of Uranium.

Illinois Institute of Technology. H. E. Gunning, Decomposition of Organic Molecules by Metal Photosensitization.

Illinois, University of. H. G. Drickamer, Mechanism of Molecular Motion Determined from Diffusion and Thermal Diffusion Measurements.

Illinois, University of. P. E. Yankwich, Studies in Radiochemistry.

Indiana, University of. L. L. Merritt, Study with Radioactive Tracers.

Indiana, University of. W. J. Moore, Rate Processes in Inorganic Solids at High Temperatures.

Indiana, University of. W. B. Schaap and F. C. Schmidt, Electrochemical Research in Amine Solvents.

Iowa, State University of. LeRoy Eyring, Preparation of Rare Earth Oxides.

Iowa, State University of. Karl Kammermeyer, Separation of Gases by Diffusion Through Permeable Membranes.

Johns Hopkins University. W. S. Koski, Nuclear Chemistry Studies.

Kansas, University of. P. W. Gilles, High Temperature Research.

Louisville, University of. R. H. Wiley, Synthesis, and Properties of Ion Exchange Resins.

Massachusetts Institute of Technology. C. D. Coryell, D. N. Hume, J. C. Sheehan and C. G. Swain, Nuclear Chemistry Research.

Massachusetts Institute of Technology. A. M. Gaudin, Techniques in Mineral Engineering.

Massachusetts Institute of Technology. P. M. Hurley, Isotopic Abundances of Strontium, Calcium, and Argon in Certain Minerals.

Michigan State College. C. H. Brubaker, Jr., Investigations into Aperiodic Oxidation States.

Michigan State College. M. T. Rogers, Physicochemical Investigation of Interhalogen Compounds.

Michigan, University of. P. J. Elving, Polarographic Behavior of Organic Compounds.

Michigan, University of. W. W. Meinke, Nuclear Chemical Research.

Michigan, University of. E. F. Westrum, Jr., Low Temperature Chemical Thermodynamics.

New Hampshire, University of. H. M. Haendler, Less Common Inorganic Fluorides.

New Hampshire, University of. H. M. Haendler, Infra-red Spectroscopy of Inorganic Fluorides.

New York State College for Teachers. O. E. Lanford, Concentration of Nitrogen 15 by Chemical Exchange.

North Carolina State College. F. P. Pike, Performance of Contactors for Liquid-Liquid Extraction.

Northwestern University. Fred Basolo and R. G. Pearson, Mechanism of Substitution Reactions of Inorganic Complexes.

Northwestern University. J. N. Pitts, Jr., Photochemistry of Organic Acids, Ethers, and Ketones.

Notre Dame, University of. Milton Burton, Radiation Chemistry Studies.

Oklahoma Agricultural and Mechanical College. T. E. Moore, Separation of Inorganic Salts by Liquid-Liquid Extraction.

Oklahoma, University of. J. R. Nielsen, Spectroscopic Properties of Fluorocarbons and Fluorinated Hydrocarbons.

Oregon State College. A. V. Logan and E. N. Marvell, Mechanism of the Jacobsen Rearrangement.

Oregon State College. T. H. Norris, Study of Generalized Acid-Base Phenomena with Radioactive Tracers.

Oregon, University of. D. F. Swinehart, Gaseous Chemical Reaction Kinetics, Using a Mass Spectrometer.

Pennsylvania State College. T. F. Bates, Mineralogy and Petrography of Uranium Bearing Shales and Lignites.

Pennsylvania State College. W. C. Fernelius, Stabilities of Coordination Compounds and Related Problems.

Pennsylvania State College. C. R. Kinney, Chemical Nature of Organic Matter of Uraniferous Shales.

Pennsylvania State College. W. W. Miller, Chemical Reactions Induced in Condensed Systems by Beta-decay.

Pittsburgh, University of. Henry Freiser, Development and Testing of Organic Reagents for Use in Inorganic Analysis.

Pittsburgh, University of. Robert Levine, Synthesis of Beta-Diketones and Beta-Ketoesters with Heterocyclic Nuclei.

Princeton University. John Turkevich, Temporary and Permanent Effects Produced by Radiation on Solids.

Princeton University. John Turkevich, Study of Nucleation Processes.

Purdue University. H. C. Brown, Chemistry of Polyvalent Metal Halides.

Purdue University. W. W. Brandt, Metal Ion Chelate Complexes.

Purdue University. Thomas DeVries, Polarographic Studies in Nonaqueous Solvents.

Purdue University. W. F. Edgell, Studies in Molecular Spectroscopy.

Purdue University. W. H. Johnston, Gas Phase Exchange Reactions.

Rensselaer Polytechnic Institute. H. M. Clark, Extraction of Inorganic Substances by Organic Solvents.

Rochester, University of. E. O. Wiig, Radiochemistry.

Rutgers University. E. R. Allen, Polar Inorganic Molecules.

Rutgers University. William Rieman, III, Analytical Chemistry of the Polyphosphates.

Southern California, University of. H. L. Friedman, Solutions of Inorganic Electrolytes in Solvents of Low Dielectric Constant.

Southern California, University of. W. K. Wilmarth, Mechanism of Base Catalyzed Exchange of Hydrogen Gas and Protonic Solvents.

South Carolina, University of. O. D. Bonner, Fundamental Studies of Ion Exchange Equilibria.

South Carolina, University of. H. W. Davis, Use of Carbon 14 in Study of Allylic Fluorination.

Syracuse University. B. P. Burtt, Mechanism of Gaseous Radiation Chemical Reactions and Chemical Reactions of Electrons.

Syracuse University. Louis Gordon, Coprecipitation Studies.

Syracuse University. Henry Linschitz, Photochemical Reactions of Complex Molecules in Condensed Phase.

Tennessee, University of. G. K. Schweitzer, Study of Radiocolloids.

Tennessee, University of. H. A. Smith, Rates of Catalytic Reactions Involving Deuterium; and Relative Vapor Pressures of Water and Deuterium Oxide in the Presence of Certain Salts.

Tennessee, University of. P. B. Stockdale, Chattanooga Black Shale of Tennessee as a Source of Uranium.

Texas, University of. G. H. Ayres, Spectrophotometric Quantitative Determination of the Platinum Metals.

Texas, University of. E. W. Steel, Effects of Biological Slimes on Sea Water.

Texas, University of. G. W. Watt, Unusual Oxidation States of Transitional Elements.

Tufts College. T. R. P. Gibb, Research on Hydrides; and Research on the Preparation of Uranium Hydride.

Utah, University of. Henry Eyring, Studies on Surface Chemistry.

Utah, University of. A. L. Wahrhaftig, Ionization and Dissociation of Molecules by Electron Bombardment.

Utah, University of. B. J. Zwolinski, Induction of Chemical Reactions by High Frequency Discharges in Gases.

Vanderbilt University. E. A. Jones, Raman Spectra of Some Inorganic Fluorine Compounds.

Vanderbilt University. M. D. Peterson, Radiation Stability and Inorganic Radiochemistry.

Virginia Polytechnic Institute. N. F. Murphy, Mass Transfer Studies in Liquid-Liquid Extraction.

Washington State College. H. W. Dodgen, Formulae and Stability of Complex Ions in Solution.

Washington University (St. Louis). J. W. Kennedy, Generation of High Voltages by Means of Nuclear Radiations.

Wayne University. K. H. Gayer, Solubility of Uranium and Thorium Oxides in Dilute Acid and Base.

Wayne University. R. B. Hahn, Analytical Chemistry of Radioactive Elements.

Western Reserve University. E. L. Pace, Thermodynamic Properties of Gases Adsorbed on Solids.

Wisconsin, University of. W. J. Blaedel, High Frequency Titrations.

Wisconsin, University of. Farrington Daniels, Geochemistry of Uranium and Recovery of Uranium from Low Grade Ores.

Wisconsin, University of. E. L. King, Rates and Equilibria of Inorganic Reactions in Solution.

Wisconsin, University of. J. E. Willard, Application of Radioactive Isotopes to Chemical Problems.

Yale University. H. S. Harned, Diffusion Coefficients of Electrolytes and Molecules.

Metallurgy

Alabama, University of. T. N. McVay, Enamels on Metals.

Alfred University. V. D. Frechette, Graphitization of Carbon.

Armour Research Foundation. Max Hansen, The System: Zirconium-Nitrogen

Bausch and Lomb Optical Co. N. J. Kreidl, Irradiation Damage to Glass.

Buffalo, University of. Stanislaw Mrozowski, Basic Principles of Manufacture of Carbons.

California, University of. E. R. Parker, Creep of Alloys.

California, University of. J. A. Pask, Mechanics of Metal-Ceramic Bonding.

Carnegie Institute of Technology. Gerhard Derge, Electrochemical Studies of Nonaqueous Melts.

Carnegie Institute of Technology. J. E. Goldman, Properties of Rare Metals.

Carnegie Institute of Technology. Roman Smoluchowski, Grain Boundaries; and Lattice Imperfections.

Carnegie Institute of Technology. Roman Smoluchowski, Radiation Damage Effects.

Case Institute of Technology. W. M. Baldwin, Jr., Scaling of Zirconium in Air.

Chicago, University of. Lothar Meyer, Structure and Properties of Graphite.

Columbia University. G. L. Kehl, Inclusions in Uranium.

Columbia University. H. H. Kellogg, Electrolytic Production of Zirconium Metal.

Columbia University. T. A. Read, Diffusionless Phase Changes in Metals and

Metal Hydrides, I
Hydride.

North Carolina St
ductivity of Poo

Ohio State Univers

Ohio State Unive
Spectra.

Oregon, University
Corrosion of Zir

Pittsburgh, Univer
dynamics to the

Purdue University.

Rensselaer Polytec
in Metals.

Stanford Universit
of Molten Lead a

Sylvania Electric P
ture Phenomena.

Tennessee, Universi
of Energy Chan
formations.

Wichita, University
Surface Areas of

Columbia University. W. A. Selke, Thermodynamic Properties of Sodium

ments.

Bartol Research F

Metal Hydrides, Inc. M. D. Banus, Research on the Preparation of Uranium Hydride.

North Carolina State College. K. O. Beatty, Jr., Measurement of Thermal Conductivity of Poor Conductors.

Ohio State University. Edward Mack, Jr., Investigation of Separative Processes.

Ohio State University. C. H. Shaw, Soft X-ray Absorption and Emission Spectra.

Oregon, University of. Pierre Van Rysselberghe, Polarographic Studies on the Corrosion of Zirconium.

Pittsburgh, University of. W. E. Wallace, Application of Chemical Thermodynamics to the Study of Alloy Formation.

Purdue University. Karl Lark-Horovitz, Radiation Damage Studies.

Rensselaer Polytechnic Institute. H. B. Huntington, Anisotropic Self-Diffusion in Metals.

Stanford University. O. C. Shepard, Resistance of Materials to Environments of Molten Lead and Bismuth.

Sylvania Electric Products. W. E. Kingston, Self-Diffusion and High Temperature Phenomena.

Tennessee, University of. E. E. Stansbury, Studies on the Direct Measurement of Energy Changes Resulting from Plastic Deformation and Phase Transformations.

Wichita, University of. Luther Lyon, Permeability Method of Determining Surface Areas of Finely Divided Materials.

Physics

Bartol Research Foundation. C. E. Mandeville, Neutron Scattering Measurements.

Bartol Research Foundation. W. F. G. Swann, Cosmic Ray Showers and Counters.[2]

Brown University. R. A. Peck, Jr., Precision Measurements of Neutron and Gamma Ray Interactions.

California Institute of Technology. C. D. Anderson, Cloud Chamber Cosmic Ray Studies.[2]

California Institute of Technology. R. F. Bacher, High Energy Physics.

California Institute of Technology. J. W. DuMond, Precision Nuclear Spectroscopy.

California Institute of Technology. W. A. Fowler, Energy Levels in Light Nuclei.[2]

California, University of. R. B. Brode, Mesons and Showers.[2]

California, University of (Los Angeles). J. R. Richardson, Proton Range Energy Studies.[2]

Carnegie Institute of Technology. Edward Creutz, 400 Mev Synchrocyclotron and Associated Research.

Case Institute of Technology. R. S. Shankland and E. F. Shrader, Gamma Ray Studies with a 30 Mev Betatron.

Chicago, University of. S. K. Allison, Reactions of the Light Nuclei and the Penetration of Charged Particles Through Matter.

Chicago, University of. H. L. Anderson, High Energy Proton Studies.[2]

Chicago, University of. Enrico Fermi, Theory of Nuclear Forces.

Chicago, University of. Marcel Schein, High Energy Primary Interactions.[2]

Columbia University. W. W. Havens, Jr., Nuclear Physics Research.

[2] Contract administered through Office of Naval Research, Washington, D. C

Columbia University. L. J. Rainwater, High Energy Proton Studies.[2]
Columbia University. C. H. Townes, Microwave Spectroscopy.
Connecticut, University of. S. S. Friedland, Inelastic Scattering of Neutrons.
Cornell University. R. R. Wilson, Photon-Meson Reactions.[2]
Duke University. H. W. Newson, Shell Structure and Fast Neutron Cross Sections.
Duke University. W. M. Nielsen, Cosmic Ray Stars.[2]
Florida, University of. D. C. Swanson, Electrostatic Generator Program.
George Washington University. Zolton Bay, Short Life-Times.[2]
Harvard University. Norman Ramsey, High Energy Particle Interactions.[2]
Illinois, University of. F. W. Loomis, Nuclear Disintegration Schemes.[2]
Indiana, University of. A. C. G. Mitchell, Beta and Gamma Spectra.[2]
Iowa, State University of. J. A. Jacobs, Research with Electrostatic Generators.
Iowa, State University of. J. A. Van Allen, Ultra High Altitude Cosmic Rays.[2]
Johns Hopkins University. G. H. Dieke, Absorption and Fluorescent Spectra Of Solid Uranium Compounds.
Johns Hopkins University. G. H. Dieke, Properties of Nuclei.
Johns Hopkins University. S. S. Hanna, Fast Neutron Cross Section Measurements.
Kansas State College. C. M. Fowler, Precision Beta-Ray Spectrometry.
Kansas State College. J. D. Stranathan, Precision Proton Reactions.[2]
Massachusetts Institute of Technology. G. R. Harrison, Echelle Spectroscopy.
Massachusetts Institute of Technology. J. P. Zacarias, Energy Levels and Radioactivity.[2]
Michigan, University of. J. M. Cork, Beta and Gamma Ray Spectra.[2]
Michigan, University of. H. R. Crane, Nuclear Research with 42-Inch Cyclotron.
Michigan, University of. H. R. Crane, Nuclear Research with 300 Mev. Synchrotron.
Michigan, University of. W. E. Hazen, Cosmic Ray Showers and Penetrating Particles.[2]
Minnesota, University of. C. L. Critchfield, Heavy Particle Component.[2]
Minnesota, University of. J. H. Williams, Precision Particle Scattering.[2]
Minnesota, University of. J. H. Williams, Operation of 50 Mev Proton Linear Accelerator.
National Academy of Sciences. Kay Way, Preparation of Tables of Nuclear Data.
National Research Council. R. C. Gibbs, Nuclear Scientific Standards.[2]
Nebraska, University of. Theodore Jorgenson, Jr., Mechanism of Energy Transfer of Slow Ions.
New York University. S. A. Korff, Relative Neutron Intensities.[2]
Notre Dame, University of. Bernard Waldman, Energy Spectra of Excited Nuclei.[2]
Ohio State University. J. G. Daunt, Nuclear Paramagnetism and Low Temperature Physics.
Ohio State University. J. N. Cooper, Nuclear Spectroscopy with Van de Graaff.
Oregon State College. E. A. Yunker, 37-Inch Cyclotron.
Pennsylvania State College. Ray Pepinsky, Neutron Single Crystal Structure Analysis.
Pennsylvania, University of. W. F. Love, Solid State Physics at Low Temperature.
Pennsylvania, University of. W. E. Stephens, Beta and Gamma Ray Studies.[2]
Pittsburgh, University of. A. J. Allen, Precision Particle Scattering.[2]

[2] Contract administered through Office of Naval Research, Washington, D. C.

Princeton University. G. T. Reynolds, Meson Energy Spectra Stars and Bursts.[2]
Princeton University. M. G. White, Nuclear Research Using 17 Mev Cyclotron.
Puerto Rico, University of. Letitia Del Rosario, Meson Studies at Low Altitudes.[2]
Purdue University. Ernst Bleuler, Research with Cyclotron.
Purdue University. Karl Lark-Horovitz, Basic Research with Linear Electron Accelerator.
Purdue University. R. M. Whaley, Research with Synchrotron.
Rice Institute. T. W. Bonner, Nuclear Physics of the Light Elements.
Rochester, University of. R. E. Marshak, High Energy Nuclear Physics.
Rutgers University. L. A. Whitmer, Nuclear Moments.[2]
Stanford University. Felix Bloch, Nuclear Moments.[1]
Stanford University. E. L. Ginzton, Limitations of Electron Linear Accelerators.
Stanford University. E. L. Ginzton, Billion Volt Electron Reactions.[2]
Syracuse University. Kurt Sitte, Electron Component in 10–100 Bev Showers.
Texas, University of. E. L. Hudspeth, Nuclear Research with Van de Graaff.
Vanderbilt University. S. K. Haynes, Beta-Ray Spectroscopy.
Washington University (St. Louis). A. L. Hughes, Nuclear Structure and Shell Structure.[2]
Washington University (St. Louis). R. D. Sard, Meson Production and Disintegration.[2]
Washington, University of. J. H. Manley, Meson Momenta and Positive Excess.[2]
Washington, University of. J. H. Manley, 60-Inch Cyclotron Development and Research.
Westinghouse Electric Corp. B. H. Jennings, Research in the Field of Nuclear Physics.
Wisconsin, University of. J. R. Dillinger, Low Temperature Research.
Wisconsin, University of. R. C. Herb, Nuclear Research with Electrostatic Generator.
Wisconsin, University of. D. A. Lind, Inelastic Scattering of Fast Neutrons.
Wisconsin, University of. R. G. Sachs, Theory of Light Nuclei.
Yale University. Franklin Hutchinson, Stopping Power of Water.
Yale University. H. L. Kraybill and E. C. Fowler, High Energy Physics.
Yale University. E. C. Pollard, Energy Levels, High-Speed Counting Techniques.[2]
Yale University. H. L. Schultz, Electron Linac Neutron Velocity Selector.
Yale University. W. W. Watson, Isotope Separation by Thermal Diffusion and Nuclear Studies with Separated Isotopes.

BIOLOGY, BIOPHYSICS AND MEDICINE RESEARCH CONTRACTS

Biology

Agriculture, Department of, Agricultural Research Administration. A. H. Moseman, The Improvement of Soil Management and Crop Production Through Investigations with Isotopes.
Agriculture, Department of, Bureau of Animal Industry. The Intermediary Metabolism of Proteins and Amino Acids in Avian and Mammalian Species.
Agriculture, Department of, Agricultural Research Administration. Berley Winton, Study of the Effects of Radiation on Chickens.
American Meat Institute Foundation, Chicago, Illinois. B. S. Schweigert, Relation of Vitamin B-12 to Nucleic Acid Metabolism.

[1]Contract administered through Office of Naval Research, Washington, D. C.

Amherst College. H. H. Plough, Studies of Mutations in Bacteria and in Drosophila Induced by Radiation.

Amherst College. G. W. Kidder, Studies on Nucleic Acid and Free Nucleotide Synthesis in Normal Tissue and in Tumor Tissue, Using Carbon 14.

Arizona, University of. W. H. Fuller and W. T. McGeorge, Utilization of Phosphorus from Biological Material and Uptake of Strontium by Various Type Crops.

Arizona, University of. E. B. Kurtz, The Synthesis of Fatty Acids in Higher Plants.

Arkansas, University of. Jacob Sacks, Studies on the Phosphorylation Cycle in the Intact Animal Using Radioactive Phosphorus.

Battelle Memorial Institute. K. S. Chester, The Use of Radioactive Indicators in the Study of Mode of Action of Fungicides.

Battelle Memorial Institute. K. S. Chester, The Nutrition of Obligate Parasites in Plants.

Boston University School of Medicine. W. C. Boyd, Blood-Group-Specific Hemagglutinins from Plant Sources.

Boyce Thompson Institute (Yonkers, N. Y.). G. L. McNew, Use of Tracer Labeled Fungicides in Determining the Mechanics of Protecting Plants from Fungus Diseases.

Brown University. J. W. Wilson, The Role of the Intestinal Flora in Radiation Injury.

California Institute of Technology (Pasadena). G. W. Beadle, The Genetic and Cytological Effects of High Energy Radiation.[2]

California Institute of Technology (Pasadena). Henry Borsook, Biological Synthesis of Protein with Use of Isotopes.[2]

California, University of (Berkeley). H. A. Barker, W. Z. Hassid, and C. C. Delwiche, Tracer and Enzymatic Studies on the Metabolism of Plants and Bacteria.

California, University of (Davis). A. S. Crafts, The Use of Radioactive Isotopes and Other Indicators to Study Absorption and Distribution of Herbicidal Chemicals in Plants.

California, University of (Berkeley). W. G. Dauben, Mechanism of Biosynthesis of Polycyclic Compounds.

California, University of (Davis). G. H. Hart, The Effect of Radiation on Work Capacity and Longevity of the Dog.

California, University of (Berkeley). Louis Jacobson and Roy Overstreet, Study of the Internal or Metabolic Factors and the External or Environmental Factors Affecting Ion Absorption by Plants.

California, University of (Davis). Max Kleiber, Intermediary Metabolism of Organic Compounds and Biological Synthesis in Farm Animals.

California, University of (Davis). A. H. Smith, Radiosensitivity of the Hen's Oviduct.

California, University of (Berkeley). P. R. Stout, Micronutrient Element Nutrition of Plants as Determined by Essential and Nonessential Soil Borne Heavy Metals of Importance in Plant Nutrition.

California, University of (Riverside). F. M. Turrell, *et al.*, Use of Radioactive Tracers in Studies of the Mode of Action of Organic Insecticides.

California, University of, at Los Angeles. T. A. Geissman, The Sites and Mechanisms of Action of Physiologically-Active Substances, with Particular Application to Drugs Acting Upon the Autonomic Nervous System.

California, University of, at Los Angeles. S. G. Wildman, The Study of Plant Virus as Approached by the Study of the Normal Plant Proteins.

Chicago, Univ
Reactivation
Chicago, Univ
Compounds.
Clemson Agric
of Action of
Columbia Univ
End-Products
Ascorbic Acid
Columbia Univ
of Drosophila
Columbia Univ
dividual Cell
Autoradiogra
Connecticut Ag
Dimond, The
Connecticut, Un
in *Claviceps p*
Cornell Univers
Einset, The I
and Other Ec
Cornell Univers
as Related to
Duke University
Light and Ga
Irradiated Lip
Duke University.
tion of Radioa
Pine; (2) A St
Into Developir
Duke University
Mutations in D
Emory W. Thur
parative Effec
Factor in Live
Emory Universit
and Temperatu
Florida, Univers
centration of M
Transfer of Th
Fordham Univers
in the Animal I
Fordham Univers
Native and Che
Georgia, Universi
Study of Land
of the Savanna
Harvard Univers
Breakage.[2]
Hawaii, Universit
Techniques for
Pacific.

[2] Contract admini

Chicago, University of. Hans Gaffron, Effect of Blue and Dark Red Light Upon Reactivation of Ultraviolet Treated Photosynthetic Microorganisms.

Chicago, University of. E. M. K. Geiling, Biosynthesis of Radioactive Drug Compounds.

Clemson Agricultural College. J. G. Dinwiddie, Jr., Investigation of the Mode of Action of Maleic Hydrazide as a Plant Growth Regulator.

Columbia University. C. G. King and H. B. Burch, To Identify Precursors and End-Products Containing Radiocarbon, in Studies of the Role of Glucose, Ascorbic Acid, etc., in Metabolism.

Columbia University. Theodore Dobzhansky, The Population Genetics of Species of Drosophila.

Columbia University. J. H. Taylor, Nucleic Acid and Protein Synthesis in Individual Cells and Chromosomes Studied by Radioactive Tracers and Autoradiographs.

Connecticut Agricultural Experiment Station. P. E. Waggoner and A. E. Dimond, Therapy of Plant Disease by Nuclear Radiations.

Connecticut, University of. A. E. Schwarting, A Study of Alkaloidal Synthesis in *Claviceps purpurea.*

Cornell University—New York State Agricultural Experiment Station. John Einset, The Induction and Testing of Somatic Mutations in Apples, Grapes and Other Economic Plants.

Cornell University. M. R. Zelle, Cytological and Genetic Studies of Bacteria as Related to Effects of Radiation.

Duke University. I. E. Gray and N. G. Anderson, The Effects of Ultraviolet Light and Gamma Rays on Cell Lipids and the Physiological Action of Irradiated Lipids.

Duke University. P. J. Kramer, (1) Study of the Factors Affecting the Absorption of Radioactive Phosphorus by Mycorrhizal and Nonmycorrhizal Roots of Pine; (2) A Study of the Absorption and Translocation of Radioactive Isotopes Into Developing Flower Parts in Order to Produce Labeled Pollen.

Duke University. C. L. Ward, A Study of the Reversibility of X-Ray-Induced Mutations in Drosophila Melangaster.

Emory W. Thurston Laboratories (Los Angeles, Calif.). B. H. Ershoff, Comparative Effects of the Known B Vitamins and an Unidentified Antitoxic Factor in Liver on Radiation Injury in the Rat.

Emory University. A. V. Beatty, Studies of the Influence of Oxygen Level and Temperature on the Effects of Ionizing Radiation.

Florida, University of. G. K. Davis, J. P. Feaster and A. M. Pearson, Concentration of Mineral Elements in the Fetus and the Relationship to Placental Transfer of These Elements.

Fordham University. L. R. Cerecedo, Fate of Thiamine and Thiamine Analogs in the Animal Body. Mechanism of Thiamine Inhibition by Thiamine Analogs.

Fordham University. F. F. Nord, Investigation on Enzymatic Degradation of Native and Chemically Modified Proteins.

Georgia, University of. E. P. Odum, J. J. Paul and D. C. Scott, An Ecological Study of Land-Use, Succession, of Invertebrate and Vertebrate Populations of the Savannah River Operations Areas.

Harvard University. Karl Sax, Intensity of Radiation and Chromosome Breakage.[2]

Hawaii, University of. M. S. Doty, The Utilization and Evaluation of Isotope Techniques for the Determination of Algal Productivity in the Tropical Pacific.

---

[2] Contract administered through Office of Naval Research, Washington, D. C.

Howard University. W. M. Booker, The Relation of Ascorbic Acid to Cholesterol.

Howard University. L. A. Hansborough, The Effect on Fertilization and Development of Labeling the Germ Cells.

Howard University. Nathan Lavenda and H. Y. C. Wong, The Influence of Radioiodine and Radiophosphorus on the Hematopoietic Systems of Leukemically-Resistant and Susceptible Strains of Mice.

Idaho, University of. W. K. Ferrell and E. E. Hubert, A Study of Absorption and Translocation of Mineral Elements in Diseased and Healthy Western White Pine by the Use of Radioactive Materials.

Illinois Institute of Technology. L. R. Hedrick, Studies on Yeast Agglutination Using Labeled Antigen.

Illinois, University of. I. C. Gunsalus, Intermediary Metabolism of Carbohydrates.

Illinois, University of. R. G. Hansen, Utilization of Carbon 14 in Studies of the Metabolism of Lactose.

Illinois, University of. B. C. Johnson, Nutritional Biochemistry on the Metabolism of Vitamins and Amino Acids.

Illinois, University of. H. H. Mitchell, Content in Human Tissues of Eleven Trace Elements.

Illinois, University of. George Wolf, Metabolism of Amino Acids Labeled with Radioactive Carbon.

Indiana University Foundation. R. C. Bard, The Biochemical Mechanism of Anthranilic Acid Utilization in Lactobacillus Arabinosus.

Indiana University Foundation. Felix Haurowitz, The Mechanism of the Combination of Antigen and Antibody.

Indiana University Foundation. H. J. Muller, The Influence of Radiation in Altering the Incidence of Mutations in Drosophila.

Indiana University Foundation. T. M. Sonneborn, Specific Immobilization Substances (Antigens) of *Paramecium aurelia.*

Interior, Department of. W. A. Chipman, Survey of Accumulation of Radioactivity in Marine Invertebrate Animals.

Iowa State College. J. W. Gowen and Janice Stadler, Quantitative Study of Lifetime Sickness and Mortality and Progeny Effects Resulting from Exposure of Animals to Penetrating Irradiation.

Iowa State College. Samuel Aronoff, The Problem of Aging in Plants in Relation to Radiation.

Iowa State College. C. H. Werkman, Synthesis and Assimilation of Bacterial Nucleic Acids.

Johns Hopkins University. Robert Ballentine and W. D. McElroy, Metabolism and Functional Significance of Cobalto-Protein.

Johns Hopkins University. B. F. Chow, Purification of Intrinsic Factor in Gastric Juice.

Johns Hopkins University, School of Medicine. Theodore Enns and Francis Chinard, A Study of Relative Diffusion Rates of Isotopes from Capillaries.

Johns Hopkins University. H. B. Glass, The Action of Radiation and Other Mutagenic Agents; (1) in Inducing Mutation in Drosophila Females, and (2) in Controlling the Action of a Specific Gene Responsible for Suppressing Uncontrolled Growth.

Johns Hopkins University. R. M. Herriott, (1) The Transformation of E. Coli B from Virus Sensitive to Virus Resistant or Vice Versa. (2) Chemical and Nutritional Studies of Bacterial Viruses.

Johns Hopkins University. W. D. McElroy and C. P. Swanson, Modification Through the Use of Supplemental Environmental Factors of the Frequency of Gene and Chromosome Changes Induced by X-rays, Ultraviolet Light and Nitrogen Mustard.

Johns Hopkins University, School of Medicine. C. P. Richter, Part Played by the Adrenals in the Ability of Rats to Withstand Radiation Effects.

Kansas State College. R. E. Clegg, Phosphoproteins of the Embryonated Egg.

Kentucky, University of. H. P. Riley, The Protective Effect of Certain Chemicals on the Sensitivity of Plant Chromosomes to Ionizing Radiation.

Long Island Biological Association, Inc. Bruce Wallace, Adaptive Value of Experimental Populations Exposed to Radiations.

Louisiana State University and A. & M. College. H. J. Bennett, The Effects of Radioisotopes on the Developmental Stages of Trematodes.

Louisiana State University. H. E. Wheeler, Investigations of the Toxin Theory of Plant Disease Using Labeled Plant Pathogens.

Louisiana State University. H. E. Wheeler, Investigations of the Physiology, Genetics, and Host-Parasite Relationships of Plant Pathogenic Fungi by the Use of Radioisotopes.

Maine, University of, Agricultural Experiment Station. K. F. Nielsen, A Study of the Translocation and Accumulation of Certain Anions and Cations within the Potato Plant.

Marine Biological Laboratory, Woods Hole, Mass. P. B. Armstrong, Studies on the Physiology of Marine Organisms Using Radioisotopes.

Marine Biological Laboratory, Woods Hole, Mass. P. B. Armstrong, Investigation of the Biochemistry of Cell Nuclei Using Radioisotopes.

Maryland, University of. W. M. Dugger and H. G. Gauch, The Influence of Inorganic Nutrients on the Translocation of Organic Materials in Plants.

Maryland, University of. J. C. Shaw, The Metabolism of Radioactive Carbon Compounds in Lactating Ruminants.

Maryland, University of. Edward Steers, The Nature and Function of the Replacement of P-Amino-Benzoic Acid by D-Lysine as a Growth Factor for *Lactobacillus Arabinosus* 17–5

Massachusetts, University of. P. A. Swenson, Effects of Ultraviolet Radiations on Phosphate Turnover of Yeast Cells in the Presence of Galactose.

Michigan State College. R. U. Byerrum and C. D. Ball, A Study of Transmethylation in Plants Using Carbon 14 as a Tracer.

Michigan State College. Bergene Kawin, The Metabolism in Animals of Some Radionuclides Derived from Fission.

Michigan State College. H. B. Tukey, The Absorption and Utilization of Radioactive Minerals Applied to the Leaves of Plants.

Michigan State College. L. F. Wolterink, Hormonal and Nutritional Factors which Influence the Biological Half Lives of Calcium and Strontium in Animals (Including Studies of Intestinal Absorption).

Michigan, University of. J. V. Neel, The Estimation of the Rate of Mutation of Certain Human Genes.

Minnesota, University of. R. T. Holman and Herman Schlenk, Studies in Lipid Metabolism by Means of Radioactive Tracers.

Minnesota, University of. W. E. Peterson, *et al.*, Study of Milk Formation by the Use of Radioactive Carbon Compounds.

Minnesota, University of. E. C. Stakman, Effects of Radioactive Substances on Plant Pathogens and Other Microorganisms.

Missouri Botanical Gardens. Edgar Anderson, Investigation of Natural and Radiation-Induced Mutations in *Nicotiana.*

Missouri, University of. Samuel Brody, Determination of Thyroid Activity in Farm Animals by the Use of Radioactive Tracers.

Missouri, University of. Jacob Levitt, Absorption and Translocation of Radioactive Minerals in Plants.

Missouri, University of. L. J. Stadler, The Genetic Nature of Induced Mutations.

Morehouse College (Atlanta, Ga.). J. H. Birnie, The Correlation of Histological Differentiation in the Thyroid Gland of Fetal Rats with the Beginning of Function.

Navy, U. S.,—Naval Radiological Defense Laboratory. R. W. Brauer, Physiological Studies Related to the Recovery of Dogs from Fractionated Doses of X-rays.

Nebraska, University of. E. F. Frolik and Rosalind Morris, The Genetic Effects of Thermal Neutron Irradiation of Crop Seeds.

North Carolina State College. W. C. Gregory, Effects of Nuclear Reactor Radiation upon Genetic and Physiological Characteristics of Peanuts.

North Carolina State College. N. S. Hall, Study of the Movement of Ions through Soil Systems.

North Carolina State College of Agriculture and Engineering. D. S. Grosch, The Genetic and Developmental Effects of Ingested Radioactives in Habrobracon

North Carolina State College. S. B. Tove, A Study of the Effect of the Diet on Lipid Metabolism Using Carbon 14.

North Carolina, University of. Maurice Whittinghill, The Partial Elimination of Lethal Genes Before Reproduction in Drosophila by the Use of Environmental Agents.

Northwestern University. G. H. Mickey, Comparison of the Delayed Effects Produced by Chemical Mutagens and by X-rays.

Notre Dame, University of. C. S. Bachofer, Study of Protection of Virus Systems Against Irradiation.

Oberlin College. G. T. Scott, Studies on the Physiology of Ion Accumulation and Electrolyte Balance in Living Cells.

Ohio Agricultural Experiment Station. O. G. Bentley and A. L. Moxon, Investigations of Vitamin B–12 and Vitamin B–12-like Substances Produced in Ruminants, Using Radioactive Cobalt.

Oklahoma Agricultural and Mechanical College. Robert MacVicar, Isotope Investigation of the Mechanism of Nitrate Reduction in Bacteria.

Oklahoma Research Institute, University of. Lawrence Rohrbaugh and E. L. Rice, Study of the Translocation of Tagged 2,4-D and Other Growth Regulators in Plants in Light and Darkness.

Oregon State College. V. E. Cheldelin and B. E. Christensen, Carbohydrate-Amino Acid Interrelationships, Using Isotopic Tracers.

Oregon State College. B. E. Christensen and Elmer Hansen, Intermediary Metabolism of Organic Acids and Proteins in Certain Fruits Using Isotopic Tracers.

Oregon State College. S. C. Fang, The Mode of Action of Labeled 2,4-Dichlorophenoxyacetic Acid and Similar Agents.

Oregon, University of. F. J. Reithel, An Investigation of Lactose Synthesis in Mammary Gland Homogenates.

Pennsylvania, University of. E. D. DeLamater, Studies on the Cytology and Cytochemistry of Microorganisms Following Irradiation.

Pennsylvania, University of. D. R. Goddard and William Stepka, A Study of Sulfate Reduction and the Biosynthesis of Organic Sulfur Derivatives in Higher Plants.

Pennsylvania, University of. L. V. Heilbrunn, Radiation-Induced Colloidal Changes and Release of Bound Materials in Protoplasm.

Pennsylvania, University of. Stuart Mudd, The Internal Organization of Normal and Phage-Infected Cells as Influenced by Radiation.

Pennsylvania, University of. P. W. Whiting, Mutation Rates in Mormoniella.

Pennsylvania, University of. D. W. Wilson, Synthesis of Isotopic Carbon Compounds Used in Biochemistry.

Pittsburgh, University of. M. A. Lauffer, Study of the Correlation of Radiation Effects with Physical and Chemical Changes in Viruses.

Puerto Rico, University of, Agricultural Experiment Station. J. A. Bonnet and A. R. Riera, The Absorption of Potassium by Tropical Crops.

Purdue Research Foundation. Henry Koffler and D. M. Powelson, The Physiology of Hydrogen Bacteria.

Purdue Research Foundation. Henry Koffler and P. A. Tetrault, Use of Radioactive Isotopes in Studying Mold Metabolism with Emphasis on the Assimilatory Mechanisms of Penicillium Chrysogenum and Other Representative Molds.

Reed College. A. F. Scott and A. H. Livermore, The Effect of Ionizing Radiation On Biochemical Compounds.

Reed College. A. H. Livermore, The Biochemical Synthesis of Peptide Bonds.

Rice Institute. R. V. Talmage, Endocrine and Metabolic Studies Utilizing Radioisotopes and Labeled Hormones.

Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine. C. C. Little, Study of Endemic and Epidemic Diseases in Mice.

Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine. E. S. Russell and W. S. Murray, The Maintenance of a Genetically Controlled Colony of Mice To Insure the Availability of Strains of Known Constitution to AEC Institutions and Contractors.

Rutgers College. N. F. Childers, L. F. Hough and J. E. Gunckel, Growth, Flowering and Fruiting Effects of Irradiation on Important Fruit Plants, Particularly Blueberry and Peach.

Rutgers College. J. E. Gunckel, Histological and Physiological Effects of Irradiation on Plant Tissues.

Smith College. A. F. Blakeslee, Studies on Effects of Neutron Radiation on Chromosome and Gene Changes in Datura.

Smithsonian Institution. R. B. Withrow, Specific Biological Indicators of Ionizing Radiation and the Mechanism of Its Action.

Smithsonian Institution. R. B. Withrow, A Biochemical Investigation of Radiant Energy as it Affects Photomaturation in Green Plants.

South Carolina, University of. W. E. Hoy, An Ecological Study of the Land Plants and Cold-Blooded Vertebrates of the Savannah River Project Area Before and After Installations Have been Completed.

Southern California, University of. H. J. Deuel, Jr., and A. L. S. Cheng, Effect of Radiation on Intestinal Absorption and Metabolism of Fats and Carbohydrates.

Southern California, University of. C. V. Harding, Protein and Nucleic Acid Metabolism in Hybrid Echinoderm Embryos.

Southern California, University of. M. G. Morehouse, A Study of the Effect of X-Radiation on the Absorption of Glycerides Utilizing Tracer Technique.

South Dakota State College. E. I. Whitehead and O. E. Olson, Metabolism of Selenium and Radioactive Sulfur in Plants.

Southern Illinois University. C. C. Lindegren, The Effect of X-Irradiation on a Polyploid Series of Yeast Cultures Containing Determined Amounts of DNA.

Southern Research Institute. H. E. Skipper, Body Retention of Carbon 14.

Southern Research Institute. H. E. Skipper and L. L. Bennett, Jr., Use of Radioactive Isotopes for Study of Certain Chromosome-Coenzyme Relationships.

Stanford University. A. C. Giese, Studies on Photoreactivation Following Ultraviolet Irradiation Injury.

Syracuse University. B. S. Strauss, The Study of Intermediate Carbohydrate Metabolism in Neurospora Using Radioactive Carbon and Biochemical Mutants.

Tennessee Agricultural and Industrial State College. H. B. Crouch, Radiation and Tracer Element Studies on Certain Pathogenic Protozoa and Nematodes of Rodents.

Texas A & M College. J. H. Quisenberry, Effects of X-ray Irradiation on Reproduction of the Domestic Fowl (Gallus Domesticus).

Texas, University of. J. W. Foster, Studies of the Metabolic Processes in Molds and Fungi with Carbon 14.

Texas, University of. W. S. Stone, Research on Direct and Indirect Effects of Radiations on the Genetic Systems of Organisms.

Texas, University of. Orville Wyss. The Genetic and Biochemical Effects of Radiation on Bacteria.

Union College. L. B. Clark, (1) Biological Effects of High Voltage Radiation; (2) Radiation Genetics of Habrobracon.

Utah State Agriculture College. F. B. Wann, Use of Radioisotopes in Studying Lime-Induced Chlorosis.

Utah, University of. J. D. Spikes and R. W. Lumry, Studies of Photosynthetic Processes in Cell-Free Preparations Using Radiation.

Utah, University of. F. E. Stephens, Study of the Frequency of Human Consanguineous Marriages and Its Relation to the Appearance of Recessive Gene Mutations.

Virginia Polytechnic Institute. E. P. Johnson, Radioactive Isotopes to Trace Leucosis and Newcastle Disease in Fowls.

Washington, State College of. Orlin Biddulph and R. L. Hausenbuiller, The Zinc Nutrition of Plants in Calcareous Soils.

Washington, State College of. Orlin Biddulph, Absorption, Translocation and Deposition of Radioactive Elements in Plants.

Washington, State College of. H. B. Milne, The Effect of X-rays Upon the Optical Specificity of Papain.

Washington, State College of. R. A. Nilan, A Study of Factors Influencing the Biological Effects of X-rays.

University of Washington (Seattle). E. J. Ordal, The Metabolism of Molecular Hydrogen, Deuterium and Tritium.

Western Reserve University. H. G. Wood and L. O. Krampitz, Intermediary Metabolism of Carbohydrates by Bacteria.

Wisconsin, University of. R. H. Burris, M. J. Johnson and P. W. Wilson, Metabolism of Organic Acids in Higher Plants and Microorganisms.

Wisconsin, University of. R. H. Burris and P. W. Wilson, Biological Nitrogen Fixation with Isotope Tracers.

Wisconsin, University of. D. E. Green, Effect of Radiation on Enzymes in the Cyclophorase System.

Wisconsin, University of. A. D. Hasler, Radioisotope Exchange Studies in Lakes.

Wisconsin, University of. J. C. Nees, The Iron, Manganese and Copper Cycles in Aquatic Insect Populations.

Wisconsin, University of. P. H. Phillips, Long Time Effects of Intermittant Radiation on Dogs.

Wisconsin, University of. A. J. Riker and J. E. Kuntz, The Use of Radioactive Isotopes in Determining the Role of Root-Grafting in Forest Trees.

Wyoming, University of. Irene Rosenfeld and O. A. Beath, Investigations of the Interrelationship of Sulphur, Phosphorus and Calcium in Selenium Metabolism in Plants and Animals.

Yale University. D. M. Bonner, Relationship of Genes to Biochemical Reactions in Neurospora.

Yale University. M. I. Bunting, The Genetics of Serratia as Revealed by Radiation.

Yale University. N. H. Giles, Jr., Investigations on the Cytogenic Effects of Radiations.

Yale University. E. C. Pollard, Irradiation of Viruses and Large Molecules.

Biophysics

Chicago, University of. R. E. Zirkle, Use of Microbeam of Light Atomic Nuclei for Biological Investigations.

Columbia University. Gioachino Failla, Dosage Determination; Biological Action of Ionizing Radiation.

Columbia University. V. K. LaMer, Filtration of Monodisperse Radioactive Solid Aerosols (Dusts).

Commerce, U. S. Department of, National Bureau of Standards. Radiation Physics as Related to Dosimetry and Radiation Protection.

Commerce, U. S. Department of, National Bureau of Standards. Louis Costrell, Radiation Monitoring Telemetering System.

Commerce, U. S. Department of, U. S. Weather Bureau. Harry Wexler, Correlation of Meteorological Trajectories with Fall-out of Atomic Debris.

Commerce, U. S. Department of, National Bureau of Standards. W. A. Wildhack, Basic Instrumentation Program.

Allen B. DuMont Laboratories Inc. Stanley Koch, Photomultiplier Tube Development.

Emory University. H. D. Bruner, Biological Studies on the Distribution of Radioactive Metals in Critical Organs.

Harshaw Chemical Co. Scintillation Counter Crystals Growing Project.

Health, Education and Welfare, U. S. Department of. R. L. Cleere, Investigation of Radon and Radon Decay Products in the Uranium Mines of Colorado.

Howard University. Herman Branson, Kinetic and Mass Spectrometric Studies of Biophysical Systems with Radioactive and Stable Isotopes.

Idaho State College. C. W. McIntosh and A. E. Taylor, An Investigation of the Effect of Uranium on Photochemical Reactions, and a Method of Determining Microgram Quantities of Strontium.

Kansas University. F. E. Hoecker, Biological Effects of Heavy Ionizing Particles.

Marquette University, School of Medicine. J. F. Kuzma, The Pathological Effects of Radioactive Isotopes of Calcium and Strontium on Bone and Soft Tissue.

Massachusetts Institute of Technology. R. D. Evans, Radium and Mesothorium Poisoning, and Dosimetry and Instrumentation Techniques in Applied Radioactivity.

Michigan, University of. H. J. Gomberg, High Resolution Detection of Nuclear Radiations.

Navy, U. S.—Naval Research Laboratory. J. H. Schulman, Research on Dosimetric Problems Emphasizing Studies in the Megaroentgen Range.

Notre Dame, University of. E. A. Coomes, Fundamental Research on Photoemission.

Northwestern University, Rheumatic Fever Research Institute. E. L. Hess, The Separation of the Proteins of Lymphoid Tissue and Characterization in Regard to Their Radiation Sensitivity.

Oregon Medical School, University of. F. B. Queen, Determination of Lifetime Accumulation of Radioactive Substances in Individuals with No Known Exposure.

Pittsburgh, University of. T. F. Hatch, Hazard from Inhaled Radioactive Particulate Matter.

Radio Corporation of America. Multiplier Phototube Development.

Sloan Kettering Institute for Cancer Research. J. S. Laughlin, Equivalence of Absorbed Radiation Energy and Cavity Ionization.

Utah, University of. J. Z. Bowers, Toxicity Studies of Plutonium and Other Radioactive Substances in Animals.

Vanderbilt University. J. I. Hopkins, Nuclear Physics Studies on Instrumentation Problems.

Washington University School of Medicine (St. Louis). W. M. Allen, W. B. Seaman and Michel Ter-Pogossian, Comparative Study of the Biological Effects of X-rays and Ionizing Radiation from Radioisotopes.

Washington, University of (Seattle). F. I. Badgely, Determination of Relationships Between Temperature Lapse Rate, Wind Speed and Wind Shear. (Atmospheric Turbulence Study.)

Washington, University of (Seattle). P. E. Church, Changes of Wind Speed and Direction with Height in Relation to the Vertical Temperature Distribution.

Wisconsin, University of. D. M. Angevine and J. J. Lalich, Development and Application of Historadiography in Relation to the Distribution of Mass and Localization of Elements in Normal and Pathologic Tissues.

Medicine

Albany Medical College. Arthur Knudson and Pradisth Cheosakul, The Mechanism of Urea Metabolism.

Arkansas, University of, Medical School. P. L. Day and Isadore Meschan, Studies on the Biochemical and Nutritional Aspects of X-Radiation Injury.

Beth Israel Hospital Association, Inc., (Boston). H. L. Blumgart, The Use of Iodine 131 in Treatment of Heart Diseases and Follow-up Studies on Biological Effects of Radiation.

Boston University School of Medicine. Isaac Asimov, Radiation-Induced Changes in Nucleic Acids and Their Hydrolysis Products.

Boston University. B. R. Lutz, The Effect of Irradiation on the Functions of Small Blood Vessels of the Hamster and the Frog.

Boston University. L. C. Wyman, The Effect of Irradiation on the Growth and Functioning of Transplanted or Regenerated Adrenocortical Tissue in the Rat.

California, University of, School of Medicine (Berkeley). I. L. Chaikoff, Studies on the Induction of Thyroid Cancer Following Administration of Radioactive Iodine.

California, University of (Berkeley). I. L. Chaikoff, Carbohydrate Metabolism as Studied with Carbon 14 Labeled Compounds.

Chicago Medical School. Philippe Shubik, A Study of the Latent Tumor Cells as Produced by Beta Radiation and a Comparison of the Latent Tumor State with That Produced by Chemical Carcinogens.

Chicago, University of. H. S. Anker, Investigation of the Mechanism of Antibody Synthesis by the Tracer Technique.

Chicago, University of. E. S. G. Barron, Studies on the Mechanism of Action of Ionizing Radiations.

Chicago, University of. P. P. H. DeBruyn, Radiosensitivity of the Lymphocytes.

Chicago, University of. W. L. Palmer, A Study of the Effect on Gastric Tissues of Irradiation Therapy in Peptic Ulcer.

Chicago, University of. C. P. Miller, Bacteriological Aspects of Radiation Sickness.

Chicago, University of. W. H. Taliaferro, The Effect of Localized X-Irradiation on Antibody Formation and Antigen Localization. The Site of Antibody Formation.

Children's Hospital of Buffalo. C. U. Lowe, Nucleic Acid Metabolism in the Liver and Effects of Radiation.

Children's Medical Center (Boston). L. K. Diamond, Study of the Possible Factors in Regeneration of Hematopoietic Tissue in the Aplastic Anemias, Both Idiopathic and Secondary to Radiation Injury, in Human Subjects.

Children's Medical Center (Boston). Sidney Farber, The Nature of Bleeding in Pancytopenia with Special Regard for Thrombocytopenia and the Vascular Defect.

Cincinnati, University of, Kettering Laboratory. F. F. Heyroth and E. J. Largent, Research on the Biological Effects of Beryllium and Its Compounds.

Colorado, University of. T. T. Puck, Bacteriophage and Radiation Mechanisms.

Columbia University. David Nachmansohn, Study of Changes in Permeability of Normal, Poisoned and Irradiated Nerve Fibers.

Columbia University. Aubrey Gorbman, Biological Effects of Radiation from Excessive Amounts of Radioiodine.

Columbia University. P. B. Hudson and J. M. Reiner, The Turnover of Specific Proteins, Protein Fractions, and Nucleic Acids in Normal and Malignant Human Testis and Kidney.

Columbia University. David Nachmansohn, Effect of Exposure to Radioactive Material and to X-ray Irradiation on Nerve Tissue.

Duke University. Philip Handler. Metabolic Studies with Tracer Techniques.

Duke University. J. S. Harris, A Study of Potassium Metabolism in Isolated Tissue.

Duke University. R. W. Rundles, Study of the Metabolism of Human Bone Marrow.

Emory University. H. W. Ades, (1) Effect of Radiation on Learned Behavior, Problem-Solving Ability and Neural Mechanisms of Rhesus Monkeys; (2) Effect of Radiation on Ground Substance of Loose Connective Tissue.

Florida, University of. F. E. Ray, The Use of Isotopes in the Study of the Metabolism of Aromatic Amines.

Fordham University. E. V. Brown, Metabolism of a New Carcinogen Using Radioactive Carbon.

George Washington University. P. K. Smith, Studies of the Effects of Radiation on the Biosynthesis and Degradation of Nucleoproteins and Its Modification by Various Agents.

Georgia, University of. S. A. Singal, The Effects of Nutritional Deficiencies on the Synthesis of Phospholipids and Nucleoproteins in the Rat.

Hahnemann Medical College and Hospital (Philadelphia). H. J. Eichel, Effects of Irradiation on the Enzymatic Activities of Cell Nuclei.

Harvard University. J. C. Aub, Study of Metabolic Activities of Living Organisms by Means of Suitable Isotopes.

Harvard University. D. G. Cogan, Production of Cataracts by Neutrons and Other Radiations.

Harvard University. A. B. Hastings, Use of Isotopes in Study of Metabolism of Organic Substances in Mammalian Tissue.

Harvard University. A. K. Solomon, Research on Biological, Medical and Biophysical Problems; Isotope Technique Research; Use of Isotopes on Medical Problems.

Harvard University. Shields Warren, Use of Isotopes as Therapeutic and Diagnostic Agents.

Harvard University, Bussey Institution. J. L. Tullis, (1) Investigation of Factors Regulating the Formation, Maturation, and Liberation of Formed Blood Elements from Bone Marrow; (2) Further Studies of the Separation and Utilization of Formed Blood Elements.

Illinois, University of. Percival Bailey, The Effects of Betatron 23 Mev X-rays upon Tumors of the Central Nervous System of Man and Upon the Normal Nervous System of Man.

Illinois, University of. S. S. Binkley, The Chemistry and Biological Significance of Carbohydrate Containing Nucleotides and Polynucleotides.

Institute for Cancer Research (Lankenau Hospital) (Philadelphia). J. A. Stekol, Metabolic Studies on Ethionine and Derivatives.

Institute for Cancer Research (Lankenau Hospital) (Philadelphia). Sidney Weinhouse and Grace Medes, Origin and Fate of Amino Acids in Plants and Animals.

Iowa, State University of. T. C. Evans and P. J. Leinfelder, A Quantitative and Morphologic Study of Radiation Induced Cataracts.

Jefferson Medical College of Philadelphia. F. W. Sunderman, Metabolic and Cytologic Changes Induced by Metallic Carbonyls.

Johns Hopkins University. C. L. Conley, (1) Studies of the Absorption, Utilization, and Excretion of Vitamin B–12, Using B–12 Containing Radioactive Cobalt; (2) Synthesis of Compounds with Vitamin K Activity Labeled with Radioactive Carbon for Use in Tracer Studies with Vitamin K.

Johns Hopkins University. J. S. Friedenwald, Enzymatic Histochemistry of the Ocular Lens.

Johns Hopkins University. J. E. Howard, Investigation of the Mechanism of Bone Deposition and Related Physiological Studies.

Kansas, University of. R. E. Stowell, Effects of Ischemia, Irradiation, and Chemical Irritation on Cytochemistry of Mammalian Tissues.

Kresge Eye Institute (Detroit). V. E. Kinsey, Effects of Neutrons and Other Radiations on the Ocular Lens.

Lovelace Foundation for Medical Education and Research (Albuquerque). W. R. Lovelace II, Indirect Blast Injuries.

Maryland, University of. T. E. Woodward, Studies on Monkeys Following Exposure to Large Doses of Total Body Irradiation.

Massachusetts Eye and Ear Infirmary. D. G. Cogan and J. H. Kinoshita, A Study of the Metabolism of the Ocular Lens with the Use of Radioactive Compounds.

Massachusetts General Hospital. J. C. Aub, I. T. Nathanson and P. C. Zamecnik, A Biochemical Study of the Effects of Radiation on Cells.

Massachusetts General Hospital. Oliver Cope, Effects of Radioactive Iodine on Biology of the Thyroid Gland.

Massachusetts General Hospital. E. L. Gasteiger, The Effects of Ionizing Radiations on Peripheral Nerve.

Massachusetts General Hospital. H. L. Hardy, Establishment of a Beryllium Case Registry.

Massachusetts General Hospital. W. H. Sweet, External Localization of Brain Tumors Employing Positron Emitting Isotopes.

Massachusetts General Hospital. W. H. Sweet, The Use of Thermal and Epithermal Neutrons in the Treatment of Neoplasms.

Massachusetts Memorial Hospitals. F. J. Ingelfinger, Effects of Radiation on the Structure and Function of the Digestive System, Particularly the Gastro-Intestinal Tract in Man.

Massachusetts Memorial Hospitals. J. F. Ross, Physiological and Therapeutic Investigations and Fundamental Blood Studies Using Radioactive Isotopes.

The May Institute for Medical Research. Sol Sherry, Studies on the Hemorrhagic State Following Exposure to Radiation.

Meharry Medical College. P. F. Hahn, Use of Radioactive Gold in Treatment of Tumors.

Miami, University of. B. E. Lowenstein, A Quantitative Study of the Effects of Radiation on the Blood Capillaries of Normal Animals.

Michigan, University of. F. H. Bethell, Hematological and Biochemical Effects of Ionizing Radiations.

Michigan, University of. F. J. Hodges and Isadore Lampe, Clinical Evaluation of Teletherapy.

Michigan, University of. W. J. Nungester, Immunological Study of Tumors.

Minnesota, University of. W. D. Armstrong and W. O. Caster, Effect of Ionizing Radiations on Electrolyte and Water Metabolism.

Minnesota, University of. J. F. Marvin, F. J. Lewis and C. W. Lillehei, Toxic Effects of Irradiation.

Minnesota, University of. Samuel Schwartz, Synthesis of Hemoglobin in Bone Marrow and Maturation and Multiplication of Blood Cells.

Minnesota, University of. C. J. Watson, The Influence of Radiation and Chemically-Induced Bone Marrow Injury upon Porphyrin Metabolism.

Montefiore Hospital for Chronic Diseases. Daniel Laszlo, A Study of the Distribution and Excretion of Lanthanum and the Rare Earth Elements.

Nebraska, University of. W. J. Arnold, Effects of Cranial X-Irradiation on Psychological Processes in Rats.

New England Center Hospital. William Dameshek and Mario Stefanini, Physiopathology of Platelets and Development of Platelet Substitutes.

New England Deaconess Hospital. S. P. Hicks, The Effects of Ionizing Radiation on the Developing Mammalian Nervous System.

New England Deaconess Hospital. S. P. Hicks, *et al.*, Acute and Chronic Radiation Injury.

New York University, Bellevue Medical Center. J. M. Converse and Mario Gaudino, (1) The Effect of Refrigeration of Human and Animal Skin upon Its Use in Skin Grafts Following Thermal Injury; (2) A Study of Antibodies Produced by Homologous Skin Grafts in Animals and Man.

New York University, Bellevue Medical Center. W. E. Smith, Investigation of Factors which may Modify Neoplastic Changes Induced by Irradiation.

New York University, Bellevue Medical Center. M. B. Sulzberger, Study of the Biological Effects of Ionizing Radiation (Alpha and Beta) on Human Skin.

New York University, College of Medicine. H. W. Smith, Study of Body Fluid Distribution in Hypertensive and Renal Disease and Collateral Physiological Studies.

New York University. Anna Goldfeder, Studies on the Nature of, and Protection from Radiation Injury.

New York University. Norton Nelson, Influence of Particle Size on the Retention of Mist Particles in the Human Respiratory System.

New York, State University of, Research Foundation. J. H. Ferguson and M. F. Hilfinger, Experimental Transfusion of Bone Marrow into Rabbits after Total Body Irradiation.

North Carolina, University of. C. D. Van Cleave and C. T. Kaylor, Radioautographic Study of Distribution and Retention of Beryllium in the Rat.

North Dakota, University of. W. E. Cornatzer, The Effect of Whole-Body Radiation on Various Enzyme Systems in the Liver, Kidney and Other Tissues.

Northwestern University. J. A. D. Cooper and H. L. Alt, The Diagnostic and Therapeutic Use of Radioisotopes in Experimental Medicine.

Northwestern University. Loyal Davis, Further Development and Utilization of Radioactive Dyes in the Diagnosis and Localization of Brain Tumors.

Northwestern University. Smith Freeman, Studies on Radiation Induced Cataracts.

Northwestern University. R. W. Schayer, Metabolism of Biologically Active Amines.

Notre Dame, University of. J. A. Reyniers, Study of the Effect of X-Radiation on Germ-Free (GF) Rats.[2]

Ohio State University Research Foundation. J. L. Morton, Use of Radioisotopes for Cancer Therapy.

Oklahoma Medical Research Institute and Hospital. C. D. Kochakian, Metabolism of Radioactive Sex Hormones.

Oregon, University of. E. E. Osgood and A. J. Seaman, Studies of Hemic Effects of Radioisotopes, X-rays and of Adrenocortical Hormones.

Oregon, University of. E. S. West and J. T. Van Bruggen, Studies on the Metabolism of Cholesterol and Ketone Bodies.

Pack Medical Foundation (New York). I. M. Ariel, Investigation of Pick-up and Effects of Radioactive Phosphorus in Primary and Metastatic Tumors of the Lung, Alone and in Conjunction with Nitrogen Mustard and Terramycin.

Peter Bent Brigham Hospital. F. D. Moore, Intracellular Changes in Trauma, Depletion and Repair; Biochemical Studies in the Human Being with the Aid of Isotopes.

Philadelphia General Hospital. H. P. Schwarz, The Effect of X-ray Radiation on the Infra Red Spectra of Neural and Radiosensitive Visceral Tissue.

Pittsburgh, University of. F. S. Cheever, The Effect of Radiation on the Virus-Host Cell Relationship.

Pittsburgh, University of. F. J. Dixon, The Study of the Effects of Radiation on the Immune Response with Special Reference to Factors which Increase the Radioresistance of the Immune Response.

Pittsburgh, University of. M. A. Fischer, Mechanism of Protection Against Radiation.

Rochester, University of. L. H. Hempelmann, Individual Response to Ionizing Radiation in Animals and Patients.

Saranac Laboratory of the Trudeau Sanitarium and Foundation. L. D. Scheel, Biochemical Aspects of Pulmonary Granulomatosis.

Sloan Kettering Institute for Cancer Research—Memorial Hospital. C. P. Rhoads, *et al.*, Biological Effect of Radiation, and Related Biochemical and Physical Studies.

---

[2] Contract administered through Office of Naval Research, Washington, D. C.

South Carolina, Medical College of. M. H. Knisely, The Development of Methods for Rapid Demineralization of Bone While Maintaining Soft Tissue Relationships and Good Histological Staining Qualities (Studies of Bone Demineralization).

St. Louis University. Henry Pinkerton, Study of the Relation of Rickettsial and Viral Infections to Radiation Injury.

St. Louis University. E. A. Smolik, The Blood Volume and Blood Turnover in Cases of Head Injury as Determined by Chromium 51 Labeled Red Blood Cells.

Tennessee, University of. Aaron Ganz, Factors Influencing the Distribution of Intravenously Administered Radiogold Colloids.

Tennessee, University of. W. M. Hale, A Study of the Effects of Cobalt 60 Gamma Irradiation on Infection and Immunity.

Tennessee, University of. Lester Van Middlesworth, Thyroid Metabolism and Study of the Metabolism of Radioactive Methionine in Tissue.

Tennessee, University of. R. R. Overman, Physiology of Water and Ionic Balance in Monkeys Subjected to Whole-Body Radiation.

Tennessee, University of. R. R. Overman, Mechanisms of Ionic Imbalance and Pathophysiologic States.

Tennessee, University of. J. D. Perkinson, Jr., Effect of Internal Irradiation on Cellular Metabolism.

Tennessee, University of. J. L. Wood, The Origin and Fate of Thiocyanate Ion in Metabolism.

Tennessee, University of. D. B. Zilversmit, The Metabolism of Radioactive Colloids.

Tufts College. David Rapport, Study of the Relation of Radiation on Reactions Associated with Growth.

Tulane University of Louisiana. G. E. Burch, Jr., Turnover Rates of Chlorine and Rubidium under Controlled Dietary and Therapeutic Conditions in Patients with Chronic Congestive Heart Failure and in Control Subjects.

Tulane University of Louisiana. R. H. Turner, The Influence of Radiation Injury Upon Physiology of Serum Lipids with Particular Reference to the Function of the Liver.

Tulane University of Louisiana. W. S. Wilde, The Metabolic Exchange of Tissue Electrolytes.

Utah, University of. M. M. Wintrobe and G. E. Cartwright, Metabolism of Trace Elements in Animals and Men with Special Reference to Their Role in Erythropoiesis.

Vanderbilt University. M. T. Bush, Metabolic Fate of Barbituric Acid Anesthetics with Special Reference to Evipal.

Vanderbilt University. W. J. Darby, Study of the Absorption and Metabolism of Lipids and the Alterations which Occur in Acute Radiation Injury.

Virginia Medical School, University of. C. L. Gemmill, The Metabolic Exchange of Radioactive Phosphorus and Potassium in Isolated Cell Systems.

Virginia, Medical College of. H. G. Kupfer and N. F. Young, Influence of Protamine Sulfate on Some Postirradiation Sequelae.

Wake Forest College. Camillo Artom, Formation of Tissue Phospholipides and Toxicity of Phosphorus 32 as Related to Dietary Factors.

Wake Forest College. G. T. Harrell, Jr., Distribution and Turnover of Sodium and Potassium in Acute Infections.

Washington University (St. Louis.) W. M. Allen, Use of Gamma Ray as a Therapeutic Agent of Carcinoma.

Washington University (St. Louis). G. T. Cori, Enzymatic Mechanisms of Glycogen Synthesis.

Washington University (St. Louis.) David Lipkin, Synthesis of Nucleotides and Related Compounds.

Washington University (St. Louis). I. L. Shechmeister, Investigations of the Relationship Between Radiation Damage and the Immune State.

Washington, University of (Seattle). C. A. Finch, Isotope Study of Hematopoiesis in Man.

Washington, University of (Seattle). R. D. Ray, Mobilization of Radioactive Emitters from Bone.

Washington University of (Seattle). R. H. Williams and H. H. Tomizawa, Studies of Isotopically Labeled Hormones.

Western Reserve University. B. M. Dobyns, (1) The Chromatographic Separation (starch column) of Iodinated Compounds of Normal and Abnormal Thyroid Tissue; (2) A Study of the Physiological Function and Histological Changes of Thyroids Irradiated with Radioactive Iodine.

Western Reserve University. H. L. Friedell, Investigations of the Biological Effects of Internally Deposited Radioisotopes and Related Radiobiology Studies.

Western Reserve University. L. A. Manson and L. O. Krampitz, Effect of Incorporated Radioactivity on the Biological Activity of Bacteriophage.

Western Reserve University. A. R. Moritz, Physiological and Pathological Aspects of Thermal and Flash Burns.

Western Reserve University. H. G. Wood, A Study of Intermediary Metabolism with Isotopically Labeled Compounds in Perfused Organs, Whole Animals, and Humans.

Wisconsin, University of. H. F. Harlow and P. H. Settlage, The Effect of Various Forms of Irradiation of the Brain on Learned and Unlearned Behavior of Monkeys and Chimpanzees.

Worcester Foundation for Experimental Biology. Gregory Pincus, Investigation of the Effects of Radiation on the Biosynthesis and Metabolism of Adrenocortical Steroids.

Yale University. C. E. Carter, Phosphorylation Mechanisms in Nucleic Acid Synthesis in Hematopoietic Tissue.

Yale University School of Medicine. J. H. Heller, Factors Increasing the Radiosensitivity of Malignant Neoplasms.

Yerkes Laboratory of Primate Biology, Inc. (Orange Park, Fla.) H. W. Nissen, Behavioral Effects of Ionizing Radiation on Chimpanzees of Various Ages.

RAW MATERIALS RESEARCH CONTRACTS

Amherst College. G. W. Bain, Conditions Requisite for Concentration of Uranic and Uranyl Compounds into Uranium Ore Bodies.

Arizona, University of. E. D. McKee, Sedimentation Studies on the Shinarump Formation.

Columbia University. C. H. Behre, Jr., Examination and Evaluation of Bird Spring Mining District, Southern Nevada.

Columbia University. W. H. Bucher, Fracture Pattern Study of the Zuni and Lucero Uplifts.

Columbia University. Paul F. Kerr, Alternation Studies at Marysvale, Utah.

Harvard University. Clifford Frondel, Mineralogical Research on the Synthesis of Secondary Uranium Minerals.

Iowa State College. T. A. Bancroft, The Application and Development of Statistical Methods Useful in Geology.

Mining Research Corporation. C. W. Livingston, Leaching of Uranium Ores in Place.

Minnesota, University of. J. W. Gruner, Mineralogical and Paragenesis of Ores Investigations with Respect to Certain Types of Uranium Ores on the Colorado Plateau.

Minnesota, University of. T. D. O'Brien, Determination of the Chemical Relationship Between Uranium and Hydrocarbon in Asphaltic Ores.

New Mexico, University of. Vincent Kelley, Geologic Structures of the Ore Producing Regions of the Colorado Plateau and Their Relation to Uranium Deposits.

Nevada, University of. V. E. Scheid, Development Studies on the Beneficiation of Uranium Ores, and Extractive Metallurgy for Recovery of Uranium from Ores.

Pennsylvania State College. J. C. Griffiths, Sedimentation Studies of the Rocks Surrounding Uranium Ore Bodies in the Salt Wash Formation.

Pennsylvania State College. Harold Wright, Study of Primary Uranium Deposits in the Boulder Batholith Area.

Research, Inc. R. M. Tripp, Research and Development in Geophysics and Geochemistry and the Development of Specialized Instruments.

Utah, University of. M. A. Cook and C. J. Christensen, Flocculation and Deflocculation in Slime Pulp Circuits.

Utah, University of. W. L. Stokes, Study of Facies Type in the Salt Wash Formation in the Carrizo-Lukachukai Area.

Washington and Lee University. M. W. Stow, Reconnaissance for and Investigation of Uranium Occurrences in Designated Areas.

REACTOR DEVELOPMENT RESEARCH CONTRACTS

Arcos Corp. R. D. Thomas, Welding of Austenitic Stainless Steel. Study of micro-fissuring and other characteristics, with the objective of improving structural usefulness of these steels.

California, University of. H. B. Gotaas, Research and Development on the Use of Sewage Treatment Processes on Radioactive Wastes. Investigating use of sanitary engineering methods for disposal of high-volume, low-level radioactive wastes.

California, University of. H. A. Johnson, Heat Transfer Characteristics of Liquid-Lead Bismuth.

Carnegie Institute of Technology. Gerhard Derge, Electrochemical Separations in Nonaqueous Solutions.

Chicago, University of.—American Meat Institute Foundation. H. R. Kraybill, Utilization of Fission Products. Study of food preservation.

Chicago, University of—Food Research Institute. G. M. Dack, Utilization of Fission Products. Study of food preservation.

Chicago, University of. L. S. Skaggs, Utilization of Fission Products. Study of food preservation.

Columbia University. Charles F. Bonilla, (1) Mass Transfer in Liquid Metal and Fused Salt Systems, (2) Boiling and Condensing of Liquid Metals.

Columbia University. E. L. Caden and C. G. King, Utilization of Fission Products. To study possibilities of a commercial process of food preservation, utilizing the bactericidal properties of penetrating X- and gamma radiation, including mixed fission products.

Columbia University. W. A. Selke, Utilization of Fission Products. Research and development on the effect of radiations from fission products, particularly the effect of gamma radiation on chemical reactions.

Commerce, Department of, National Bureau of Standards. Franz Alt, Shielding Calculations. Detailed calculations of gamma ray attenuation in various media, covering a wide range of gamma energies.

Commerce, Department of, National Bureau of Standards. Ugo Fano, Penetration and Diffusion of High-Energy Gamma Rays. Analytical and experimental studies to provide knowledge basic to design of gamma ray shields.[2]

Commerce, Department of, National Bureau of Standards. W. A. Wildhack, Basic Instrumentation.

Harvard University. Philip Drinker, Air Cleaning. Research and development on air cleaning, including improved methods and equipment, sampling methods, and training of personnel.

Harvard University. H. A. Thomas, Waste Disposal. Determination of distribution and disposition of radioactive material introduced into fresh water reservoir and streams.

Illinois, University of. B. B. Babbitt, Effects of Radioactive Elements on Anaerobic Digestion of Sewage Sludges. Investigation of feasibility of concentrating radioactivity using sludge digestion process.

Illinois, University of. H. F. Johnstone, Aerosol Research and Development. Investigation of fundamental properties of aerosols as related to air cleaning.

Interior, Department of, U. S. Bureau of Mines. R. C. Corey, Incineration of Radioactive Wastes. To develop a practical incinerator for disposal of solid combustible radioactive wastes.

Johns Hopkins University. Abel Wolman, Disposal of Liquid and Solid Radioactive Wastes. Adsorption of radioactive material on natural waterborne silts; circulation of estuarial waters; distribution of radioactivity charged into institutional incinerators; and treatment of contaminated laundry wastes.

Johns-Manville Co. H. T. Coss, Thermal Insulation Matter. To develop insulations with better insulating properties than those now available and with characteristics suitable for reactor use.

Little, Arthur D., Inc. Earl Stafford and W. J. Smith, Filter Research and Development. Development of high-efficiency, high-temperature, acid-resistant filters for removal of aerosols from gaseous effluents.

Massachusetts Institute of Technology. Rolf Eliassen, Water Decontamination. Removal of radioactivity from water supplies by modified water-treatment methods.

Massachusetts Institute of Technology. B. E. Proctor, Utilization of Fission Products. An investigation of uses for fission products in the sterilization of foods, pharmaceuticals, and tissues.

Michigan, University of. L. E. Brownell, Industrial Utilization of Fission Products. Investigate possible use of fission products and identify areas within which (1) industrial uses of such products are technically and economically feasible, and (2) further research and development would be useful.

Minnesota, University of. H. S. Isbin and N. R. Amundson, Reactor Cooling Investigations to Study Pressure Drop and Transient Flow Characteristics in Two Phase, Water-steam Systems.

National Canners Association. Dr. E. J. Cameron, Fission Product Utilization.

New York University. Gail P. Edwards and William E. Dobbins, Waste Disposal. Feasibility of trickling filter for treatment of dilute radioactive wastes.

[2] Contract administered through Office of Naval Research, Washington, D. C.

Nuclear Development Associates. Herbert Goldstein, Shielding Studies. Broad review of field, including evaluation of sensitiveness of calculated attenuations to physical data employed, comparison of theoretical methods, collation of experimental results, and development of engineering formulae.

Rensselaer Polytechnic Institute. L. G. Bassett, Development of Isotope Separation Methods.

Rensselaer Polytechnic Institute. J. O. Hougen, Liquid-Liquid Extraction Studies. Research in liquid-liquid extraction; experimentation with pilot plant size extraction column.

Tennessee, University of. R. M. Boarts, Effect of Wetting on Heat Transfer Characteristics of Liquid Metals.

Texas, University of. E. W. Steel, Disposal of Low-Level Radioactive Wastes by Algae Concentration. Studies of practicality of handling low-level wastes through concentration capacities of algae.

Tufts College. T. R. P. Gibb, Research on Light Metal Hydrides as Shielding Components for Nuclear Reactors.

Vitro Corporation of America. W. R. Peterson, Evaluation of Methods for High-Level Waste Disposal.

Yale University. R. H. Bretton, Utilization of Fission Products. Research on effect of radiations from fission products, particularly gamma radiation on chemical reactions.

283269—54——10

APPENDIX 8

The AEC Program for Publication and Distribution of Unclassified Technical Information

The volume of unclassified and declassified information originating in the Atomic Energy Commission's program is far larger than is generally supposed. The classification restrictions apply to a minority of the information-producing activities carried on within the national atomic energy program. It is necessary to safeguard this area of classified information zealously; it is likewise necessary in the interest of most rapid progress in this new field, to publish and disseminate widely the unclassified information which will aid research and development workers on public and private payrolls by stimulating their thinking and helping them avoid dead-end investigations over fields which have already been covered. To serve this latter purpose, the AEC maintains a comprehensive publication and dissemination program making use of all available outlets.

PUBLICATION PROGRAM

Publication in Established Journals and Periodicals. Following the establishment of declassification procedures, the Commission, in 1947, adopted a policy of encouraging each laboratory, and to the extent possible, each individual scientist, to prepare and submit for publication in the journal of his choice the nonclassified results of research and development. Up to July 1953 more than 10,000 articles based on AEC-supported work had been published by such journals. In support of this phase of the technical information program, the AEC in 1950 adopted a policy of authorizing contractors to pay the established page cost charged by nonprofit journals that applied to articles submitted by scientists to report AEC-supported work.

On occasion, special arrangements for financing publication of supplements to journals have been made by AEC. For example, the AEC contracted with the American Chemical Society for the publication of a supplement to the *Journal of the American Chemical Society*, carrying 57 pages of selected articles on the synthesis of radioisotope labeled compounds in the May 5, 1952, issue.

As with scientific research, laboratories and individuals carrying on engineering research and development are encouraged to prepare and supply nonclassified findings to the journals of engineering societies and to the commercial trade press serving industry. Special arrangements have been set up to speed the identification, declassification (when this is needed and possible), preparation for publication and provisions of releases and articles to appropriate outlets. The Technical Information Service maintains a three-man staff to expedite the work. An Advisory Committee on Industrial Information (See Appendix 2), with "Q" cleared membership from the engineering societies and the trade press, helps to promote and guide the program. An internal Industrial Information Committee (See Appendix 2) of representatives of contractors provides internal liaison on policy and operations. The AEC has authorized its contractors to budget for personnel to carry on this work at their laboratories and plants.

publication of Proceedings of Conferences and Symposia. The conference or symposium is an efficient method of identifying unclassified and declassifiable information and placing it before the most interested groups in science and industry. This device serves both those who take part through the papers and in discussions on and off the floor, and a wider audience which may purchase copies of the proceedings. Such conferences and symposia (with publication of proceedings) have come to constitute a major outlet for AEC-developed information. Two types have been employed—those arranged by AEC or AEC contractors, and those arranged by scientific and engineering societies and organizations.

The larger AEC laboratories have conducted such conferences and have assisted other organizations in sponsoring special conferences. Examples of the proceedings which have been published are as follows:

a. HEALTH PHYSICS INSURANCE SEMINAR, by K. Z. Morgan [and others]. Health Physics Seminar for Insurance Company Representatives, Feb. 6–10, 1950. Sponsored by Brookhaven National Laboratory and U. S. Atomic Energy Commission. (TID–388.) Oak Ridge, Tenn., Technical Information Service, U. S. Atomic Energy Commission, 1951. 161 p. Available from Office of Technical Services, Department of Commerce, Washington 25, D. C. $0.50.

b. THE ROLE OF ENGINEERING IN NUCLEAR ENERGY DEVELOPMENT. Proceedings of the Third Annual Oak Ridge Summer Symposium, Aug. 27–Sept. 7, 1951. Compiled by N. F. Lansing. Presented by Oak Ridge National Laboratory and Oak Ridge Institute of Nuclear Studies; sponsored by American Society for Engineering Education. (TID–5031.) Oak Ridge, Tenn., Technical Information Service, U. S. Atomic Energy Commission, 1951. 509 p. Available from Office of Technical Services, Department of Commerce, Washington 25, D. C. $1.40.

c. A CONFERENCE OF THE USE OF ISOTOPES IN PLANT AND ANIMAL RESEARCH. Kansas State College, June 12, 13, and 14, 1953. Sponsored by Kansas State College, Argonne National Laboratory, Isotope Division, USAEC. (TID–5098; Report no. 4, Agricultural Experiment Station, Kansas State College.) Washington, U. S. Atomic Energy Commission, 1953. 272 p. For sale by Government Printing Office, Washington 25, D. C. $1.25.

d. THE ROLE OF ATOMIC ENERGY IN AGRICULTURAL RESEARCH. Proceedings of the Fourth Annual Oak Ridge Summer Symposium, Aug. 25–30, 1952. Compiled by C. L. Comar and S. L. Hood. Presented by Oak Ridge National Laboratory and Oak Ridge Institute of Nuclear Studies; sponsored by University of Tennessee-Atomic Energy Commission Agricultural Research Program. (TID–5115.) Oak Ridge, Tenn., Technical Information Service, U. S. Atomic Energy Commission, 1953. 483 p. Available from Office of Technical Services, Department of Commerce, Washington 25, D. C. $3.10.

e. CONFERENCE ON USE OF TRACERS IN ORGANIC REACTION MECHANISM STUDIES. Brookhaven National Laboratory, Chemistry Conference #4, Jan. 19–20, 1950. (BNL–44.) Oak Ridge, Tenn., Technical Information Division, U. S. Atomic Energy Commission, 1950. 131 p. Available from Office of Technical Services, Department of Commerce, Washington 25, D. C. $0.50.

f. "DISCUSSION ON THE PRESENT STATUS OF RADIATION GENETICS." Given at information meeting for Biology and Medicine of the Atomic Energy Commission, Mar. 26, 27, 1948. Sponsored by the Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn. *Journal of Cellular and Comparative Physiology 35*, Supp. 1, June 1950. 210 p.

g. "SYMPOSIUM ON RADIATION MICROBIOLOGY AND BIOCHEMISTRY." Sponsored by the Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn., Apr. 11, 12, 1949. *Journal of Cellular and Comparative Physiology 39*, Supp. 1, Mar. 1952. 129 p.

h. "SYMPOSIUM ON PHYSIOLOGICAL EFFECTS OF RADIATION AT THE CELLULAR LEVEL." Given at Research Conference for Biology and Medicine of the Atomic Energy Commission. Apr. 12, 13, 1951. Sponsored by the Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn. *Journal of Cellular and Comparative Physiology 39*, Supp. 2, July 1952. 233 p.

i. "SYMPOSIUM ON RADIOACTIVE ISOTOPES." *Journal of Clinical Investigation 28*, 1247–1385 (Nov. 1949, Part 1). Edited by Dr. John Z. Bowers, Deputy Director, Division of Biology and Medicine; planned by the Atomic Energy Commission.

j. CONFERENCE ON RADIATION CATARACTS AND NEUTRON EFFECTS. *Proceedings.* National Academy of Sciences Building, Washington, D. C., Feb. 17, 1950. Under the auspices of the National Research Council, Division of Medical Sciences, for the U. S. Atomic Energy Commission. Washington, D. C., National Research Council, 1950. 96 p.

k. SECOND CONFERENCE ON RADIATION CATARACTS. *Abstracts of Papers.* National Academy of Sciences Building, Washington, D. C., Dec. 8, 1950. Under the auspices of the National Research Council, Division of Medical Sciences, for the U. S. Atomic Energy Commission. Washington, D. C., National Research Council, 1950. 30 p.

l. THIRD CONFERENCE ON RADIATION CATARACTS. *Abstracts and Proceedings.* National Academy of Science Buildiug, Washington, D. C., Jan. 28, 1952. Under the auspices of the National Research Council, Division of Medical Sciences, for the U. S. Atomic Energy Commission. Washington, D. C., National Research Council, 1952. 53 p.

m. FOURTH CONFERENCE ON RADIATION CATARACTS. *Abstracts and Proceedings.* National Academy of Science Building, Washington, D. C., Feb. 28, 1952. Under the auspices of the National Research Council, Division of Medical Sciences, for the U. S. Atomic Energy Commission. Washington, D. C., National Research Council, 1953. 118 p.

n. LABORATORY DESIGN FOR HANDLING RADIOACTIVE MATERIALS. Research Correlation Conference, Nov. 27–28, 1951. Sponsored by the American Institute of Architects and the U. S. Atomic Energy Commission. Washington, D. C., Building Research Advisory Board, National Research Council, 1952. 140 p. $4.50.

At nearly every annual and many regional meetings of professional organizations which have developed particular interests in atomic energy, special program sections or symposia have been arranged on this subject in the past 5 years. Some examples are:

a. American Society for Metals, Eighth Western Metal Congress and Exposition, Los Angeles, Mar. 23–27, 1953. Symposium on Zirconium and Zirconium Alloys.

b. American Association for the Advancement of Science, 119th Annual Meeting, St. Louis, Dec. 26–31, 1952. Symposium on Nuclear Science Industry, cosponsored with Oak Ridge Institute of Nuclear Studies, Dec. 29.

c. American Association for the Advancement of Science, 118th Annual Meeting, Philadelphia, Dec. 26–31, 1951. Symposium on Nuclear Engineering, Dec. 28.

d. Case Institute of Technology, Conference on Radioisotopes in Industry, Cleveland, Apr. 2–6, 1951.

e. New York University, Conference on Industrial and Safety Problems of Nuclear Technology, New York, Jan. 10–12, 1950.

f. Institute of Radio Engineers, National Convention, New York, Mar. 6–9, 1950. Symposium on Nuclear Science and the Radio Engineer, Mar. 6.

g. The American Society for Experimental Pathology, 34th Annual Meeting, Detroit, Mich., Apr. 19–22, 1949, Symposium on Atomic Energy, Apr. 20.

h. National Association of Manufacturers; 57th Congress of American Industry, Dec. 5, 1952, New York. Special Panel Discussion on Industrial Research and the Atomic Future; 58th Congress of American Industry, Dec. 4, 1953, New York. Special Panel Discussion on Atomic Energy and the Industrial Future.

i. American Society for Engineering Education, Mid-Atlantic Section Meeting, Rutgers University, New Brunswick, N. J., May 12, 1951, Conference on Engineering in Atomic Energy.

j. University of Wisconsin, Department of Engineering, Nuclear Technology Institute, Madison, Wis., May 12–14, 1953.

The papers presented on these occasions customarily have appeared in the organizations' journals. A large portion of the papers have been presented by scientists doing AEC-supported research or development, and they constitute an important part of the 10,000 journal articles previously noted as coming from AEC projects.

In the engineering field the tendency has been toward the development of special symposia, sometimes in connection with annual meetings, and subsequent publication of the proceedings by the societies (and in one case by AEC) as separate volumes. Such symposia and subsequent publication of proceedings have been arranged, with cooperation in every instance by the AEC, by the following professional engineering organizations:

The American Society for Engineering Education
The American Institute of Architects and the Building Research Advisory Board of the National Research Council
The American Institute of Chemical Engineers
The American Society of Mechanical Engineers
The American Society for Metals

Further detail on these conferences and symposia is given later in a section on cooperation with professional societies.

Commercially Published Books. In line with the policy of seeking publication in the regular channels of communication with the scientific and technical community, the AEC has encouraged authors working on its projects to make their own arrangements for publication of their nonclassified books. Where necessary to protect the government's interests the AEC has itself entered into contracts for publication by commercial houses of such books.

Following are some examples of books by project scientists who made their own arrangements with publishers.

a. ISOTOPIC CARBON, TECHNIQUES IN ITS MEASUREMENT AND CHEMICAL MANIPULATION, by M. Calvin, C. Heidelberger, J. C. Reid, B. M. Tolbert, and P. E. Yankwich. New York, Wiley, 1949. 376 p. $6.75.

b. INTRODUCTION TO RADIOCHEMISTRY, by G. Friedlander and J. W. Kennedy. New York, Wiley, 1949. 412 p. $5.50.

c. PILE NEUTRON RESEARCH, by D. J. Hughes. Cambridge, Addison-Wesley, 1953. 386 p. $7.50.

d. ELEMENTARY PILE THEORY, by H. Soodak and E. C. Campbell. New York, Wiley, 1950. 73 p. $3.00.

e. MESONS, a Summary of Experimental Facts, by A. M. Thorndike. New York, McGraw-Hill, 1952. 242 p. $5.50.

The National Nuclear Energy Series. Of particular importance in the AEC publication program is the National Nuclear Energy Series, published under contractual arrangements with the McGraw-Hill Book Co. This series is a cooperative program of the AEC and its contractors for presenting the results of project work in a uniform set of books. Twenty-three NNES volumes with a total of 15,678 pages have now been declassified and published. A list of these volumes is included as Appendix 8 to the Thirteenth Semiannual Report to Congress. The subject coverage reflects the wide interests of the national atomic energy program, from high-vacuum engineering to the biological effects of radiation. The volumes have been prepared by recognized experts in their respective fields and are designed to supply a sound basis for further research. The copyrights on these books are held by the AEC. Royalties on sales of the books are paid to the U. S. Treasury.

Other Commercially Published Books. Three other books have been published under contractual arrangements with the D. Van Nostrand Co., Inc., New York. The contracts were awarded on the basis of competitive bids, with one criterion being the lowest cost to the purchaser of the books. The copyrights on these books and on the National Nuclear Energy Series volumes are held by the AEC and royalties on the sales of the books are paid to the U. S. Treasury. The three books are:

THE SOURCEBOOK ON ATOMIC ENERGY, by Samuel Glasstone, a 546 page treatise on the development of the field of atomic energy and nuclear science. It is written with the authoritative detail usually presented in a general college text. It was prepared at the suggestion of the American Textbook Publishers' Institute as a balanced guide to major nonclassified aspects of atomic science and engineering.

THE ELEMENTS OF NUCLEAR REACTOR THEORY, by Samuel Glasstone and Milton C. Edlund, 416 pages, written for scientists, engineers and advanced students interested in the field of nuclear reactors. It explains methods for calculating critical conditions for chain reacting systems.

ENERGY IN THE FUTURE, by Palmer Putnam, a 556 page report of a study of the maximum plausible demands for energy compared with the availability of low cost nuclear fuels and all other sources of energy to meet these demands.

NRC Publication of Reports and Compendia. The National Research Council has established a Committee on Nuclear Science with representatives from many AEC facilities and from other groups. This committee has issued a number of reports summarizing significant nuclear data, drawing heavily on results obtained in AEC laboratories, but including also all other results available. Most

significant among the NRC publications in this field is the series, *Annual Reviews of Nuclear Science*, started in 1951. The present editor is Dr. J. G. Beckerley, AEC Director of Classification. AEC laboratory personnel and staff have had a large part in the preparation of this series of volumes.

Publication of AEC Documents by Government Printing Office. Many books, handbooks, and reports have been printed and issued for the AEC by the Government Printing Office. Some of the more important of these are: *The Effects of Atomic Weapons*, a 456 page book prepared in cooperation with the Department of Defense, and presenting the official analysis of atomic bomb phenomenology as deemed publishable in 1950; (this also was published, with AEC permission, by the McGraw-Hill Book Co., and Infantry Journal Press); *Liquid Metals Handbook*, a 269 page handbook prepared in cooperation with the Department of the Navy and presenting the data compiled in the course of a study of the properties of liquid metals for possible use as heat transfer media in reactors; *Handbook on Air Cleaning*, an 80 page publication describing the air filtering and cleaning apparatus developed and tested for use in removing radioactive contamination from gases and atmosphere in and around the various AEC installations; and now in press, *Introduction to Neutron Diffusion Theory*, a mathematical treatise on neutron physics prepared for advanced work in reactor engineering and nuclear physics. *Prospecting for Uranium*, a 123 page pocket size book, prepared in cooperation with the U. S. Geoglogical Survey, is a simple guide explaining the fundamentals for prospecting for uranium, the pertinent laws and regulations, laboratory assays, and selling procedures. Copies of all these publications are on sale by the Superintendent of Documents.

Publication by AEC Printing Plant at Oak Ridge. Nonclassified individual reports of research or development results which are important in the project, and which are not otherwise published through the open literature as outlined above, are duplicated in the printing plant maintained by the Technical Information Service at Oak Ridge. Besides distribution within the project, those reports which promise usefulness elsewhere are made available for sale by the Office of Technical Services, Department of Commerce, Washington, D. C. This office is the central Government agency for sale of matter printed in field plants (i. e., elsewhere than the GPO). Up to July 1, 1953, 1,711 AEC documents had been made available for sale by OTS, and 1,230 were currently in print and available.

DISSEMINATION PROGRAM

Depository Libraries. Availability in libraries of the great volume of published material described above depends, so far as non-Governmental publications are concerned, upon the subscription and purchase programs of individual libraries throughout the nation. However, in order to make sure that the Government-published material is available in all sections, the AEC has designated 42 libraries, principally in industrial or academic centers, as depository libraries. To them go copies of essentially all nonclassified documents published by the AEC itself. They receive the guides to AEC-developed information described in the following section. They maintain collections of published materials from other sources. Together with the documents that AEC supplies, their collections afford a comprehensive selection of existing nonclassified information on atomic energy. Each library, before designation as an AEC depository, agrees to provide reference and publication services to requestors.

The list by states of AEC depository libraries follows:

CALIFORNIA

Berkeley, University of California General Library
Los Angeles, University of California Library

COLORADO

Denver, Denver Public Library

CONNECTICUT

New Haven, Yale University Library

DISTRICT OF COLUMBIA

Washington, Library of Congress

GEORGIA

Atlanta, Georgia Institute of Technology Library

ILLINOIS

Chicago, John Crerar Library
Chicago, University of Chicago Library
Urbana, University of Illinois Library

INDIANA

Lafayette, Purdue University Library

IOWA

Ames, Iowa State College Library

KENTUCKY

Lexington, University of Kentucky Library

LOUISIANA

Baton Rouge, Louisiana State University Library

MASSACHUSETTS

Cambridge, Harvard University Library

MISSOURI

Kansas City, Linda Hall Library
St. Louis, Washington University Library

NEW JERSEY

Princeton, Princeton University Library

NEW MEXICO

Albuquerque, University of New Mexico Library

NEW YORK

Buffalo, Lockwood Memorial Library
Ithaca, Cornell University Library
New York, Columbia University Library
New York, New York Public Library
Troy, Rensselaer Polytechnic Institute Library

NORTH CAROLINA

Durham, Duke University Library
Raleigh, North Carolina State College Library

OHIO

Cincinnati, University of Cincinnati Library
Cleveland, Cleveland Public Library
Columbus, Ohio State University Library

OKLAHOMA

Stillwater, Oklahoma Agricultural and Mechanical College Library

OREGON

Corvallis, Oregon State College Library

The list by states of AEC depository libraries—Continued

TEXAS
Austin, University of Texas Library

UTAH
Salt Lake City, University of Utah Library

WASHINGTON
Seattle, University of Washington Library

WISCONSIN
Madison, University of Wisconsin Library

Service to Other Non-AEC Libraries. In addition to the complete document collections maintained by AEC Depository Libraries, smaller collections consisting of the documents offered for sale are provided to a large number of other libraries. This enables these other libraries to maintain partial collections of the AEC report literature.

AEC Direct Loan Program. Under AEC policy, documents are loaned to requestors whenever practical where the supply is such that a copy cannot be given to the requestor or a publication reference cannot be provided. This policy is intended to minimize the difficulty in obtaining the out of print or short print run documents.

Nuclear Science Abstracts. The AEC issues an unclassified abstract journal called *Nuclear Science Abstracts.* This journal is printed semimonthly by the Government Printing Office and is available on a subscription basis from the Superintendent of Documents. It contains abstracts and indexes of all nonclassified reports prepared under the national atomic energy program as well as pertinent material from the open literature, both foreign and domestic.

Each annual volume of *Nuclear Science Abstracts* is carefully indexed by author and subject, and cumulative indexes are issued at 5-year intervals to facilitate use of the AEC report collections. Each annual index also contains a cumulative "Numerical Index of Reports." Through this index an investigator can locate a copy of every nonclassified report issued in the national atomic energy program, either in the open literature, at the office of Technical Services, or in the depository libraries.

Card Catalog. The AEC prepares standard card catalogs of the nonclassified reports for use in the libraries of the AEC sites. In addition, sets of these catalog cards have been furnished on request to several of the AEC depository libraries, where they provide a detailed subject guide to AEC technical reports. Each complete unclassified card catalog contains about 60,000 cards which index and abstract roughly 8,000 reports.

Bibliographies and Reference Service. In the course of the reference work carried out in the libraries of the AEC and its contractors, a number of bibliographies are prepared which provide guides to the literature on specific subjects. These bibliographies are printed and distributed along with the other AEC reports to aid scientific and technical personnel in the efficient use of atomic energy literature. Most such bibliographies are sold by the Office of Technical Services.

Following is a list of typical bibliographies available from the OTS:

TID–4043	Bibliography of Bibliographies
TID–369	Barium: A Bibliography of Unclassified Literature
TID–3036	Isotope Separation and Isotopic Exchange: A Bibliography of Unclassified Literature
TID–375	Radioactive Waste Disposal
TID–3039	Tetanium Metallurgy
TID–363	Radium: A Bibliography of Unclassified Literature

Selected Readings on Atomic Energy (1951), a survey of the literature on atomic energy of general interest was compiled in 1951 by the AEC and published by the Government Printing Office. On occasion, special bibliographies have been prepared upon the request of other Government Agencies, as in the case of *Civil Defense Against Atomic Warfare*, a selected reading list, prepared at the request of the Federal Civil Defense Administration and currently being revised.

Nuclear Data Index. The AEC has issued a simple cross index to the nuclear properties of the nuclides (isotopes). It consists of a set of IBM punched cards which can be collated manually in terms of specific properties of specific nuclear species. This has been endorsed as a superior method of presentation of data on nuclear properties.

Supporting Services for the Dissemination Program. There are several supporting programs carried out to aid the general information dissemination program of the AEC. Most notable are:

a. THE MICROCARD PROGRAM. To provide economical microcopy of AEC documents the AEC has initiated a microcard program. A microcard is a 3" x 5" card, on which up to 47 regular report pages can be photographically reduced and printed. Thus, current, active report collections can be greatly reduced in size and cost. An average of 1.24 cards per report is required for this type of reproduction. Microcards of the AEC nonclassified documents are supplied on request to depository libraries which have suitable machines for reading microcards.

b. EXCHANGE PROGRAM. The AEC maintains an exchange program in which the journal, *Nuclear Science Abstracts*, is offered to scientific and technical organizations in exchange for publications of comparable value. At present there are 167 domestic and 406 foreign exchange agreements in operation.

c. TRANSLATIONS PROGRAM. The AEC is assisting in a translations program sponsored by the National Science Foundation, under which selected articles from the principal Russian physics journals are translated by a contract group at Columbia University. The translations are reproduced by the AEC, and copies are distributed to the AEC depository libraries as well as the AEC laboratories. Copies are also sent to the Office of Technical Services for sale to the public. The National Science Foundation and the Atomic Energy Commission have sponsored the establishment of the Scientific Translation Center in the Library of Congress which specializes in the collection of Russian translations. A non-Russian translation pool has been established by the John Crerar Library under contractual arrangements with the Special Libraries Association. The AEC contributes to and utilizes both of these services.

d. THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS has appointed a Nuclear Energy Committee, most of whose members are associated with AEC laboratories. This committee is sponsoring a nuclear engineering conference in June 1954 which will serve to publicize all aspects of nuclear engineering that can be declassified by that date. The proceedings of this conference will be published by A. I. Ch. E.

e. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. The AEC has been regularly represented at meetings of the ASME Nuclear Energy Applications Committee and staff members have assisted in planning and producing published materials such as the booklet, *Uranium, Plutonium and Industry*; and in ar-

ranging special national meeting programs such as the panel discussion on "Progress toward Industrial Atomic Power" held as a part of the ASME annual meeting in New York Dec. 1, 1953.

f. AMERICAN SOCIETY OF CIVIL ENGINEERS. The "Centennial of Engineering" program sponsored by ASCE in Chicago in September 1952 included a special symposium exhibit, and separate technical and semitechnical papers arranged in cooperation with the AEC staff.

g. AMERICAN SOCIETY FOR METALS has organized experience in special technology developed largely in AEC facilities for presentation in ASM-sponsored symposia, such as the zirconium metallurgy conference held in Los Angeles in March 1953 and a meeting on beryllium metallurgy scheduled for Boston in March 1954. The proceedings of these symposia are published by ASM.

Cooperation with Professional Societies. Mutual arrangements have been made with professional societies for cooperative work as follows:

a. THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION has set up a Committee on Atomic Energy Education with six members from each of the main geographical areas of the United States. This committee has held annual meetings at which committee members and AEC representatives have studied ways and means of improving nuclear engineering education. As a result of the Committee's efforts, more than fifteen regional conferences of the ASEE have been held throughout the United States, devoted to nuclear energy education. The most ambitious of these have been held by the Southeastern Region in cooperation with the Oak Ridge National Laboratory and the Oak Ridge Institute of Nuclear Studies. Proceedings of these conferences have appeared as TID 5031 "The Role of Atomic Energy in Nuclear Energy Development" and TID 5115 "The Role of Atomic Energy in Agricultural Research."

b. THE AMERICAN INSTITUTE OF ARCHITECTS has appointed a Committee on Nuclear Facilities which has familiarized itself with AEC construction problems (each member holds "Q" clearance) and works with the AEC to make nonclassified architectural information available to architects outside the national atomic energy program. As a result of the efforts of this group, a conference on "Laboratory Design for Handling Radioactive Materials" was sponsored jointly by the AIA and the AEC in November 1951 and conducted by the building Research Advisory Board of the National Research Council. The proceedings of this conference were published in toto as *Laboratory Design for Handling Radioactive Materials* and excerpted in AIA journals.

Special Informational Activities. The AEC has recently given special emphasis to the reporting to potentially interested industries on the nonsecret developments of industrial significance in atomic energy plants and laboratories. AEC's objectives in this program are:

a. To create on the part of industrial management and personnel constructive interest in the atomic energy program, its achievements, problems, and objectives.

b. To facilitate the development of industrial competence in specialized atomic energy techniques.

c. To develop the maximum contribution of atomic energy technology to the technology of the United States.

The information-for-industry program was set in motion with a recommendation by an industrial advisory group which in December 1948 urged the AEC to consider declassifying and releasing to American industry much more technological information. As noted above, aiding and advising the AEC on techniques and carrying out this recommendation is an Advisory Committee on Industrial Information, composed of representatives of engineering societies and industrial magazines. Members of this advisory committee are making a series of visits to AEC sites, reporting their findings for the guidance of technical personnel, thus helping the Commission to speed the development of facilities for processing, publishing and disseminating this kind of industrial information from AEC facilities throughout the country.

The AEC information-for-industry program recognizes the communications problems inherent in atomic energy work and seeks to stimulate and encourage engineering and development personnel in the atomic energy program to write, for the literature, valuable data on techniques and "know-how" and to assist the technical press in its customary role of locating and evaluating potentially publishable material of this kind.

Typical of current activities and projects in the information-for-industry program are these:

a. PERIODIC LISTINGS indicating availability of all AEC unclassified technical reports of special interest to industry—about 1,000 to date.

b. OPEN FILES of AEC-developed industrial information (technical papers, photos, drawings, etc.) at AEC depositories in libraries throughout the country.

c. "WHAT'S-IN-IT-FOR-INDUSTRY" and "How-To-Get-Started" articles in trade magazines, describing particularly the uses for isotopes, the prospect for atomic power, AEC contract opportunities and a special series in "Aids for Small Business" publication of SDPA.

d. USE OF SPECIAL PUBLICATIONS—such as:

(1) "URANIUM, PLUTONIUM AND INDUSTRY" (48-page booklet)—concise introduction to the atomic energy program for men in industry, prepared by the Nuclear Energy Applications Committee of the American Society of Mechanical Engineers.

(2) "REPORTS TO THE AEC ON NUCLEAR POWER TECHNOLOGY" (88-page booklet)—an AEC publication—presenting to general industry the declassified versions of the first study reports on power reactor feasibility by the industrial study groups.

(3) INDUSTRIAL EXHIBITS—visual presentation of AEC material and process developments of interest to general industry, together with references to information sources, prepared in cooperation with the AEC Office of Industrial Development. This service is available for industry trade shows.

To facilitate the publication of information of interest to industry, editors of business and technical publications are encouraged to maintain regular relations with AEC installations; and special introductory tours of unclassified technical facilities have been arranged for this segment of the press.

Close liaison has been maintained with the Office of Technical Services of Commerce Department to bring significant atomic energy program developments to the attention of the industrial audience reached by OTS publications.

AM

T

Be it enacted l
of America in
Energy Act of
"(B) a Divi
(not to exceed
sary to the dis
direction of a
be compensated
$16,000 per ann
be a member o
division to exe
determine."

SEC. 2. Sectic
amended, is ren

SEC. 3. Sectio
is amended by a
"(iv) In the
(B) (i) and (i
subject of the i
mission shall re
conduct of a ful
the Civil Servic

SEC. 4. Sectio
is amended by a
"(v) If the P
time to time, ca
by sections 10 (
Investigation rat

SEC. 5. Section
is amended by a
"(vi) Notwith
(ii) above, a m

[1] Previous amend
of Ninth Semiannu
Congress, January

APPENDIX 9

AMENDMENTS TO THE ATOMIC ENERGY ACT OF 1946 [1].

PUBLIC LAW 164—83D CONGRESS

CHAPTER 283—1ST SESSION

S. 2399

AN ACT

To Amend the Atomic Energy Act of 1946, as Amended

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 2 (a) (4) (B) of the Atomic Energy Act of 1946, as amended, is amended to read as follows:

"(B) a Division of Military Application and such other program divisions (not to exceed ten in number) as the Commission may determine to be necessary to the discharge of its responsibilities. Each division shall be under the direction of a Director who shall be appointed by the Commission and shall be compensated at a rate determined by the Commission, but not in excess of $16,000 per annum. The Director of the Division of Military Application shall be a member of the Armed Forces. The Commission shall require each such division to exercise such of the Commission's powers as the Commission may determine."

SEC. 2. Section 10 (b) (5) (B) (iv) of the Atomic Energy Act of 1946, as amended, is renumbered as section 10 (b) (5) (B) (vii).

SEC. 3. Section 10 (b) (5) (B) of the Atomic Energy Act of 1946, as amended, is amended by adding the following subsection:

"(iv) In the event an investigation made pursuant to sections 10 (b) (5) (B) (i) and (ii) develops any data reflecting that the individual who is the subject of the investigation is of questionable loyalty, the Civil Service Commission shall refer the matter to the Federal Bureau of Investigation for the conduct of a full field investigation, the results of which shall be furnished to the Civil Service Commission for its information and appropriate action."

SEC. 4. Section 10 (b) (5) (B) of the Atomic Energy Act of 1946, as amended, is amended by adding the following subsection:

"(v) If the President deems it to be in the national interest, he may, from time to time, cause investigations of any group or class which are required by sections 10 (b) (5) (B) (i) and (ii) to be made by the Federal Bureau of Investigation rather than the Civil Service Commission."

SEC. 5. Section 10 (b) (5) (B) of the Atomic Energy Act of 1946, as amended, is amended by adding the following subsection:

"(vi) Notwithstanding the provisions of sections 10 (b) (5) (B) (i) and (ii) above, a majority of the members of the Commission shall certify those

[1] Previous amendments to the Atomic Energy Act of 1946 can be found in Appendix 10 of Ninth Semiannual Report to Congress, January 1951, Eleventh Semiannual Report to Congress, January 1952, and Twelfth Semiannual Report to Congress, July 1952.

specific positions which are of a high degree of importance or sensitivity and upon such certification the investigation and reports required by such provisions shall be made by the Federal Bureau of Investigation rather than by the Civil Service Commission."

SEC. 6: Section 12 (a) of the Atomic Energy Act of 1946, as amended, is amended by adding the following subsection:

"(9) authorize such of its members, officers, and employees as it deems necessary in the interest of the common defense and security to carry firearms while in the discharge of their official duties. The Commission may also authorize such of those employees of its contractors engaged in guard duties at facilities owned by the United States as it deems necessary in the interest of the common defense and security to carry firearms while in the discharge of their official duties."

SEC. 7. Section 12 (a) of the Atomic Energy Act of 1946, as amended, is amended by adding the following subsection:

"(10) make, promulgate, issue, rescind, and amend such rules and regulations as may be necessary to carry out the purposes of this Act."

SEC. 8. Section 15 (e) of the Atomic Energy Act of 1946, as amended, is amended by adding at the end thereof the following sentence: 'The committee is authorized to permit such of its members, employees and consultants as it deems necessary in the interest of common defense and security to carry firearms while in the discharge of their official duties for the committee."

SEC. 9. The provisos contained in section 1 of the Act to provide for certain investigations by the Civil Service Commission in lieu of the Federal Bureau of Investgation and for other purposes, approved April 5, 1952, are hereby repealed as of the date of this Act insofar as they apply to the Atomic Energy Act of 1946.

Approved July 31, 1953.

PUBLIC LAW 262—83D CONGRESS

CHAPTER 432—1ST SESSION

S. 671

AN ACT

To Amend Section 9 (b) of the Atomic Energy Act of 1946 relating to the exemption of activities of the Atomic Energy Commission From State and Local Taxation.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 9 (b) of the Atomic Energy Act of 1946 is amended by striking out the last sentence thereof.

SEC. 2. This amendment shall be effective only as to tax liabilities which accrue on or after October 1, 1953.

Approved August 13, 1953.

PUBLIC LAW 137—83D CONGRESS
CHAPTER 228—1ST SESSION
H. R. 4905

AN ACT

To Amend the Atomic Energy Act of 1946, as Amended.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled. That section 12 of the Atomic Energy Act of 1946, as amended, is amended by adding a new subsection (d) as follows:

"(d) The Atomic Energy Commission is authorized in connection with the construction or operation of the Oak Ridge, Paducah, and Portsmouth installations of the Commission, without regard to section 3679 of the Revised Statutes, as amended, to enter into new contracts or modify or confirm existing contracts to provide for electric-utility services for periods not exceeding twenty-five years, and such contracts shall be subject to termination by the Commission upon payment of cancellation costs as provided in such contracts, and any appropriation presently or hereafter made available to the Commission shall be available for the payment of such cancellation costs. Any such cancellation payments shall be taken into consideration in determination of the rate to be charged in the event the Commission or any other agency of the Federal Government shall purchase electric-utility services from the contractor subsequent to the cancellation and during the life of the original contract."

SEC. 2. The first proviso under the appropriation to the Commission for "Plant and equipment" in the Supplemental Appropriation Act, 1953, is hereby repealed.

Approved July 17, 1953.